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The interlinked roles of ecosystem-based adaptation and empowerment

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LUND
UNIVERSITY

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Abstract

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Key words; empowerment; power; nature-based solutions, climate change adaptation, ecosystem-based adaptation; sustainability science; frames, reflexivity; ecosystem services; transformation

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MADE IN SWEDEN

"Our lives are not our own. We are bound to others, past and present, and by each crime and every kindness, we birth our future."

– David Mitchell

"A tree is a little bit of the future"

– Franck Prévot

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Papers included in this PhD

I. **Woroniecki** S, Krüger, R., Rau, A-L., Preuss, M.S., Baumgartner, N., Raggers, S., Niessen, L., Holländer, L., Beyers, F., Rathgens, J., Wagner, K.C., Habigt, L., Krause, T., Wamsler, C., von Wehrden, H., Abson. D. 2019. The framing of power in climate change adaptation research. *WIREs Climate Change* ;e617

II. **Woroniecki**, S., C. Wamsler, and E. Boyd. 2019. The promises and pitfalls of ecosystem-based adaptation to climate change as a vehicle for social empowerment. *Ecology and Society* 24(2):4.

III. **Woroniecki**, S. 2019 Enabling Environments? Examining Social Co-Benefits of Ecosystem-Based Adaptation to Climate Change in Sri Lanka. *Sustainability*, 11, 772.

IV. **Woroniecki,** S; Brink; E, Wendo, H, Vargas, A. M, Krause, T, Islar, M, Mahmoud, Y. (No date) Natural's not in it: How knowledge and power shape 'nature-based' approaches to societal challenges. *In Review.*

Contributions:

I am the lead author of all four articles. Together with TK, DA, HVW and CW, I developed the research design and framed Paper I. I took the lead in analysing and writing the paper. The data collection, analysis and writing were conducted jointly by all authors. I had the original idea for Paper II, undertook the review, analysis and led the write-up. CW also assisted in the paper framing and writing process, and CW and EB provided overview, guidance and feedback. I developed and led the process of Paper IV, designed the methodology and led the writing phase. The data collection and analysis were conducted jointly by all authors.

Other relevant publications

West, S. Haider, J, Stålhammar, S, Woroniecki, S. (No date) A relational turn for sustainability science? Experiences from emerging research pathways. *Ecosystems and People. In Review*

Abstract

Nature-based solutions (NBS) focus on the material functioning of ecosystems as part of a transformative response to societal challenges. NBS represent a growing response to climate change with a range of interventions emerging across the world to address the causes and effects of climate change. The adoption of NBS is claimed to address a range of Sustainable Development Goals, including empowerment of marginalised people (Goals 10 and 15).In this thesis, I investigate these claims within the context of climate change adaptation. More specifically, I ask if and how ecosystem-based approaches (EBA) to climate change adaptation, as a type of NBS, empower vulnerable and marginalised groups. Four papers are presented that draw respectively on systematic review, conceptual synthesis, empirical, and comparative study. The empirical findings are from two sites in Sri Lanka with a range of climate vulnerabilities. **Paper I** systematically reviews adaptation case studies to show how empowerment can arise in an adaptation context amidst broader power relations. **Paper II** demonstrates theoretically the bounded and overlapping roles of EBA and empowerment. In **Paper III**, I show that EBA have the potential to support people's empowered adaptive strategies amidst broader transformation of social-ecological relations, but this potential is presently constrained. In the studied cases, the dominant mode of EBA action as intervention limited the ability to support people's empowered adaptive strategies. Across these papers, I demonstrate that frames embedded in EBA shape the institutional and material dimensions of these actions, becoming central to their capacity to support empowerment. Frames are discursive dimensions of power, or dominant modes of expression, that prefigure outcomes for who is empowered or disempowered through EBA initiatives. In **Paper IV**, I find that frames of EBA appear to reinforce assumptions of the passive dependency of marginalised people on ES. Further, the way that EBA is framed in biophysical terms may empower external experts and interventions, and lend authority to the knowledge claims of natural scientists. The papers collectively show that current frames of EBA do not make visible the social processes of adaptation or the predominant manner in which EBA is implemented as an intervention. These blind spots have consequences for empowerment since these frames hide people's diverse and situated social-ecological knowledge, subjectivities, and agencies – aspects which better represent the ways in which people and ecologies emerge in co-evolutionary processes, including through responses to climate change. Confronting the issue of people being left out of the picture in NBS to climate change will entail a sizeable shift in the science and practice of these approaches. This turn would be facilitated by sustainability scientists acknowledging their position in power relations, confronting governance and equity issues in nominally benign solutions, and letting go of problematic assumptions about the relationships between people and nature.

Prologue

> "If our species does not survive the ecological crisis, it will probably be due to our failure to imagine and work out new ways to live with the earth, to rework ourselves and our high energy, high-consumption, and hyper-instrumental societies adaptively. We struggle to adjust because we're still largely trapped inside the enlightenment tale of progress as human control over a passive and 'dead' nature that justifies both colonial conquests and commodity economies. The real threat is not so much global warming itself, which there might still be a chance to head off, as our own inability to see past the post-enlightenment energy, control and consumption extravaganza we so naively identify with the good, civilised life to a sustainable form of human culture. The time of *Homo reflectus*, the self-critical and self-revising one, has surely come. *Homo faber*, the thoughtless tinkerer, is clearly not going to make it. We will go onwards in a different mode of humanity, or not at all."
>
> Val Plumwood, 2007[1]

Powerful ideas meet the rich contexts of particular places with unpredictable consequences (Scott, 1998; Li, 2013). As illustrated by the case studies highlighted in this thesis, it is useful to compare people's own adaptive responses to climate change with external interventions backed by such powerful ideas. In the Sri Lankan drylands, systems for managing climate uncertainty and water security date back millennia, given that people's livelihoods and daily practices are embedded in ecology. "Let not one drop reach the ocean without being used"[2] was the rallying cry for an intricate system of *Elangawa*, cascades of reservoirs and ecological components for maintaining water quality and reliability. Sri Lanka is still a predominantly rural nation, and people who live in the countryside have developed a range of community-led adaptive strategies such as *Bethma* and *nawa kekulama* that draw from ancient stewardship and risk-sharing practices as well as ideas of equity and commons (Nianthi & Dharmasena, 2009). Though not homogeneous, rural communities generally view their environment as part of the community. In the highland village of Serupitiya, people will take risks

[1] https://bit.ly/2PuqGbM - accessed 8.12.19

[2] "*Not a single drop of water received from rain should be allowed to escape into the sea without being utilised for human benefit.*" Available at https://bit.ly/2qBJLRe - accessed 8.12.19

to protect what they value, such as *Kumbuk* and *Neem* trees, by resisting incursions from powerful groups.

Social ties, collective property rights, and knowledge developed across generations are drawn on to deal with emerging threats associated with climate change, such as droughts, floods, and water insecurity, that challenge people's ways of living in these landscapes. For instance, *Sharamadana* (a customary institution) integrates collective resource management, labour sharing, and recognition of complex hydro-ecological dynamics. But my intention is not to romanticise rural life. Over successive generations, liberalisation of the market has created more social difference at various levels of Sri Lankan society. This circumstance plays out in more individual responses to climate shocks, such as using private wells to confront drought, which may ultimately undermine the collective sources of resilience that people in poverty rely on.

In Sri Lanka the natural resource governance actions of external agents such as governments and development actors are framed in terms of empowerment and adaptation. These interventions focus on restoring ecosystem functions as a way to enable rural livelihood resilience and – to use the favoured term – 'empower' the most at risk. This restoration philosophy is essentially a green version of *a rising tide lifts all boats*. However, attempts to create participation in such interventions are at odds with the abstract, disconnected nature of the strategies implemented. The clash between local and global ideas is uneven, and it leads to failure to recognise people's own situated agency, knowledge, and perceptions of risk. When different groups strive to make their voices heard in such projects, the effects are unpredictable, and the project veers from its anticipated outcomes.

In some cases, the resolute focus on ecosystem services has inadvertently entrenched the marginalisation of remote communities and the most vulnerable groups therein, provoked conflicts and resistance, and, most importantly in the context of climate solutions, arguably undermined some quite effective local social-ecological adaptation strategies. Why does this happen? The language used seems to matter. *Ecosystem-based* actions framed as 'solutions' are based in particular world views and power relations, that go on to set the stage for certain roles, like 'expert' and 'dependent beneficiary' to be performed in diverse settings, such as the rich contexts of Serupitiya, a village in the central highlands of Sri Lanka, and Galgamuwa, a rural distinct in the north-western dry zone.

I present these examples here to lay out what is at stake for the people most vulnerable to climate change. These case studies show how dominant world views hold sway over a setting for sustainability interventions – especially views that contain implicit assumptions about the relationship between nature and society. The examples also

illustrate how such dominant world views have effects within a setting characterised by diverse world views – or subjectivities that are formed in relationships affected by power.

Sustainability science is often invoked to legitimatise so-called solutions such as these interventions, and in so doing the behaviour of powerful actors that make use of them (Cooke et al., 2016), whether they be 'key stakeholders', 'policy-makers', or 'decision-makers'. Consequently, sustainability science must be undertaken in a way that is cognisant of how research occurs and how the results are used within relationships of power. I would like this thesis to be read as a constructive criticism of sustainability actions and narratives that builds on how sustainability research and practice are interlinked in often unrecognised ways. I think a sustainability science thesis is an appropriate venue to reflect on how different people are affected by the knowledge practices and frames we employ in order to know 'nature' and our relationships with it.

Photo - Harvest of the rice paddy in the highand village of Serupitiya village, Nuwara Eliya district, Sri Lanka. This is a collective activity, whereby poor, sometimes landless, farmers come together to share labour, time, food, and conversation. These culturally symbolic, ritualised, and physically demanding practices have disappeared elsewhere in Sri Lanka as agriculture has become more mechanised and individualised.

Introduction

> "Radical, comprehensive changes are urgently needed to save the diversity of life on which we all depend…the plundering of the land and ocean [comes]at the expense of a clean, healthy and diverse environment on which billions of women, children and men depend, now and in the future."
>
> Andrew Norton, Director of the International Institute of Environment and Development (a London think tank) responding to the findings of the IPBES Global Assessment on 6 May 2019[3]

Nature-based responses to societal challenges

Recent statements from the world's top scientific bodies have shown how the continued degradation of nature represents multiple interacting threats to human well-being (IPCC; 2014; IPBES, 2019; Chaplin-Kramer, et al., 2019). In unusually bold terms, these organisations have clearly stated that things cannot continue as they are. To disrupt the status quo, transformation is required across different scales of human social organisation (Global Assessment, 2019). The head of the United Nations (UN) Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), Robert Watson has stated that "The destruction of Nature threatens humanity at least as much as human-induced climate change"[4], a statement backed by the findings of his organisation's Global Assessment on Biodiversity and Ecosystem Services (2019). This statement is in agreement with the scientific evidence, showing how current social-ecological predicaments on different scales do not represent single-issue challenges but are rather dimensions of a larger set of interacting risks and forms of harm, which have common causes and are experienced together, not in isolation (Chaplin-Kramer et al., 2019; Leichenko and O'Brien, 2008; Ensor et al., 2019). Scientists have emphasised that such "an ecology of crisis"[5], to use a phrase used by British environmentalist Chris Packham, warrants an ecological – or integrated –

[3] https://bit.ly/38icn2L - accessed 8.12.19
[4] Robert Watson, 29 April 2019 https://bit.ly/350XNe9 - accessed 8.12.19
[5] Chris Packham, 6 May 2019 https://bit.ly/343Im3o - accessed 8.12.19

response (IPCCSRCCL; 2019; Chazdon and Brancalion, 2019). The IPBES recently stated that "Climate Change, Biodiversity Loss and Land Degradation [are] interconnected issues [that] must be addressed together"[6].

Nature-based solutions (NBS) form the apparently integrated, transformative response to the climate crisis put forward by high-profile environmental actors, such as the recently convened NBS for Climate Coalition (UNFCCC, 2019; IPBES, 2019, p18). This umbrella term describes activities aiming for "human and ecological benefits beyond the core objective of ecosystem conservation, restoration or enhancement" (Ershad Sarabi et al., 2019; Albert et al., 2017). In this view, NBS are integrated responses that can address multiple Sustainable Development Goals (Seddon et al., 2016; IPBES, 2019, p18). For example the Nature-based Solutions Initiative recently agreed with the UN that "Biodiversity loss [and] climate change are intertwined in complex ways. Solutions preserving biodiversity to fight climate change can help achieve both societal objectives."[7] Thus, NBS are put forward as the holistic response to the ecology of crisis.

The UN Environment lead, Inger Andersen, recently expressed the cross-cutting opportunities of 'natural' responses to climate change: "Nature is a way to solve societal challenges for the benefit of both nature and society. It is a critical part of the climate puzzle."[8] On the back of such claims, NBS are quickly rising on the political agenda, both within the United Nations and in Europe, where the concept first emerged (Tozer et al., *forthcoming*; Maes and Jacobs, 2017; Faivre et al., 2017).

Actors working to centre NBS within climate change discourses appeal to nature as a vital, under-recognised ally to confront the climate crisis (Chazdon and Brancalion, 2019). These appeals are rooted in the *nature for people* paradigm of ecosystem management (Mace 2014). Within the Western philosophy, nature has been predominantly represented as an external entity, distinct from humans (Stephenson et al., 2012, Taylor, 2016). NBS can help to reassert the connection between humans and nature. This normative goal of NBS to "reconnect [humans] to the biosphere" is shared with the concepts of biosphere-based sustainability science (Folke et al., 2016; Rockström et al., 2011), human-nature connectedness (Ives, et al., 2018), ecosystem services (Lele et al., 2013), and latterly nature's contributions to people (Diaz et al., 2018). Underlying these efforts is the assumption that the relationship between people and nature is one of non-negotiable and universal dependency (Folke et al., 2016). The

[6] IPBES, 8 August 2019 https://bit.ly/38mEJZZ - accessed 8.12.19
[7] Nature-based Solutions Initiative, 30 April 2019 https://bit.ly/36ff2Zf - accessed 8.12.19
[8] Inger Anderson, 28 August 2019 https://bit.ly/352048O - accessed 8.12.19

IPCC Special Report on *Climate Change and Lands* finds comprehensive evidence for such dependency:

> "Land provides the principal basis for human livelihoods and well-being including the supply of food, freshwater and multiple other ecosystem services, as well as biodiversity. Human use directly affects more than 70% (likely 69-76%) of the global, ice-free land surface (high confidence). Land also plays an important role in the climate system... Land provides the basis for many other ecosystem functions and services, including cultural and regulating services that are essential for humanity (high confidence). IPCCSRCCL, 2019, p2"

Whilst NBS is policy-driven field, its body of technical knowledge stems predominantly from scholarship on ecosystem services (Nesshöver et al., 2017), which are "the conditions and processes through which natural ecosystems sustain and fulfil human life" (Daly, 1997). The concept of ecosystem services (hereafter ES) helps to focus attention more precisely on discrete relations between people and ecosystems. In so doing the concept can be said to structure human behaviour in line with restoring or maintaining the ecosystem functioning that people value, especially when enacted in programmes like NBS (IPBES, 2019). The IPBES Global Assessment and the IPCC Special Report use the ES concept to highlight the risks to humans as these conditions and processes are affected by anthropogenic forms of environmental change, especially climate change, demonstrating the ecology of crisis, in the form of concurrent deleterious effects on many aspects of human well-being and development efforts (ibid). From such focussed awareness, NBS emerge as an appropriate and potentially integrated and transformative response, even though these assessments, amidst much of the emerging literature on NBS, do not go into detail on the pathways through which such 'win-win' outcomes are meant to emerge (Seddon et al., 2019). In fact, the potential for such pluralistic outcomes are a key part of engineering support for these solutions, shifting the balance sheet in the eyes of states, donors, and investors (Faivre et al., 2017).

Whilst the concept focusses attention on the relationship between climate change, ecosystem degradation, and human well-being, preventing these issues from being siloed, this body of technical knowledge does not make clear whose well-being is at stake from particular changes in this relationship and how restoration of ecosystems through NBS might benefit particular people (Seddon et al., 2019; Raymond et al., 2017). This social differentiation may represent a blind spot in the ES concept and the NBS it helps to create (Schröter et al., 2014; Hamann et al., 2018; Leach et al., 1999; Fischer et al., 2016).

Social benefits, transformation, and inclusion

Nesshöver et al. (2017) stated that as an emerging concept, current ideas about NBS remain vague and require more specification. Careful evaluations of NBS are only now beginning to emerge (Seddon et al., 2019). More specifically, several gaps exist in our understanding of how social benefits are meant to accrue from NBS for particular people (Kabisch et al., 2016). Three areas of ambiguity are especially visible.

First, the IPBES Global Assessment emphasizes that only through transformative change can nature be restored (IPBES, 2019). Beyond the vague but widely represented notion that nature itself can effect transformative change across the grand temporal and spatial scale and achieve the depth of changes required (NBS Manifesto), more precise descriptions of transformation are lacking (Feola, 2015; Scoones et al., 2015, Kates et al., 2016; Moser, 2016)[9]. Despite reduced inequalities and gender equality being Sustainable Development Goals (Goals 5 and 10, respectively) often cited as deliverable through NBS (Faivre et al., 2017; Kabisch et al., 2016), calls for transformation are rarely discussed in ways that allude to social differences and processes of marginalisation or empowerment (Pelling, 2011; Scoones et al., 2015). Explicit references to inequality are especially rare in such calls (Fazey et al., 2018; Nightingale et al., 2019; Klinsky et al., 2017).

Secondly, the IPBES Global Assessment recognises the importance of empowering marginalised people within efforts to address environmental degradation. The Global Assessment provides a breadth of empirical evidence to show the instrumental role of integrating historically marginalised people's rights, knowledges, and world views in nature protection efforts (IPBES, 2019)[10]. Yet the agency and knowledge of marginalised groups are underrepresented within global efforts to address the crisis (Diaz et al., 2018)[11]. How the efforts of marginalised groups may be engaged with and

[9] Recognizing the need for profound social changes and making transformative decisions at different scales are crucial to achieve the sustainable development goals (IPBES, 2019, p9). For instance, the IPCCSRCCL report finds that different socioeconomic pathways affect levels of climate-related risks (IPCCSRCCLSPM, p13). A transformative pathway with low population growth, high income and reduced inequalities, food produced in low greenhouse gas emission systems, effective land use regulation, and high adaptive capacity leads to much lower levels of risk, reducing desertification, land degradation, and food insecurity (IPCCSRCCLSPM, p13).

[10] Forests have been best protected where people have secure land tenure and particularly where indigenous peoples manage the land (Ibid). One of the most marginalised groups on Earth, indigenous people make up less than 5% of the total human population but manage or hold tenure over 25% of the land area and about 80% of global biodiversity (Garnett et al., 2018).

[11] Existing research shows that management responses that emphasise the impacts of climate change and the role of technology or infrastructure may be constrained in recognising and engaging the contributions of marginalised people (Nightingale et al., 2019; Diaz et al., 2018).

their knowledge and agency recognised is a gap in current conceptions of transformative change, especially through NBS (Brink and Wamsler 2018; Seddon et al., 2019).

Thirdly, the focus on ES within responses to interrelated societal challenges is said to accrue additional benefits and 'win-wins' (Seddon et al., 2016; Raymond et al., 2017). Co-benefits have arguably become a constitutive element of NBS. In turn, the potential for co-benefits helps proponents "make the case" (Tozer et al., *forthcoming*) for such solutions and gain funding and recognition for NBS, including through the United Nations Framework Convention on Climate Change (UNFCCC) and in the European Union's budget (ibid). The opportunity for co-benefits has been observed across different kinds of NBS, but is particularly prevalent in reference to climate change. The IPCC Special Report (IPCCSRCCL, P39) finds strong evidence for such co-benefits:

> "Near-term action to address climate change adaptation and mitigation, desertification, land degradation and food security can bring social, ecological, economic and development co-benefits (high confidence). Co-benefits can contribute to poverty eradication and more resilient livelihoods for those who are vulnerable (high confidence)." IPCCSRCCL, 2019, P39

Claims are made about social benefits including social inclusion, empowerment, and reduced inequalities (UNESCAP, 2019; Buijs et al., 2016; Faivre et al., 2017). According to the International Union for the Conservation of Nature, NBS:

> "…are determined by site-specific natural and cultural contexts that include traditional, local and scientific knowledge; produce societal benefits in a fair and equitable way, in a manner that promotes transparency and broad participation; [and] maintain biological and cultural diversity and the ability of ecosystems to evolve over time." (Cohen-Shachem et al., 2016, P xii)

What these discourses leave unsaid concerns how social benefits are meant to emerge, especially if such benefits are defined as progressive social change (cf. Munang et al., 2014; Seddon et al., 2019). The implicit assumption appears to be that social change will be an automatic consequence of making nature work for people, recalling debates on the deterministic link between ES and human development (Fisher et al., 2014) and more broadly, ecological change and society (Carpenter et al., 2012; Fischer et al., 2015). Studies that make visible the processes through which social change occurs from NBS are rare; impact evaluations are more common (e.g. Doswald et al., 2014; Munang et al., 2013; Brink et al., 2016; Roberts et al., 2012).

If NBS are a vehicle for empowerment of marginalised people, how does such change emerge, and what facilitates or constrains the potential for such social benefits? What are the challenges and impediments to engaging marginalised perspectives within these nature-based approaches? In this thesis, I will explore these questions through reference

to theories of power and a specific type of NBS relevant for understanding social benefits – adaptation – in order to clarify the potential of these 'solutions' to be empowering for groups with the most at stake in the ongoing crisis but often the least say in response to it.

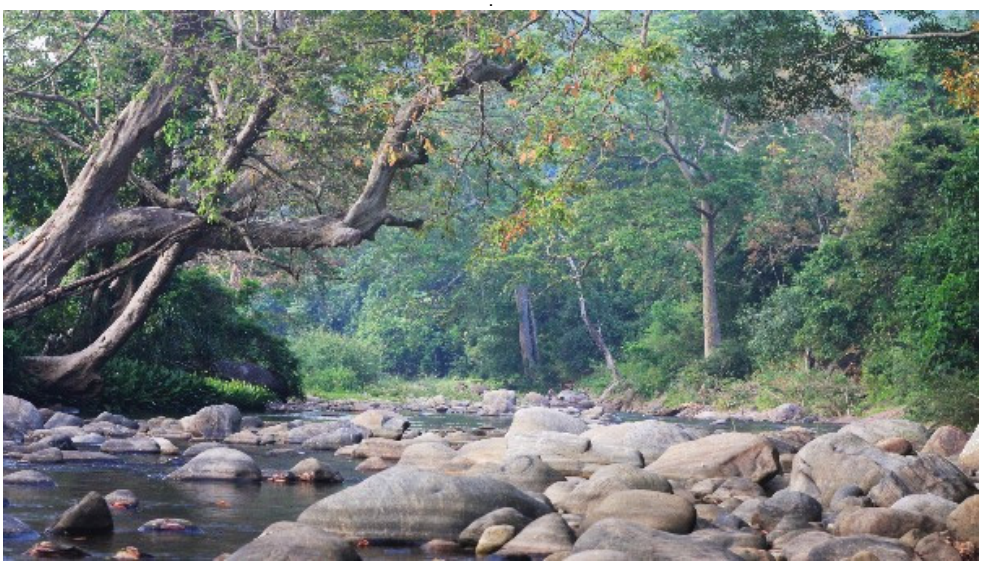

Photo – The river that runs through Serupitiya village, Nuwara Eliya district, Sri Lanka. This is one of the specific empirical cases where nature-based approaches have been applied in a climate change adaptation context as an intervention. This is called 'ecosystem-based adaptation'.

Ecosystem-based adaptation and empowerment

The same claims about NBS are present in the more defined context of ecosystem-focused forms of climate change adaptation. Ecosystem-based adaptation (EBA) is defined by the Convention on Biological Diversity (CBD) as "the range of opportunities for the sustainable management, conservation and restoration of ecosystems to provide services that enable people to adapt to the impacts of climate change" (CBD, 2009). Crucially, despite this sub-field of NBS being more established, we also find the same absence of further clarity as to the processes through which these social benefits will emerge. The IPCC's Special Report on *Climate Change and Lands* finds evidence that climate responses focussed on lands provide positive contributions to sustainable development and other societal goals (IPCCSRCCL, 2019, p24). The report in turn states that adaptation measures that preserve and restore ecosystems –

EBA – "can in some contexts alleviate poverty and provide co-benefits such as protecting livelihoods" (IPCCSRCCL, 2019, p21) and that:

> "Reducing and reversing land degradation, at scales from individual farms to entire watersheds, can provide cost effective, immediate, and *long-term benefits to communities* and *support several Sustainable Development Goals (SDGs)* with *co-benefits for adaptation*" [emphasis added] (IPCCSRCCL, 2019, p24).

According to advocates, EBA offer more flexibility and opportunities for participatory engagements with affected communities than hard-infrastructural equivalents (Mercer et al., 2012; Doswald et al., 2014, Brink et al., 2016; Quinn et al., 2018; Brink and Wamsler 2018). Relative to other forms of climate response such as hard-infrastructural approaches, EBA represent low-hanging fruit when it comes to climate change, with less negative effects, lower costs, and fewer trade-offs (Doswald et al., 2014; Jones et al., 2012; IPCCSRCCL, 2019). We can find explicit claims that EBA can deliver social change as a co-benefit of adaptation action focused on ES, including gender equality, social cohesion, and empowerment (Munang et al., 2014; Quinn et al., 2018; Colléony and Shwartz, 2019)[12]. Some scholars have attributed the social benefits of EBA to an apparent pro-poor disposition that better enables incorporating the knowledge and priorities of marginalised people (Quinn et al., 2018; Uy et al., 2012). Indeed EBA have been acknowledged to have a greater disposition towards 'bottom-up' or community-based forms of responding to climate change (Mercer et al., 2012; Reid, 2015; Brink et al., 2016; Brink and Wamsler 2018).

Given such emancipatory promise, it is surprising that knowledge production for EBA focusses predominantly on the technical dimensions of such approaches. When focussed on the social dimensions of EBA, knowledge production appears to prioritize national and international scales of governance or economic cost-benefit analyses (Nightingale et al., 2019; Doswald et al., 2014; Jones et al., 2012). The implication is that poorer and historically marginalised groups in society stand to benefit the most through ecosystem restoration because of their differential dependence on ES. Here the legacy of Western philosophy is again revealed, in terms of Aldo Leopold's *Land Ethic* (Leopold, 2018; cf. Wieland et al., 2016). However, the narrow view of social difference embedded in this discourse does not take into account scholarship that shows how power relations condition vulnerability and marginalisation for different groups (cf. Leach et al., 1999). This more critical branch of scholarship also highlights how

[12] Whilst several organisations, notably the International Union for Conservation of Nature, have issued policy documents that list features of successful EBA (Cohen-Shachem et al., 2016, P xii; Andrade et al., 2011), it is not clear how such rhetoric has been put into practice, as we find the same absence of processual aspects of EBA.

adaptation responses have costs and benefits for different groups (Marino and Ribot, 2012; Brink, 2018).

To recap, this thesis is situated in a broader discussion on NBS and their potential to deliver transformative social change. It specifically focusses on the potential of EBA to support empowerment. (See Figure 1 for a schematic representation; Table 1 for definitions)

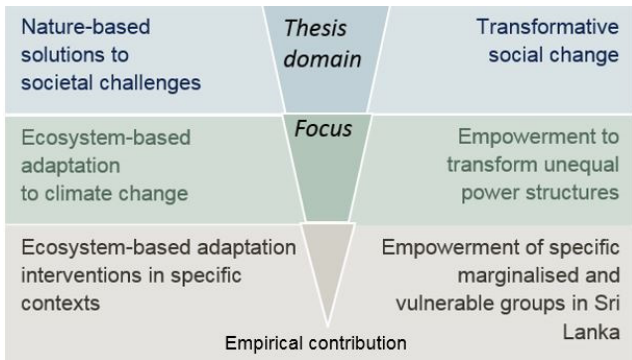

Figure 1 – This thesis is situated within a broader discussion of nature-based solutions and their potential to deliver transformative social change. The thesis specifically focusses on the potential of ecosystem-based adaptation to support empowerment. The empirical focus is whether ecosystem-based adaptation conducted as interventions in specific contexts can empower groups made marginalised and climate vulnerable in and through those contexts.

Empowerment as a concept, metric, and process

Few studies have yet to analyse the processes of EBA as a societal response to climate change in terms of power or use empowerment as a lens through which to analyse the potential for social benefits. Empowerment is understood here as a critical concept that appears to bring these complexities together into a single coherent picture. Firstly, valuable insight may be gained by using empowerment as a lens to look more closely at issues of social change amidst a changing biophysical context (Manuel-Navarrete, 2010; Manuel-Navarrete and Buzinde, 2010). Next, empowerment is a processual concept, meaning it can be applied to make social processes explicit even where dominant discourses would seemingly deny their importance (Kabeer, 1994). As a goal in itself, empowerment emphasizes historically marginalised people taking charge of their own decision making, with reduction in inequalities to follow (Kabeer, 1999). In this sense, empowerment forces a conversation about subjectivity, diverse knowledges, and agency (ibid; Castán-Broto et al., 2015). This is how I justify my use of empowerment as a metric to evaluate the social benefits of EBA, following Kabeer (1999).

Do EBA merit such an analysis? Contrary to coordinated efforts for climate change mitigation, the differentiated, unpredictable, and inherently locally experienced nature

of climate change impacts may lend itself to more collaborative, adaptive forms of governance and natural resource management (Thompkins and Adger, 2004; Wamsler and Brink, 2014; Castán Broto et al., 2015; Reid, 2015; Brink and Wamsler 2018). Recent research has shown adaptation can too often become a top-down imposition, and that adaptation actions may redistribute vulnerabilities rather than ameliorate them (Atteridge and Remling, 2017). Since inequitable outcomes have also been observed in natural resource governance actions and policies (Pelling and Gardagen, 2019), empowerment could play an instrumental role in guarding against such outcomes within EBA (García-López, 2018; Wieland, et al., 2016).

These questions are also relevant to questions of justice. Just institutions constitute a Sustainable Development Goal in their own right (Goal 16). Ensuring real participation and recognition is important given the ways that climate change and the responses to it threaten people's rights (Roberts and Parks 2006; Wainright and Mann, 2013; Sovacool et al., 2015). Study of empowerment might reveal power dynamics at scales that have rarely been taken seriously but are nevertheless important causes of differential vulnerability (Elmhirst, 2015; Tschakert et al., 2016).

The bounded and conditional role for empowerment becomes especially relevant when adaptation is defined as the "process through which an actor is able to reflect upon and enact change in those practices and underlying institutions that generate root and proximate causes of risk, frame capacity to cope and further rounds of adaptation to climate change." (Pelling, 2011, p. 21). This definition of adaptation is similar to the definition of empowerment given by Kabeer (1999): "the process by which those who have been denied the ability to make choices acquire such an ability".

Contribution to existing debates

This study is positioned within several contemporary research agenda. First, the present research can be understood within academic debates on ES, because EBA is principally based on the concept of ES (see Table 1 for key concepts used in this thesis). Whether ES can *deliver* social change has been the subject of some research (see Fisher et al., 2014; Wieland et al., 2016), but the possibility has not yet been studied empirically in a climate change adaptation context. How the management, conservation, and restoration of ES may empower marginalised people as part of transformative responses to interlinked societal challenges is a missing link in these debates. ES are traditionally understood as discrete entities whose relations are somewhat predictable; namely, humans manage ecosystems according to particular value sets, and otherwise independent ecosystems respond predictably by providing services to human beneficiaries (Thoni, 2019). More recent research has emphasised trade-offs between different ES, the possibility of their being co-produced within social-ecological

relations, and issues of equity (Daw et al., 2016; Kadykalo et al., 2019; Masterson et al., 2019), though the ES concept itself may be constraining the broader uptake of these perspectives (Kadykalo et al., 2019).

As an approach, EBA emanates from the Global South (Uy et al., 2012, Brink et al., 2016), with many rural farmers and smallholders (including in Sri Lanka) using ecosystems as part of daily practices and adaptation strategies (Pandey et al., 2015; Harvey et al., 2017; Vignola et al., 2015). *As a concept*, EBA has been adopted and shaped by Western academic institutions and environmental organisations to incorporate the tradition of ES research, and has thus adopted their epistemological and ontological assumptions (cf. Brink et al., 2016)[13].

Here nature is not only being invoked to confront itself, but it is also being invoked to confront society – in the form of social inequalities. The issue is that this 'biosphere-based sustainability science' (Folke et al., 2016; Fischer et al., 2015) emphasises human-nature interdependence but does not shed light on theories of social (-ecological) change (O'Brien, 2016; Brown and Westaway, 2011). In particular, the role of human agency vis-à-vis social and biophysical constraints remains under-explored (Manuel-Navarrete, 2010; Westley et al., 2013; Ahlborg and Nightingale; 2018). EBA are defined in the language of the natural sciences using technical and biophysical terms and expressions, precluding attention to power within the current approach. Perhaps making these dimensions visible by reframing EBA according to a lens of empowerment will allow a clearer understanding of their potential to deliver social benefits.

Secondly, the present research can be understood within academic debates on adaptation and transformation. In contrast to such a specific type of transformation, within climate change adaptation scholarship, attention to the biophysical character of hazards tends to situate vulnerability as external to society and to lead to a technical, managerial approach, in which climate change can be addressed according to short-term, often technological 'fixes' (Boyd, 2017; Nightingale et al., 2019). In this sense, focus on undifferentiated biosphere-based understandings of society, focussing especially on provisioning ES and climate change hazards, may unintentionally defer social responsibility, rekindling debates on the social construction of disasters caused by climate change (Ribot, 2010; Ribot 2014; Bassett and Fogelman 2013; Watts, 2015). For instance, Pelling (2011) has argued that this technical and managerial paradigm to climate change responses tends to have a socially regressive effect, maintaining the status quo and reinforcing underlying causes of people's vulnerability.

[13] In the scheme of Western academic epistemologies, the concept of EBA appears closest to natural and engineering sciences, with their mechanistic understanding of entities, relationships, and causation.

Issues of power and inequality, as well as mediating societal conditions, may go unattended in such a framing of adaptation.

To draw these two distinct scholarly conversations together, the debate at hand appears to be whether EBA represent a quick-fix 'solution' that only addresses the biophysical aspects of hazards and exposure to climate change, or whether they represent transformations in power relations that can lead to reduced inequalities in vulnerability and agency (cf. Pelling, 2011). Since little research has yet examined the relationship between these dimensions of climate change responses, addressing this gap is warranted. Recognising the interlinked basis of such questions, I use a relational approach in this thesis to show how vulnerability, power, social marginalisation, and ES are linked across the conduct of EBA and the context in which they intervene. Investigating two cases of such EBA in Sri Lanka, I unpack how these solutions hold both promise and challenges for transformative change to support the groups most at risk, and in doing so, I address how sustainability science can contribute to or hinder such change.

Table 1
Concepts and definitions used in this thesis

Concept used in this thesis	Definition
Transformation	"A fundamental, system-wide reorganization across technological, economic and social factors, including paradigms, goals and values". (IPBES, 2019)
Nature-based solutions	"Working with and enhancing nature to help address societal challenges" (Seddon et al., 2019)
Power	"The probability that one actor within a social relationship will be in a position to carry out his own will despite resistance" (Weber, cited in Boonstra, 2016)
Ecosystem-based adaptation	The Convention of Biological Diversity (CBD, 2009, p. 41); defines EBA as "the range of opportunities for the sustainable management, conservation and restoration of ecosystems to provide services that enable people to adapt to the impacts of climate change".
Climate change adaptation	The "process through which an actor is able to reflect upon and enact change in those practices and underlying institutions that generate root and proximate causes of risk, frame capacity to cope and further rounds of adaptation to climate change" (Pelling, 2011, p21)
Ecosystem Services	"The conditions and processes through which natural ecosystems sustain and fulfil human life" (Daly, 1997)
Empowerment	Empowerment is the contingent, political process "by which those who have been denied the ability to make choices acquire such an ability" (Kabeer, 1999).
Frames	Reifying (dominant) modes of expression (after Elias, 2012; cf. Lakoff and Johnson, 1980)

Research focus, aim, and questions

EBA and empowerment are said to be transformative responses to climate change, biodiversity loss, and inequality. However, it is unclear how they are, or are not, interlinked. The research aim is therefore to explore how processes of EBA and empowerment interact, particularly in empirical contexts in Sri Lanka. Understanding these interactions is a step towards assessing the current potential of these approaches to transform the power relations in which vulnerability is determined for specific marginalised groups.

Accordingly, the overarching research question I seek to address is: How do EBA and empowerment interact?

Four sub-questions address this topic:

1. What power relations have to be considered when studying EBA and empowerment?
2. How are the interconnections between EBA and empowerment theorised?
3. How do EBA and empowerment interact in empirical settings?
4. How do frames prefigure the potential for empowerment in nature-based responses to societal challenges?

Although the four papers presented in this thesis more or less correspond to each these four questions, respectively, all papers in fact contribute to different research questions to some extent (see Table 2).

Table 2 –
Research questions in relation to thesis papers

Research question	Paper			
	I	II	III	IV
1. What power relations have to be considered when studying EBA and empowerment?	■	■	■	■
2. How are the interconnections between EBA and empowerment theorised?	■	■	■	■
3. How do EBA and empowerment interact in empirical settings?	■		■	■
4. How do frames prefigure the potential for empowerment in nature-based responses to societal challenges?		■	■	■

The research focus of this thesis is the application of EBA. The empirical portion of the work is instances of EBA studied as interventions in specific contexts, specifically two sites in Sri Lanka that address different climate change impacts using different types of EBA.

Contribution to sustainability science

Sustainability science differentiates itself from adjacent disciplines through an ontological focus on human-environment interactions (Clark, 2007; Kates, 2011; Jerneck and Olsson, 2011). Though the discipline attempts to bridge epistemologies of the social and natural sciences, little direct attention is given to the challenges of bridging the historical epistemological divide involved (Debaise, 2017; Labban et al., 2015). The way that contemporary crises of climate change and inequality interact is an example of the challenge of bridging this divide. Considering humans, environments, and their relations together is at the heart of definitions of sustainable development (Escobar, 1999; Chakrabarty, 2009), but we see variations in climate change adaptation that work from different assumptions about human-environment interactions that entail different responses (Watts, 2015; Brown, 2016).

Sustainability science is defined as a 'use-inspired' discipline, meaning that its explicit normative stance differs from most other disciplines (Jerneck and Olsson, 2011). It seeks to resolve actual problems affecting human well-being rather than theoretical problems. In fact, most sustainability science starts from a particular empirical sustainability challenge (Jerneck and Olsson, 2011). In this case, the sustainability challenge in question is climate change and associated adaptation, whilst ES relates to biodiversity loss and land degradation which are other prominent challenges.

From here, the contributions of this thesis to sustainability science are threefold:

1. Unpacking dominant assumptions in sustainability science using theories of power
2. Informing understandings of change using agency and subjectivity
3. Clarifying the embedded roles of sustainability scientists using frames

Firstly, in the domains of climate change, land degradation, and biodiversity loss, the emphasis of social scientists to ask 'how and why' questions can uncover the roles of social power (Ribot, 2014; Cannon and Müller-Mahn, 2010; Jetskotwitz, et al., 2018). In part, asking questions about power is a means by which to uncover social differences in transitions towards sustainability, which relates to another sustainability challenge – inequality (Hamann et al., 2018). Power and sustainability science can be integrated in order to theorise the meaning and modes of transformation (Scoones et al., 2015; Navarrete, 2010; Avelino, 2017; Pelling et al., 2014; Fazey et al., 2018).

Secondly, pressing issues in sustainability relate to issues of agency and subjectivity, including how actors constitute identities, meanings, and dispositions in relation to the sustainability practice, the contextual social relations, and the human-environment

interactions in which they are constituted (Agrawal, 2005; Brown and Westaway, 2011; Tschakert et al., 2016; Boyd et al., 2014; Brown, 2016; Kaijser and Lövbrand, 2019). These issues are under-examined dimensions of how power relates to sustainability and transformative change, particularly in the empirical context of sustainability interventions (cf. Long, 1990; Leach et al., 1999; de Hann and Zoomers, 2005). Recognising subjective dimensions of sustainability and how they differ between people within relations of power can help to challenge naturalised or generalist representations implicit in science, opening up space for subjective (and ontological) diversity and knowledge (Scoones et al., 2015; Nightingale 2016; Bee, 2013; Ahmed, 2006; Petheram et al., 2010).

Thirdly, frames – dominant modes of expression – form part of the relational context of sustainability science (Wutich et al., 2018). Frames are "storylines that provide meaning by communicating how and why an issue should be seen as a problem, how it should be handled, and who is responsible for it" (Asplund et al., 2013, p197). Frames analyses have been used in sustainability science in part to make the researcher visible as part of the relationships within a given case (Petheram et al., 2010; Whatmore and Landström, 2011; Pickering, 2013). In the context of power imbalances, such analyses can clarify the embedded roles of sustainability scientists to enable or constrain transformative change.

Photo – *Elangawa* landscape characteristic of dry zone Sri Lanka, which comprises many different land-uses, such as paddy rice farming, home gardening, and *chena* cultivation, a type of slash and burn agriculture in forested catchments. *Chena* cultivation has increasingly been used to grow hybrid maize, a commercial crop, and this commercialisation of what has previously been a small-scale, subsistance activity has resulted in degradation of *Elangawa* characteristics, to the detriment of the wider community who depend on its properties during times of water insecurity.

Theoretical framework

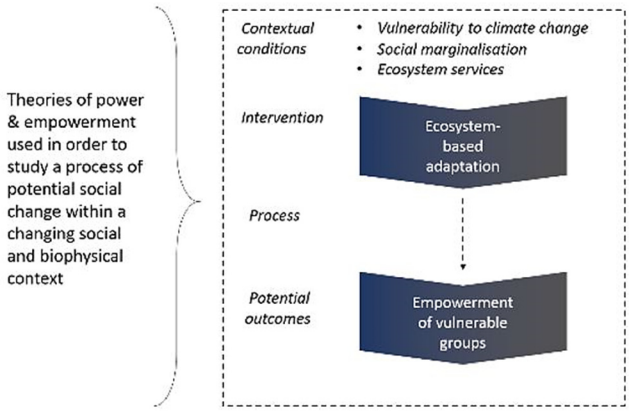

Figure 2 – Figure showing the main concepts used in the thesis to analyse the interactions between ecosystem-based adaptation and empowerment. The theoretical framework below sets out how these ideas are related and how they inform the analysis.

Theories of power and empowerment vis-à-vis EBA

Figure 2 sets out the overall approach taken to conceptualise the relationship between empowerment and EBA. I use theories of power and empowerment as the principle means to formulate my analytical approach to studying the process of EBA within the dynamic context of vulnerability, marginalisation, and ES. This approach addresses the black box of EBA implementation, namely the process through which social benefits such as empowerment may emerge. More details on specific theoretical approaches are given in the respective thesis papers.

The theoretical framework set out here conceptualises how empowerment may emerge from EBA, using the definitions set out in Table 1. In this section, I introduce the concepts of power, which form the architecture I use to relate the concepts of EBA and empowerment. In this design, I treat the EBA and empowerment concepts in different ways. ES is the epistemological foundation predominantly observed in current conceptions of EBA. On the other hand, empowerment is operationalised as an

analytical lens through which to study the process and outcomes of EBA in terms of a specific social benefit.

My intention is to analyse how EBA interventions articulate within a dynamic social-ecological context, and how those articulations play out for the vulnerabilities of particular groups. I use theories from cognate disciplines, especially sociology, development studies, and geography, as well as ecological and climate sciences. This interdisciplinary approach is an attempt to bridge the ecological and social dimensions of sustainability science, but I do not claim to have managed this exhaustively.

In this thesis, I take the position that power is constituted in relations, rather than a resource to be owned by any particular actor (Avelino, 2011). Further, following Eyben et al. (2006), I see power as a dynamic and emergent phenomenon, rather than something that is formal or mechanistic. I am ambivalent about the role of any single theory of power to provide a comprehensive and universal reading of the concept. Many different theories of power exist and are useful, but as Haugaard shows, these theories may be incommensurable (Haugaard, 2010). I see power as a recursive category; power acts upon the way we think, and partly for this reason, we should be sceptical of any particular 'truth claims' that originate in research, including those related to power (Wacquant, 1989). Accordingly, I follow Isabel Stenger's call for situated readings of power that do not overly prefigure ontology prior to their use in enquiring about a given context (2000)[14]. Such sensitivity to context and particularities of a given configuration of relations arguably warrants such a reflexive ontology.

Power can be expressed in different forms. A useful and predominant definition for power refers to the capacity to influence the general course of events, including the behaviour of others (Avelino, 2017). A common distinction of power is to separate it according to a productive category of *power to*, which is also understood as agency, as well as a constraining category, or *power over* (Hayward and Lukes, 2008). As scholars of power have demonstrated, agency and power over are inseparably linked. An actor may intentionally or unintentionally constrain the actions of another actor (Barad, 2007). Likewise, the ability of any one actor is constrained by the actions of others (Stirling, 2015; Pansardi, 2012). Following Vij et al. (2019) and Karpouzouglou et al. (2019), I thus see power as an emergent property of relations between people and environments that may be both tangible (material) and intangible (ideational).

[14] I avoid critical realism because of its claims to go beyond appearance to reveal the reality of power relations. In line with Kant (cf. Stevenson, et al., 2012), I am more ambivalent about the role of any human to go beyond appearance (cf. Rosendahl et al., 2015). Feminist scholars have likewise challenged such attempts to see power from a 'universal' (or objective) position, which Haraway (1991) likens to a 'God Trick' (cf. Rose, 1997).

According to the sociologist Elias (1970), social relations can be represented both as discrete "dyadic" relations, such as in the conduct between two individuals, as well as "diffuse" relations, that form the context in which conduct between individuals plays out (cf. Pansardi, 2012). Tschakert et al. (2016) apply a similar conceptualisation to climate change adaptation to theorise the conduct of a specific adaptation action 'pushing out' on contextual power relations, whilst said context 'pushes in' to shape that conduct. Boonstra (2016) and Karpouzoglou et al. (2019) have applied Pansardi's framework in the cognate disciplines of sustainability science and water governance, respectively. On this basis, it was assumed an adaptation intervention can be similarly conceptualised[15].

I consider that theories of empowerment and the ES concept can be coherently integrated through reference to Stephen Lukes' three-dimensional view of power (Lukes, 1974; Peterson, 2000; Brown, 2016; Eyben et al., 2006; Haugaard, 2010). These three dimensions of power are set out vis-à-vis ES in Table 3. Lukes focusses on the constraining function of power and attributes power over to material, institutional, and discursive dimensions. Recent feminist scholarship has emphasised how these dimensions co-produce social marginalisation, create embodied forms of social difference, and differentiate vulnerabilities (Guthman and Mansfield, 2015; Nightingale, 2011; Elmhirst, 2015)[16]. Institutional forms of power (norms, rules and rights, after Ostrom, 2015) represent a tangible means of control through which actors are able to act deliberately to bring about expected outcomes according to a set of values. The discursive level of power shapes how some values (in the sense of dispositions towards human-environment interactions) are more recognised than others. Such imbalances shape marginalisation of particular people's values and knowledges (Fraser 2004).

[15] Long (1990), De Haan and Zoomers (2005), and Leach et al. (1999) working with development studies, capabilities, and livelihoods approaches, respectively, have revealed the embedded power that stretches across the tangible and intangible relations of a given intervention conduct and its context. Such work has been applied in empirical adaptation contexts by Sallu et al. (2010) and Hoque et al. (2018).

[16] This recursive view of power, that does not prioritise the intangible over the material as the dominant conduit through which power over is experienced, is also used in embodied and performative approaches to power in feminist political ecology (cf. Velicu and Garcia-Lopez, 2018).

Table 3
Three dimensions of material, institutional and discursive power set out vis-à-vis ecosystem services

Dimension of power	Relevance to Ecosystem Services research
Material relations Matieral relations of power represent the distribution of a given resource, such as energy, or firepower, that enables certain actors to act in ways not available to others. See: Boonstra 2016; Pansardi, 2012; Ahlborg and Nightingale, 2018; Brisbois and de Loë, 2016; Fortnum et al., 2018; Chaigneau et al., 2019.	As a realist-materialist concept, we may locate ecosystem services principally at the material level of power, as the ecosystem structures and material flows of benefits that they confer in order to meet people's material wellbeing. This is a legacy of the origin of the concept in the natural sciences. Through a matieralist, natural-science lens, EBA appears to offer an adaptive response focussed on addressing the constraining function of reduced ES provision (due to climate change impacts) and the increased adaptive capabilities offered by restoring such services. Risks of harm from climate change exposure and can be seen as an expression of material power relations. Power is visible in the way risks are distributed unevenly to different groups, owing to deficiencies in the kinds of resources necessary for safety and security. (Roberts and Parks, 2006; Nixon, 2011).
Institutions Institutional forms of power represent the means of control through which actors are able to act deliberately in order to bring about expected outcomes in the behaviour of a given system, through reference to asymmetrically distributed entitlements, rights and priveleges. Institutional forms of power are expressed in formal decision-making spaces, and determine who is able to set the agenda of a given form of decision-making. See: Lukes 1974; Avelino, 2011; Gaventa 2019.	Though mostly focussed on natural sciences, ecosystem services scholarship increasingly encompasses some governance research – though economics has dominated the social science treatment of the subject to date (Thorén and Stålhammar, 2018). Governance work on ecosystem services shows the institutional dimensions of the concept. Latterly EBA scholarship has utilised the ecosystem services management 'cascade model' which evokes institutional dimensions of power (Brink et al., 2016). Institutionally, the cascade includes modes of ecosystem services management and control (Leach et al., 1999; Sallue et al., 2010). Institutional forms of power are located in the form of rules, sanctions, policies and programmes (Daw et al., 2016). Such forms mediate who is represented in particular sites of decision-making about ecosystem services, or in other words, who gets to decide (Hoque et al., 2018).
Discourse Discursive power is located in values, norms and what is deemed to be 'common sense'. Power diffuses through discourse to affect how the needs of different groups are recognised systematically to a greater or lesser extent. Such power is represented in how dominant notions about a given phenomena are framed. This dimension of power is related to Gramsci's *Hegemony* and Bourdieu's *Habitus.* See: García-López, 2018; Velicu García-López, 2018; Manuel-Navarrete and Pelling, 2015.	People value different aspects of ecosystem services. Discursively, the cascade model also includes values, which are here seen as an intangible, often hidden or deeply embedded form of power (Wieland et al., 2016; De Hann and Zoomers, 2005; Mosse, 1997). This has subsequently been adapted for EBA (Brink et al., 2016; Newsham et al., 2018). Subjectivity refers to the effects of power 'in recoil' which herein means how discursive power affects the way an individual experiences her reality and in turn acts accordingly within environments (Nightingale, 2013; Manuel-Navarrete and Pelling, 2015; Boyd et al., 2014; cf. Butler, 2001; c.f. Foucault 1980). Values in ecosystem services are seen here as constituted within power relations that shape different people's subjectivities, and located at the discursive level (Stålhammar and Thorén, 2019; Stålhammar and Pedersen, 2017). Discursive forms of power also operate in research to condition how we concieve of, for instance, the relationship between humans and nature (Steel and White, 2012). The ontology of ecosystem services can be deconstructed according to a discursive theory of power (cf. Escobar; 1999; 2006).
Recursive Power *(special case)* Power flows recursively through these 3 dimensions. However any framework that attempts to bridge material, instituttional and discursive dimensions is tentative, given the fraught ontological relationships between material and intanglbe dimensions of power (Labban et al., 2015). See: Guthman and Mansfield, 2015; Nightingale, 2011; Elmhirst, 2015. Velicu and Garcia-Lopez, 2018; Pelling et al., 2014.	More recently ecosystem services scholarship has emerged that focusses on issues of power, equity, and context-specificity (Kadykalo, et al., 2019; Masterson et al., 2019). Furthermore, in parallel to the embodied, performative approaches to power, recent ecosystem services scholarship emphasises a more emergent co-production model that sees 'services' as constructed within social-ecological relationships (Ernstson, 2013; Haider, 2017). With reference to co-constructions of ecosystem services, and recursive, performative notions of power, we can conceptualise social benefits as emerging through EBA from recursive changes in power that are embedded in social-ecological relations. In this view social-ecological relations are seen as constructed and separations between ecological and social systems (and change) as political (West et al., *forthcoming*; Latour, 2005; Whatmore, 2002).

Empowerment

In parellel with Wisner's description of the vulnerability concept (2016), I view empowerment analytically as a lens, evaluatively as a valuable goal or 'metric' relevant for adaptation, and ontologically as a process. I use these different views together to normatively challenge deliberate and inadvertent forms of marginalisation through adaptation, including the three dimensions of power mentioned above. I have used empowerment to analyse the potential for EBA to yield social co-benefits for marginalised groups, and such benefits are analysed exclusively in terms of empowerment. I admit this approach represents a partial frame, but I use it with the intention of focussing attention on hitherto under-recognised dimensions of adaptation processes. To conduct the analysis, I foreground the relations engendered when an action associated with EBA intervenes in a specific context (cf. Long, 2001). This relational approach evokes both the conduct and the context of a particular intervention.

I follow feminist scholars in understanding empowerment exclusively as a political process of self-emancipation that emerges from recursive interactions between discursive, institutional, and material relations to challenge incumbent power inequalities (Veneklasen, 2009). Again, this is a partial view that highlights the process of empowerment and its often contested nature as ways to create the necessary critical distance with the normative orientation and apparent linearity and simplicity of NBS. Emphasising the politics of empowerment helps to make visible the complexity and non-linearity of social processes. I adopt Kabeer's definition of empowerment as the process by which people who have been denied the ability to make strategic choices acquire such an ability (Kabeer, 1999). The constitutive elements of this definition concern access to resources, agency, and achievements (Kabeer, 1999; de Hann and Zoomers, 2005). In the context of EBA, access to resources may include capacities and assets (such as human, social, natural, physical, economic), including but not limited to ES. If access is available to resources, the second element of concern is agency. Agency is conceived as an immutably contingent concept; it is a social, material, and cognitive category. An individual must first recognise the possibility of acting on a particular set of entitlements and then choose to do act *alternatively* to what is expected based on dominant rules and values. Then, through intentional actions, these possibilities and choices must translate into actions in the name of specific achievements that overcome incumbent inequalities (instead of reinforcing them). The end goal of Kabeer's conceptualisation is achievements of 'strategic life choices' (1999). In an adaptation context, this goal may translate as empowered adaptive strategies (Gabriellson and Ramasar, 2013), in which "an actor is able to reflect upon and enact change in those practices and underlying institutions that generate root and proximate causes of risk" (Pelling 2011; Brown and Westaway, 2011).

Implications for knowledge production

This thesis is inspired by feminist epistemology and attempts to draw from its analytical and normative sensibilities (cf. Harcourt and Nelson, 2015; Bee, 2013; Nightingale, 2003). This means, broadly speaking, that I conduct research based on how environmental change interacts with social difference, including, but not limited to the role of gender in environments (Elmhirst, 2015). This approach informs the way I understand how knowledge is produced and used within contexts of asymmetric power relations. The recursive character of power makes studies of power more complex and feminist epistemology becomes more relevant, since links between knowledge, power, and subjectivity are central themes of this paradigm. Making explicit the practices through which knowledge production for sustainability emerges can help highlight more precisely how and where power plays a role in shaping outcomes for particular groups (Fazey et al., 2018; van der Molen, 2018). The social contexts in which research is done leave an imprint on the research itself; science is not immune to power but rather diffuses it (Foucault, 1980; Macgregor, 2009; Kaijser and Kronsell, 2014). When we consider the discursive dimension of power, we can understand that power is located in the relations between researchers and the subjects of research (Cutter 2003; Moser, 2016). For instance, fixed or 'taken for granted' notions used in research, such as ecological dependency, may be constructed notions with political implications (Wacquant, 1989; Latour, 2005; Elias, 2012) Dependency in this example then, in this constructivist or post-constructivist view, is not a fixed or 'real' thing in itself (c.f. Taylor, 2016) or an object (Wittgenstein, 2001). It is rather a constructed representation that engenders particular subjectivities.

Feminist political ecology (FPE) focuses on some neglected dimensions of power in research on social-ecological relationships. These dimensions are also relevant to processes of empowerment in the context of vulnerability to climate change. The neglected aspects of power include people's diverse values, knowledges, and entitlements vis-à-vis ecosystems; their intersecting claims to relevant rights; and their ongoing struggles to secure recognition and representation within decision-making arenas (Elmhirst, 2015). Interpretations of power in sustainability science have to date tended to focus on more material and institutional aspects (Vink et al., 2013; Boonstra, 2016) and on the more visible aspects of access to and distribution of resources and representation in decision making (Brisbois and de Loë, 2016). To foreground hitherto under-recognised and hidden dimensions of power in sustainability science, I have highlighted frames expressed by particular actors within contexts of sustainability and attempted to trace their effects.

Photo – Typical agricultural landscape of dry zone Sri Lanka, comprising home gardens with trees, and paddy rice cultivation. Increasing mechanisation and subsidised use of chemical inputs has led to wellbeing gains whilst also undermining the landscape characteristics that help deal with climate change shocks and stresses, including, drought and water insecurity. Such degradation of environments hits marginalised groups hardest, as they have generally least recourse to alternative sources of clean water. Clean water was especially prioritised in women's focus groups, where female participants spoke of their concerns of increasing water toxicity during drought conditions.

Photo – The villagers of Serupitiya had, in interviews and focus groups, told us that water insecurity was their greatest concern, amongst many other climate-related impacts. Forested hillsides that had at one time provided steady water supply to the village were now no longer providing, and stream beds were running dry. Thus, certain individuals in the villagers were mobilising to secure a second source of water, making campaigns to government officials – which we witnessed first hand in participant observation, and even to us as we carried out the research activities.

Methodology

In this section I explain and justify the mixed methodology used in relation to the research questions and discuss some epistemological dimensions and limitations of each. The relationship of the methods to the research questions is shown in Table 4. This table also describes their methodological elements of each research question. Further details can be found in the respective thesis papers.

Overall approach

Ontology

Broadly speaking, following the task set out by Latour (2005), my methodological approach is designed to explain EBA as an emerging concept, rather than assuming the adaptations are objects that exist in themselves (Taylor, 2016). So, following Escobar (1995), I seek to 'encounter' EBA in research and practice and thereby trace the enactment of the concept (and by extension the biosphere-based sustainability thinking that appears to be represented in its invocation) as it prefigures interactions and thereby relations and processes (Thoni, 2019; Allan, 2017; Law and Urry, 2004; Law and Singleton, 2013; Tsing, 2015). My main tool for this investigation is to view EBA through a lens of empowerment (c.f. Barad, 2007). In this thesis, the radical, political character of the empowerment concept (Kabeer, 1994) acts as a means of redress or even ontological resistance (Butler, 2001; cf. Foucault, 1980; Muehlbacher, *forthcoming*) to challenge the emergent politics and discursive power engendered in EBA and the hegemonic power relations that may be hidden through their expression (Remling, 2019; Thoni, 2019; Gonzales Lindberg, 2019).

There are possible challenges to the privileged ontological position given to empowerment in the thesis[17]. One could validly point out that the biophysical basis of

[17] This approach represents an admittedly limited and partial ontology. Further, this ontology reifies empowerment as a concept, even whilst attempting to deconstruct the concept of EBA. Thus empowerment is not afforded the same reflexive attention as I give to EBA. An empowerment frame

EBA calls into question the anthropocentrism and mental primacy implicit in empowerment theory. I concede that one does not get the opportunity to reflexively 'encounter' empowerment in this thesis. Though the thesis is not constructed to offer this analysis, further study could seek a form of mutualistic redress between socially and ecologically orientated theories, allowing them to be 'read through each other' on more equal terms to offer a theory of processual agency that is both "enculturated and enearthed" (Schill et al., 2019; cf. Barad, 2007; Castree and Braun, 2002).

Epistemology

Tsing's scholarship draws attention to the politics of knowledge production in a capitalist political economy, and her work highlights mechanisms of power in translation, abstraction, standardisation, and reductionism, which enable policy-orientated concepts such as EBA to function within dominant, international political economic relations (Tsing, 2015; cf. Thoni, 2019; Kabeer, 1994; Adger et al., 2001). In the approach I take to knowledge production, I extend such critical analysis into the ways that EBA are constructed as objects in knowledge production and practice, which then prefigure complex social interactions that occur thereafter (Tsing, 2015; Kaijser and Kronsell, 2014; Remling, 2019; Fairclough, 2013; Kuntz, 2015).

Departing from the observation by Brink (2018) that EBA might in principle support citizen engagement but the material focus on NBS appears to hide these opportunities, my research design focusses on unpacking the 'blackbox' implicit in such a "people-less frame" (Long, 2001). In Papers I and IV, I draw on a power-sensitive stance to knowledge production akin to Fairclough's critical discourse analysis, to analyse the process of how EBA interact with other dimensions of power. More specifically, such an approach makes visible how frames, power, and knowledge interact, and a clear emergent finding of Paper I sets the stage for the rest of the thesis. In Papers II and III, I focus on the elements hidden from view in the dominant frame of EBA: social relations, processes, and power. To do this, I draw my epistemology from the broadly constructionist approaches to knowledge production of relational sociology and FPE (cf. Escobar, 2006). The approach that comes closest to mine is Long's actor-orientated social constructionism (2001; cf. Fairclough, 2013)[18]. From this perspective, in Papers

is similarly likely to prefigure interactions and relations, and I find evidence for how the concept prefigures researchers' attention to power relations in Paper I.

[18] Long's actor-orientated constructionist perspective "focuses upon the making and remaking of society through the ongoing self-transforming actions and perceptions of a diverse and interlocked world of actors. These emergent processes are complex, often ambivalent, and highly contingent upon the evolving conditions of different social arenas. They also entail networks of relations, resources and meanings at different scales of organisation. These range from small-scale interactional contexts, institutional domains in which actions, expectations and values are framed and contested, to more global scenarios that shape human choices and potentialities at a distance but which are themselves

III and IV, I seek to demonstrate how a discourse (broadly defined, after Taylor, 2016; Long, 2001 and Butler, 2010) is enacted in and across particular contexts, and I analyse how that shapes relations, processes, and power imbalances (after Law and Urry, 2004; Allan, 2017; Thoni, 2019; Calliari et al., 2019; Jasanoff, 2004).

Data collection and analysis

I have used a mixed methodology in accordance with the commitments my stance on knowledge production entails (Nightingale, 2003). I use four distinct kinds of methods, each of which focusses on a specific type of social relations highly relevant to the study and to the practice of EBA, but is apparently under-examined. Paper I is a mostly quantitative systematic review that shows how researchers' studying adaptation relate to adaptation *as a research object*, through implicit frames of power. Paper II is a more qualitative literature review that examines relations between the two main concepts of the thesis, which can be understood both as bodies of knowledge and as structured ways of looking at the world that focus attention on a particular set of objects at the expense of others – in other words, as frames (Taylor, 2016; Lakoff, 2010; Lele et al., 2018; Wittgenstein, 2001; Butler, 2010). Paper III uses a variety of narrative and participatory methods to show how people relate to each other in the conduct and context of the implementation of EBA (Pansardi, 2012; Elias, 2012). I combine these methods to understand how people self-consciously experience climate change and adaptation interventions within a broader relational context. Finally, Paper IV uses a comparative study to draw different cases – and their respective authors – into conversation with one another (Barad, 2007). The aim here is to tease out how *nature-based* frames are used to construct cases as cogent and coherent research objects (Fairclough, 2013) within complex and ambivalent settings comprising dynamic contexts wherein many diverse actors relate to each other (Tsing, 2015; Long, 2001; Haider, 2017). Specific details of each method are provided in Text box 2 and further elaborated in the respective papers.

Across these different analyses, I rely on an iterative approach to analysis, alternating between different types of logical inference. Since each of the papers begins by establishing a determinate frame to gather and analyse data in a more traditional form of research design (Fairclough, 2013; Yin, 2008; Flyvbjerg, 2006b), the papers can be considered to mainly rely on deductive reasoning (Yin, 2008; Denzin & Lincoln;

the products of the extended chains and repercussions of social action and their impacts on both human and non-human components." (Long, 2001, p2)

2005). However Papers II to IV also deal with more iterative approaches, whereby emergent findings became visible, and thus are representative of a more abductive approach (ibid). For the empirical elements of Paper III, I followed the reflexive livelihoods methodology of Prowse, who proposes an iterative method between different kinds of methods, going backwards and forwards to trace emergent findings (Prowse, 2010; c.f. Remling, 2019). The reflexive livelihoods methodology attempts to introduce ways for the subjects of a given research topic to have more say in the research and offer the chance for people in the research to challenge the interpretative choices made by the researcher. There is an instrumental purpose to such a movement, in attempting to reduce bias. This approach enables a kind of triangulation consistent with a feminist epistemology (Nightingale, 2016; cf. Tengö et al., 2014).

The thesis uses methods applied to different scales of social relations engendered in EBA. The thesis starts with two macro-scale analyses. The first is a systematic review of adaptation case studies published worldwide. The second, a literature review of EBA and empowerment, takes account of the development of the discourse on EBA at the international scale. In Paper III, I focus on two case studies, delving deeper into the micro-scale social complexities of EBA interactions – understood according to what Fairclough would refer to as "transdisciplinary" power relations – as processes in specific situations (2013). To focus on the particulars of the case, I prioritised qualitative methods as being better able to uncover situated knowledge of these power relations. The data for this case thus comprise diverse people's narratives, perceptions, and accounts of how the EBA interventions were conducted, how they engaged nominal beneficiaries, and what they represented to these constituencies. I believe that seeing EBA in this way is consistent with a bottom-up, critical approach to empowerment scholarship, honouring the radical, grassroots origins of the concept (Kabeer, 1994). Finally, through the comparative approach of Paper IV, I zoom back out to a meso-scale level to understand how emergent findings from this case could be traced across different instances of nature-based approaches.

Research Journey

During the thesis process I was able to use findings from one paper to structure the research of a subsequent paper in an iterative manner. It would be disingenuous to suggest that my approach was ready as a package at the beginning of the process. Over the course of the four and half years in which my research was conducted, the study increasingly became a relational sociology of intervention, in a context of social-ecological relations. Over time, my thinking on the methods used has changed, and with the benefit of hindsight, I can see this change reflected a shift away from a mechanistic approach to power and adaptation, that had perhaps reflected my

background in systems thinking, resilience, and ecological science. I moved to acknowledge the methodological implications of relational sociology and FPE latterly, in a more relational approach. With a more post-structuralist approach learnt from relating to critical adaptation scholars and drawing from my reading of these fields, I could start to more appropriately capture how project engagements were embedded in relations of power and trace people's own struggles and choices related to climate change and the fulfilment of aspirations. In this task, resistance, subjectivity, and frames emerged as analytical categories that better explained the trajectory and outcomes of the interventions associated with EBA I analysed in Paper III. This I would contend was more in line with the normative and analytical commitments of empowerment theory. The exploratory, comparative research design of the final thesis paper emerged from the analyses in Papers II and III. In this latter phase of the thesis, I attempted to understand if and how particular nature-based frames were prefiguring relations and processes across different cases, employing different frames of nature in order to construct a research object. This comparative study therefore enabled me to understand how subjectivities, frames, and knowledge interacted across multiple contexts to prefigure the agencies of diverse people, thus enabling a more rigorous and hopefully more reflexive explanation of EBA in terms of power relations.

Table 4
This table describes the major methodological elements used in each paper.

Paper *Approach*	**Research object**	**Analysed Material**	**Analytical focus and logic**
Paper I *Systematic Review and quantitative and qualitative frames analysis.* *Main focus: Research Question 1*	The focus is on how empirical studies of adaptation worldwide reveal the implicit functioning of power, according to five implicit frames of power revealed through systematic frames analysis.	The search string was returned 4,886 bibliometric entries potentially dealing with power. The screening process resulted in 221 potentially relevant papers (Table 1). After the full text of these papers was read, the final number of papers was reduced to 143 based on their actual relevance. The dataset for the quantitative and qualitative content analysis consisted of numbers, words, and text fragments. See Paper I for more details.	Deductive approach: Each paper's content was analyzed according to 22 review categories, including 5 frames of power deduced from the literature on power, which were analysed quantitatively using Max QDA and R software, and qualtiatively according to commonly-agreed protocols. The categories comprised descriptive characteristics of the cases, including elements relevant to the study of power relationships, such as the subjects and drivers of adaptation actions, and the location of the study authors.
Paper II *Qualitative literature review and conceptual synthesis* *Main focus: Research Question 2*	EBA *as a concept is* studied vis a vis Empowerment *as a concept*	The review resulted in more than 90 articles from databases Science and Scopus academic databases, after applying inclusion and exclusion criteria.	Deductive logic was used. In the review, each article was read and evaluated by the first author of this paper, guided by the framework. The two bodies of literature were studied in reference to three dimensions of a predetermined framework, that enabled both concepts to be integrated in reference to a common framework. See Paper II for more details.
Paper III *Empirical case study of two EbA in Sri Lanka* *Main focus: Research Question 3*	EBA encountered as it was implemented in particular contexts. The relations, process and power-laden interactions are made visible through the lens of empowerment.	Focus groups, background material and document analysis, interviews at national, regional and community level, feedback workshops, were all conducted in accordance with the Reflexive Livelihoods Methodology (Prowse, 2010). Respondents for focus groups and key stakeholder interviews were recruited through snowball sampling techniques, whilst those for narrative interviews were gathered using more systematic sampling techniques (every fourth household in Galgamuwa). The team was careful to ensure equal representation in terms of gender and members of a diversity of livelihoods.Field assistants with a relevant educational background assisted with data collection. The dataset for the qualitative content analysis consisted of text fragments. See Paper II for more details. Data gathered January to June 2017	Interview and focus group transcripts were coded deductively according to the analytical framework set out in Paper III, using both word processor and handwritten codes to elicit themes.The deductive codes were a good fit for the data, but new inductive codes were introduced through the process (such as 'resistance') in an interative method to capture emerging themes. I triangulated initial findings with narrative and key stakeholder interviews and confirmed and nuanced emerging findings through feedback workshops.

Paper IV *Self-reflexive comparative study of three cases of EbA, one one of Environmental Peacebuilding, and one of Environmental Justice* *Main focus: Research Question 4*	Frames of nature engended in 5 cases that invoked a nature-based frame to understand societal challenges	This was an exploratory, collective exercise in reflexivity. We used our own respective cases as the analysed material, in a process of re-presenting cases and re-analysing the case *constructions* in reference to a commonly-developed protocol. For the details of respective cases see Brink 2018, and Paper III (this volume) (EBA), Islar, 2012 (Environmental Justice), Krause, 2019 (Environmental Peacebuilding). The analysis is conducted principally on how these cases express power relations, especially through the intangible dimensions of power; frames, subjectivity and knowledge (politics).	The cases were analysed according to a 5-step, iterative process. First, identification of relevant case studies by the authors, second, in a workshop setting we co-designed the review protocol. Third, team members elaborated the protocol, answering a series of fixed questions (deductive analysis) (See Paper IV, Appendix 1). With these responses, a review table was created, which enabled the cases to be compared to reveal otherwise hidden phenomena. During a second workshop we reviewed the data table and discussed emergent findings. Then, in a second round of analysis (inductive coding) – team members "read cases through each other" as inspired by Barad, 2007, using the data table, and answered each others' questions, examples of which are shown in Appendix II, Paper IV.

Case Study design

In Paper III I make use of a case study in order to enquire into specific expressions of the phenomena in question. Given that a case study represents a particular configuration of actors involved in a specific instance of EBA, it is suitable for such an enquiry. Two instances of EBA were located and the processes through which they were implemented were investigated, together with the configurations of actors and contextual relations involved in those processes. If EbA represents a diversity of modes of implementation, and the configuration of actors and relations that represent the context in which it intervenes are also diverse, not reducible to standardised patterns, then I do not expect these case studies to be typical of the given research phenomena. I do not seek to uncover specific instances of universal laws and generalizable conclusions regarding EBA. Rather I seek to understand how apparently generalisable ideas are encountered in particular circumstances (Balvanera et al., 2017; Diaz et al., 2018).

However I do expect these instances to represent a 'critical case' (Flvybjerg, 2006), because as I shall show, these projects specifically aimed to bring about empowerment through adaptation projects focussed on ecosystems. In other words, if empowerment were to take place through an externally-led EbA, then it should have happened here. These EBA represent interventions that originated external to the places that they were applied, and sought to empowerment a particular set of marginalised beneficiaries whose vulnerability was said to originate because of livelihood dependence on nature[19].

Once I had analysed the data from these cases, in Paper IV I sought to compare these findings with other case studies. In Paper IV I compared the findings from the case in Sri Lanka, to two other instances of EbA, as well as one case each of environmental peace-building and environmental justice. Each of these cases represented an approach that makes use of a particular frame of nature in order to inquire into processes of social change in response to a particular societal challenge (adaptation, conflict, and injustice respectively). This comparison enabled an exploration of whether the findings observed in the cases in Paper III were valid in other cases, across and beyond the concept of EbA, to a broader set of 'nature-based' approaches.

[19] I assume that EBA *as intervention* is the dominant form of EbA practice, and to a certain extent I see this assumption confirmed empirically through the systematic review in Paper I (I do not consider that EbA is being implemented in a systematically different way to adaptation actions more generally).

Field site: Sri Lanka

Sri Lanka was originally chosen for the case study because I could locate the key dynamics of the thesis from a pilot study and background reading. I provide a few examples here. Firstly, social marginalisation plays an important – but not definitive – role in shaping vulnerability for different groups. Such socially driven differential vulnerability is structured according to different social categories (in Sri Lanka, along lines of race, class, ethnicity, religion, gender, caste, and/or sexuality) as well as at different levels of social organisation (also even longer than usual: international, national, provincial, district, municipal, community, and household). Vulnerabilities are also structured by economic (such as share-cropping arrangements, debt bondage) and social relations (such as political party or governmental affiliation). The Sri Lankan nationally determined contribution to the UNFCCC, a key policy document (Sri Lanka, 2016a, emphasises adaptation more than mitigation. There are likewise many mentions of EBA across the different sectors (Sri Lanka 2016b). Sri Lanka displays high social-ecological diversity, and it is at risk from a variety of climate impact exposures across different landscapes. In civil society, EBA also prominently feature in people's own adaptive strategies. There are long histories of biocultural diversity and collective forms of natural resource management in Sri Lanka (Dharmasena 2004; Nianthi and Dharmasena, 2009). Additionally, biophysical variations in exposure and sensitivity to climate changes also shape climate change vulnerability, helping to explain why EBA are important in people's own empowered adaptive strategies (Vidanage et al., 2005). Furthermore – and this warrants further research – at the national level, countries in the bracket of Sri Lanka (mid to low income) continue to form their climate change action plans around adaptation rather than mitigation (Quinn et al., 2018).

Case study: EbA Interventions in Sri Lanka

The EBA concept is relevant as a lens through which to study autonomous adaptation actions as well as interventions in Sri Lanka, despite the phrase 'EBA' not being used explicitly there. I have labelled the actions and interventions as EBA based on their characteristics because they work with 'ecology' as compared to alternatives like infrastructure, technology, or more social interventions. The NGO Green Movement of Sri Lanka analysed autonomous adaptation actions around the whole of Sri Lanka through their network of community-based organisations. Farmers and other resource users repeatedly stated that ecosystems are key parts of their adaptive strategies (preferred). Sri Lanka's own National Adaptation Plan refers to ecosystems as being part of the country's wider adaptation strategy (Sri Lanka, 2016). To identify EBA and their potential to enable empowerment, I used policy documents to find EBA-type projects in the most vulnerable districts of Sri Lanka. Following visits to the sites of

several potential projects, I selected two projects for in-depth study. I chose these projects because each includes explicit claims to deliver social change and targets the needs and priorities of marginalised and vulnerable groups. These sites also represent diverse contexts and climate change impacts.

The two projects selected for the research were implemented in the municipality of Galgamuwa and the village of Serupitiya. Galgamuwa represents a dry-zone agricultural area experiencing climate-related droughts, floods, and increasing water insecurity, and Serupitiya, in the central highlands, represents an upland forested agro-ecological system experiencing increasing water insecurity and landslide risk from more intense rainfall events. At the time of data collection, Sri Lanka was experiencing a severe drought driven by climate change. Data for a third case focussing on coastal EBA were gathered but not used. Other relevant knowledge and data were gathered during the other pilot visits. The Galgamuwa project was led by the United Nations Development Programme (UNDP) and was aimed at restoring traditional forms of watershed management called *Elangawa* cascades, which consist of a number of old 'tanks', or *wewa*. These ancient systems of water management were built according to ecological characteristics of the landscape and managed as commons resources (Vidanage et al., 2005; Mosse, 1997). The project in Serupitiya was led by UNDP and Sri Lankan academics alongside a local non-governmental organisation (NGO). The intervention was intended to address soil erosion and landslides associated with increasingly intense rainfall due to climate change. The project implemented contour hedgerows, tree planting, and improvement of home gardens. These measures were implemented in the district of Sri Lanka that has the highest landslide risk in the country. Each of the projects use EBA. In Galgamuwa, the adaptations involved the conservation of the ecological characteristics of the traditional *Elangawa* (tank cascade) system, and in Serupitiya, ecosystem-based forms of land management were used to reduce landslide risk. The rural populations in these districts are largely dependent on rain-fed agriculture, such as paddy cultivation, and *Chena* (slash and burn agriculture) in the catchment area of the *Elangawa*, as well as home gardens.

Photos - Multi-story home gardens in Galgamuwa characteristic of dry zone Sri Lanka.

Photo - Research assistant Prabath Kaushalya in conversation with farmers, who are resting and eating together during the harvest period in Serupitiya village.

Photo - Traditional farming practices demonstrating sacred and cultural ecosystem services in Serupitiya village.

Reflections and Limitations

Mixed methodologies have particular risks and limitations based on the way they synthesise different methods that may be legacies of very different interpretations of knowledge production (Nightingale, 2016). In this way, a mixed methodology approach may run similar risks as interdisciplinary sustainability science (Persson et al., 2018). Epistemological and ontological inconsistencies may be present between the approaches used, that may go unaccounted for (ibid). This situation may be less problematic from a feminist (constructionist) epistemological perspective than a realist perspective, since each approach is acknowledged as a partial perspective, giving rise to its own particular ontology (c.f. Whatmore and Lindström 2011; Stengers, 2000). What I present *is* inherently a partial interpretation based on a partial selection of data. This is just one of many ways that bias might be expressed in the thesis, even whilst I have attempted to use frame awareness, reflexive methodologies, and triangulation across approaches and cases to increase the rigor and validity of the results (Yin, 2008).

A *systematic review* is intended to be a transparent method, in order that methodological choices made by researchers are clear. However, biases still persist in interpretation, even when the focus of the systematic review in the present thesis is a frames analysis attempting to reveal bias and blind spots of research. The potential for biases of the systematic review method have been debated in an adaptation context by Bassett and Fogelman (2013) and Lorenz et al., (2014). In the thesis, I would suggest that the focus on deterministic power of frames in Paper I, where I leant on a particular interpretation of what frames do, I would see differently in hindsight (as more embedded in social relations and recursive).

Conceptual synthesis is more at risk due to bias of the researcher as it is more open to interpretation and less transparent. As opposed to a systematic review, the methods used to synthesise disparate concepts are not often made visible, even when employed by credible researchers in highly cited papers (e.g. Preiser et al., 2017, Polishchuk and Rauschmayer, 2012; Berbés-Blázquez et al., 2016). In such a synthesis, in which the steps of the literature review are not made available, the audience are forced to trust in the logical inferences made by the researcher[20].

A case study has well-publicised limitations, especially when it is used for theory building (cf. Flybjerg 2006a). Scholars may question the validity of generalising one instance of a given phenomenon into abstract, universally applicable propositions. They may see risks in attention focussed too narrowly on one particular instance, at the expense of more generalizable inferences approach (Flyvbjerg, 2006a). In the present thesis, I chose to forego a third case for which I collected data because of time and resource limitations. A weakness of the case study I have undertaken is that it foregoes a more discrete and systematic analysis of how social difference at different scales is interrelated with power. Further, it foregoes a closer examination of social heterogeneity across scales, which would have enabled a political ecology analysis of 'winners and losers' (Brown, 2016). Originally, I conducted a survey to collect structured, quantitative data establishing 'dependence' of different groups on different ES, and to understand how power was expressed in the mediating function of institutions. Whilst I chose not to use the survey data and to focus more on social relations and processes represented in the project, the data were collated into a table, and initial inspection of the results suggested to me that a quantitative analysis of these results would accord with the qualitative findings I have chosen to focus on. What I gained by choosing an alternative path was the space to enable narrative approaches to follow people's own struggles and rights claims, in order

[20] A good example of such a synthesis which makes the method transparent is the recent paper by Kadykalo et al., (2019). In this case, the authors make visible how they construct the 'third party' means to evaluate the concepts in relation to each other.

"to ask the right questions" (c.f. Ensor et al., 2019), especially allowing a richer understanding of the stakes at play for different groups in the EBA interventions.

A *comparative study* of empirical material may help to validate some assertions that emerge from a particular case study. Such a comparative study can address some of the biases of a single case study, thus potentially offering more representative analyses, between and across specific conditions (Müller, 2014; Bisaro and Hinkel, 2016; Johannessen et al., 2019). However, I acknowledge that even in a comparative study there is still so much complexity not accounted for (Flybjerg, 2006), and a more superficial reading of the cases may increase the risk of missing important facets of a given situation for want of following an abstract analytical framework (ibid).

Feminist epistemology asks researchers to be cognisant of their positionality (Alaimo and Hekman, 2008; Harcourt and Nelson, 2015). My introduction to NBS/EBA was through working at the so-called 'science-policy interface'. I consider such background relevant because it was part of my own environmental subject formation (cf. Kaijser and Lövbrand, 2019; Boyd et al., 2014; Adger et al., 2001). I was part of an environmental 'think tank' that, relatively speaking, was in a very privileged position in power asymmetries and epistemic relations. In hindsight, with this positionality in mind, I acknowledge limits, ambivalences, and the possible ways in which power is hidden and enacted through this thesis.

The thesis focus is the social dimensions of ecosystem-based climate change adaptation, a cross-cutting issue which arguably requires multi-disciplinary competencies stretching across the social, natural, and technical sciences. Whether I have drawn sufficiently on all relevant disciplines is doubtful. Clearly, there are limits to what a single person can do. Paths not taken here include a greater focus on the biophysical and ecological dimensions of the studied EBA interventions. The issue of climate change itself – in terms of ethics, historical responsibilities, and engendered injustice – also goes unattended to, though I hope to have approached the subject matter cognisant of the wider injustices at play, which I consider to be extremely serious. I have tried to navigate the sensitivities of focussing on the vulnerabilities of the groups that are often cast as being most dependent on natural resources, but there is a risk that in this work I have reified dominant tropes and subjectivities (c.f. Kabeer, 1994; Escobar, 1995).

Transformative research on adaptation may have focussed on other scales of power and paid closer attention to the ways in which adaptation processes interrelate with broader processes of development (Ensor et al., 2019; Pelling, 2011). I could surely have focussed more on such broader relations of power operating across different scales. However, I judged that this approach would have precluded attention to the more finely detailed power relations that were engendered in the conduct and context of the

EBA interventions. It may have also precluded attention to people's own situated struggles and interpretations of the context in which these EBA projects intervened.

The theories of power and empowerment that I have used have limitations. Doubtlessly, roads less travelled may have revealed other important aspects of how power influences environments and social difference. Precedent might suggest that paying attention to people within social-ecological relations would mean taking a resilience perspective, perhaps in conjunction with adaptive management (Brown, 2016). Resilience mostly lacks attention to issues of power over (ibid), and the mechanistic character of systems ontology at its core is not receptive to more relational analysis of the social dimensions of EBA. Centring power in the analyses could have been achieved by using a more explicit political ecology or environmental justice analysis, emphasising 'winners and losers' (Brown, 2016). I have incorporated some aspects of these fields in the present study. For instance, environmental justice is embedded in my conceptualisations of empowerment amongst social-ecological relations (Nixon, 2011; Manuel-Navarrete and Buzinde, 2010), especially Nancy Fraser's and David Schlosberg's frameworks of redistribution, representation, and recognition (Fraser, 2004; Schlosberg, 2007), which map well onto the biophysical, institutional, and discursive dimensions of power in my theoretical framework[21]. Further, I have drawn on FPE in order to show how social marginalisation and environmental degradation are co-produced across material and discursive relations.

[21] The environmental justice literature is focussed on a conflict ontology, which I did not feel was warranted before I began my investigation.

Findings

Studying EBA and empowerment in contexts of power

Research Question 1: What power relations have to be considered when studying *EBA and empowerment?*

Table 5
Findings relevant to Research Question 1

Headline finding	Paper			
	I	II	III	IV
1. Adaptation is often an imposition of top-down power with unpredictable consequences for the vulnerability of different groups.				
2. Many adaptation actions are interventions, conducted by one actor on behalf of another.				
3. Top-down adaptation action can lead to maladaptation and redistributing vulnerability to already-marginalised groups.				
4. Empowerment and resistance have bounded roles to play to counter-balance such top-down impositions of adaptation and the risks therein.				
5. The complex power relations, dynamics, and processes of adaptation have important knowledge dimensions, demanding reflexivity.				

The findings presented here demonstrate the different kinds of power expressed in adaptation, putting the study of empowerment and EBA in context. The overview table (Table 5) shows that all the papers contribute to answering Research Question 1. The main findings (1–5) that address this question are detailed below. For instance, these findings demonstrate the corrective function of empowerment processes in contexts of unequal power relations in adaptation. They also highlight how a researcher is a part of power relations in adaptation, which demands reflexivity.

1. Adaptation is often an imposition of top-down power with unpredictable consequences for the vulnerability of different groups (Papers I, II, III, and IV).

Through Paper I, I find that diverse power relations are represented in the systematic review. In fact, empirical studies reviewed in Paper I show that adaptation efforts are

able to disrupt power relations, with positive consequences, including empowerment, for particular groups. However, hierarchical power relations (characterised by the frame 'power over') often appear to be the determining factor in steering adaptation governance in certain directions, with intentional or unintentional consequences for relatively powerless groups. For instance, local elites involved in an adaptation project often work in favour of existing social hierarchies, sometimes exacerbating them, and constraining adequate responses to hazards.

By drawing attention to conceptual and empirical work on the links between power and adaptation, the findings show that the social-ecological relations that influence differential vulnerability can be both positively and negatively influenced by the relations of power between social groups and individuals. Given that such dynamism, and therefore potential for progressive social change, is embedded in adaptation processes, Papers I, II, and IV show that adaptation action is more likely to reinforce existing inequalities. Moreover, in Paper I, I observe that existing research strongly associates such dynamics with the dominating and constraining functions of *power over*. Paper III demonstrates how powerful groups within the community drove the EBA projects according to their interests at the expense of others.

2. Many adaptation actions are interventions, conducted by one actor on behalf of another (Papers I, III, and IV).

The findings from Paper I indicate that the cases of empirical adaptation action in which power is found to play a role has a structural trend and a specific character. The paper shows how adaptation is generally conducted as an intervention, conducted by one actor on behalf of another. The systematic review revealed that national and local governments were the most prevalent actors for driving and implementing climate adaptation actions, followed by local communities and then civil society, academia, international actors, and private enterprises. In contrast, the review showed that local communities were most often the subjects (i.e. recipients) of adaptation actions, followed by particular groups of resource users and local governments. The prevalence of adaptation *as intervention* was confirmed in an EBA context across Papers III and IV of the thesis.

3. Top-down adaptation action can lead to maladaptation and redistributing vulnerability to already-marginalised groups (Papers I, III, and IV).

Papers I, III, and IV show that adaptation interactions characterised as one powerful actor enacting power *over* other actors can have unpredictable impacts on different groups of people. Papers I and IV show for instance that in a climate change context, such negative effects of these top-down governance interventions can lead to *maladaptation.* Indeed, Paper I shows that in many cases maladaptive actions are

embedded in power relations, leading to unsuitable policies, such as encouraging development in disaster-prone areas or introducing counterproductive incentives. Some policies also discourage already effective local ways of dealing with climate change impacts, such as local and resilient food crops or forms of common-pool risk management. Paper I shows that *power over* is also associated with negative effects, in the sense that costs of adaptation appear to fall disproportionately on marginalised people, who cannot bear the cost of remediation. These expressions of top-down adaptation action are shown to be problematic, engendering shifting distributions of vulnerabilities towards more marginalised people in a given setting.

4. Empowerment and resistance have bounded roles to play to counter-balance top-down impositions of adaptation and the risks therein (Papers I, II, III, and IV).

In this context, the papers together provide evidence detailing how empowerment and resistance have bounded roles as a 'corrective' function (Sovacool and Brisbois, 2019) to counter-balance top-down impositions of adaptation and the risks therein. The findings from Papers II, III, and IV indicate this may be especially critical where such risks go systematically unrecognised in the nominally apolitical concepts and practice of adaptation 'power holders' (researchers, decision-makers, donors, NGOs).

The thesis papers indicate that adaptation, irrespective of being included among EBA or not, is a contingent and often antagonistic process with divergent consequences for different groups. Each of the papers demonstrates that frames of adaptation that make power relations visible show the social processes within adaptation are often tension-filled interactions between groups with different stakes and perspectives. Papers III and IV demonstrate how power relations are expressed in adaptation processes, with implications for how vulnerabilities are distributed, and they also present strong evidence for negotiations and contestations of power through and adjacent to EBA. Papers II, III, and IV indicate that marginalised groups have most at stake when adaptation results in negative consequences. Each of the thesis papers shows that the frames of resistance and empowerment critically challenge the notion of an unproblematic adaptation intervention whose outcomes can be assessed simply by evaluating outcomes rather than understanding the process of adaptation itself.

Each of the thesis papers shows that adaptation actions and governance arrangements are more likely to repeat patterns of exclusion and marginalization than to challenge them. Papers II and III show that empowerment has a profound and relational role in challenging social marginalisation that creates vulnerabilities for specific groups. Papers I, III, and IV show that resistance to such patterns is often a necessary part of adaptation from the perspectives of those who suffer such effects. Papers I, II, and III also show that resistance as a frame of power reveals the complexities of power in governance of

climate change impacts. In Paper I, I found that in relation to adaptation, resistance is associated with relocation, threats to traditional identities and norms, and subordination. Resistance was seen where political institutions' exercise of power was undesired. The systematic review identified cases in which local communities resisted policies that did not recognise local knowledge. Resistance was also shown in sites with a history of conflict. Those resisting leveraged institutional resources such as legal frameworks or political networks. Perceptions of losing power are also expressed in governance processes, with powerful actors resisting changes to an inequitable status quo when changes do not align with their interests. In the case studies analysed in Paper III, resistance was also expressed in this way. In Serupitiya, resistance was expressed in response to incursions of powerful actors cutting the Kumbuk trees. In Galgamuwa, resistance was expressed in the EBA project itself, when community members refused to participate in tree planting programmes in the *Elangawa*, because of historical experiences in which the government agents had claimed ownership over trees in the community and cut them down, leaving the community feeling very aggrieved about tree planting.

5. The complex power relations, dynamics, and processes of adaptation have an important knowledge element, demanding reflexivity (Papers I, II, III, and IV).

The findings show that researchers influence the ways that adaptation is conceived and practiced. All the papers reveal how researchers are embedded in the power relations of adaptation. In this way, the subjects of research and the researchers themselves are connected in social relations, in which knowledge production and power asymmetries are inherent. This has important implications when we see that different interpretations of EBA and empowerment matter. So, whilst dominant expressions of empowerment tend to focus on its apolitical dimensions, in the contexts of power and adaptation mentioned above, empowerment is less appropriately interpreted as an unproblematic, instrumental function for adaptation, and more appropriately understood in terms of its 'corrective' function to address the risks associated with top-down impositions of power in adaptation. Likewise, focus on EBA as interventions in which science only relates to studying outcomes, rather than processes, appears to be a highly relevant choice for the researcher to make given the patterns of power and adaptation detailed above.

The findings from each paper highlight the risks and opportunities of how researchers deal with EBA, especially when empowerment is a stated goal. Papers I and IV follow the political implications of knowledge production processes. These processes can have negative or positive effects in addressing injustices and inequalities, including through empowering marginalised knowledges and subjectivity, or providing platforms for resisting the dominance of particular problem and solution frames.

Moreover, the thesis findings demonstrate that reflexivity is required to study EBA and empowerment. Each of the thesis papers show that scientists and experts can hold power over the adaptation process, limiting options and alternatives through possessing knowledge and interpreting the meaning of results, and focussing on narrow dimensions of adaptation contexts at the expense of others. Paper I demonstrates the power of researchers' frames, opening space for exploring how researchers borrow from, and contribute to, ways of thinking that are important for empowerment in the context of EBA. The frames analyses of Paper I show how understandings of adaptation, even when social relations are taken into account, are partial lenses, emphasising some of their dimensions, whilst creating blind spots that obscure others. As Papers II, III, and IV show, the dominant frame in nature- or ecosystem-based approaches systematically focusses attention on ecology at the expense of institutional and normative dimensions. Paper IV traces the implications of these structured ways of thinking in action.

Photo: The research team entering the village of Nochiya, in Galgamuwa, to do participatory activities, focus groups, interviews and observations. Galgamuwa was the site of the *Elangawa* restoration project initiated by the United Nations Development Programme, aiming to empower marginalised and isolated groups, especially rural women, as part of efforts to adapt to climate change. At the time of our research, Sri Lanka was experiencing its worst drought in decades. Villages like Nochiya were particularly hard-hit, because they lie in the dry zone of Sri Lanka, and do not benefit from the large-scale irrigation infrastructure in other parts of the dry zone.

Theorising the connections between EBA and empowerment

Research Question 2: How are the interconnections between EBA and empowerment theorised?

Table 6
Findings relevant to Research Question 2

Headline finding	Paper			
	I	II	III	IV
1. Ecosystem-based adaptation is a material-based theory that claims to deliver multiple social benefits.		■	■	
2. EBA theory is based on the assumption of universal ecological dependency, though certain groups, such as marginalised people, women and children are framed as especially dependent on natural resources.		■		
3. EBA potentially offer a range of affordances for empowerment, such as enabling local priorities and knowledges, but this is not guaranteed. It depends on EBA governance arrangements.		■		
4. A blind spot in the frames and conceptions of EBA is the process of implementation itself and the social context in which this process takes place.		■		
5. An empowerment lens emphasises the role of dynamic social processes in EBA and the politics engendered in EBA between actors with diverse subjectivities.	■	■	■	■

As shown in Table 6, research question 2 is mostly addressed in Paper II, especially how EBA are constructed in relation to empowerment. The findings relevant to Research Question 2 clarify how empowerment can be translated into an EBA context and the implications of seeing EBA through an empowerment lens as set out in Table 5. All main findings (1–5) that address Research Question 2 are detailed below.

1. Ecosystem-based adaptation is a material-based theory that claims to deliver multiple social benefits (Papers II and III).

In Paper II, I identified the main aspects through which EBA enable empowerment: EBA are said to deliver multiple, socially oriented benefits, are based on a pro-poor livelihood approach, and aim to be participatory and locally sensitive in character. EBA scholars have constructed the concept around, inter alia, explicit social benefits and co-benefits that are relevant when addressing the vulnerabilities of people experiencing marginalization, social exclusion, or poverty. In some cases, such as the definition from the Convention of Biological Diversity Secretariat, social benefits are seen as a

constitutive element of EBA. Paper II shows how EBA interventions might lead to progressive social change. Expressions of 'multiple benefits' of the ecosystem-based approach are widespread across empirical and theoretical scholarship on EBA. Here each of these claims should be understood in light of the conceptualisation of EBA, which foregrounds the natural dimensions of a given setting of EBA by reference to ES.

2. EBA theory is based on the assumption of universal ecological dependency, though certain groups, such as marginalised people, women, and children are framed as especially dependent on natural resources (Paper II).

In the review in Paper II, I located many instances in which the EBA concept is closely associated with, or constituted through, references to the disproportionate dependency of some social groups. Papers II and IV show that EBA are usually framed within the paradigm of climate hazard management. The implication therein is that EBA are concerned with building an ecosystem buffer to protect communities from the damaging effects of climate change, making EBA along the lines of an ecological technical project (or 'fix'). The analysis in Paper II shows that pro-poor social benefits are expected to occur through EBA because of the assumption that marginalised people are disproportionately vulnerable to the climate impacts that such initiatives are designed to address. This assumption appears to be related to the finding from Paper II that EBA have been framed mostly through the lens of ES, focusing on their protective and facilitative function in relation to climate-affected livelihoods, such as agriculture, fisheries, and forestry. In this context, EBA are formulated around the principle of considering ecological functions and processes as part of strategies that are designed to proactively address climate change impacts. Paper II shows that if EBA contribute to building physical and livelihood security, this is considered a social benefit that is especially important for marginalised groups because of the underlying assumption that such groups are disproportionately dependent on functioning ecosystems.

Furthermore, Paper II shows that EBA scholars often construct a mandate for ecosystem-based solutions presupposing the dependence of the rural people living in poverty on ES for their livelihoods, and the threat to these services posed by climate change. This ubiquitous reference to dependence of certain groups presupposes that livelihoods most closely associated with natural resources are disproportionately vulnerable to changes in climate, and that it is these livelihoods that marginalised, rural, and the poorest groups are disproportionately dependent on.

3. EBA potentially offer a range of affordances for empowerment, such as enabling local priorities and knowledges, but this is not guaranteed. It depends on EBA governance arrangements (Paper II).

Paper II confirms that the concept of EBA emphasises the pro-poor, responsive character of the approach. Thus, both research and practice of EBA position the approach as more appropriate for addressing the needs of the very poorest and most socially marginalized groups, including in responding to climate change and building adaptive capacity. Paper II finds that existing research confirms that EBA have less negative side effects as well as reduced costs compared to other approaches. The paper shows that this represents a pro-poor social benefit since marginalised groups are assumed be more vulnerable to the negative side effects of adaptation actions (maladaptation).

Paper II also confirms that scholars of EBA position the approach as inclusive and participatory, managing ecosystems jointly and in traditional ways not possible with alternative 'grey' approaches that rely on expensive and/or technical solutions, such as maintenance of storm protection levees or the development of drought-resistant hybrid seed varieties. Indeed, in the literature review, I observed that existing scholarship emphasises the value of participatory mechanisms and knowledge sharing for EBA and their compatibility with community-based adaptations. Existing scholarship on EBA also considers knowledge from different sources, not just scientific knowledge, to be valid.

Furthermore, Paper II shows that scholarship on EBA emphasizes knowledge integration and participation as potentially empowering mechanisms in themselves. The empowerment lens introduced in Paper II highlights that such discursive and institutional affordances may support marginalised peoples, and in an epistemic setting, at least provide the entry point for understanding the social processes that bring about social change. However, the review located no studies that address how knowledge has been integrated from diverse sources into EBA projects, nor any evidence of participatory mechanisms being explicitly incorporated into EBA project design. Thus, the paper shows that whilst claims about EBA appear to be reinforced across scholarship and practice, rigorous and independent evaluations of EBA to test the validity of such claims have not been undertaken.

The analysis in Paper II demonstrates that social benefits are not an automatic consequence of implementing EBA. In fact, the empowerment lens shows that contingency (i.e. non-deterministic character of social change), agency, and subjectivity are important dimensions of social benefits that have been neglected so far in EBA scholarship. The paper shows that EBA express power relations that may empower

already-marginalised people, but without explicit attention to governance arrangements that address asymmetries of power, such forms of adaptation may more likely increase risks of further marginalisation of such groups.

4. A blind spot in frames and conceptions of EBA is the process of implementation itself and the social context in which this process takes place (Paper II).

Paper II finds that EBA theory pays insufficient attention to the way in which people's variegated agency interrelates with ecology, dependency, and vulnerability in contexts of unequal power relations. The empowerment theory presented in the same paper shows how empowerment is a political process. Together processes of marginalisation and empowerment may occur as a consequence of the frames and institutions through which EBA are enacted.

A key finding from Paper II is that EBA fail to pay sufficient attention to the process of an adaptation action itself. Paper II shows that little evidence exists on how the aforementioned social benefits emerge through EBA, so we are left to infer the mechanisms based on the epistemic base of EBA, that is, ES. In Paper II, I show that the evaluation criteria used to judge social benefits are either mixed with socio-economic indicators or simply non-existent. In fact the 'evidence' for social benefits is anecdotal. In cases in which social benefits are explicitly mentioned, there is a lack of transparency regarding the qualitative or quantitative methodology used, and little attention to the social processes that underpin outcomes. In fact, in Paper II, I found a dearth of theoretical and empirical data backing such claims, and no account of the social processes that underlie social-benefits outcomes.

5. An empowerment lens emphasises the role of dynamic social processes in EBA and the politics engendered in EBA between actors with diverse subjectivities (Papers I, II, III, and IV).

Empowerment conceived as a radical form of progressive social change is a necessary concept to challenge the ways and means through which power-laden processes and their implications for marginalised people are hidden through EBA. In the context of vulnerability and adaptation, I find in Papers I and II that empowerment has often been framed as an apolitical process of capacity development, or even capacity delivery. Paper III shows how this framing aids an enaction of EBA whereby social benefits can be mechanistically provided in a deterministic relationship between powerful ES providers and powerless beneficiaries. However, in Kabeer's definition, empowerment is the contingent, political process "by which those who have been denied the ability to make choices acquire such an ability" (Kabeer, 1999, p. 437). Paper II thus shows that empowerment is always deployed as a concept with a view to undoing the disempowerment of particular groups, and always with a view to facilitating actors' own

strategic achievements. Such processes can be characterized by struggles about meaning as much as by struggles over distribution of risks or resources. Empowerment entails a combination of changing discourses and representations, including building self-awareness and self-confidence ('power within'), and a greater ability to change the representations and legitimacy of marginalised groups' voices in wider society. Such processes can be expressed across a variety of platforms, including institutions that govern natural resource use.

According to the review of empowerment scholarship in Paper II, power is a dynamic and evolving social force that conditions the distribution of access to resources for particular people and is in turn shaped by its performance, making it liable to disruption. Paper II shows how access to ES and conversion of such resources into adaptation strategies is mediated through power relations. Indeed, many intervening social factors affect the achievement of aspirations.

Paper II shows that a relational way of understanding the role of power relations to mediate the potential for EBA interventions to facilitate empowerment is to study the interactions between the conduct of the action itself and the in situ contextual relations in which this conduct takes place. The paper demonstrates how a process of EBA allows for the reinforcement, renegotiation, and contestation of power relations that condition peoples' adaptive capacity. Understanding adaptation as a political (institutional and discursive) process invoking different actors in different roles and responsibilities (i.e. subjectivities) can enable relational understandings of diverse aspects of adaptation, such as legitimacy, authority, knowledge, and learning.

Paper I establishes a strong link between empowerment and participation in the context of adaptation. As Papers III and IV show, recognising the social process of EBA may have important outcomes, in the form of both instrumental and distributional effects. In particular, equity and effectiveness are key issues in relation to the outcome of adaptation processes. Paper I shows that mechanisms of participation are unavoidably linked to the means by which such processes engage different actors in power relations with respect to authority and knowledge (i.e. subjectivities). Participation can be seen as a neutral descriptor of the character of adaptation processes referring especially to "who is involved and how they are involved… in practice" (Aldunce, 2016, p58). Paper I reveals that when seen within different frames of power, participatory inclusion can be expressed as a constructive, transformative force for effective adaptation action or as power relations and trade-offs between different actor groups.

Empirical relations between EBA and empowerment

Research Question 3: How do EBA and empowerment interact in empirical settings?

Table 7 –
Findings relevant to Research Question 3

Headline finding	Paper			
	I	II	III	IV
1. Enabling marginalised peoples' agency is integral to specific achievements around securing ecosystem functioning as an adaptive response to climate change impacts.			■	■
2. In the empirical cases, the social and ecological dimensions of empirical cases of EBA cannot be straightforwardly separated.			■	
3. The conduct of EBA implementation matters. Outcomes, including in terms of social benefits, happen when EBA are implemented in careful deliberative participation.	■		■	
4. Both resistance and empowerment are relevant in the empirical contexts of EBA.			■	
5. Empowerment and resistance are especially relevant to counter the expert-led, top-down, and technical forms of EBA.			■	■

As shown in Table 7, the findings for the third question predominantly come from Paper III, which presents an analysis of two case studies of EBA in Sri Lanka through the lens of empowerment. Further case studies and empirical data on EBA were gathered from the comparative study in Paper IV, and in one instance I have included empirical data from the systematic review.

1. Enabling marginalised peoples' agency is integral to specific achievements around securing ecosystem functioning as an adaptive response to climate change impacts (Papers III and IV).

Papers III and IV reveal that people's agency, rather than just their nominal dependency on ES, is relevant to understanding how vulnerabilities of different groups emerge in a particular place. The findings from the case studies in Paper III show how people's adaptive strategies are linked to how they relate to ecologies. At each site, climate change impacts are resolved through the ecological relationships that people are embedded within. Marginalised groups in particular are increasingly vulnerable to water insecurity because of the degradation of landscapes. The resolutions effect social change, such as increased marginalisation, because of the historical and contemporary power relations embedded in such ecologies. Paper III shows how ecology forms the focus of many of people's empowered adaptive strategies encountered in the analysis. Findings from both case studies show how enabling marginalised people's agency is integral to specific

achievements around securing ecosystem functioning as an adaptive response to climate change impacts. Ecological relations are a tangible component of people's daily lives that helps make them capable (that in turn they are capable of modifying). As anticipated in the theoretical framework and in Research Question 2, agency is limited according to particular contextual power relations, such as the constraining power of tenure rights and share-cropping agreements. These findings are confirmed in the case of EBA in Sweden and Kenya studied in Paper IV. The findings show how different groups are actively involved in reshaping ecologies according to their own empowered adaptive strategies. Consequently, the fulfilment of empowerment as a social benefit of EBA is crucial in order to avoid further marginalisation and increased vulnerability to climate change. Power shapes and is shaped by these dynamic relationships, which links back to the 'corrective' function of empowerment and resistance identified in Research Question 1. Likewise, Paper III shows clearly how resistance, as an expression of agency, to external impositions of power is an important driver of how landscapes change or are maintained according to values held by communities or certain groups within them.

The historical *Elangawa* cascade system described in Paper III is a prominent example of such productive agency in the sense that people's modifications of the landscape affect their 'downstream' abilities. Alternatively, when the *Elangawa* fall into disrepair because of the actions of powerful, corrupt tank maintenance contractors, people's abilities in these landscapes suffer.

Home gardens represent another critical example of how agency is embedded in ecologies, co-producing ES, whilst in turn being enabled through ES. Paper III shows that home gardens themselves, and moreover the networking activities that women create around them, represent a particularly relevant adaptation strategy for marginalised groups (women within rain-fed agricultural communities). These gardens (also known as *Kandyan* gardens) are an ancient and widely distributed practice and land-use type in Sri Lanka, across both dryland and upland areas. They are social-ecological systems, and moreover, they are active responses to combined pressures, rather than static or passive dependences on natural ecosystems. They represent enactions of individual and collective agency. Women (and some men) organize around particular livelihoods and ecologies.

2. In the empirical cases, the social and ecological dimensions of people's agency and vulnerability cannot be straightforwardly separated (Paper III).

The empirical findings in Paper III show that social-ecological relationships shape and are shaped by people's experience of vulnerability and the empowered adaptation strategies people strive for as a result. The response of the Serupitiya community to water insecurity and drought is a good example of this. Each of the sites is an isolated,

marginalised farming community, largely dependent on rain-fed agriculture. Consequently, people at these sites are vulnerable to an array of climate-related risks, especially water insecurity, that are mediated by the ecological characteristics of the landscapes. For instance, in Galgamuwa, a dry-zone area vulnerable to climate-related droughts and floods, vulnerability is exacerbated through the reinforcing feedback loops of commercialised agricultural development. Changing agro-ecologies results in a gradual shift away from the multifunctional qualities of each landscape that provide for a wide variety of livelihoods and basic needs, towards landscapes that provide fewer benefits for fewer individuals and greater incidence of harms and insecurities for a greater proportion of the population. This situation in turn contributes to a greater dependence on cash and to more out-migration to seek employment to meet individuals' needs. In Serupitiya, a rise in pest problems following gazettement of forested hillslopes increased people's livelihood insecurity (Paper III). Human-animal conflict was exacerbated by forest degradation in Galgamuwa, threatening livelihood security and mobility, especially during climate-related droughts. Through their contribution to existing ecological trends, climate change impacts may reinforce such trajectories, in turn increasing marginalisation.

Ecologies express power relations operating at different scales and timespans. Paper III finds evidence that at the political-economic level, colonialism and its legacies have led to a deterioration of common-pool resource management institutions, including for *Elangawa* maintenance and watershed protection. The deterioration has been reinforced by changes to village economies, agricultural practices, and land-tenure institutions facilitated by government policies, such as incentives for high-input commercialised paddy production. For instance, at the household scale, power is expressed in gendered agricultural practices and especially in the prioritization of the male-dominated cash crop cultivation of paddy and hybrid maize at the expense of female-dominated home garden cultivation. At the individual scale, power expresses itself in people's changing ecological values, including reduced interest in alternative livelihoods such as animal husbandry, as well as a reduced awareness of the ecological functioning of the *Elangawa* system. The tanks become reduced in people's imaginations to hard infrastructure designed to provide water for commercial paddy harvests twice a year, making the case for ecological restoration much harder. Furthermore, the degradation of landscapes and the resulting differentially experienced vulnerabilities can drive further marginalization. For example, a water crisis like that experienced during the 2017 drought means that only priority activities receive water, and elite forms of adaptation such as well-digging exacerbate the vulnerability of those poorer community members reliant on the *Elangawa* system. Otherwise, water insecurity disproportionately affects those without wells, a piped water supply, or cash

for bottled water, and the associated risks of poor water quality are distributed unevenly, exacerbating social inequality.

3. The conduct of EBA implementation matters. Outcomes, including in terms of social benefits, happen when EBA are implemented in careful deliberative participation (Papers I and III).

Paper III reveals how critical collective action is in building joint agency to influence decision-making at municipal and national levels. Empirical papers located in Paper I show how efforts to manage the complex set of power relations within adaptation contexts have often comprised decentralised forms of participatory and collaborative arrangements. Such distributed responsibilities have implications for power relations – including for the dynamism of power. Participatory processes have also led to further marginalisation through a lack of recognition and representation in adaptation decision making.

Paper III shows how the conduct of the EBA actions in the case study was embedded within the context, making them platforms for renegotiation of power relations. This circumstance has implications for social benefits. In the two cases in which social benefits could be tentatively said to have occurred, outcomes were dependent on attention to formal participatory processes as well as more informal means of renegotiating project aims, each of which was embedded in the broader power relations shaping agency for different groups (such as women who were home gardeners). For instance, in Serupitiya, EBA provided opportunities for social benefits through dairy production which was an addition to the project negotiated by community members. In Galgamuwa, support to women's home garden committees was due to a careful deliberative process. The social benefits emerging from support to these committees in Serupitiya perhaps represented the clearest instance of empowerment-relevant process in either of the two cases, as well as the other cases of EBA presented in Paper IV. These were actions that aligned with women's own adaptive strategies, enabling them forms of collective agency to challenge power relations at household, village, and municipal levels.

4. Both resistance and empowerment are relevant in the empirical contexts of EBA (Paper III).

The EBA projects – and the social benefits that occurred through them – represented expressions of power and transient opportunities for change. These are inseparable from wider struggles over what the ecological dimensions of communities and landscapes represent to different actors as part of their own agencies and aspirations. In the cases studied in Paper III, power relations critical to shaping the vulnerability of particular people were not addressed through formal participation mechanisms or knowledge

exchange opportunities. The cases showed that the conduct of such EBA actions is bounded unequivocally by broader power structures, such as tenure or the economic or gender-based forms of marginalisation. The empowerment expressed in these cases is shaped by land-tenure dynamics that neither people nor the EBA projects have much control over. Likewise, the extent to which surplus production from home gardens can be converted into economic empowerment depends on a wide range of entitlements that condition access for different people. Project actors themselves may contribute to such dynamics, for example, by overriding marginalised peoples' risk priorities and acquiescing to broader forms of marginalisation.

Paper III shows that in the face of such power, ecological relations can represent catalysts for marginalised people's agency in the face of change. Such action is illustrated by the example of home gardens. At both sites, women are able to effect change in their home gardens more than larger-scale catchment ecosystems, and they can leverage these changes as part of empowering adaptive strategies. In these contextual constraints on individual agency, collective power is especially important for marginalised groups. People at either site engage in collective action to manage common-pool resources, labour sharing, and risk spreading and to honour sacred practices. They are involved in campaigns of resistance, as well as campaigns to get state actors to recognise their diverse (adaptive) needs and aspirations. People come together to increase their collective agency through common-property management and institutions. The maintenance and renewal of such institutions is an important empowered adaptive strategy in which people play an active role in maintaining enabling environments. Encroachments of powerful actors that threaten to block marginalised people from accessing ecological resources have faced resistance. For instance, people in Serupitiya led a coordinated and successful campaign against the attempted dispossession of forest resources (recognised for their water security and bio-remediation benefits).

5. Empowerment and resistance are especially relevant to counter the expert-led, top-down, and technical forms of EBA (Papers III and IV).

Both Papers III and IV reveal how empowerment and resistance are especially relevant as means of redress when EBA are conducted as interventions by external experts focussed on the biophysical dimensions of a given context, which may risk exacerbating forms of social marginalisation and associated vulnerability. Paper III reveals the power relations that are implicit in two EBA interventions. Likewise, Paper IV draws from across different cases of EBA to reveal how these interventions in diverse locations are driven by powerful actors external to a given case, who do not directly experience the consequences of environmental degradation or of the impacts of climate change as the beneficiaries of the interventions do. Paper III demonstrates that the creation of enabling environments was not enough by itself to fulfil social benefits outcomes, particularly the empowerment of marginalised groups such as women and people without access to many of the resources necessary for adaptation. In fact, cases presented

in Papers III and IV show that projects framed around *ecological* relationships appear to make practitioners less capable of recognizing the *social* dimensions critical to achieving such outcomes. The focus on horticultural home gardens in Serupitiya (Paper III) in a context in which dependence on cultivating steep slopes was shaped by lack of livelihood alternatives and unjust tenure arrangements exemplified this. Although ecology plays a key role in contexts that mediate the impacts of climate change at both sites, the ecological dimension was foregrounded to the extent that the important social dimensions that would be critical to achieving empowerment were not adequately recognised. In this context, empowerment and resistance were expressed to counter the misrepresentations of complex social-ecological relations that the EBA projects represented. This is particularly clear in the cases from Sweden and Kenya presented in Paper IV.

Paper III shows that the EBA projects themselves represented power relations in different ways, including formal mechanisms for participation as well as informal mechanisms, such as negotiation and resistance. Projects became sites for renegotiating and disrupting the power relations that shape marginalised peoples' vulnerabilities. Here, marginalised people's agency was expressed in the project itself, countering more top-down frames of EBA overly focused on ecologies.

Another important finding in Paper III was that empowerment can emerge, not only from taking part in, but by actively resisting and organising against projects. And resistance has consequences, both for participation in project activities and more broadly because the resistance itself becomes a stepping stone for people to achieve societal goals, such as recognition by state actors. For instance, in the *Elangawa* restoration project, people organised collectively to resist specific parts of the project plan. In so doing, they confirmed their relative power at the district government level. They also pushed for new additions to the project, such as a road across the top of the reservoir levy. Participatory conduct does not always work in favour of EBA. As an example, when a well-connected community of commercialised paddy farmers resisted ecological rehabilitation of their tank system, it showed how the varied interests of the actors become expressed within processes of participation.

Paper IV shows that marginalised groups of people often bear the brunt of costs and trade-offs associated with official, institutional, and socio-technical responses to environmental change, including through dominant forms of EBA. Thus, the resistance of these groups depended in part on resisting the particular ways that EBA was being implemented. The cases from Kenya and Sweden in Paper IV show how resistance to material dimensions of an EBA project coincided with resistance to the framing of EBA in terms of ES. Similarly, Paper III shows how parts of EBA projects that clashed with the interests of particular groups in the studied communities were resisted, including by powerful groups such as rice paddy farmers with stakes in the transition process towards ecological restoration.

The power of frames

Research Question 4: How do frames prefigure the potential for empowerment in nature-based responses to societal challenges?

Table 8
Findings relevant to Research Question 4

Headline finding	Paper			
	I	II	III	IV
1. The framing of adaptation as 'ecosystem-based' appears to have institutional and material implications on the ground.			■	■
2. The frame in which EBA is conducted shapes opportunities for empowerment because of the way it creates blind spots on issues of social process, relations, and power.		■	■	■
3. Different forms of nature-based approach, including ecosystem-based adaptation and environmental peacebuilding, invoke particular frames of nature.		■	■	■
4. Alternative frames situated in the studied cases entail more transformative potential but are marginalised in dominant frames of nature-based approaches, including EBA.			■	■
5. Dominant frames of 'nature' constrain the empowerment potential of the research and practice of various types of nature-based approaches and risk reinforcing social marginalisation.		■	■	■

The overview of the findings for this question (Table 8) shows that the findings for this question come mostly from Papers III and IV. These papers present empirical findings that indicate how power-laden frames shape interactions in EBA actions. These papers show how the assumptions that underpin these frames of EBA are powerful insofar as they enable EBA to be implemented in a particular mode.

1. The framing of adaptation as 'ecosystem-based' appears to have institutional and material implications on the ground (Papers III and IV).

The analyses from Papers III and IV reveal that specific frames of nature are enacted through the EBA projects studied, both in Sri Lanka and elsewhere. In the fit between the broader frame of EBA as ecosystem-based and the form of conduct in which they were conducted in the two sites, I infer evidence that broader-scale frames shape the conduct of EBA and thus affect the processes and outcomes of these actions. These frames of nature can be traced back to assumptions made in the discourse on ES which underpins the EBA concept (see Research Question 2).

Such a frame was revealed, for instance, in Paper III where project actors stated that ecological context was more important than the conduct of the intervention. Leopold's

Land Ethic was inadvertently in the minds of the project staff (i.e. that ES provision would cause social change) tasked with enacting EBA. The frame of nature appeared to condition the conduct of the EBA projects. I found that project managers' justification of the inattention to conduct – which precluded inclusive engagements with marginalised groups – was based on their implicit invocation of this biosphere-based land ethic. Their justification was that even if the most vulnerable people were not included in the project design and formal mechanisms of participation, EBA contributed to forming an enabling environment, which would have a disproportionately positive impact on marginalised peoples because of their disproportionate dependence on ES.

Furthermore, the frame of nature appeared again where ecological context was prioritised above social-ecological context by EBA actors in forming such an 'enabling environment' for marginalised people. One academic in charge of the Serupitiya project was not concerned about overruling the risk priorities and social-ecological knowledge of the community.

The findings from Paper III show that frames of nature are being enacted in EBA that condition the power relations, interactions, and processes of these interventions. In Sri Lanka, project managers predominantly referred to ecology as something separate, an entity that needed protecting from adjacent communities. Such a frame empowers the managers themselves as the experts with appropriate authority for the task. The nature-based frames of adaptation lent legitimacy to these external actors, at the expense of local people's knowledge and priorities, whose histories of interaction with such ecosystems went mostly unrecognised. Whilst these were people with deep, place-based expertise, they were rarely deemed legitimate knowers. Assuming that ecosystems are something universally understood rather than locale specific, the EBA frame coincides with and reinforces an already-existing mode of adaptation as a short-cycle 'solution' best undertaken by external experts. Central to such narratives are universal assumptions that poor rural people are inevitably dependent on benevolent, but otherwise independent ecosystems. In Paper IV, I compared the Sri Lankan case to other cases of EBA in Kenya and Sweden and to other forms of nature-based approaches. In the diverse contexts engendered, people's expressions of agency and knowledge were highly visible. They were encapsulated in, for instance, existing or novel collective adaptation strategies like sustainable grazing plans or other forms of common-pool resource management. As the case of the EBA intervention in Northern Kenya vividly showed, despite such local knowledge and collective agency on display for those who would seek to find it, local communities played a very minimal role in conceptualization or design of their own 'community-based' approaches, besides

attending 'awareness' and 'capacity building' meetings that were poor examples of participatory forms of engagement.

2. The frame in which EBA is conducted shapes opportunities for empowerment because of the way it creates blind spots on issues of social process, relations, and power (Papers II, III, and IV).

I contend that the collective analysis across Papers II, III, and IV constitutes evidence showing that the conduct of EBA is subordinate to the frame under which it is conducted. This frame constrains the opportunities for empowerment through the various EBA interventions analysed in Papers III and IV. The findings from Papers II, III, and IV suggest that frames of EBA constructed at the international scale shape how vulnerability and responses to it are conceived at the national and project scale. The findings from the empirical work suggest that managers perceive vulnerability as an outcome of climate change impacts, rather than ultimately being borne in the context of a given place, and can thus be managed through discrete interventions targeting people's exposure to hazards, as mediated by ES. Papers II, III, and IV demonstrate that this frame creates a blind spot (i.e. where the focus of attention is systematically lacking (cf. Lakoff and Johnson, 1980)) in terms of the role of power and context in shaping vulnerability for specific groups. Furthermore, the frame does not make visible the social processes that occur through the intervention. Lastly, the frame reinforces notions of dependency of marginalised groups. Meanwhile, the analysis, drawing from empowerment theory and FPE, shows how dependence is not a taken-for-granted reality, but constructed within power relations. Thus, marginalised people are cast with a particularly disempowering environmental subjectivity which disallows their agency and knowledge, representing a real form marginalisation in itself.

Taken together, Papers II, III, and IV show that EBA researchers and practitioners have often framed the adaptation problem as one in which nature is a universal, objective phenomenon. In this frame, nature can be predicted, managed, and controlled by an independent, apparently objective expert actor invoking generally applicable scientific expertise. Papers II and III indicate that these actors are assuming that their effects emerge from reducing exposures to hazards through use of ecosystem functions and services. Implicit within such a programme is the biophysical determinacy characteristic of cause-and-effect thinking in the natural sciences. At the international level, EBA researchers are motivated to build an evidence base on how interventions targeted in the biophysical dimension of a place will have determinate consequences for the vulnerability of different people, no matter the social or social-ecological contextual relations. Such ways of thinking preclude the causes of differential vulnerability, because people are seen as a singular homogeneous entity differentiated only by relative

dependency on ES; their vulnerability and their potential to respond to it become part of the biophysical determinacy of this form of adaptation by intervention.

Across the four papers, I observe that the predominant mode of conducting EBA arrives to a particular adaptation context as an intervention, but the frame under which they are conducted blinds project actors to what occurs during the process of intervention, including the aforementioned forms of marginalisation. This blindness causes contingent and unpredictable outcomes, which may even reinforce social marginalisation. Paper III shows, for instance, how alternative frames entail different subjectivities, especially for those marginalised under particular frames of nature. The evidence for such performative and relational effects of frames was strengthened through the comparative case study in Paper IV. Here, EBA in different places took advantage of participatory affordances of EBA and created forums through which people could be engaged in EBA implementation. However, when power relations were not made explicit as part of the conduct of the projects, space was left for dominant interests to capture the forms for participation, such as resistance to ecological elements of the *Elangawa* restoration by powerful community members.

EBA research currently does not appear to problematize such blind spots and their associated risks. Whilst proponents of these approaches recognise the material affordances, they do not appear to recognise the risks of this nature-based character or the intangible dimensions of these approaches. In Papers II, III, and IV, reference to empowerment theory provided the means to rectify this blind spot, showing that the otherwise hidden intangible power relations such as between subjectivities, knowledges, and the performative power of frames, were necessary to understand the social benefits potential of EBA at different places.

3. Different forms of nature-based approach, including ecosystem-based adaptation and environmental peacebuilding, invoke particular frames of nature (Papers II, III and IV).

A comparison of the findings from Paper III and especially from Paper IV shows that particular frames of nature are consciously or inadvertently repeated across different instances of nature-based approaches. This repetition strengthens the argument that nature-based approaches are associated with particular ways of framing social-ecological relations that privilege attention to the biophysical dimensions of such relations, with concrete implications for power relations and social marginalisation. Paper II reveals the conceptual development of the EBA concept in biophysical terms that privileged certain biophysical aspects of a particular vulnerability context whilst creating blind spots on especially social issues (cf. Research Question 2). Papers III and IV indicate that the legitimacy of biophysical-orientated frames of nature (where ecology is seen as separate) across different forms of nature-based responses stems from the perception of

universal applicability of assumptions of its biophysical dimension, which is a partial and problematic frame to view the relationships between environments, vulnerability, and social difference. Paper IV drew from both cases of EBA and from a case of environmental peacebuilding, an alternative nature-based approach which conceives of the way nature can be an ally in mediating conflicts.

The evidence clearly demonstrates that despite the narrow biophysical focus of these nature-based frames, these responses to societal challenges cannot be understood outside of their social context. The contingencies embedded in social and social-ecological relations reduce the extent to which EBA or environmental peacebuilding can be generalised. In the case of EBA, no doubt, patterns of how ecosystems help to reduce exposure to particular climate change impacts may be deducible across cases. However, the evidence suggests that simply referring to such inferences to create an evidence base for EBA and inform EBA governance and planning arrangements is problematic. In Paper IV, the instrumentalised, materialist nature resource frame embedded in the environmental peacebuilding literature and practice appeared to follow a similar trajectory. The evidence suggests that its enaction in the Colombian case created an inappropriate 'managerialism' on ecological resources and created a space for powerful actors and interests to use the peacebuilding process to further their goals. Meanwhile cases of EBA in Sweden and Kenya demonstrated that the material-realist frames of EBA were again invoked in EBA projects, with important implications for how interactions were prefigured by power relations in a given context.

The comparative study in Paper IV allows us to see the commonalities in the way that EBA is conducted across cases. This revelation helps to emphasise more concretely how particular interpretations of sustainability governance that foreground the material world – in this case those founded on ideas of 'nature' stemming from the natural sciences – are constitutive of NBS practice and research. In all these cases, such partial and problematic ideas are powerful misrecognitions of the ways that societies, embedded in environments, respond to different kinds of challenges. The reference to environmental justice as an alternative departure point in one case in Paper IV provided a means for redress, or in other words a critical case whose invocation made visible the deficiencies in the EBA and environmental peacebuilding frames. The case became a way to read EBA and environmental peacebuilding through the lens of a more pluralistic nature-based approach, orientated towards social justice. Thus, one interpretation of the findings as a whole is that NBS currently represent various forms of epistemic and recognitional injustices in themselves. Furthermore, in the context of achieving the Sustainable Development Goals through NBS, these injustices and misrecognitions also appear to preclude more transformative responses to societal

challenges and greater inclusion of epistemological pluralism, thus denying any potential affordances of these approaches to meet those goals.

4. Alternative frames situated in the studied cases entail more transformative potential but are marginalised in dominant frames of nature-based approaches, including EBA (Papers III and IV).

Despite the narrow focus of nature-based approaches, the empirical analysis offered in Papers III and IV shows that social-ecological relations can be framed in alternative ways that are situated in the power relations that shape environmental change in a given place and its implications for marginalised peoples' empowered responses.

Taken together, the findings from the thesis papers indicate that in practice increased attention afforded to the biophysical dimensions of a given social-ecological context becomes associated with top-down, technical, and managerial ways of conducting adaptation that are not exclusive to EBA. These top-down approaches appear to constrain opportunities for participation or recognition of marginalised people's alternative priorities, situated knowledge, and diverse ways of relating to 'nature' co-produced in particular forms of life. Thus in the studied cases (Papers III and IV), nature-based frames appear blind to the people's alternative expressions of agency orientated towards ecological relations they are embedded within, expressions that implicitly acknowledge different frames, knowledges, and subjectivities that bear little resemblance to the frames of nature embedded in these top-down impositions. Drawing on empowerment FPE as an analytical lens, Papers III and IV make visible how modes and frames of EBA further marginalise alternative voices, perspectives, and ways of relating to 'nature' (subjectivities).

Paper III shows that in Sri Lanka, alternative frames of nature that are not visible in these dominant modes of operation include the cultural and historical ways of conceiving of the landscape. This circumstance is exemplified in the co-produced nature of the *Elangawa* cascade in the Galgamuwa case, with its various components (*Katukaduwa*) and forms of common-pool resource management (*Sharamadana*) and positions of authority (*Vel Vidane*). Whilst individual EBA practitioners were personally aware of the ways the *Elangawa* represented a cultural hub (for instance, in shared evening bathing practices), these 'socio-natures' (cf. Castree and Braun, 2002; Mosse, 1997) were not recognised in the embedded frames of the EBA intervention. Likewise, the social elements of *Katukaduwa* and *Sharamadana* (the related concept of *Bethma* was excluded completely) were not considered important to the project design, and within its short timeframe, the project reduced these concepts to simply biophysical infrastructure, misrecognising the communal social relations and situated knowledge that these concepts have historically presented. This finding indicates that the frame of

EBA constrains opportunities for acknowledging pluralistic and relation perspectives on EBA even where these are recognised by people involved in the project. In other words, the framing power is partial not total, providing means for redress for people to challenge these misrecognitions and engendered subjectivities. Despite the bias of the dominant EBA frame, marginalised people took advantage of EBA on their own terms, using it as a platform for renegotiation and contestation of dominant power relations that did represent a fuller appreciation of the knowledges, frames, and power-laden stakes for different groups embedded in these places.

Elsewhere, the analysis showed how alternative frames of nature were important dimensions of people's ways of acting *otherwise*. In Paper IV, the case from Skåne County in Sweden, shows that people conceived of nature in terms of inherent values rather than the instrumental values embedded in the frames of EBA planners. In the Kenyan case, also from Paper IV, communities had long-standing, more locally situated frames of nature (*Enkutu* and *Dedha*) coherent with and embedded within forms of grazing management that had co-developed over generations in the context-specific ways of pastoralist life. Outside of EBA, the case in Colombia showed that faced with dominant frames of nature embedded in the environmental peacebuilding process, marginalised people fought for the recognition of indigenous ways of relating to nature that were not dependent on a nature-society distinction or the instrumentalism and managerialism this supported. In this same paper, the case of environmental justice in Turkey confirmed the central role of politics of recognition. Different frames of nature played a central role in broader struggles over rights and access to resources, and they were again embedded in the social and economic relations between different groups vis-à-vis the riverine environments at stake.

5. Dominant frames of 'nature' constrain the empowerment potential of the research and practice of various types of nature-based approaches and risk reinforcing social marginalisation (Papers II, III, and IV).

When the results of the thesis paper are considered together, the evidence appears to strongly support that the dominant frames of nature in which EBA is conducted constrain the empowerment potential for these approaches and risk exacerbating the social marginalisation that plays an important role in how particular groups of people experience vulnerability to climate change. This has implications for how researchers are able to contribute to progressive social change, and it appears to demand greater reflexivity with regard to how researchers position themselves vis-à-vis broader nature-based approaches to societal challenges.

The biophysical conceptions of EBA located in Papers II, III, and IV drive focus away from the need observed in these papers to develop reflexive research capable of taking

critical distance from a policy-orientated concept, such as EBA, and environmental peacebuilding, and NBS more generally. These papers indicate that, without reflexivity on such issues, researchers involved in the science of EBA are risking reifying the embedded assumptions, subjectivities, and power relations. Such reification may occur through diverse but often under-recognised ways in which researchers are embedded in the multiscale social (power) relations that help to drive nature-based approaches and their enaction in specific places. As Paper III shows, the extent to which social complexity is recognised as a factor worthy of consideration appears to be hidden by technical accounts of EBA. Papers III and IV show how such reductionism can lead to discrete management interventions where politics has been deliberately or inadvertently avoided, which leads to negative effects or maladaptation. Paper I establishes more generally how adaptation researchers are implicated in the power relations of adaptation itself.

Each of the thesis papers expresses in different ways how knowledge-orientated relationships (i.e. the relationships engendered in research) have empowerment-related implications, especially when we recognise these relationships occur in contexts of diverse subjectivities. In particular, the cases in Paper IV show how the development and application of EBA as a research object reveals how researchers are themselves involved in enacting the power-laden processes that play out in the EBA interventions, in part through expressing the dominant frames of EBA. Thus, the researchers are implicated in reinforcing the asymmetrical power relations that occur in governance processes, making them partly complicit in ongoing but often intangible forms of social marginalisation. This complicity also entails researchers being partly responsible for limiting the potential for social benefits from these approaches.

Photo: Research assistant Prabath Kaushalya and I walk between interviews in the village of Serupitiya, a highland village near to the Victoria reservoir reserve, a protected area (visible in the background). The mostly landless villagers of Serupitiya face multiple interacting pressures associated by climate change, including soil erosion and landslide risks. Most farmers in Serupitiya did not own their own land, were forced into grievous sharecropping arrangements, and were compelled to cultivate steep slopes in their home gardens, aggravating soil erosion and landslide risk.

Discussion

> "Our task is to make trouble, to stir up potent response to devastating events, as well as to settle troubled waters and rebuild quiet places…Staying with the trouble requires learning to be truly present… as mortal critters entwined in myriad unfinished configurations of places, times, matters, [and] meanings." Donna Haraway, 2016, p1

Overview of findings

In this thesis, I aim to examine the apparent transformative possibilities of nature-based responses to climate change. Specifically, the thesis centres on adaptation to climate change impacts using ecosystems, through EBA. The thesis is founded on the assumption that to be sustainable, response must be transformative and not reinforce a fundamentally unsustainable status quo that degrades ecosystems and burdens already marginalised people who have the most acute vulnerabilities to climate change (Pelling, 2011). Empowering marginalised populations is an important, but limited part of broader transformative processes. However, research gaps in a number of areas are preventing us from understanding more precisely how such empowerment may arise in sustainability interventions, particularly EBA. Climate change adaptation represents a suitable setting to unpack how it might do so. This is because both ecosystems and empowerment are important determinants of historically marginalised peoples' vulnerability to climate impacts. To investigate how EBA and empowerment are interrelated, I have used the lens of power in this thesis. Assuming the need for transformative social change, I asked how EBA solutions could challenge the power relations through which marginalised people are made vulnerable.

The EBA cases studied were external interventions in a given place by an external actor acting on behalf of a nominally 'dependent' subject. This scenario appears to be a prevalent mode in which ecosystem service management and restoration are conducted, despite the widespread appeal of ecosystem-based approaches to marginalised groups and the relevance of their knowledge. These factors have implications for the potential of EBA to be inclusive and lead to social benefits. EBA, as an approach, highlights how ecological context affects people's vulnerability to climate impacts. Crucially, however,

interventions appear to be limited in their recognition of and engagement with the social context that they act within. This limitation is as important to explaining patterns of vulnerability for marginalised people as the ecological context.

Drawing together site-specific instances and broader-scale analyses on how EBA is currently conceived, this thesis finds that specific EBA interventions expressed conceptual frames of EBA. These frames prefigured the conduct of these interventions. However, this framing did not necessarily produce outcomes in favour of social benefits and inclusion.

EBA enacted in specific places was subordinate to a dominant external frame of EBA, which constrained some potential material and institutional advantages of EBA (i.e. transformative pre-conditions). The findings from the empirical cases presented are consistent with the theoretical and comparative studies: Namely, current frames of EBA appear to occlude issues of power, context, and heterogeneity. Social difference is represented simplistically as marginalised groups' higher dependence on ES. The project staff in the studied EBA interventions understood that acting on these ES would benefit the marginalised groups in question. However, they positioned themselves as the appropriate actors to carry out such work on their behalf, perceiving participatory conduct to be less important. Given these findings, there appears to be a high risk that EBA, when enacted according to particular assumptions, frames, and modes of implementation, is in danger of becoming a quick fix, foregoing its transformative affordances. This potentially exacerbated existing forms of marginalisation and injustice that play out in cross-scale relations.

Despite power not being accounted for in dominant frames of EBA, power was embedded in and around the studied EBA, and it was made visible in the research through the lens of empowerment. Despite the misrecognition engendered in this discursive frame of EBA, in the case studies, the conduct of the interventions was embedded within but essentially marginal to broader and deeper contestations of power. The findings indicate this misrecognition contributed to constraining the potential of such initiatives to transform the power relations that condition vulnerabilities for certain groups. Therefore, the interventions engendered power relations and marginalisation. Simultaneously, they were complicit in the ways in which unequal power relations and their effects were hidden from view.

Nevertheless, these power relations in EBA mattered to the groups with most at stake in their effects. Especially, embedded contestations of power mattered to the nominal beneficiaries of EBA, the marginalised groups that were assumed to be passive, dependent beneficiaries of such projects. The findings indicate diverse struggles of marginalised groups were often linked to how power relations constrained or enabled

their daily practices and adaptive strategies within landscapes (cf. Bebbington, 2008; Richerzhagen et al., 2019; Polishchuk and Rauschmeyer, 2012). For instance, people mobilised actively to resist incursions against valued ecosystems. They made use of networks to leverage ecological resources for individual, familial, and collective aspirations. This use included those struggles, strategies and goals related to confronting the impacts of climate change.

These findings show the imperative of examining underlying assumptions that apparently dictate the relevance of green solutions to marginalised people and that are embedded in the claims that they are inclusive, transformative, and capable of delivering social benefits[22]. Instead of simplistic assumptions, such as how change will emerge deterministically from particular management actions of interventions (in terms of social benefits) or the dependence of people on the biosphere, the thesis shows that the social-ecological complexities need to be accounted for. Together, these findings challenge assumptions about the relevance of EBA to marginalised people because of their inherent dependence on ES.

Examining assumptions

I began this thesis by identifying and setting out three common types of claims that have been and continue to be made on behalf of EbA. The findings presented herein establish more precisely some contemporary modes and frames in which EbA is currently expressed and enacted. This enables a more precise appraisal of those claims.

Transformation

The first claim was the potential of EBA to deliver transformative change[23]. The thesis contributes to understanding the kinds of social change that may contribute to addressing the ecology of crisis. With the upcoming UN Decade of Restoration and the loud calls for transformation from the world's most prominent scientific bodies,

[22] Similarly, Thoni (2019) found in her work on ecosystem-based responses to climate change that complex realities, of vital importance to marginalised people, are hidden or at least reduced in the standardised frames in which such NBS are expressed at higher scales of social organisation. Thoni argues that this enables them to function as "global governance objects" (Allan, 2017, p131) or "global environmental discourses" (Adger et al., 2001, p 681).

[23] The IPBES (2019) and IPCC SRCCL (2019) find that transformative action is necessary to address the ongoing social-ecological crisis, but leave open what transformative social change might entail, presumably to avoid being politically prescriptive. Nevertheless, protagonists behind NBS are positioning themselves as central to transformations (see e.g. Faivre et al., 2017).

this is an opportune moment to clarify what *nature for transformation* will entail for particular actors engendered in EBA, and more broadly, NBS.

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To move towards transformative change, the thesis adds to calls to challenge problematic and simplistic assumptions about vulnerability and social change to better account for the interrelation between processes driving the ecology of crisis. Here, vulnerability is not located as an outcome of climate change per se but instead experienced through contextual, place-specific relations that also comprise social marginalisation and degradation of environments (cf. O'Brien et al., 2007; Nightingale et al., 2019; Boyd, 2017). Relational, context-orientated understandings of vulnerability appear more suitable to understanding how marginalised peoples' vulnerabilities emerge from complex interactions in a particular context (Wisner et al., 2003; Lopez-Morrero and Wisner, 2012; Taylor, 2013; Coirolo and Rahman, 2014; Ensor et al., 2019).

Asserting the central role of marginalised peoples' agencies and subjectivities means that social change that reduces inequality, land degradation, biodiversity loss, and climate change will be a fundamentally contingent, often uncomfortable, context-specific process. This outcome is supported by previous research on transformative change as an unpredictable, non-linear, and co-evolutionary process (Pelling et al., 2014; Haider, 2017; Pelling et al., 2014). The findings suggest such processes are likely to emerge through the struggles of those embedded in the contextual relations that produce such interrelated social-ecological challenges. As Haraway notes (1991), people situated in these struggles are more likely to see power. Reading contemporary instances of EBA through a lens of empowerment makes visible how these solutions are based on biophysical assumptions about vulnerability and social change, a systematic bias that appears to constrain the recognition of power, contributing to its occlusion. This finding is in line with post-structuralist scholars of discourse and subjectivity (Foucault; 1980; Lakoff and Johnson, 1980; Butler; 2001). In contrast, an empowerment lens makes social processes and power relations visible and shows how they make the outcomes of EBA more contingent. Here, it showed how the reductionism, standardisation, and abstraction of EBA are inappropriate. It also showed how the lack of recognition of the way environments are part of relations that shape vulnerability of different groups is detrimental.

For instance, one particularly problematic form of reductionism in current assumptions that underpin EBA is how protagonists and adaptation researchers tend to speak about empowerment as if it was a form of incremental, additive change, such as in the sense of adding capacities in a complementary (non zero-sum) manner. This view implies agency is a resource or form of capital, not contingent on social relations or power asymmetries. This conception enables transformation and empowerment to be delivered deterministically, including through delivery of ES, without ever taking social processes and power relations into account. This mirrors the transformative claim of biosphere-based sustainability science. Both offer an implicit theory of change akin to *if we recognise the contributions of nature to society, then social change will follow*. Mobilising empowerment as an apolitical, non-relational notion and agency as a resource enables 'empowerment' to be delivered as a special kind of 'ecosystem service'. This is likely compounded by the 'solutions' rhetoric and lack of awareness of social costs.

This thesis also shows the importance of politically explicit conceptions of social change. Scoones et al. (2015) assert that transformation means contesting dominant power relations that create the conditions for the ecology of crisis. Such contestations are inherently political because different groups perceive different stakes in the transition (Calliari et al., 2019; Krause, 2019). Insisting on an interpretation of empowerment as an often antagonistic socio-political process challenges the implicit developmentalism[24] that appears to be at risk of re-emerging in nature-based conceptions of sustainable development (Westholm 2016; Westholm and Arora-Jonsson, 2015). In this reading, empowerment is not a form of growth towards a determinate end point (sustainable development), nor can it be a special kind of ecosystem service delivered by a dominant actor on behalf of a dependent adaptation subject. Empowerment theory insists on a more radical movement to counter material, institutional, and discursive forms of marginalisation, including those expressed in contemporary modes and frames of adaptation.

To be truly transformative, an EBA must challenge power relations. Where the baseline condition of inequality is not lack of growth but variegated and cross-scalar marginalisation, EBA implicitly framed as a form of service delivery is unintentionally reinforcing marginalisation as well as hiding the power relations through which such marginalisation takes place. Conceiving of the baseline condition of vulnerability as a function of inequalities of power, empowerment theory enables us to interpret

[24] "Developmentalism refers to a particular ideology marked by a sense of inevitability about the nature of change and to political interventions to implement particular strategies of development." – Buğra, 2017. See also, Escobar, 1995.

transformation more precisely and more critically as a form of challenging contemporary power relations that maintain inequalities and resultant vulnerabilities to climate change (Manuel-Navarrete and Pelling, 2015). Here, I translated empowerment theory into a social-ecological context and conceptualised it in reference to overcoming power asymmetries that are expressed in dynamic social-ecological relations. In these relations, empowerment was the inherently unpredictable contingent political process that could arise through EBA, in spite of EBA, or even through resistance to EBA. Despite the claims made, there is no deterministic causal trajectory whereby ecological restoration will necessarily lead to empowerment, or vice versa (Isgren, 2018; Wieland et al., 2016).

EBA appeared to represent sites for power relations to be negotiated and contested, but not in ways that were necessarily in line with the interests of researchers or EBA practitioners (the drivers of projects and interventions). The thesis findings thus help to clarify empowerment as a necessarily bounded, often ambivalent, and always evolving contribution to broader transformative processes, where transformation is the contestation of dominant power relations across multiple scales that drive inequality and vulnerability (Richerzhagen et al., 2019). Tracing contestations of power enabled showing how people claimed space for struggles that encapsulated *integrated* responses to an inherently interconnected set of issues. Indeed, studies show climate change and adaptation are only ever parts of broader interacting processes of change (Nightingale et al., 2019). Ensor et al. (2019) contend that instead of focussing myopically on climate change impacts, asking "What are the most significant changes taking place in people's lives?" can help to understand why people act in the way they do, and also reveal more holistic responses to interrelated challenges.

Where transformation is a contingent social-ecological process, empowerment and resistance are, *inter alia*, actual political responses of marginalised groups to the constraining (marginalising) effects of dominant discourses, institutions, and material relations. Indeed, the thesis indicated that empowerment and resistance may be particularly relevant when adaptation is conducted as an intervention by one actor on behalf of adaptation subjects. Though I found expressions of empowerment and resistance in the EBA processes, these were not recognised in practitioners' accounts of their interventions, nor are they present in the EBA concept.

Inclusion

The second claim that prompted this research was that EBA is, as a nature-based approach, inherently predisposed to inclusive engagements with marginalised groups, more easily integrating marginalised people's knowledge, agency, and priorities (which

I interpret here as subjectivities). In the thesis, I investigated why claims about participatory affordances were being made, and I investigated the social processes through which EBA was enacted as an intervention – which appear to be a dominant mode in which EBA is currently implemented. Whilst I do find that environmental degradation is highly relevant to many marginalised groups' adaptive strategies and concerns, this connection did not translate into EBA becoming more participatory and inclusive.

The studied EBA interventions did offer participatory affordances perhaps not available to a hard-infrastructural alternative – for instance, in supporting common-poor resource management institutions like those embedded in *Elangawa* or supporting female-dominated home garden networks, supporting findings from similar research on EBA (Brink and Wamsler, 2018). However, in the studied cases project managers made clear their key pro-poor contribution was the restoration of ecosystems in themselves. Thus, the expressions of agency necessary for understanding empowered adaptive strategies vis-à-vis EBA went for the most part unrecognised and unrepresented. This finding is supported by research in related disciplines (ibid). Such findings were also observed in a recent study of EBA social benefits and costs in Colombia by Richerzhagen et al. (2019). The assumption that ecosystems are an external service-providing unit, best managed by external experts (Thoni, 2019) on behalf of 'dependent' subjects, appears to severely constrain the apparent participatory affordances and inclusive dispositions that EBA may have[25] and instead risks creating circumstances of further marginalisation. The findings showed that such effects also reduce trust in advance of future interactions between citizens, the state, and other actors to safeguard ecosystems in order to protect against climate risks, especially when coupled with a culture of corruption (such as in forest management or *Elangawa* maintenance) and top-down imposition of power against the express wishes of affected constituencies. This finding correlates with similar observations made by Haider et al., (2019) about historical interactions influencing the success of collaborative ecological management.

As shown in the long-standing body of literature on participation (c.f. Mancilla Garcia and Bodin, 2018; Mancilla Garcia and Bodin, 2019), participatory modes of engagement are affected by dominant power relations, shaping outcomes for inclusion and closing down marginalised voices and knowledge (Westholm, 2016). Following Tschakert et al. (2016) in particular, I studied how these social processes became sites

[25] Thoni finds that the managerial notions and narratives of control that emerged in the governance of coastal ecosystems were coherent with the standardisation inherent in ecosystem services concept, as well as the process of establishing 'blue carbon' as a global governance object (2019).

for the renegotiation and contestation of power relations. Using Pansardi's theory of power (2012) that differentiates conduct and context, I could analyse how EBA interventions contained embedded power relations that 'pushed out' on the context in which they intervened, whilst these same contexts 'pushed in' on those interventions to influence their processes and outcomes. Making such politics visible was enabled through Tschakert et al.'s (2016) lens of micro-politics, which revealed that people's expressions of agency were more likely to occur outside of formal channels for 'participation' than within them.

The reference to environmental justice in the final paper shows how NBS may take account of plural perspectives and conflicts embedded in the context of an EBA project. Environmental justice demonstrates how expressions of resistance, when seen from the grassroots level, are not undesirable obstacles or barriers to nature-based approaches. They are informal expressions of power in which people create spaces for their voices to be heard and their agency expressed, even when denied such opportunities in formal channels of participation.

People's agency was not made visible in the dominant frames and modes of EBA, undermining the apparent disposition as inherently sensitive to people's own strategies, priorities, and knowledges. Though hidden in dominant expressions, agency of marginalised actors was highly visible through the alternative frame of empowerment. It could be found in response to climate change and other stressors through remaking environments, resisting incursions of powerful actors, and protecting common-pool resources. Each of these was an important way in which power relations were being remade through, in spite of, or as resistance to the studied EBA interventions[26]. Future work on participation and inclusive forms of NBS research and practice could depart from a resistance lens to explore how marginalised people confront present and historical injustices on different dimensions of power (including epistemic power).

The more situated collaborative approach suggested in the papers on EBA could position this nature-based approach better to enable engagement with the agencies, subjectivities, and knowledge of groups with most at stake in environmental degradation. In practice this may lead to very different types of engagements with marginalised groups, working to centre their efforts and create safe spaces for anticipatory planning processes (Pereira et al., 2018). This would accord with Elmhirst and Darmastuti (2015), who showed how place-making, networking, restoring multifunctional landscapes, and diversifying livelihoods were all situated forms of

[26] For instance, people in Serupitiya negotiated to add a livestock element to the project, and therein they created for themselves a dairy-production element that they integrated with their existing livelihoods.

adaptation by women in response to social-ecological change in Indonesia. To engage with these strategies more effectively, EBA research and practice could build on emerging insights on citizen science, civic ecologies, commoning, and place-making (Groulx et al., 2017; Krasny et al., 2014; Wamsler and Raggers 2018; Sato and Alarcón, 2019; Masterson et al., 2019). Creating just institutions (Sustainable Development Goal 16) would not only improve instrumental outcomes for adaptation, it would also contribute to environmental justice and a reduction in inequality. A need exists to expand attention to governance and equity issues in EBA. Further work could depart from Arendt's political philosophy to explore how NBS could become spaces for deliberative democracy (cf. Haugaard, 2010; Eyben et al., 2006; Stirling, 2015) that go beyond assumptions of consensus but rather seek to set out areas of consent as well as dissent within processes of NBS planning and implementation.

Social benefits, or just adaptation?

The third claim motivating this thesis pertained to the apparent 'social benefits' EBA can deliver. Whilst the findings support the general conception that EBA appears to offer an approach for delivery of 'win-win' solutions when it comes to equity and environmental sustainability (Seddon et al 2016), the findings demonstrate that this outcome is highly conditional.

The findings indicate that potential outcomes including empowerment, gender equality (Sustainable Development Goal 5), and reducing inequality (Sustainable Development Goal 10) are being expressed as politically neutral and unproblematic 'co-benefits' distinct from adaptation goals per se[27]. It appears that social change as *social benefit* allows a social process such as empowerment to be made commensurable with other kinds of adaptation outcomes, and even other ES. In the present circumstances, ensuring that EBA are effective and equitable appears challenging, especially in the context of outcome-focussed interventions in which the social process is unaccounted for (Nightingale et al., 2019; Boyd 2017). Addressing the real risks that EBA carry to marginalised people may be critical to their success, rather than simply being discussed in terms of multiple benefits, co-benefits, or social benefits (Reid, 2015; Dawson et al., 2017; Westholm and Arora-Jonsson, 2018). As *social processes* are abstracted and translated from particular locations into universal notions of *social*

[27] Such expressions may be needed for fulfilling political strategies within certain spheres of political action. Claims of multiple benefits appear to be key to the construction of EBA – and NBS more broadly – as global governance objects (cf. Thoni, 2019). For instance, this may assist in mainstreaming NBS at the international level in United Nations, in European Union level programming, or to justify UNDP's modes of conduct in the countries in which it works.

benefits, they are enabled to function as part of making the case for adaptation. The thesis demonstrates that when scientists adopt these assertions, for instance when designing their research towards contributing to the evidence base for EBA, they are reifying these problematic and power-laden assertions[28]. This thesis suggests the need to challenge the notion of co-benefits and social benefits and their unproblematic deployment as part of making EBA policy legible and coherent.

Social benefits is a euphemistic and misleading phrase for what is otherwise potentially confrontational social change inseparable from broader social-ecological relations. Currently, social benefits are being conceived simplistically as deliverable through the management of ES, rather than the disruption of power relations that shape people's vulnerabilities to climate change and degradation of landscapes leading to social costs of adaptation and exacerbation of climate-related loss and damage (Seddon et al., 2016; Tozer et al., *forthcoming*). The conflation of such social change with apolitical 'social benefits' outcomes is risking that reducing inequality and achieving gender equality will be limited to satisfying quantitative indicators or be lost within vague notions of 'social and environmental sustainability'. This reduction of justice to a measurable indicator is both enabled and reified in the modes and frames in which EBA was enacted herein. Such language hides the politics and radical social change needed to address social inequalities (Ensor et al., 2019). These findings have implications for how EBA is made to work for the interests embedded in the status quo at different scales and how it is turned away from its transformative potential. Further work could insist on taking an empowerment, FPE, or environmental justice lens to parse the enabling and constraining elements of a transformative approach.

Separating social benefits from the relations and processes that constitute vulnerability and adaptation is a misrepresentation of the complex context of EBA. This misrepresentation tacitly reifies existing epistemic injustices whereby natural sciences are overvalued at the expense of lay, tacit, and embodied knowledges of diverse people (Tengö et al., 2014; Nightingale, 2016). Misrepresentations are part of the way that power is enacted through research and reinforces material and intangible forms of marginalisation (Kuntz, 2015). Facilitating social benefits is more likely if EBA researchers and practitioners recognise and create more space and time for the social processes needed for equitable and effective EBA. Bringing together diverse actors in

[28] These are mechanisms of power in translation (Tsing, 2015), facilitating the standardisation, demarcation, and valorisation of particular contexts into universally-applicable knowledge in their abstraction to higher scales of governance and knowledge production (Allan, 2017; cf. Ernstson and Sörlin, 2013; Adger et al., 2001).

the governance and knowledge of EBA would contribute to revealing and challenging implicit biases, forms of misrecognition, and potential social costs.

Drawing on scholarship on subjectivity and governmentality vis-à-vis EBA (Agrawal, 2005; Boyd et al., 2014), further research could seek to challenge the essentialisms emerging in nature-based discourses, the instrumentalisation of social justice concerns, and the occlusion of situated, historically marginalised knowledge. Critical engagement with these discourses is needed, in part to problematize the notion that nature-based accounts of societal challenges concern biophysical boundaries, limits, and constraints. From the vantage point offered by the findings herein, I would contend that such a biophysical language risks imposing an unwarranted determinism on sustainability science, whilst also maintaining dichotomies between social and ecological dimensions of a given case that the findings show are instrumental to the types of marginalisation that have been documented. Relational approaches to sustainability science discount the naturalisation and objectification of 'social' and 'ecological' elements, and instead point to the co-production of the social and ecological. The research shows how these categories are structuring the experience of sustainability. Though these abstractions may be necessary presuppositions for many concepts, they are not grounded in many people's experience (Cooke et al., 2016). This deconstructionism will help pave the way for more pluralistic ways of knowing and help in realising "enearthed and enculturated" responses to societal challenges (Schill et al., 2019).

Contributions

Now that I have established the findings and set them against the claims made on behalf of EBA, I turn to discuss the contribution of these findings to the fields and bodies of knowledge of ES, adaptation, and sustainability science. I also consider how emerging insights from these fields might inform how EBA can better deliver on its transformative claims.

Ecosystem Services

Whilst EBA does provide an otherwise neglected ecological perspective on adaptation, an inclusive framing of EBA can be further extended beyond the limitations posed by the ES paradigm. Particular ecologically orientated elements of adaptation that require increased attention in future research include knowledge gaps on how social and ecological elements co-evolve in complex adaptive responses to multiple pressures. Further studies could build on recent research showing the links between climate

change and ecological functioning in progressively dangerous levels of climate change, where risks of tipping points and non-linear effects become increasingly likely (Rockström et al., 2011). Other studies are demonstrating the hidden social effects and social-ecological feedbacks vis-à-vis climate change impacts on ecosystems (Pinho et al., 2014a). Gaps in adaptation research vis-à-vis EBA include ecological limits to adaptation, the residual impacts of climate change on ecosystems after all adaptation has been attempted, and the disproportionate impacts of damage to ecosystems on marginalised groups (Maru et al., 2014; Pinho et al., 2014b; Fernández-Llamazares et al., 2014; IPCC SROCCC, 2019). Such work could make more explicit who is likely to be affected by changes in ES provision in different climate change scenarios, and it could be cognisant of the risks of slipping back into problematic tropes and assumptions when social science is not given due space (Jetzkowitz et al., 2018; Colléony and Shwartz, 2019).

My findings contribute to ongoing discussions in the ES field by showing how the enactment of commonly held assumptions underpinning ES literature constrains the space for empowerment of peoples most at risk. Such risks abound from both climate change itself and dominant responses to it, including those that are notionally apolitical or ecosystem focussed. Essentialist assumptions about dependency of marginalised people on otherwise independent and benevolent ES appear to often further marginalise the people EBA is intended to benefit. Indeed the essentialist notion of a poor, passive, and dependent rural woman that appears to be enabled in the ES-orientated adaptation frame is one of the longest running tropes of development discourse (Escobar, 1995; Kabeer, 1994). As cases of EBA in diverse contexts of Sri Lanka, Kenya, and Sweden showed, research on ES management is not apolitical. Such research instead entails differential costs to different groups (or 'trade-offs'). The findings support the contention that making social difference visible in ES research means recognising how marginalised groups of people are especially likely to bear the costs and negative side effects of ES governance actions, unless such risks are accounted for and mitigated (Wieland et al., 2016; Newsham et al., 2018; Brink and Wamsler, 2018). The findings indicate that biophysical framings of societal challenges embedded in NBS instead empower external experts and interventionists and confer authority and legitimacy to natural scientists and powerful actors. As the case of environmental peacebuilding showed, they also indicate that such framings enable the instrumentalisation of nature in the service of dominant interests.

The assumption that NBS will deterministically address social inequalities has a precedent in the *nature for people* paradigm of conservation and ecological science. Such claims have previously been made about conservation and poverty alleviation (Reid 2015; Suich et al., 2015), but the outcomes of these initiatives have often fallen short

of expectations (Reid, 2015; Wieland et al., 2016). Scholars have showed that such expectations were often based on simplified assumptions about the local realities (Leach et al., 1999). The findings indicate that not recognising such simplifications in ES research risks the same disappointing outcomes repeating themselves through their enaction in programmes such as NBS, as well as in broader 'nature-based' accounts of sustainable development (Folke et al., 2016; Fischer et al., 2016). I contend that frame-reflective ES research could help to focus attention on the discursive power relations behind these simplistic assumptions and show why they continue to be operationalised despite the previous bad experiences. This is another reason for greater critical distance between ES research and practice, given the discursive coherence between NBS and knowledge produced under an ES frame and institutionally, in overlapping mutualistic relationships between ES scientists and practitioners[29].

The thesis highlights the need in power-laden circumstances to make visible complexities that appear to be easily hidden in ES research. The thesis demonstrates that material and intangible power relations are embedded in ES practice, echoing the research by Thoni (2019). I do not consider it coincidental that power was not acknowledged by practitioners in the studied cases, nor is it acknowledged in most ES research (cf. Fischer et al., 2015; Berbés-Blázquez et al., 2016). Herein, by reference to empowerment theory and relational sociology, the role of intervention and social process vis-à-vis ES 'management' is also clarified. These theories helped to show how EBA actions attempting to reduce marginalised people's vulnerability through interventions to manage ES were problematic, precisely because they avoided the many social complexities they invoked.

The findings support the recent turn towards co-productive and relational models of ES generation (Berbes-Blazquez et al., 2016; Lele et al., 2018; IPBES, 2019;) that moves beyond the notion that ecosystems are service provisioning units that mostly stand outside of human society except when they are predicted and controlled through management actions (Ernstson, 2013; Thoni, 2019). In the studied cases, beneficial outcomes of social-ecological relations are born from people's differentiated agencies and situated knowledges as well as practices of common-pool resource management (Groulx et al., 2017; Wamsler & Raggers, 2018; Krasny et al., 2014). The paradigm of research around "socio-natures" (Castree and Braun, 2002; Shillington, 2008; Singh, 2018) may better account for such beneficial outcomes as emerging from such forms of co-production. Socio-natures (and the co-production of ecosystem services)

[29] The recurrence of such claims, as well as the recurrence of failure and simplistic assumptions about change, suggests that the concepts that underlie these approaches are coherent and systematic, which is in accordance with contemporary theories of language (cf. Lakoff and Johnson, 1980; Taylor, 2016).

constructively integrate different sustainability challenges within understandings of unequal power relations (Castree and Braun, 2002; Nightingale, 2011; Singh, 2018; Ernstson, 2013). Socio-natures show how beneficial outcomes emerge from the same relations that also produce environmental degradation, climate change vulnerability, and social marginalisation, and they may provide a more useful foundation to developing integrated approaches that can address multiple Sustainable Development Goals.

Frames analysis may help to uncover and move beyond embedded Cartesian ontologies and enlightenment values embedded in the ES concept as it has been applied in a wider set of cases and domains. Frames analysis was herein useful to show how atomistic, reductionist frames of nature that presuppose a dualism between nature and society appear to be supporting dominant interests and knowledges that enjoy more authority. Herein, I showed how the dominance of such frames in ES-informed research and practice also unwittingly undermined alternative frames better aligned with epistemic, recognitional, and distributional justice (Fraser, 2004; Roberts and Parks, 2006; Steel and White, 2012).

Empowerment theory appears to be a useful lens for future climate-related ES research since it enables an analysis of how management actions constitute social power relations with differential risks and benefits for different groups. The radical, grassroots legacy of empowerment theory can help to align the interests of ES research with relatively powerless actors, rather than power holders. Centring the agency of such groups, rather than their dependency, in turn requires more place-based, indeterminate understandings of ES, as suggested by Daw et al., (2016), Pelling et al., 2014, and Merçon et al., (2019). This means departing from the cascade model of ES that enables the concept to function unproblematically as a planning tool for managers, and moving beyond narrow notions of ecosystems as liable to prediction and control by a limited set of authoritative and often external actors and experts (Thoni, 2019). Application of an empowerment lens to ES research can also reveal the way power functions within the relationships surrounding ES management (Thoni, 2019). Making visible the interventions through which ES-type ideas were enacted and reified enables and is supported by more relational understandings of social-ecological relations and emergent outcomes for human well-being (see Polishchuk and Rauschmeyer; 2012 Berbés-Blázquez et al., 2016). Perhaps, it is even time to leave the ES framework behind. Centring the most vulnerable people in accounts and practices of EBA would likely be enabled through moving from ES to the more relational and contextually explicit 'nature's contributions to people' (Kadykalo et al., 2019).

To challenge the abstract, reductionist, and generalising assumptions about ES, which facilitate their prediction and control, it may be helpful to turn to FPE. More situated,

contextually responsive ES research does not necessarily challenge the overall proposition that humans are dependent on nature. However, it could be useful in a conversation about how particular kinds of knowledge construction are relevant to particular spheres of human action and organisation. Feminist research on triangulation (Nightingale, 2003; Bee, 2016; Nightingale, 2016) could perhaps be productively combined with ES research seeking more pluralistic accounts, in part by demonstrating how different ontologies may be valid (Tengö et al., 2014; Tengö et al., 2017)

In order to take diverse knowledges on board in NBS research and practice in a meaningful way, participatory and transdisciplinary approaches to understanding the role of nature in mediating climate change risks could be developed further, whilst acknowledging the complex power relations that often characterise such epistemic projects. To address this ambivalence, these approaches could be based on the normative commitments of feminist scholarship, given its contributions to understanding the roles of situated knowledge and its demonstration of how dominant discourses and practices constrain alternative expressions (Haraway, 1991).

Adaptation and Transformation

The research findings appear to align with the field of community-based adaptation. Community-based adaptation is a paradigm of adaptation practice that works from the assumption that local-level adaptations are often most effective in addressing people's real adaptation needs and priorities (Eriksen and Lind, 2009; Tanner et al., 2015; Reid, 2015). Downscaled decision-making in adaptation may better fit the social dilemmas that emerge from particular biophysical changes (Bisaro and Hinkel, 2016). Previous research shows that ecosystem- and community-based adaptation can be productively combined (Reid, 2015; Ershad Sarabi et al., 2019). Together, they may reduce top-down imposition of inappropriate, techno-managerial solutions that do not take local context or root causes of vulnerability into account (Nightingale et al., 2019). Clearly, this reduction is not automatic, and the research shows EBA may in fact represent just such an imposition. Further, a limitation of this thesis is that it only focusses on such scales, whilst I acknowledge that adaptation, including EBA, may occur across different scales.

Even where EBA are top-down impositions, the research observes that interventions still provide platforms for actors to contest and renegotiate power relations, supporting research by Tschakert et al. (2016). In this sense it matters whether EBA conducted as top-down interventions offer affordances for marginalized groups to make use of as they contest power relations (Castán Broto et al., 2015). Maximising such affordances may require a rights-based, people-centred approach to EBA. Whilst participatory

development and community-based natural resource management approaches have been long assumed to be more responsive to needs of marginalised groups, this thesis accords with existing scholarship that participatory processes are themselves often ambivalent, power-laden processes (Mancilla-Garcia and Bodin, 2018; Mancilla-Garcia and Bodin, 2019).

The thesis contributes to long-running calls to overcome the notion that adaptation can be meaningfully conducted as an intervention by an authority on behalf of a passive subject. In particular, the thesis concurs with recent research by Haider, in the context of development interventions designed to overcome social-ecological traps (Haider, 2017; Boonstra, 2016). Namely, interventions appear systematically constrained in recognising power relations, social processes of the intervention, and local context (Long, 1990; de Hann and Zoomers, 2005). Opening NBS to more place-based interpretations of adaptation may better facilitate their transformative and inclusive potential. This may position them better to reduce inequality and accommodate just institutions (Sustainable Development Goal 16) (Wieland et al., 2016).

The research can contribute to nuancing discussions about empowerment, but most importantly, it adds weight to calls to maintain the radical character of the concept. As represented in the findings, empowerment itself can mean different things to different actors. The word has been criticised as part of a devolution agenda. In this critical account, empowerment helps to centre the individual within capitalist relations of consumption and production and contributes to a concomitant disempowerment of central government and other societal actors capable of large-scale systemic change (Coirolo and Rahman, 2014; Westholm and Arora-Jonsson, 2018; Brink, 2018). Practitioners and policy-makers continue to make 'empowerment' an explicit part of their projects, programmes, and policies. The word is also widespread in contemporary consumer society (including in Sri Lanka). So there is a continual need to unpack why empowerment is being used in particular ways and whose interests are served in such discourses (cf. Kabeer, 1999). This thesis maintains the radical origins of the concept in feminist scholarship as a political process that repositions the configurations of actors involved in adaptation, with a view to enabling the agencies and subjectivities of those most affected by climate change and dominant societal responses to it (Dodman and Mitlin, 2010; Merino and Ribot, 2012). The findings show resistance has been an under-represented dimension of power in adaptation research. Future research could depart productively, using a resistance lens to uncover the hidden power in climate change responses (Butler, 2001). Post-structuralist discourse analysis, such as that developed by Remling, can focus on the hidden processes of subjection in adaptation thought and practice (Remling, 2019; cf. Kabeer, 1994; Butler, 2001). Perhaps post-

structuralist discourse analyses can help uncover the obstacles to developing adequate forms of resistance.

The thesis evokes outstanding ambiguities in how agency (and social change) relates to social structures, biophysical constraints, and adaptation limits, and it suggests such ambiguities can be addressed using the insights of relational sociology (Emirbayer 1997; West et al., *forthcoming*). As conceptualised in feminist scholarship, empowerment centres agency as a contingent emergent phenomenon that puts people's subjective strategies, aspirations, and embodied engagements at the centre of analysis. However, this centring does not mean such expressions of agency are not limited by ever-tighter biophysical limits as well as evolving institutions and discourses at different scales (Navarrete, 2010; Navarrete and Pelling, 2015; Maru et al., 2014; Westholm, 2016). On the basis of these findings, relational-sociology analysis could be elaborated in future studies on adaptation. The findings of the thesis fit best within a relational-sociological interpretation of adaptation interventions. Relational sociology, here interpreted most explicitly in terms of empowerment, helped to open the black box of social processes, relations, and power in the "people-less" frame of adaptation (cf. Long, 2001, p1) and showed how interventions cannot be expected to deterministically deliver the promised social benefits. Further work could focus on understanding more precisely how actors mobilise and contest top-down interventions and how power imbalances condition the resultant outcomes. This work could be extended into analyses of how people transform the determinants of vulnerability amidst diverse types of dynamic social-ecological landscapes, such as urban landscapes. A more elaborated relational sociology might draw from Bourdieu's theory of *habitus (*Haugaard, 2008*)* translated into a social-ecological context.

Political ecology has tended to emphasise structures that constrain the lives of marginalised people, often positing a prominent role for large-scale social structures such as economic relations (Taylor, 2013). Whilst not discounting the importance of such analyses, focussing exclusively on these scales of power can inadvertently marginalise the forms of subjectivity, knowledge, agency, and types of contestations that are occurring at other scales (Elmhirst, 2015; Boyd, 2017; Tschakert et al., 2016). In addition, FPE has emphasised other scales at which power is expressed, reinforced, and contested (Bee, 2013; Elmhirst, 2015;), and the ways in which adaptation-related politics play out at the household and community level in material and intangible dimensions of power (Bee, 2016; Shillington, 2008). Here, I followed the intersectional feminist tradition of enquiring into other scales and domains of political activity, and I attempted to demonstrate their importance for understanding adaptation processes (cf. Eriksen et al., 2015; Kaisjer and Kronsell, 2014; Kaijser and Lövbrand, 2019). FPE enabled a deconstruction of the embedded subjectivities of external experts and passive

dependent beneficiaries. This analysis reveals how long-standing tropes of development discourse have entered the EBA concept (Kabeer).

Sustainability Science

This thesis is written for a degree in sustainability science, which combines both critical and solution-orientated approaches. Here I unpacked emerging discourses on ecosystem- and nature-based approaches to societal challenges, in particular research on EBA approaches, using concepts of power, knowledge, and subjectivity. I sought to demonstrate material and intangible dimensions of power therein. I used insights from feminist scholarship, which has shown how material and intangible dimensions of power interrelate to shape social difference. For instance, Nightingale (2011) attends to the co-productive relationship between knowledge, subject formations, and material realities that reinforce social differences[30]. This approach helps to challenge some of the embedded concepts in sustainability science that perpetuate problematic distinctions.

This thesis is an example of critical engagement with biosphere-based sustainability science that invites further constructive engagement. The work thus helps to translate some features of biosphere-based sustainability science – namely complexity and non-linearity – into a lens through which social relations, processes, and power are made more explicit, shaping people's abilities to manage context and self-organise and in doing so transform the determinants of the landscape (Long 2001). The findings suggest that the biosphere-based thinking is not limited to the domain of adaptation or sustainability, but is expressed in responses to a range of societal challenges that appear, at least superficially, to be amenable to nature-based responses (Nightingale et al., 2019). I see such critical engagement with biosphere-based sustainability science as finding common cause with scholarship unpacking the politics of transformation and planetary boundaries (Scoones et al., 2015).

Further, biosphere-based sustainability science, while apparently recognising the interdependence of people and the biosphere, appears to foreground materialist issues, such as dependency, biophysical limits, and constraints to adaptation, at the expense people's agency and subjectivity, foreclosing attention to the role of politics in denying

[30] Nightingale states "Subjectivities are produced out of the multiple and intersecting exercise of power within socio-natural networks... Inequalities emerge through space as social and material meanings are co-produced. Difference is understood as an emergent process that must be continually renewed, challenging the idea of fixed identities… Symbolic ideas of difference are produced and expressed through embodied spatial interactions that are firmly material… [as] everyday embodied activities (agro-forestry, food consumption) that have profound consequences for ecological processes and social difference." (Nightingale, 2011 p154).

certain futures and potentialities. Further research could elaborate on the presented findings and their implications, such as post-structuralist engagement with biosphere-based sustainability science, unpacking the narratives of *reconnecting to the biosphere*, *human-nature connectedness*, or *leverage points for social-ecological transformation* (Ives et al., 2019; Folke et al., 2016; Fischer et al., 2016). Despite normative statements to the contrary, the thesis findings suggest that instances of biosphere-based sustainability science may entail a turn towards natural science epistemologies to explain human-nature interactions. This may foreclose the possibility of more ambivalent "encultured and enearthed" analyses of sustainable challenges and solutions, as proposed by Schill et al., 2019.

The thesis findings show that separations between nature and society are constructed in epistemic relations across research and practice. Making visible such forms of "making the cut"[31] (Whatmore, 2002, p92) are a central preoccupation of science and technology studies and are increasingly being used to unpack knowledge production about sustainability challenge such as climate change (Allan, 2017; Latour, 2005; Thoni and Livingston, 2019; Thoni, 2019). Escobar's post-constructivist political ecology and Stenger's experimental constructivism (Escobar, 2006; cf. Whatmore and Lindström, 2011) ask us to be ambivalent about the capacity of any particular actor to frame a particular boundary as a physical entity that precedes social relations, and instead recognise biophysical dimensions of sustainability as co-produced (cf. Taylor, 2013; Castree and Braun, 2002).

By following how frames are enacted in EBA and other types of nature-based approach, I have demonstrated their reifying effects (Alaimo and Hekman, 2008). Frames prefigure intersubjective relations and processes, reinforcing dominant assumptions and biases at the expense of alternatives (Kabeer, 1994; Escobar, 1995; Haider, 2017; Lele et al., 2018). The thesis showed that whilst knowledge is translated between global discourses and local experiences, local complexities are simplified in order to fit the generalising ontologies of a particular field. Here I revealed how vital complexities are hidden across different types of NBS to societal challenges that prioritise the biophysical basis of sustainable development, including multiple cases in which groups acting in the name of such approaches foreground notions of dependence at the expense of agency. Previous studies have shown how natural resource governance interventions, such as those focussed on blue carbon, or sustainable development, reduce complex realities into narrow abstractions (Thoni, 2019 and Haider, 2017).

[31] 'Making the cut' refers to the drawing of dichotomous distinctions between socially-imagined ontological objects such as 'human' and 'non-human', or 'political' and non-political.

Co-productive representations of sustainability science are not easily abstracted as "views from nowhere" (Haraway, 1991). Such forms of sustainability science might allow reflexively understanding how all knowledge production is situated in embodied relational processes, whilst being cognisant of how power knowledge and biophysical relations are co-produced (Nightingale, 2011; Guthman and Mansfield, 2015). To extend such attention in sustainability science, future research could combine relational approaches to sustainability science (West et al., in review), with constitutive theories of language (Taylor, 2016; cf. Wittgenstein, 2001; Butler, 2001; 2010) to demonstrate how frames and social-ecological relations are co-produced.

As sustainability science seeks to understand nature-society relations, a need exists for reflexive interpretations of power therein. Such reflexivity may be enabled through participatory, transdisciplinary, or co-created analyses to counter the biases of singular, generalist, or reductive epistemological positions (Ahlborg and Nightingale, 2018; Kabeer, 1994). Historically marginalised knowledge may be especially valuable in shedding light on power relations that constrain just and effective sustainability science, in ways hidden by dominant modes and frames of sustainability practice. In this thesis, the case study from Skåne County in Sweden by Brink showed how transdisciplinary knowledge production (i.e. involving many different actors in the research production process) represents an important mode of reducing the bias of researchers and other actors (such as government actors) especially regarding the choices involved in case construction. Science that takes on a broader range of perspectives and subjectivities, and even crosses paradigms, may better contribute to reducing inequalities, biodiversity loss, and climate change through avoiding biases and blind spots (Haider 2017; Jetzkowitz et al., 2018). The IPBES Global Assessment shows how diverse actors are critical to transformative approaches (IPBES, 2019).

Feminist approaches to sustainability science could be used in a wider range of circumstances than they have heretofore been applied, helping to make visible under-appreciated dimensions of power in sustainability practice and the knowledge production conducted in its name. Whilst major international science platforms such as IPBES do position a key role for marginalised knowledge in sustainability transformations, future research needs to ensure marginalised peoples' expressions of agency and knowledge are represented even when they diverge from the normative commitments of policy-driven concepts such as NBS and the Sustainable Development Goals. Such research could examine how privileged epistemic positions may need to be re-considered in calls for 'epistemological pluralism' and mechanisms for inclusion in the IPBES and IPCC platforms (Tengö et al., 2014; Diaz et al., 2018). Dominant epistemological positions have historically been instrumental in social marginalisation, including by entrenching marginalised subjectivities and situated, embodied forms of knowledge (Kabeer 1994).

Conclusion

Recent high-level scientific reports have placed sustainability challenges in stark terms (IPBES, 2019; IPCCSRCCL, 2019). The overlapping challenges of biodiversity loss, climate change, and land degradation – along with inequality, which sustainability scientists should insist on adding – represent what British environmentalist Chris Packham calls "the ecology of crisis". This expression emphasises how these challenges are interconnected, including how they share causes and effects. Packham's term also seems to recognise the problem with separating the social from the ecological and the importance of integrated sustainability solutions, such as EBA, to climate change.

Advocates claim that EBA can deliver a range of so-called *co-benefits* beyond climate change adaptation. Such potential for 'win-win' outcomes makes these approaches more attractive to decision-makers, funders, and NGOs. But are such claims warranted? In this thesis I contribute to knowledge on if and how adaptation action focussed on securing ecosystem functioning can deliver transformative change to reduce inequality. Because of the relevance of people's own agency, knowledge, and subjectivity in responses to climate change, transformative change is interpreted as empowering marginalised groups. Empowerment is a political, often antagonistic process that results in reduced social inequalities. Apart from playing a crucial role in adaptation, reducing inequality also represents two of the Sustainable Development Goals of reducing gender inequality and reducing inequality (Goals 5 and 10).

To examine whether the claims are warranted, I rely on a multi-methods approach, including a systematic literature review, a conceptual synthesis, and empirical and comparative studies. The main finding I draw from these approaches is that only in specific circumstances do EBA represent a truly integrated response capable of reducing inequality while simultaneously safeguarding or restoring ecosystem functioning. This potential crucially depends on a number of mediating factors.

To understand why benefits are not automatic, but require careful consideration, I contend we need to understand the implications of specific interpretations of society and nature in both the research and practice of EBA. In rural settings, climate change vulnerability and social inequality are often related through environments. Different discourses of climate change adaptation practice and research account for such social-

ecological relations to varying degrees. Dominant conceptions of social-environmental relationships contain different assumptions about how the world works and the roles of different actors.

These nature-based approaches to societal challenges are based on the same conceptual assumptions as 'biosphere-based sustainability science'. These emphasise ES, an anthropocentric concept that highlights the benefits people obtain from nature. Formal representations of ES are assumed to drive change through universal recognition of people's dependence on the biosphere. But in practice, approaches founded on ES tend to position certain people as inherently more dependent on ES, especially women, children, and rural populations of the Global South. These essentialist assumptions are also expressed in discourses aimed towards galvanizing social change, and they are even found in actions whose stated goal is empowerment. These ideas about dependency can lead to a positioning of already marginalised people as passive beneficiaries incapable of restoring and safeguarding ecosystem functioning and in want of external assistance to manage these services. The findings show that dominant ideas of EBA are shared across research and practice. Both interpret people's vulnerability simplistically as the way that climate change impacts are buffered or exacerbated by ecosystem functioning. When EBA are seen just as implementing the delivery of ES, this supports the notion that an EBA practitioner can meaningfully conduct adaptation as an intervention on behalf of a dependent adaptation subject.

In contrast, empowerment scholarship foregrounds the role of social-ecological complexities, positioning social power as a primary driver of human vulnerability and inequality. Such context-orientated explanations of human vulnerability to climate change have implications for how transformative social change is considered. Empowerment theory provides the critical distance to evaluate the EBA assumptions and modes in which they are conducted. It also highlights social differences and the role of power in determining people's vulnerability. A negative expression of such power would be the unjust land rights or share-cropping arrangements, whilst a positive expression would be the successful forms of resistance to incursions of top-down power and threats of dispossession.

Contrary to any claims that the process of reducing inequality through empowerment will be realised through the delivery of ES, the thesis finds that focussing on the material functioning of ecosystems to address climate change adaptation is an inadvertently political act, because it hides the effects of power in the production of ES and vulnerabilities. The cases of EBA studied herein play out in complex social-ecological contexts that were not recognised by external 'experts'. Emphasising the disassociated, material aspects of socio-natural relations is not inevitable. It is rather an effect of hidden power; politics at work but not made visible. In fact, the ecosystem-based frame

appears to encourage standardised frameworks of universal relevance for understanding adaptation and vulnerability. This thesis challenges such generalising perspectives.

Arguably, neither EBA nor empowerment offers a holistic (or complete) analysis and response to the social-ecological crisis. The thesis suggests that both contribute aspects that are relevant to understanding transformation. Bringing them together requires recognition that in practice agency and dependency are expressed in lively contextual dynamics not reducible to generalised expertise or essentialist assumptions. EBA for empowerment would depart from altered assumptions, recognise benefits are not automatic, explicitly account for social processes and power relations, and deal with the complex social-ecological relations that cause sustainability problems. Without addressing power imbalances, researchers risk contributing to social marginalisation, negating the potential of these approaches to address Sustainable Development Goals 5 and 10.

Responding to calls for more inclusive research on transformations in response to ongoing ecological crises, researchers can play a key role in challenging the dominant modes and assumptions of the most visible approaches, such as EBA and other nature-based approaches. To begin to counter such assumptions, researchers in high-profile scientific platforms such as IPCC and IPBES can acknowledge their historical responsibility in marginalising alternative but equally valid knowledge and subject positions. One implication of the thesis findings is that building reflexivity appears to be a vital mode of reducing the risk that transformations through nature are simply quick fixes that reinforce the ways of thinking that drive the ecology of crisis. Reflexivity as discussed in sustainability science offers a way to overcome potential risks of displacing or undermining change in longer-term, transformative ways.

Similar to approaches that have been used in other contexts to create more open frames, this research also shows a participatory or transdisciplinary knowledge production could also help create more open frames in which to co-develop radical responses to dealing with uncertainty and confronting joint and variegated vulnerabilities. Researchers can also use their positions of power to co-create situated and inclusive spaces for alternative, historically marginalised knowledge and perspectives – to be expressed alongside Western modes of science for sustainability. Such spaces can help counter the bias of partial perspectives which emerge in policy-driven fields such as EBA based on abstract principles that are only partially relevant.

As I conclude this thesis I look back at the analyses I have presented. I have tried to lay out what is at stake for people made vulnerable by the status quo when they encounter projects undertaken in the name of sustainability, such as nature-based solutions. Implicit in nature-based ideas and the nominally transformative solutions they inspire

is a naiveté about change that comes from a narrow way of looking at the world. Out of sight of this narrow view, both sustainability science and interventions in fact express power relations that help maintain the harmful status quo. In this thesis, marginal perspectives helped to reveal the hidden power. Foregrounding such perspectives focussed attention on the unequal social relations that shape people's diverse relations with each other and environments, and continue to result in alternative viewpoints being silenced. Such forms of injustice appear, worryingly, at risk of being reproduced in nature-based solutions. As we seek to transform our societies away from hyper-instrumental, enlightenment-inspired myths of progress and human control over passive and 'dead' nature[32], the results speak to the need to counter this unintentional naiveté with more social foresight and responsibility. As sustainability scientists we have obligations to be cognisant of the way our research occurs and the results are used within unequal social relationships. As we inform projects which aim to 'adapt' quiet places, so it is our responsibility as sustainability scientists to acknowledge how such places continue to be silenced and made passive. Researchers must help keep power visible, as it tries to slip away.

[32] After Plumwood, 2007

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Photo: – Prabath Kaushalya, Menaka Rajapakhsa and Chiranthi Herath in Galgamuwa after the day's work, with the *Elangawa* landscape behind.

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Confronting the ecology of crisis

In a warming and highly unequal world, people are searching for integrated, holistic solutions that can move beyond the siloes of social or environmental sustainability. In this context, there are tendencies, even in research, to assume that green is good, and that green is fair. Against this backdrop, nature based solutions to climate change have risen to prominence as a go to approach for delivery of win-win solutions when it comes to social change and empowerment of vulnerable groups. In this thesis I focus on Nature-based Solutions to Climate Change Adaptation in Sri Lanka. Using a power-based analysis, I explore the potential of such solutions to facilitate empowerment of the most climate-vulnerable groups. I locate some promises and pitfalls of these solutions, and make some suggestions how they can better acknowledge social relations and processes.

Stephen Woroniecki is an interdisciplinary scientist interested in understanding the social and the natural dimensions of climate change, biodiversity loss, and sustainability. He has a background in ecology, and conservation, and resilience, having studied in Edinburgh, Stockholm, and Lund.

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