Adapting Dutch nature conservation to climate change:

How practitioners frame problems and solutions

Esther van der Lugt, March 2015

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Abstract

Climate change is expected to have profound effects on nature's various organisation levels from genetics to biome shifts, manifold vulnerable species and ecosystems may not be able to adapt to the different climatic circumstances. The adaptation of nature conservation therefore is of critical importance; yet Dutch nature conservation lacks a strategy and structural climate change adaptation. Neither is it known how practitioners in regional Dutch nature conservation, who are responsible for climate adaptation, comprehend the issue and its urgency. This research's purpose is understanding how practitioners in regional Dutch nature conservation view climate adaptation and ascertain what the implications are of the ways in which practitioners frame climate adaptation for the expected way in which Dutch nature conservation may develop in the next decade regarding climate adaptation.

Frame analysis was performed to accomplish this aim, Entman's approach providing focus and structure. Content analysis facilitated the examination of practitioners' frames and their identification of problems, causes, solutions and responsibilities regarding nature related adaptation until 2050. Results indicated practitioners primarily framing climate adaptation as a water quantity issue, other subjects generally imbued with greater uncertainty and less prominence. The study illustrated how frame conflicts in this domain can lead to intractable policy making, particularly regarding land and water claims. Practitioners revealed clear preferences for provinces and water boards as initiators and land owners and users as implementers of adaptation.

Based on interviews with key decision makers from the nature, agricultural and water the following can be expected for the development of climate adaptation within Dutch nature conservation. Climate adaptation of Dutch nature conservation is likely to focus on water issues that urgently require adaptation, yet this water focus may insufficiently address other urgent climate change risks. In addition, adaptation requiring structural changes in agricultural land and water use may cause conflicts between agriculture and nature, depending on locally contingent factors. Voluntary adaptation by land owners and users seems less likely when adaptation necessitates efforts and investments moving beyond contemporary (agricultural) nature management. Furthermore, if provinces and water boards do not take up a leading and initiating role then it can be expected that climate change adaptation is unlikely to become structurally embedded in Dutch nature conservation in the next decade.

Acknowledgement

This thesis is the last step of the research master Sustainable Development, track Environmental Governance at Utrecht University. This study has given me useful tools to contribute to a more sustainable society, which I am eager to put into practice and keep learning about, as this domain keeps evolving.

This study is the sum of meeting many stakeholders and visiting stakeholder meetings concerning the adaptation of Dutch nature conservation, therefore a first word of thanks is intended for the people who took the time to share their views regarding this topic with me. Seeing and hearing from people in the field how climate adaptation could affect Dutch nature conservation and the interests of other sectors has provide me with even more respect for the professionals that deal with the local and regional complexities involved in nature policy development, regional (agricultural) nature management and water management. After the finalization of this thesis my interest in this subject has by no means come to an end and it I look forward to following developments in this domain, also in the light of my participation in a local sustainability group.

Furthermore, a heartfelt thank you for my supervisors for their useful feedback but also for their enthusiasm and encouragement, dr. Hens Runhaar and dr. Jerry van Dijk. This enabled me to critically rethink the ways in which the research could be approached and to end this project on a positive note. Also thanks to the second reader of the thesis: prof. Driessen.

My gratitude also goes out to my family for supporting me unconditionally, foremost to Thijs, my mother, mother and father in law, Janneke, Patrick and Jirisan. Thank you for believing in me and just for being the loving people that you are. Also many thanks to the friends whose company and feedback (not just regarding the thesis) is greatly appreciated: Yvette, Eveline, Iris, Sophie, Lavinda, Marjolein and last but not least, Sandra. Also a word of thanks to my fellow members of the Groene Tomaat, may we make our hometown more sustainable and have a lot of fun in the process!

Overall, I am grateful for this experience and all the support I have received. I hope you will enjoy reading this report.

Esther van der Lugt, Tilburg, March 2015.

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1. INTRODUCTION

1.1. Introduction

Climate change has been the subject of considerable political and public debate over the last decades, and governments around the world have sought ways to address its consequences. Many countries have created mitigation policies that aim to boost the production and consumption of renewable energy (Fischer & Newell, 2004) and developed adaptation measures to deal with the increased risk of climate change induced flooding (Biesbroek et al., 2010). Although climate change can profoundly alter both living and non-living systems of nature and effects have already been witnessed (Solomon et al., 2007; Parmesan & Yohe, 2003; Walther et al., 2002), Dutch nature conservation has not yet been adapted to deal with projected changes (Trouwborst, 2009; Netherlands Court of Audit, 2012).

For the development of adaptation within Dutch nature conservation it is necessary to explore current ideas, more specifically the frames of policy actors (policy makers, nature managers and relevant stakeholders) about this issue. According to Entman (1993), frames define problems, diagnose causes, make moral judgments and suggest remedies. If frames do not match, a lack of shared understanding can lead to conflicts and intractable policy making (Schön & Rein, 1994; Van Eeten, 1999; Dayton, 2000). Therefore it is important to analyze if frames reveal shared understanding of problems, risks, opportunities, causes and solutions in the context of Dutch nature policy and management. To arrive at short term adaptation, frames should not merely reveal consensus, but equally a sense of urgency (Benford, 1993), which will also be investigated. Since Dutch nature conservation is decentralized and a regional adaptation perspective is lacking (Netherlands Court of Audit, 2012), this study will explore what the frames of practitioners (provincial policy makers, conservation agencies, farmers, private owners and water boards), suggest about the adaptation of Dutch nature conservation to climate change.

1.2. Dutch nature policy & climate adaptation

The degree to which nature will be affected by climate change will be mediated by the extent to which nature conservation effectively responds to these changes (Trouwborst, 2009). It has been argued that Dutch nature policy and management requires adjustment for adequate response to climate change (Kramer & Geijzendorffer, 2009; Vonk et al., 2010), as it currently lacks structured and planned adaptation (Netherlands Court of Audit, 2012). While the need for a more concrete agenda and national adaptation strategy was put forward a number of times in the last decade, few tangible goals were established. In the Dutch decentralized context, individual provinces can adapt their nature policy, however, climate change risks continue to be ill-addressed (Netherlands Court of Audit, 2012).

Contemporary Dutch nature policy is largely shaped by the provinces, regional nature management can be executed by conservation agencies, farmers, private owners, and in some instances water boards. The National Nature Network is the main pillar of Dutch nature conservation, furthermore

international obligations regarding the European Birds- and Habitat Directives and Natura2000[1] are in effect (Kramer & Geijzendorffer, 2009). These frameworks generally have fixed nature goals in terms of nature types and number/types of species prescribed to specific localities. However, if nature alters rapidly and profoundly due to changes in climate, fixed goals may be unattainable or ineffective to maintain and flexibility in approaches is advocated (Kramer & Geijzendorffer, 2009; Vonk et al., 2010). Furthermore, instead of trying to conserve historical conditions or the natural "status quo", climate change may call for more experimental conservation methods and learning by doing, allowing greater changes in nature (Hannah et al., 2002). Whether these academic concerns also "live" in conservation practice will be examined in this study.

The large majority of nature conservation related adaptation studies deal with biophysical climate change risks or suggested adaptation means by scholars, however societal perspectives are for the most part lacking and the extensive literature review by Heller & Zavaleta (2009) confirms this gap in conservation research. This gap contrasts with assumptions that inclusion of stakeholder perspectives and preferences allow for more effective adaptation of both natural and social systems (Berkhout et al., 2006; Berkes, 2007; Gunderson, 1999). Moreover, the analysis of practitioner frames can fuel further academic endeavours, as they can be used to evaluate the relevance of academic discussions for practical adaptation development and ascertain which aspects require further research. Since the National Nature Network is critical within Dutch nature conservation and a revision of this policy can be expected in 2025, this research will ascertain what the frames of practitioners suggest for the development of adaptation for nature conservation in the next decade.

1.3. Research objective and questions

The research objective is to explore the frames of practitioners regarding climate adaptation in relation to Dutch nature conservation by means of a frame analysis regarding the problems, causes, anticipated risks, solutions and division of responsibility. This approach will give an indication whether there is sufficient consensus, mutual understanding, sense of urgency and support to develop adaptation in the context of Dutch nature conservation and how such initiatives may develop. This study will thereby contribute to the academic climate adaptation discussion by revealing the perspectives of practitioners that thus far have been obscured academically.

What are the implications of the ways in which practitioners frame climate adaptation for the expected way in which Dutch nature conservation may develop in the next decade with regards to climate adaptation?

1. How do practitioners involved in Dutch regional nature policy and management frame the consequences of climate change for nature conservation?
2. How do practitioners involved in Dutch regional nature conservation frame the desired ways of adapting Dutch nature conservation to climate change?

[1] The National Nature Network is a network of existing and to be developed nature areas that have to protect specific nature goal types and goal species. The European Birds- and Habitat Directives set out which habitats and species Member States should protect. Natura 2000 is a network of European nature areas, ordained by European laws. The Red Species List catalogues which species are threatened (Kramer & Geijzendorffer, 2010).

3. What do the level of agreement, sense of urgency and conflict potential as can be derived from practitioner frames imply for the ways in which adaptation can be expected to develop within Dutch nature conservation?

1.4. Relevance and motivation

The framing of policy issues is crucial at the beginning of the policy cycle, when policy problems and political positions still have to be negotiated, as frames can steer their agenda-setting, the type of actions and the ways in which policy will be implemented (Entman, 1993; Schön & Rein, 1994). Frames thus are critical for comprehending how policy problems are understood, since they are the "principles of selection, emphasis and presentation composed of little tacit theories about what exists, what happens, and what matters" (Gitlin, 1980, p. 6). Furthermore, frames can provide a glimpse into possible alliances and conflicts (Van Eeten, 1999), risk perceptions (Nisbet, 2009) and willingness to take action (Benford, 1993), all critical aspects for the development of adaptation. Since adaptation in the field of Dutch nature conservation is at the beginning of the policy cycle (Ligtvoet et al., 2013), the study of frames is vital for understanding how and why particular problem and solution frames may steer the adaptation of Dutch conservation.

Conservation science points to several climate change problems for nature conservation since the phenomenon can profoundly alter nature. For instance, species phenology (timing of life-history events[2]) and physiology (growth and decomposition processes) can change (Walther et al., 2002; Heijmans & Berendse, 2009), and large scale migration of species towards more suitable climate zones is predicted (Vos et al., 2007). In addition, climate change may lead to (aggravated) drought, flooding, decrease of water quality (Vos et al., 2007; Van Bodegom et al., 2013; Vonk et al., 2010; Verweij et al., 2010) and increased nature fire risks (Verkaik et al., 2009; Vonk et al., 2010). Despite substantial uncertainty, a grim future for biodiversity is predicted by many studies and in worst cases even "mass extinctions" (Bellard et al., 2012). Overall, climate change could lead to entirely new ecosystems and species assemblages (Harris et al., 2006). Since problem perceptions are considered critical factors in the development of adaptation as they can (de)motivate for taking action (Van Buuren, 2009), the way practitioners frame these issues requires further investigation, as will be presented in this study.

There is ample academic discussion regarding the ways to shape adaptation of conservation policy and management and this research will investigate to what extent these discussions are currently relevant to Dutch practitioners. How Dutch practitioners frame adaptation solutions for nature conservation can reveal what solutions they are likely to pursue and where conflicts may emerge. For instance, whether nature goals should be adjusted and if deemed necessary, should resist or enable environmental change (see Millar et al., 2007), or alternative ways of climate proofing nature goals are considered needed. Similarly, it is unknown whether practitioners share a sense of urgency for short term action and prefer the more traditional, common nature management practices or more experimental approaches (Mawdsley et al., 2009; Heller & Zavaleta, 2009). Furthermore, in terms of process, it needs to be assessed whom practitioners deem responsible for adaptation and how they see public versus private responsibilities as well as their own roles. In literature, some argue that adaptation should be "customized" to local circumstances and therefore be steered from the

[2] Small increases in temperature can affect the start of reproduction seasons, flowering and migration patterns.

local/regional scale (Bauer et al., 2011), however centralized adaptation for effective coordination, cooperation and impartial monitoring may be needed (Netherlands Court of Audit, 2012). As such, the thesis will explore a broad practitioner perspective spanning different sectors (water, nature, agriculture) regarding adaptation content and process aspects.

1.5. Outline of the thesis

In the next chapter frame theory, policy analysis and conservation studies will be investigated to develop an analytical framework for assessing frames. Chapter 3 explicates the methodological foundations of the study. In chapter 4 and 5 the frames of practitioners in regional nature policy and management of two case studies are analysed and their meaning for adapting nature conservation in these cases (see chapter 3 for case study methodology rationale). In chapter 6 the case study results are compared to one another. In chapter 7 a discussion will be provided by placing the results in the broader context of academic literature and the debate on how to adapt Dutch nature policy to climate change. Chapter 8 will provide the final conclusions and suggestions for further research.

2. FRAMING THEORY AND ANALYTICAL FRAMEWORK

Framing theory forms the basis of this research and this chapter shall start with explaining how frames can be identified and how they can inform in terms of expected consequences for adapting nature conservation. To this aim an analytical framework has been developed, which will be presented at the end of the chapter.

2.1. Frame theory

Since people have a limited attention span and limited ability to oversee the full range of possible policy problems and consequences of actions, human cognition has been called “boundedly rational” (Simon, 1987 in: Barros, 2010). Rational decision making has its limitations, also because it is steered by affections (Barros, 2010). Frames help with decision making, therefore Gitlin defined frames as sense making devices: “Frames are principles of selection, emphasis and presentation composed of little tacit theories about what exists, what happens, and what matters" (Gitlin, 1980, p. 6). By focusing on specific problem aspects while leaving out others, different cause-effect relationships come into being and point to other solutions (Weick, 1995). For example, if a water issue is framed as a supply rather than a consumption problem then it seems more logical to address supply issues. Furthermore, by not referring to particular issues it shows what is considered more and less important (Entman, 1993).

Framing theory is built upon various disciplines examining the framing process and its output. For instance how media frames can influence public opinion (communication studies), how frames affect individual (psychology) and political (policy studies) decision making (Putnam & Holmer, 1992). Entman (1993) referred to framing theory as “a fractured paradigm” since a coherent theory of framing is lacking. Frames are the “stories or narratives participants are disposed to tell about policy situations” (Hoppe, In: Hajer et al., 1993, p. 11). These frames “promote a particular problem definition, causal interpretation, and moral evaluation and/or treatment recommendation” (Entman, 1993, p. 52). Frames can be seen as cognitive mental constructions, or knowledge structures based on prior knowledge, activated when triggered by certain keywords linked to this stored knowledge (Dewulf et al., 2009). According to Entman, these constructions are translated or organized in texts or other types of communication. In this instance, the interest lies in this communication “output” rather than the psychological processes underlying the framing process, thus frame content rather than framing process.

Frames can influence the political decision making in distinctive manners, for instance in the process of agenda setting, which is most relevant for this research as climate adaptation for nature is still in the agenda setting process. Agenda setting is defined as “the process of moving a problem to the attention of the government so that solutions can be considered” (Furlong, 2004, p. 37), and a prerequisite for realizing political action is that an issue is taken up on the policy agenda (Dery, 2000). Frames are of importance for getting issues on the policy agenda since policy problems do not exist on their own, only when labelled as such they come into being (Dery, 2000; Weiss, 1989). Since politicians have limited time and capacity to process all available information frames serve as simplifiers of complex policy issues (Heise, 2005). The degree to which frames can hamper or

stimulate the development of policy will be discussed in section 2.3.1. Subsequently, the frame elements are operationalized, and it is assessed how frames can affect decision making.

2.2. Entman's frame elements: problem, causal, solution and responsibility frames

The approach by Entman (1993) has been employed to develop an analytical framework. Entmans' article "Framing: Toward clarification of a fractured paradigm" has been cited over 4149 times and his conceptualization is authoritative in frame analysis (Vliegenthart & Zoonen, 2011). According to Entman, frames perform four functions: articulating problem definitions, causal interpretations, moral evaluations and/or treatment recommendations. Each of these frame elements can be seen as variables (Matthes & Kohring, 2008). Other ways of analysing frames are possible (see for instance Dewulf et al., 2009), yet for the analysis of the content of frames, Entman's practical approach to frames was considered the most suitable.

PROBLEM FRAMES. The following dimensions of problem frames recur in literature: 1. the issue(s)/aspects deemed problematic (Matthes & Kohring, 2008, Cobb & Coughlin, 1999). 2. The severity of the problem (Rossi et al., 2004; 1998; Cobb & Coughlin, 1999). The **severity of a problem** is relative: how serious it is considered compared to other policy issues – thus a matter of ranking priorities, what should be acted on first (Cobb & Coughlin, 1999). Some form of agreement on the problem definition is essential for getting an issue on the policy agenda (Rochefort & Cobb, 1993); therefore an assessment of the problem definition provides an indication which aspects of the problem are more likely to be acted upon. In addition to problems, **opportunities** can likewise be part of the problem definition since these can equally motivate for policy action. All in all, the problem frame concerns the aspects deemed problematic or constituting an opportunity, and the ranking of these aspects compared to other policy issues that require policy action, their severity. In this research the most obvious aspects of the problem and opportunity frame would refer to climate change impacts and effects on nature and its conservation.

CAUSAL FRAMES. Causal beliefs concern the empirical question "What has caused this policy problem?" (Stone, 1989). This section situates these **cause-effect relationships** in the realm of climate adaptation. Defining causal relations is a matter of perspective[3] and available knowledge from science, popular culture, the media or other sources such as traditional knowledge (Stone, 1989). This study will focus on causes of vulnerability of Dutch nature and Dutch nature policy and management to climate change. Climate change studies generally use the concept of vulnerability to assess causal relationships determining the extent to which climate change impacts are problematic or beneficial for the entity under study. Vulnerability relates to the degree of exposure to and sensitivity for climate change impacts, and to what extent the system can adapt (Gallopin, 2006), to what extent a system can adapt depends on both internal and external socio-economic and biophysical factors and the ways in which these interact (Füssel, 2007).

SOLUTION FRAMES. These frames favour specific policy **solutions** and feature goals, strategies and individual activities (Coburn, 2006; Benford & Snow, 2000). In the rational goal setting tradition, goals ought to be measurable and precise to allow evaluation and should be attainable, however other in other policy science strands goals are seen as more abstract (Edvardsson & Hansson, 2005). Thus,

[3] In principle causal relations can be stretched back to the Big Bang, depending on how far one goes back in causal chains.

goals can differ in their degree of precision and extent of being realizable. **Strategies** are the plans or patterns of coherent behaviour to achieve a policy or management goal (Mintzberg, 1987) and **activities** being the individual steps of the strategy (Rossi et al., 2004). The framing of solutions is critical, as mentioned, since issues with available solutions are more likely to end up on the policy agenda (Weiss, 1989). As to be expected, this research will focus on the goals, strategies and actions that aim at adapting Dutch nature and the policy and management that aims to protect it, to climate change.

RESPONSIBILITY FRAMES. The moral component of Entman's frames signifies who is deemed **responsible** for taking action to solve a problem, and this can refer to public and/or private actors (Stone, 1989), therefore it will be referred to as the responsibility frame within this research. Rather than looking at responsibility from a legalistic perspective that relates to the capacity of being responsibility (Cane, 2002), responsibility can be seen as the various roles policy actors can perform during the stages of the policy process: agenda setting, decision formulation, implementation and evaluation (Birkland, 2011 in: Mees et al., 2012). This can range from propagating a particular problem definition to taking financial responsibility to evaluating policy and management. In this context, the research will focus on the division of responsibility for taking adaptive action for Dutch nature areas.

Entman (1993) argued that the problem and solution frames are the most important frames, since problem frames steer which solutions are viable. On the other hand, Wildavsky (1979) argued that available solutions steer problem definitions since policy makers can score better when focusing on solvable problems. Therefore interrelatedness of the frame elements is apparent, although the direction of influence between frame elements may vary. Nevertheless, without actors willing to realise solutions, action is unlikely to be facilitated as frames do not exist in a vacuum. Furthermore, frame elements can be used to distil meta-frames by synthesizing the individual components that recur throughout Entman's individual frame elements to meta-frames, as done by Parry (2010). See Figure 1 for operationalisation.

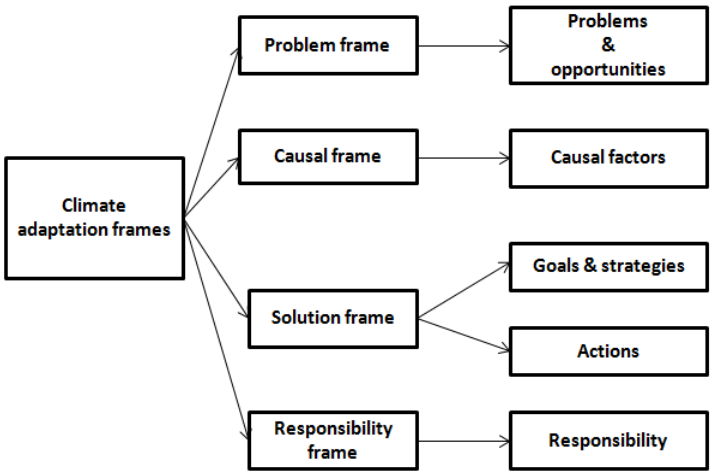

Figure 1: Operationalisation of frames

2.3. Frames and policy decision making

In this section it will be assessed what frames can indicate about political decision making; how they can articulate the need for action, the existence or potential conflict, or have little influence on the policy process.

2.3.1. Frames motivating for action

Frames can stimulate the development of policy action by mobilizing for action by conveying an appropriate sense of urgency and severity (Snow & Benford, 2000; Benford, 2005). By calling for action and by assigning responsibility to specific actors frames can mobilize policy actors (Stone, 1989; Benford, 1993) and therefore have been labelled "action frames" (Schön & Rein, 1994). Without some level of consensus, developing policy action becomes problematic (Rochefort & Cobb, 1993). Therefore it will be assessed to what extent frames are similar (expressing agreement) with regards to the problems and opportunities.

However, merely pointing to a condition of concern is insufficient to motivate for action since it should likewise be conveyed that action cannot wait (Benford, 1993), frames must express a sense of urgency. A sense of urgency can be derived from the prioritization of issues (Nisbet, 2009), or how risk and uncertainty are dealt with. Risk perceptions can be used to understand the degree of urgency, to comprehend why action is or isn't considered necessary in the short term (Leiserowitz, 2007). Whether risks urge to action depend on the degree of uncertainty[4] involved (Jones, 2000). Overall, high levels of uncertainty can lead to postponement of action (Jones, 2000; Füssel, 2007), unless management or governance is aimed at decision making under high levels of uncertainty, for instance adaptive management (Clark, 2002). Therefore, the analysis of risk will scrutinize whether risks require short term ameliorative action. In addition, a logical assumption may be that one needs parties willing to be responsible for realizing the solution. In addition, it will be scrutinized if parties are willing to take or share responsibility for taking action.

2.3.2. Frames indicating conflict or stalemate

Frames can equally hamper political action if conveying fundamentally different understandings and preferences (Schön & Rein, 1994), and Van Eeten (1999) refers to a "dialogue of the deaf". This is not a dialogue in its true sense as this concerns "A discussion in which each party is unresponsive to what the others say" (Oxford Dictionaries, 2013), and pertains to "people who talk but don't listen" (Van Eeten, 1999, p. 3). The outcome is deadlocked decision making for longer time periods (Van Herten & Runhaar, 2012; Van Eeten, 2001; Saarikoski, 2006). It is defined by van Eeten as "a policy controversy deadlocked even after extensive deliberation, in which stakeholders, including policymakers and public managers, talk past each other, advancing arguments that are valid in their own right, but which can differ fundamentally from each other" (Van Eeten, 1999, p. 2).

Not all dialogues of the deaf are equal but share that they lead to deadlock. When frames are mutually exclusive this can be a sign of conflict or create future conflict (Van Eeten, 1999). Stalemate can for instance arise due to highly divergent problem definitions (Weiss, 1989), differing goal

[4] Uncertainty can concern a lacking ability to estimate probabilities (statistical uncertainty), relations between variables (model uncertainty) and novel problems where models do not apply (Peterson et al., 1997)

settings (Brunk et al., 1995; Mees et al., 2012) and opposing risk perceptions[5] (Vaughan & Seiffert, 1992), or division of responsibility. Furthermore, frame related deadlocks can occur due to non-negotiable issues and/or parties that do not realise they agree on many aspects of the issues due to a lack of trust and respect between them (Saarikoski, 2006). Thus, the research focus will be on the existence of oppositional views, non-negotiable issues, diverging problem, causal, solution and responsibility frames.

2.3.3. Frames, actors and coalitions

Who "owns" a policy problem has great impact on whether policy issues are picked up (Gusfield, 1984). If frames are sponsored by powerful political actors this advances these particular frames in comparison to others (Carragee & Roefs, 2004), as these individuals have the ability to make their framing the dominant one (Gusfield, 1984). Even though frames can reveal agreement, if there are no influential actors supporting these frames, issues may still not be picked up [6](Noy, 2009; Chakravarty & Chaudhury, 2012).Therefore the frame analysis will consider whether powerful actors and coalitions are supporting or hindering particular climate adaptation frames.

2.4. The analytical framework

Based on the abovementioned literature, the following analytical framework has been developed (Figure 2).

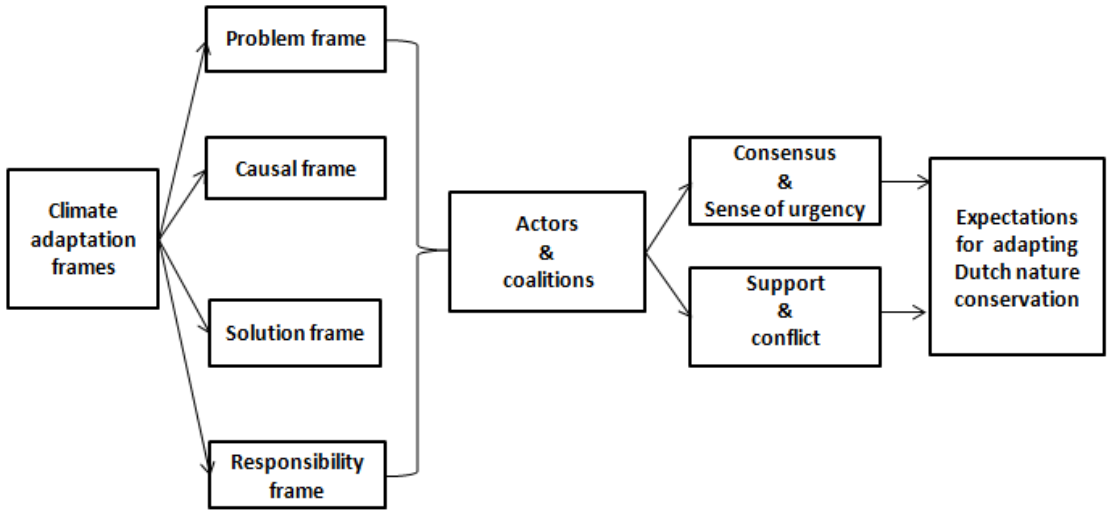

Figure 2. The analytical framework

[5] For instance between those taking a precautionary approach to risk and uncertainty and those first wanting hard proof before resorting to action (Van Eeten, 1999).

[6] Noy (2009) showed that although there was substantial agreement between leftist policy actors, no winning coalitions could be formed. Instead part of the left merged with liberals, who held essential resources.

3. METHODOLOGY

In this chapter it will be explained which research strategies and method were used to assess the possibilities for developing climate adaptation within the field of Dutch nature policy and management, based on the degree of consensus and acknowledgement of risks by practitioners.
The research framework will be presented (see Figure 3) and the consecutive steps that were taken in order to answer the research question will be described.

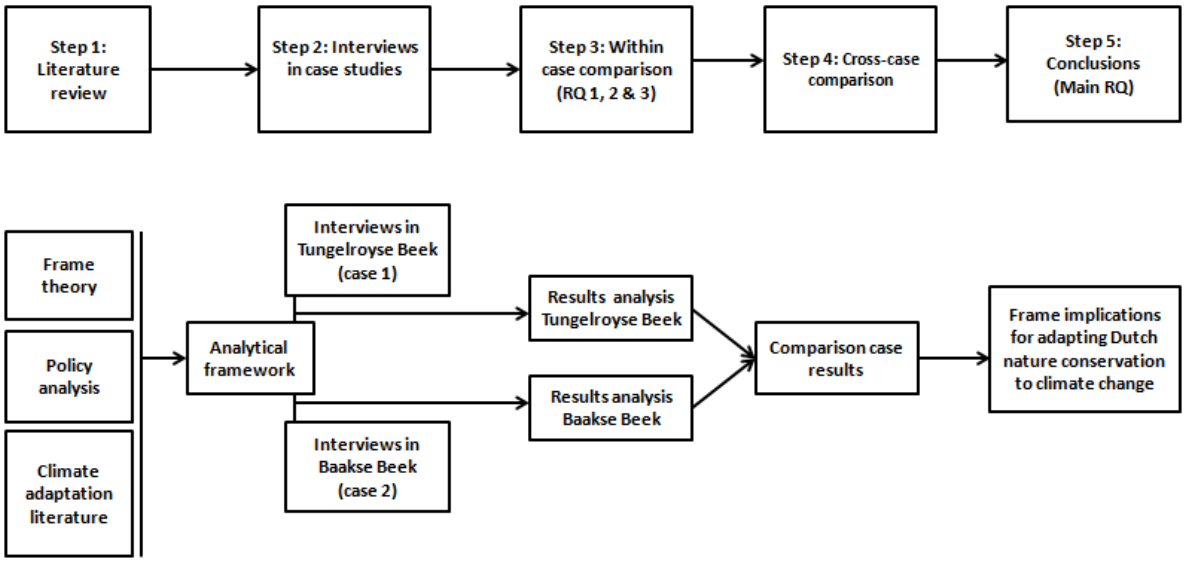

Figure 3. Research framework

3.1. Step 1: desk research

At this stage, desk research was performed to develop an analytical framework for assessing the content and consequences of frames. The main strands of the examined literature pertained to frame theory, policy analysis, climate adaptation and conservation studies (see Figure 3). The analitical framework presented in the previous chapter was based on the Entman framework and situated in the context of climate adaptation and nature conservation. Frame theory was further examined in order to assess to what extent frames can stimulate or hinder the development of policy and the management efforts. This way an appropriate framework was developed for assessing the future of climate adaptation within the field of conservation.

3.2. Step 2: interviews in case study research

At this point interviews exploring different case studies were held in order to find out how practitioners involved in Dutch regional nature policy and management frame climate adaptation in relation to nature.

3.2.1. A case study strategy

This approach was used for several reasons. Firstly, case studies are particularly suited for "how" research questions (Yin, 2008). Secondly, frames may be highly contingent upon local circumstances, as climate change impacts differ (and thus problem perceptions and viable solutions) per area in the Netherlands. This renders an in-depth approach with attention for context and detail necessary, making a case study setting very suitable (Yin, 2008). Thirdly, the aim of this analysis is to identify patterns in framing among different respondent groups and to find out what consequences these frames have for the development of adaptation. This can be done more adequately by a comparative/multiple case study method than by a single case study. If similar patterns are distinguished despite geographical variation, conclusions are assumed to be more robust than those provided by a single case study (Yin, 2008) and that is why the chosen cases concern two different provinces.

Due to the scope of this research two cases have been selected that are similar with regards to their general characteristics, expected climate change problems and a number of other factors (see Table 1). This choice was made because exploratory phenomena can best be examined by means of a most similar case study design since this allows for greater comparability as results can be compared to the same characteristics and the way they may affect frame patterns and their implications, whereas a maximization of different case characteristics will make such linking of results to contextual factors more complex (Verschuren & Doorewaard, 2010). By limiting the study to two cases, more time could be reserved for in-depth interviews, enabling practitioners to expand on their views, facilitating a more comprehensive analysis which adds to a better validation of findings. Despite context specificity of frames, they can still provide valuable, more general information, as areas of focus, potential cooperation opportunities and conflicts that are critical for the overall development of adaptation in relation to nature.

The Baakse Beek and the Tungelroyse Beek areas were chosen because climate adaptation discussions are ongoing in these regions. These areas feature adaptation projects and knowledge development where local stakeholders have been involved. In addition, stream valleys face particular risks due to climate change (see Table 1) and they are vital for the development of climate adaptation, as they function as natural connection zones and are critical for the regional water system (Vonk et al., 2010). Although these cases are similar with regards to various aspects, certain differences can be discerned as Table 1 illustrates (to what extent these influence the results will be discussed in chapter 6. More information about the case studies will be presented in the case study chapters.

Table 1. Similarities and differences of the case studies

Similarities	
Boundaries	Catchment areas
Soil characteristics	Elevated sandy soils, little water absorption capacity
Agricultural land use	Grass land and maize production
Main nature goal types	Stream valleys, wet forests and open terrain, heath, peat and unfertilized meadowlands and grasslands
Nature policy	• Designated TOP-areas • National nature network areas and ecological connections
Water system	Water systems adjusted to agricultural land use
Climate change risks for stream valley areas (Besse-Lototskaya et al., 2007; Vos et al, 2007)	• Increased drought, stream valleys may run dry • Increased flooding: water damage and dispersion of pollution • Changes in ground water levels can affect local percolation water systems that are important for biodiversity • Coldwater species may not be able to cope with warmer stream water
Research	• Knowledge for Climate case studies • The provincially commissioned research: Climate Impact Atlases
Length stream valleys	• Tungelroyse Beek is approx. 36 km • Baakse Beek approx. 30 km.
Differences	
Geography	• Baakse Beek: province of Gelderland • Tungelroyse Beek: provinces of Limburg and Noord-Brabant
Nature policy	• The Tungelroyse Beek: Natura2000 area • Baakse Beek: no Natura2000 areas
Research	• Start Knowledge for Climate research in the Baakse Beek: 2008-2009 • Start Knowledge for Climate research in the Tungelroyse Beek: 2012-2013
Agricultural land use	• Baakse Beek area: live stock and milk production, fewer farmers per ha • Tungelroyse Beek: diversity in agricultural production, more farmers per ha
Stream patterns	• Tungelroyse Beek: no structural dry fall of stream • Baakse Beek: structural dry fall of (parts of) the stream

3.2.2. Interviews in case studies

19 interviews were conducted with regional managers from the main nature conservation agencies, provincial policy makers from water and nature departments and other relevant stakeholders. These include: provincial decision makers, conservation agencies, agri-environmental collectives, private owners and water boards[7]. Many participants were involved in adaptation projects. For an overview of the interviewees see appendix A. Even though the number of interviews is limited, the fact that the participants were key decision-makers ensured that the most influential views were incorporated, which is in accordance with the explorative character of this study.

Interviews were conducted at two different moments. A first batch was collected by other researchers in 2010 via the Baakse Beek CARE project (Van Dijk en Van Kouwen, unpublished data), interview transcripts were provided to me in spring 2013. The remainder of interviews were conducted by me from May-September 2013. Since the CARE project investigated nature managers

[7] Water boards also have nature areas under their care, for instance stream valleys surroundings, which is the case in the Tungelroyse Beek. Agrarian interest organizations are included in the research since their interests are affected by adaptation projects requiring land.

responses to climate change, Tungelroyse Beek interviewees were asked to identify determining factors for nature conservation until 2050, to maintain similar interview structure. This served as context information to ascertain influential factors for developing climate adaptation and understand respondents' interests and concerns. Next, two climate and socio-economic scenarios were used to stimulate discussion about climate change impacts. The use of climate scenarios is supported by literature; their robustness still upholds (Hilbers & Snellen, 2010; Klein Tank & Lenderink, 2009). See Appendix B for the utilized scenarios.

Respondents were asked what they considered the most urgent climate change related **problems** and **opportunities** for nature (conservation) and what were the main **causes** of vulnerability for nature in these case studies. Additionally, respondents were encouraged to suggest the most feasible and adequate adaptation **solutions** (goals, strategies and measures) as well how the **responsibility** for adaptive action should be divided. Respondents from the Van Dijk and Kouwen study (those available in the time of this study) were re-interviewed in order to discuss the issues which were not touched upon in that project. All interviewees received interview summaries for validation, their additional comments included in the analysis. Interview questions are listed in Appendix B.

3.3. Step 3: individual case study analysis

At this stage, content analysis was used in order to analyze the interviews belonging to each individual case study and answer research sub-questions 1 and 2. Content analysis was selected because it is the method for "making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" (Krippendorff, 2004, p. 18). Qualitative content analysis has frequently been applied for the analysis of frames (Matthes & Kohring, 2008) because it is more useful for identifying nuances in texts and the different ways in which meaning is produced. It furthermore allows researchers to identify how meaning is distributed over different frame categories, thus what are considered the most critical issues (Schreier, 2012).

A coding frame was developed consisting of main and sub- categories. The coding frame categories can be theory and/or data driven. By combining data and theory driven categories, it was possible to zoom in on theoretical interests (theoretical categories) and explore texts (data driven categories), thereby providing some degree of focus yet allowing novel ideas to emerge from texts (Schreier, 2012). The analytical framework's Entman elements served as the main coding categories, whereas sub-categories were derived from data. By breaking up a frame into frame elements, the analysis' reliability and validity were enhanced. Analyzing one big frame simply leaves too much scrutiny to the researcher and is more difficult to interpret (Matthes & Kohring, 2008). For the data-driven category construction an open coding strategy was used. This entailed searching for recurring concepts. Similarities between these concepts were translated into categories. Interview transcript texts were divided into text units, each text unit being devoted to one subject or theme, and placed under the relevant sub-category in the coding frame.

Thereafter frames were analysed using a combined quantitative and qualitative approach. According to Schreier (2012) counting text units per sub-category gives an indication of the prevalence of a particular frame. However, due to the inevitable discrepancy between earlier collected data (by van Dijk and Van Kouwen) and data collection in this research, counting text units would be misleading

and instead the number of respondents referring to a particular issue was counted. Subsequently the issues which were prioritised per respondent (group) were analysed. The degree of consensus could then be derived by comparing the number of respondents within a respondent group per (sub-) category.

A more in-depth qualitative analysis was developed by close reading of interview texts, focussing on respondents' explanations for their reasoning. This analysis thereby aimed to stay close to practitioners own views while remaining critical and analysing the consistency of practitioners' frames. The projection of what these frames imply for adaptation development in terms of expected areas of focus, possible coalitions, support and conflicts was mainly based on practitioners' assumptions and a critical analysis thereof, combined in cautious extrapolation of current practices and preferences, which are expected not to alter drastically in the next decade. Events that could nevertheless could radically alter views and preferences nevertheless were considered. To warrant frames' validity, inferences from texts to the real world should be justifiable (Krippendorff, 2012). Therefore, projections span a decade rather than a longer time span. The study's reliability was furthermore increased by the fact that respondents were given the opportunity to comment on summaries.

3.4. Step 4: cross case analysis

At this stage a comparison was made between the individual case studies in order to identify similarities and differences in frame patterns and to consider their implications for the development of climate change adaptation and thereby answer research sub-question 3: To what extent do the frames of practitioners involved in Dutch regional nature policy reveal agreement, sense of urgency and potential for conflicts?

To answer this question, content analysis was used with a focus on the different groups of respondents rather than on individual contributions. This analysis was qualitative rather than quantitative and ascertained the degree of consensus, sense of urgency, support and conflict potential regarding mentioned adaptation measures. The data was approached with caution in order to prevent uncalled for generalizations, given the context specificity of frames.

3.5. Step 5: discussion and conclusion

Step 5 entailed a discussion of the main findings in relation to literature and the methodological limitations of the study. Subsequently, the main research question was answered in the conclusion, illustrating the novel insight of this study, their practical relevance and recommendations for adaptation and further research were presented.

4. CASE STUDY TUNGELROYSE BEEK

4.1. Introduction

In this chapter the Tungelroyse Beek case study results and analysis will be presented. Firstly, the frames of respondents will be described: the problem, causal, opportunity and responsibility frames. Secondly, a more in-depth discussion of results will be provided, aiming to explain the results and ascertain the existence of meta-frames. Thirdly, it is considered what the degree of consensus, sense of urgency and conflict potential imply for the adaptation of nature conservation in the Tungelroyse Beek area in terms of possible coalitions, areas of focus, support for adaptation and resistance against particular measures.

The Tungelroyse Beek stream valley is approximately 26 km long, originates in Belgium and flows into the river Meuse. It is 3-10 metres wide and 0,25- 1,3 metres deep (Van Kempen, 2010) and it has no structural dry fall. A number of nature policy and management developments are relevant. The Tungelroyse Beek contains National Nature network and TOP[8] areas, as well as a Natura2000 area (the Leudal). Furthermore, a major stream valley sanitation project has eradicated substantial amounts of nickel, zinc and cadmium pollution from the Tungelroyse Beek stream area. The project has been executed between 1999 and 2011, entailing the removal of 70.000 m3 polluted sludge and partially re-meandering the stream, costing approximately 30 million Euros (Waterschap Peel en Maasvallei, 2011). Adaptation projects are being developed in the catchment area, for instance the Deltaprogram Hoge Zandgronden (DHZ), which focuses on climate change, fresh water supply and drought (DHZ, 2013). Furthermore, ARK Natuurontwikkeling[9] developed adaptation projects in the Weerterbos and Kempen-Broek (ARK, 2013). Furthermore climate adaptation research by the Knowledge for Climate research programme is ongoing since 2012.

Map 1. Tungelroyse Beek area

Source: www.abeek.be

[8] TOP-areas are nature areas designated by the provinces where drought alleviation measures are to be implemented.
[9] ARK Natuurontwikkeling is a nature development organisation, see: http://www.ark.eu

In the next sections Entman's frame elements are assessed, and the degree of consensus that can be derived from these frames.

4.2. Framing consequences for nature conservation: problems and vulnerabilities

In this section research question 1 will be answered for this case, by describing the problem and causal frame. As explicated in chapter 2, the problem frame entails the content of perceived problems and opportunities (see Figure 4). Most recurring frames related to how an altered climate would impact the water system and species in nature areas, and effects for nature policy and management. Water issues were dominant within the problem frame, the provinces, the water board and conservation agencies unanimously assumed water quantity to become severely affected in nature areas.

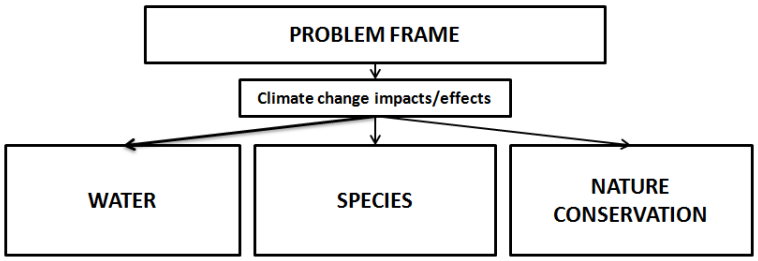

Figure 4. Summary of the problem frame

4.2.1. The water related problem frame

The impact of climate change on nature's water system was the most debated issue. Table 3 shows the number of respondents referring to an issue, and a short summary of the different comments. A majority of respondents was concerned about climate induced drought and flooding in nature areas, and as Table 3 illustrates, water quantity issues were problematized more often than predicted water quality effects regarding the Tungelroyse Beek. This difference in perceived severity was visible through the use of adjectives ("serious drought" and "severe aggravation of drought", "great water shortages" etc.). Conservation agencies and provinces considered drought as the most problematic for nature, however acknowledged the negative consequences of peak discharges, weather extremes and water quality deterioration. Farmers and private owners did not refer to water quality issues. The water board problematized climate change driven drought yet assumed planned adaptation measures could reduce risks whereas the lack of water quality abatement policy and measures concerned them more. Overall, the majority of farmers and private owners did not recognize climate change as a realistic phenomenon.

Table 2. The water related problem frame. N= the number of respondents. Examples of statements provided by individual respondents.

Water related frame (N=11)		Examples of statements
Water is crucial 4 conservation agencies		• "We mainly associate climate change effects with water" • "It is through water that climate change effects are experienced" • "The hydrological situation will be the crux"
Drought **8**	2 Provinces 1 Water board 4 Conservation agencies 1 Farmer	• A mismatch between the water needs of nature and availability • Very serious drought expected for nature, more frequent and longer periods of drought • Severe aggravation of drought in nature areas • Drought is a greater problem for nature than flooding • Stream valley can run dry periodically
Flooding **8**	2 Provinces 1 Water board 4 Conservation agencies 1 Farmer	• Flooding and more extremes will affect nature negatively • Certain nature cannot deal with inundation • The stream valley can overflow, particularly when rivers artificially meander
Water quality **6**	1 Water board 1 Province 4 Conservation agencies	• Polluted flooding will affect nature • Increase algae blooms in aquatic environments • Less water of poor quality will have stronger impact • Aquatic oxygen depletion will increase • Great problem, insufficient adaptation policy
Not a problem **3**	1 Farmer 2 Private owners	• Global warming is exaggerated, cooling down is more likely • Don't see evidence of climate change • *If* the climate would change, nature and society will adjust to the new conditions, for instance via technological innovations

Table 2 shows[10] that the greatest consensus existed between province, conservation agencies and water board however their frames differed significantly from part of the farmers. The farmer interest organisation identified problems for nature from increased flooding and drought. Nevertheless, other farmer and private owners assumed that nature would adapt and that technology could solve water issues such as drought and flooding, for instance by pumping water away and water containment by improving the soil's absorption capacity. The farmers and other respondents furthermore argued that a substantial part of farmers was neither occupied with climate change nor with its effects on nature. Several respondents however identified a growing awareness regarding drought among that farmers and therefore assumed more agreement on this matter would develop in the future.

4.2.2. The species related problem frame

All respondents agreed that *if* the climate would alter, species would be affected[11]. Responses were fairly down to earth, as Table 3 illustrates, no projections of mass extinctions, although some individual species could face problematic circumstances and perhaps be lost for the Netherlands. Respondents generally did not refer to specific species, although one province and three conservation agencies referred to studies projecting that a number of vertebrates, the Norwegian wool mouse and critical species in general and (non mobile) insects may no longer find suitable habitats in the Netherlands or due to limited migration capacities may be lost in this region. Farmers,

[10] The example statements are provided to give a broad overview of the different views, for instance regarding drought, flooding or water quality by the individual respondents.
[11] The climate sceptics also agreed to this statement.

water board and private owner's species frames were more generic. The provinces foresaw high risks for current species, and water board pointed to aquatic species possibly unable to migrate. Table 3 reveals that species migration was considered realistic if the climate would change, resulting in new species opportunities and biological invasions. The latter could negatively affect native species and ecosystems, although difficult to predict how. The table furthermore illustrates the high levels of uncertainty expressed by nearly all respondents. Overall, it can be argued that the species frame was imbued with high levels of uncertainty, not alarmist in nature and the most attention was paid to discussing (uncertainties) of novel and invasive species.

Table 3. The species related problem frame

Species related frame N= 11		Examples of statements
Species migration **8**	2 Provinces 1 Water board 1 Farmer 4 Conservation agencies	• Species will migrate northwards
Challenges individual species **7**	2 Provinces 1 Water board 1 Farmer 3 Conservation agencies	• Problems for individual species and possible loss of some species
Invasive species **7**	2 Provinces 1 Water board 1 Farmer 3 Conservation agencies	• Threats for native species and ecosystem
Effects highly uncertain **6**	2 Farmers 1 Province 1 Water board 2 Conservation agencies	• Difficult to see if problems are caused by climate change or other factors • Difficult to predict which species are at risk • Difficult to predict the balance of species • Consequences of invasive species uncertain
Opportunity new species **5**	2 Farmers 1 Province 2 Conservation agencies	• New and special types of species may provide opportunities for local biodiversity
Not a problem **3**	1 Farmer 2 Private owners	• Species will adjust or die, changes in species not a problem • Other (anthropogenic threats) more haphazard than climate change
Phenology **2**	2 Conservation agencies	• Life events already occuring earlier in the year
Physiology **1**	1 Farmer	• Plants will grow faster, for instance trees and grasses

In general, the frames of private owners and farmers revealed little resemblance to those of provinces and conservation agencies, as they lacked problem perceptions, as can also be derived from Table 3. If the climate would change, changes in species composition were regarded natural, not as problematic. Changes in phenology and physiology were mentioned incidentally.

4.2.3. Nature conservation opportunities frame

Besides framing climate change as a problem for nature, climate change was framed as an opportunity for realizing nature goals. Table 4 shows three discerned beneficial effects for nature conservation: opportunities for generating more dynamic or robust nature[12], more funding for nature related goals, and enhancing cooperation between regional parties. Conservation agencies, the provinces and water board assumed that growing awareness, increasing and overlapping drought problems for nature and agriculture would prompt more cooperation between sectors, the farmer interest organisation saw adaptation as a means to learn more about each other's work, enhancing mutual understanding. The conservation agencies, provinces and water board considered climate change an effective way for explaining necessities of dynamic or robust nature, as enlargement and connections between different nature types were thought to most effectively enhance nature's ability to absorb climate change related shocks. Furthermore, combining (non-)adaptation related (nature) goals would increase funding, main funding opportunities identified in water projects.

Table 4. Nature conservation opportunities

Nature conservation opportunities (N=11)		Examples of statements
Cooperation **6**	2 Provinces 1 Water board 1 Farmer 2 Conservation agencies	• More cooperation with farmers and private owners • Create more understanding about each other's work • More intense cooperation with water boards
Robust nature **5**	1 Province 1 Water board 3 Conservation agencies	• Opportunities to stimulate the creation of robust and dynamic nature
Funding **4**	2 Provinces 1 Water board 1 Conservation agency	• Combining various sources of funding • EU funds, Deltafund, funding via water boards and stream valley and water projects

Overall, private owners lacked opportunity frames, being very sceptical of climate change in the first place. Due to heterogeneity of the private owners group, no predictions could be made about their individual willingness to cooperate, or as a group.

4.2.4. The causal frame: vulnerability factors

As mentioned in chapter 2, causal frames concern factors and relationships making a socio-ecological system more or less vulnerable to climate change, whereas a robust or resilient system would be capable of absorbing climate change impacts (aspects of which concern the coping capacity). The main sub-frames of the causal frame were: sources of coping capacity, current nature problems, and a lack of financing and public support as well current legislation (see Figure 5).

[12] Robust or dynamic nature was mainly described as a certain amount of space to facilitate species migration and natural processes, and connecting nature areas.

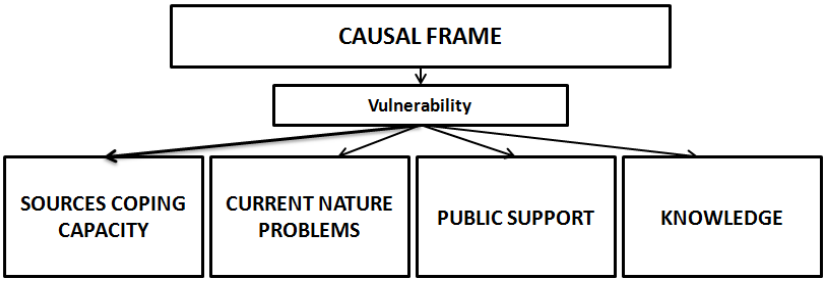

Figure 5. Summary of the causal frame

The Tungelroyse Beek as a whole was seen as relatively robust; respondents pointed to current strong nature elements and already planned adaptation and nature recovery plans as sources of coping capacity, see Table 5.

Table 5. The causal frame

Causal frame (N = 11)		Examples of statements
Sources of coping capacity **5**	1 Water board 1 Farmer 2 Private owners 1 Province	• Tungelroyse beek still has certain strong nature elements • Large areas such as Tungelroyse beek are relatively robust in light of climate change • Stream valley are generally are strong, also assumed of Tungelroyse beek • Adaptive measures will be taken to solve climate induced problems
Current nature problems **5**	2 Provinces 1 Water board 2 Conservation agencies	• Drought in nature areas is a vulnerability that will be aggravated by climate change, also due to low water levels. • Capital intensive crops and drainage will enhance drought • Fragmentation of nature
Financing **3**	1 Province 2 Conservation agencies	• Financing has been a bottleneck in realising adaptation • Current nature management funding will not be sufficient to realize adaptation
Public support **3**	1 Province 1 Farmer 1 Water board	• Currently there is insufficient public and political support for nature related adaptation, the issue lacks urgency
Legislation **2**	1 Conservation agency 1 Farmer	• Certain Natura2000 goals will be unattainable in light of climate change and make effective adaptation more difficult

Nevertheless, provinces, water board and conservation agencies identified several vulnerability factors (Table 5). The majority of factors related to current environmental problems were linked to land use types: drought aggravation by drainage and water consumption and nature area fragmentation. Nearly all respondents indicated adaptation measures would be important coping capacity sources. One of the provinces however warned for an overestimation of adaptation effects, due to often deplorable null-situations and nature goals often remaining at great distance to targets. Explicit reference by a mere 6 respondents to funding and public support should be placed in context. Many stated that funding and public support for nature management varied significantly throughout time and is fragile. Table 5 reveals that particularly provinces and conservation agencies were concerned about current environmental problems whereas private owners expressed the greatest optimism, identifying more sources of coping capacity than vulnerability.

4.3. Framing desired ways of adaptation: goals, strategies, actions and responsibility

Subsequently the adaptation goals, strategies and actions for conservation as advocated by respondents shall be presented, thereby answering research question 2 for this case.

4.3.1. The goal frame

As mentioned in chapter 2, nature goals provide general directions for nature management. Overall, two types of nature goals were discerned (see Figure6): a mixed approach and an approach aiming for far more flexibility. The former entails an approach which advocates fixed nature goals for protecting specific species and nature types in predetermined areas while at the same time aiming for a robust system (with some degree of flexibility). Flexible nature goals concern an approach that argues for far more flexibility in nature goals, mainly focussing on system health and natural processes, rather than individual species or preserving particular nature types.

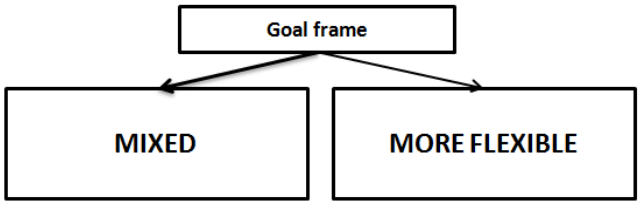

Figure 6. Summary of the goal frame

Conservation agencies described contemporary nature goals as having gained in flexibility and allowing for a degree of change[13] . Furthermore, in case of lacking funding, nature goals currently can be reassessed (although done sparsely). As Table 6 displays, outcomes did not reveal a clear majority preferences for either of the approaches. Resilient or robust nature was aimed for by 6 organisations[14], these respondents assumed that larger and better connected nature would have greater capacity to deal with climate change. However, a purely systemic approach would be insufficient for safeguarding species and specific ecosystems in the light of climate change; high uncertainty remained on the regional species specific level, therefore the provinces and a conservation agency were reluctant to abandon nature goals, opting for a mixed approach. Three others did not know if nature goals should be altered, due to a lack of knowledge how individual species would react to climate change on a local scale. Overall, farmers were modest in taking a stance as it was not their area of expertise. Nearly half of respondents favoured a system approach with far more flexibility in nature goals (two conservation agencies, the water board, one farmer organisation and private owner).

[13] Heath in France is different from heath in Gelderland, and within the Netherlands there are also differences discernible. In addition, nature goals nowadays are less strictly formulated around nature types and goal species and more system oriented.

[14] This concerned the provinces, 3 conservation agencies and the water board.

Table 6. The goal frame

Goal frame (N=11)		Examples of statements
Mixed approach **6**	2 Provinces 2 Conservation agencies 1 Private owner 1 Farmer	• Purely systemic approach will not work with poor abiotic circumstances, therefore focus on both systems approach and protection of specific nature types and species via fixed goals. • Don't know whether nature goals should be adjusted
More flexibility **5**	1 Water board 1 Farmer 1 Private owner 2 Conservation agencies	• Nature goals should be far more flexible, focus on systems rather than species and nature types

Despite the absence of a clear majority preference or respondent group patterns, Table 6 shows that both provinces and half of conservation agencies did not see reasons to alter goals on the short term.

4.3.2. The strategy frame

Strategies are the patterns of behaviour, as mentioned in chapter 2, and four main frames were identified: the integral, the natural system versus the technical approach and a no regret strategy, (see Figure7).

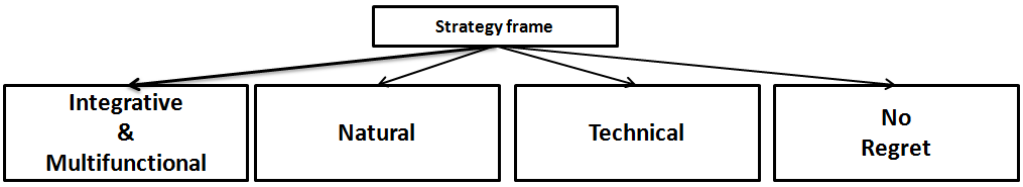

Figure 7. Summary of the strategy frame

Table 8 illustrates the prevalence of integral and natural approaches. The integral approach was described as combining multiple goals and thinking from a system perspective rather than individual sectors, advocated by the majority, however, keeping track of bigger picture was deemed challenging for sector oriented organisations. The natural strategy envisions utilizing natural processes for adaptation, using as little energy and technology as possible. Spatial planning should aim to arrange functions in accordance with the climate altered water system. The natural strategy was mostly proposed by provinces and conservation agencies. The farmers and a private owner would rather rely on technologically fuelled adaption for nature; this would be just as sustainable and effective. Water board strongly believed in a natural, robust water system *and* technical adaptation innovations and thereby could be divided in both categories. The no regret strategy focuses on established practices and was reported to be often employed in current adaptation projects. Private owners argued for a prioritization of action beneficial under any climate scenario, rather than focusing on a particular scenario. A province and conservation agency however pointed to bottlenecks of the no regret strategy, which in practice favoured the status quo rather than allowing for cutting edge cross-sector innovation.

Table 7. The strategy frame

Strategy frame(N=11)		Examples of statements
Integrative & multifunctional strategy **7**	3 Conservation agencies 2 Provinces 1 Farmer 1 Water board	• Climate adaptation strategies should combine the goals of multiple-sectors, increasing the support and funding for adaptation measures for nature, support for nature generally fragile • Adaptation for nature is a matter of developing smart combinations with other sectors
Natural strategy **5**	2 Provinces 3 Conservation agencies	• Natural processes more sustainable to shape adaptation for nature than technical fixes • Locations of functions should be based on the natural water system • In some instances technical fixes are unavoidable
Technical strategy **3**	2 Farmers 1 Private owner	• Technical measures can solve climate change problems. • Technical measures can be more effective and sustainable than merely using natural processes as solutions.
No regret strategy **2**	2 Private owners	• With substantial uncertainty best opt for established approaches

The strategy frames pointed to different cultures of working; whereas the nature sector employed a perspective taking natural processes as points of reference, the majority of farmers and private owners reasoned more from a technical angle.

4.3.3. The action frame

With regards to actions two main frames have been identified: water and species migration. The water related action frame was the most dominant, particularly water quantity measures, followed by the species migration frame.

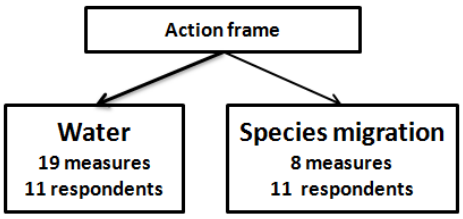

Figure 8. Summary of the action frame

4.3.3.1. Promoted water related action

Mainfold water measures were proposed, mainly water quantity rather than quality, and several related to agricultural water management, the latter having a substantial impact on water levels in nature areas. Table 8 illustrates the proposed solutions.

Table 8. Promoted water related measures

Reading instructions: The column of the provinces illustrates that both support water containment, one of the provinces supports increasing the soils absorption capacity and in total 11 water related solutions have been proposed by the provinces. The last column shows how much respondents considered a measure to be important, for instance 11 respondents supported water containment.

		Provinces (2)	Water board (1)	Conservation agencies (4)	Private owners (2)	Farmers (2)	Nr of resp.
	WATER QUANTITY						
1	Water containment	2	1	4	2	2	11
2	Climate/water buffer	2	-	4	-	1	7
3	Increasing soil's absorption capacity	1	-	2	-	1	4
4	Supplementary drainage	1	1	-	-	2	4
5	Temporary water storage	2	1	3	-	1	7
6	Beekdal brede benadering	1	1	1	-	1	4
7	Stream valley community	-	-	-	-	1	1
8	Farmers as water managers	1	1	1	1	-	4
9	Higher water levels	2	1	4	-	1	8
10	Sprinkler irrigation	-	-	-	-	2	2
11	Increase pumping	-	-	-	1	1	2
12	Saving water	1	-	-	-	-	1
13	Compensating water damage	1	-	1	-	2	4
	WATER QUALITY						
14	Forests for water filtering	-	1	1	-	-	2
15	Inserting wood into stream valley	-	1	1	-	-	2
16	Sewer adjustment	-	1	1	-	-	2
17	Reduction nutrients	-	1	1	-	-	2
18	Shadowing of stream valley	-	1	1	-	-	2
	GENERAL	-	-	-	-	-	
19	Water as a steering mechanism	2	1	-	-	-	3
	Nr of water solutions	11	12	13	3	11	

As Table 8 shows, water containment both in nature and agricultural areas was supported by all respondent groups. The following measures were the most consensual and lacked controversy during interviews. *Water containment, climate buffers* and *temporary water storage* were assumed to alleviate both drought and flooding for several functions, and were supported by people of all respondent groups. Increasing the soil's water absorption capacity was not widely proposed, however neither evoked controversy. Farmers supported *supplementary drainage,* which could be made more efficient. The *brede Beekdal concept*[15] was considered suitable for multifunctional adaptation, entailing a structural, systematic approach which was supported by the provinces, water board and farmer interest organisation. A novel idea from the farmer interest organisation was to create a *stream valley community*, in which all regional parties are united and water management tasks are divided and climate change becomes a community/shared problem[16]. Ownership of land should remain unchanged in this solution, making it more attractive for farmers to participate.

[15] This concept does not only look to the ecological quality of streams but also to the surrounding valleys (with nature areas and agriculture).

[16] Various parties are now discussing the possibilities to realise this idea.

Substantial disagreement regarded *higher water levels*, favoured by the provinces, water board and conservation agencies and despite one farmer supporting higher water levels, many farmers were reported to be opposed. Farmer resistance however depended on *how* and *when* water levels would be raised and individual farmer perceptions. A small farmer proportion started to accept higher water levels: If water damage would be compensated and agricultural lands would remain tillable in spring, matters could be negotiated. If not, substantial resistance could be expected since Dutch farmers generally fear water damage.

A number of technical water management solutions were promoted by farmers and part of private owners. For instance *supplementary drainage* realizes temporary higher water while limiting water damage, which was generally accepted among farmers. Disagreement related to *sprinkler irrigation* and *pumping*. Table 8 shows a lack of support for such measures (except among farmers and one of the private owners), often seen as unsustainable on the long term, since sprinkler irrigation could aggravate drought in nature areas and pumping away water had its limitations in keeping (excess and polluted) water out of nature areas. Most respondents expressed understanding for farmers' reliance on sprinkler irrigation, yet the fact that drought related adaptation would need to be cheaper than sprinkler irrigation was considered a substantial difficulty for implementation.

The idea of *farmers as water managers* (via technical water management*)* was generally disputed in the context of climate change since farmers generally preferred lower water levels. Experiences with weir management by farmers were mixed. Proponents argued if farmers could control water levels directly they would be inclined to experiment more with higher water levels. Some conservation agencies however suggested that farmers frequently neglected their weir management. This however could be caused by a lack of guidance in farmers' weir management, offering opportunities for improvement. *Water as a steering mechanism* for spatial arrangements for instance could imply that water intensive crops would no longer be cultivated in drought prone areas next to nature areas. This advocated by provinces and the water board and fitted within the natural adaptation approach. Instead of adjusting water levels to spatial functions, spatial functions would need to fit the natural water system.

As Table 8 reveals, water quality abatement measures were least proposed, nor mentioned by farmers or private owners, considered difficult to realise due to a lack of farmers and municipalities support. Overall, provinces assumed sufficient support for small adjustments of the water system, however profound changes regarded unfeasible. Table 9 furthermore shows a respondent majority mainly proposing water quantity measures, except the water board. Private owners proposed the least water related measures, explainable by their climate change scepsis. They would, nevertheless, support measures that would be beneficial under any climate scenario, such as water containment. The results show that water containment is well accepted among practitioners and considered beneficial under any climate scenario. Overall, farmers mainly proposed technical solutions and provinces, conservation agencies and water board more measures connected to the natural approach, which envisions space for water for a more robust water system.

4.3.3.2. Promoted species migration related action

The facilitation of species migration was the second most common frame; a large majority attributed great importance to implementation of measures supporting species migration. Table 10 shows strongest support for the National Nature Network and ecological connection zones. Larger nature areas, "robust nature" and the National Nature Network were favoured by all conservation agencies, both provinces and the water board. Farmers argued for better nature maintenance instead of more nature at the cost of agricultural land, and therefore supported the National Nature Network in its current form but not an enlargement. Ecological connection zones were advocated by respondents from all respondent groups, nevertheless should not lead to a loss of agricultural lands or ownership changes, according to farmers.

Stream valleys were deemed ideal ecological connection zones, often allowing South-North migration. Landscape elements could be maintained by farmers and facilitate climate related migration however was not proposed by farmers. The province of Limburg furthermore aimed to develop landscape zones for facilitating climate related species migration, particularly the bronze green zones[17] would be suited for multifunctional adaptation. Farmers making an effort for facilitating migration[18] should be compensated according to water board, half of conservation agencies, farmers and a private owner. Sodding or relocating species were considered as extreme measures by two conservation agencies.

Table 9. Promoted species migration related measures

		Provinces (2)	Water board (1)	Conservation agencies (4)	Private Owner (2)	Farmers (2)	Nr of resp.
	Facilitate migration	2	1	4	1	2	10
1	National nature network	2	1	4	-	2	9
2	Robust, large nature	2	1	4	-	-	7
2	Ecological connections	2	1	4	1	2	10
3	Landscape elements	1	1	2	-	-	4
4	Landscape zoning	1	-	-	-	-	1
5	Stream valleys as connection zones	2	1	1	-	-	4
6	Compensating agricultural nature management	-	1	2	1	2	6
7	Sodding	-	-	1	-	-	1
8	Relocating species	-	1	2	-	-	2
	Nr of solutions	6	7	8	2	3	

The responses revealed tensions possibly arising from measures requiring extra agricultural land in case of insufficient compensation provision or farmer relocation to arable lands. Table 9 mainly reveals common practices in nature management (except for relocating species which was generally

[17] Gold green zones are ones that are financed via the National Nature Network; silver green zones contain nature with lower nature values and bronze-green zones that envision more extensive agriculture and recreation, and generally higher water levels.

[18] Compensation could be granted for maintenance of ecological connections, nature management or landscape elements.

not supported), since practitioners argued a lack of novel solutions and knowledge on the species specific level.

4.3.4. The responsibility frame

As mentioned in chapter 2, the responsibility frame relates to the question who should take responsibility for adaptation action. In general, the responsibility frame consists of three sub-frames: the government as facilitator and initiator of climate adaptation and land users as implementers of adaptation (see Figure 9). Since nearly all respondents argued necessity of shared public and private responsibility for action, an overarching frame was identified: the joint sharing of responsibility. In line with this frame, almost all respondents attributed themselves with certain roles (except private owners), yet the subsequent analysis will reveal a substantial differentiation in elaborateness of frames.

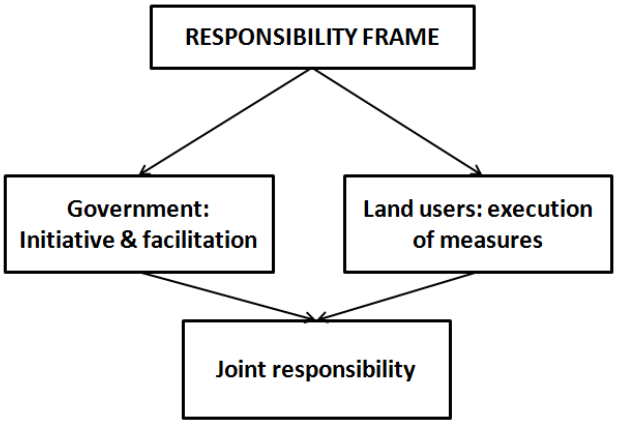

Figure 9. Summary of the responsibility frame

The majority currently did not have explicit climate change goals or separate climate change policy and only a minority explicitly incorporated climate change in relation to nature in their decision making (the water board and provinces). Most of the respondents referred to the government, primarily the province and water board but also the central government for initiating action, setting goals and facilitating the means for other parties to implement conservation related adaptation on a local/regional scale. The water board was explicitly mentioned as a leader due to their expertise about climate change and the water system as well as practitioners positive experiences regarding their contemporary leading role in adaptation projects. This division of responsibility was similarly supported by the provinces and water boards. In Table 10 represents practitioners' self-ascribed responsibilities.

Table 10. The self- attributed responsibilities of practitioners

	Provinces (2)	Water board (1)	Conservation agencies (4)	Private Owners (2)	Farmers (2)	Nr of resp.
Agenda setting	1	1	4	-	1	7
Knowledge creation regarding climate impacts and adaptation	1	1	1	-	1	4
International cooperation	1	-	-	-	-	1
Cooperation other provinces	1	1	-	-	-	2
Stimulate regional adaptation efforts	2	1	4	-	2	9
Formulating vision	1	1	-	-	-	2
Formulating solutions and strategies	1	1	3		2	7
Utilizing spatial & legal instruments	1	1	-	-	-	2
Initiating adaptation	1	1	-	-	-	2
Executing adaptation measures	-	-	3	-	1	4
Risk assessment	1	1	-	-	-	2
Nr of tasks	10	9	5	0	5	

Overall, the water board and provinces framed their responsibility the most elaborately, see Table 10, other respondents primarily regarded advocating action, talking and thinking about solutions as their short term role. None asserted responsibility for financing adaptation. The provinces explicitly expressed willingness to provide policy space, vision development and legal instrument appropriation to boost adaptation of nature conservation, nevertheless, the time of abundant government subsidies had ended. The water board no longer recognised itself as implementer of water measures, as risk and tasks were increasingly allocated to private parties, which would likewise be the case for adaptation.

Land users (farmers, private owners and conservation agencies) would, on the long term, be willing to implement measures in their terrains yet were unspecific regarding the what, where and when. The need for ongoing stakeholder participation was acknowledged as elementary by the majority, particularly by farmers and private owners, necessary for establishing affected interests, combining goals and making trade-offs. Table 10 illustrates private ownerships lacking willingness to take responsibility for adapting nature to climate change. They argued *if* the climate would change the government would be the legitimate right party to develop long term adaptation action, adaptation was not the private owners task.

4.4. Discussion of results

This section will provide explanations for the ways in which practitioners framed adaptation, and ascertain whether there is are practitioner related frame patterns or meta-framing in terms of topics.

PROBLEM & CAUSAL FRAME Provinces, conservation agencies and water board consistently framed climate change as a water problem, the water system being an important vulnerability factor for climate change. In general, water problems and vulnerabilities were defined better than those of

species, forest fires or soil, latter two issues were mentioned incidentally. Dominance of water frames can be explained by contemporary preoccupations, the water board's expert role and experienced (un)certainty. Provincial and conservation agencies concerns about climate change aggravated drought seem fuelled by their preoccupation with contemporary drought problems connected to water related case characteristics: poor infiltration capacity of elevated sandy soils, agricultural drainage patterns, potential dryfall and flooding of the stream valley, which would become increasingly relevant in a warmer climate. The water boards' expert role was established: Conservation agencies currently benefitted substantially from the water boards' general ecological knowledge[19] and their climate change integrated models were frequently employed by provinces and conservation agencies. The water boards' water related frames were the most elaborate and informed by their practical field observations and climate modelling. In addition, the provinces, water board and conservation agencies expressed greater certainty that climate change, as KNMI scenarios showed, would lead to water excess and shortage yet expressed more uncertainty regarding other impact domains, such as impacts on species.

The apparent discrepancies between abovementioned problem and causal frames and those of farmers and private owners' can be explained by climate scepsis, knowledge and operational preoccupations. Their problem and causal frames were less specific: they identified fewer impacts, details and vulnerability sources[20]. Their majority referred less to conservation studies and more to the fact that climate science is inconclusive, the need for more field studies and less reliance on climate models, which were considered less able to make accurate longitudinal predictions. In addition, farmers and private owners stated greater occupation with their daily operations than long term developments as climate change. Moreover, farmers and private owners framed climate change impacts more as agricultural opportunities than nature problems[21] and this explains why their adaptation frames regarding conservation were less developed than those of provinces, conservation agencies and water board.

SOLUTION FRAME As mentioned, the nature goal frame did not reveal clear respondent group preferences and answers favouring a mixed approach may have been influenced by politically correct answering (transgression of EU nature goals leading to penalties). On a more abstract level a meta-frame could be distinguished within advocated strategies and measures: "the natural versus the technical adaptation approach". These preferences for either a natural or technical approach furthermore reveal different working cultures and possibilities for bridging these. Attitudes of conservation agencies, private owners and farmers seemed to relate to their working cultures that were either natural system oriented (conservation agencies and provinces) or based on technology (farmers and private owners), or a way of working that bridges both ways of working (the water board). Tension between approaches mainly centred on the advocacy of additional spatial claims by the natural approach for nature and the development of "more natural", higher water levels. Resistance however did not indicate a resistance against adaptation or nature per se but rather a lack of acknowledgement for farmers' role as sole provider of land, and fear for water damage which was

[19] Water boards often have ecologist advisors and department, and conservation agencies stated that they often employed their knowledge.

[20] An exception was the farmer interest organisation that also referred to conservation science in this field.

[21] *If* the climate would alter, opportunities would emerge due to increased plant productivity, food production in other parts of the world would become more problematic thereby making Western Europe, including the Netherlands, the food barn of the world.

reported to be deep-rooted in the farmer community. Although in the next decade a large part of farmers was expected to cease their business activities, it was generally not expected that these lands could be used for nature development as the remaining farmers were assumed to take over these lands.

Similarly, on a more abstract level, the dominance of water quantity solutions can be explained by the tendency to focus on issues with more scientific, financial and political certainty. Water quantity issues were claimed to have been attributed more funds and already having been translated into adaptation policy. Likewise, the preference for common practices could be distinguished among all respondent groups, either via common nature management practices or no regret measures allowing the status quo in terms of water and spatial division. Less advocated solutions were reported to be less severe and more uncertain, as well as experienced to receive less political, public and financial support. In addition, climate adaptation was often framed in terms of contemporary problems and solutions rather than isolated climate change impacts within nature conservation.

RESPONSIBILITY FRAMES A number of explanations can be provided for the reliance on provinces and water boards for initiating adaptation. Firstly, conservation agencies, farmers and private owners considered policy developments more steering for their goals and action than climate change and therefore looked for initiative in this direction. Secondly, the negotiations about allocation of responsibility had yet to begin and there may have been reluctance to clarify stances prior to the negotiation process. Thirdly, references were made to water boards and provincial resources, which made them particularly suited for initiating action and leadership: climate change expertise, legislative tools, funding ability, ability to transcend stakeholder interests and oversee regional developments. The local level of municipalities was assumed to lack knowledge and resources, although had their importance for adjusting local spatial planning for climate adaptation. Lastly, clarity was lacking regarding actual costs, precise measures and locations, making it more difficult to define responsibilities.

Subsequently, it will be assessed to what extent a meta-frame could be identified and what patterns could be distinguished per respondent group. Despite the lack of consensus in terms of severity and urgency, an overarching meta-frame could be distinguished which summarizes the ways in which practitioners framed adaptation as “a matter of drought and flooding”, since drought and flooding played an essential role in the majority of all frame elements, of all respondents. Nevertheless, the ways in which individual practitioners framed adaptation revealed some inconsistencies. These inconsistencies can be connected to on the one hand the recognized lack of knowledge yet on the other hand overt trust in adaptation, for instance regarding adaptation via natural systems (conservation agencies) or water technology (farmers and private owners). This shows how solution frames can affect problem and risk frames, which could potentially lead to risk underestimation.

Overall, farmer and private owner’s frames were generally logically consistent in treating climate change problems and solutions in a hypothetical sense which may explain why their adaptation frames were less developed regarding nature[22]. They generally framed climate adaptation of nature conservation in an agricultural perspective by prioritizing climate change effects on agriculture and

[22] As earlier mentioned, an exception was the farmer interest organisation, whose frames were better developed than other farmer and private owners.

deriving thereof the effects on nature. Water levels and land claims were sensitive issues but negotiable if compensated properly. Although private owners did not consider adaptation their responsibility but awaited government initiative and policy, farmers and private owners were interested in business opportunities involved in the adaptation of nature conservation (compensation, tourism, and production in nature areas combined with adaptation) and supported adaptation via measures that would be beneficial under any climate scenario. Provinces and water board both framed climate adaptation mostly in terms of water quantity issues and displayed the most urgency to adapt nature conservation to climate change, although contemporary water and nature policy and management issues were prioritized. Nevertheless, in comparison to other practitioners, provinces and water board acted as the main problem owners. Of all practitioners, conservation agencies most explicitly framed climate adaptation as a water quantity issue however, did not display a great sense of urgency and rather awaited policy developments and available budgets.

4.5. Expected consequences for adapting Tungelroyse Beek nature conservation to climate change

In this section, the implications of practitioner frames for the expected ways in which next decade adaptation may develop in the Tungelroyse Beek will be assessed, thereby answering research question 3. This will be accomplished by ascertaining the extent to which consensus, sense of urgency, and presence of parties supporting and blocking adaptation are likely to affect adaptation in this case study.

Although practitioners framed adaptation mostly as “a matter of drought and flooding” with broadly varying degrees of severity from no problem to grave risk for nature, clear **consensus** was lacking. This was best discernible in the problem and solution frames. While provinces, water board and conservation agencies agreed drought and flooding would substantially affect nature and desired natural approaches to adaptation, private owners and farmers did not univocally described these matters as either problems or as opportunities, and envisioned other, more technical adaptation approaches. Future adaptation in the case study area therefore is most likely to be mainly focussed on water quantity, particularly drought abatement. Future alliances between provinces, water board and conservation agencies can be assumed harmonious, and since no signs of serious conflicts or non-negotiable issues were identified and alliances with farmers and private owners have potential. Future adaptation via the natural and technical approach may conflict regarding the amount of space provided for nature and water, however, due to the water boards familiarity of both ways of working and strong ties with farmers and private owners the water board can play a bridging function. The solution and responsibility frames furthermore revealed strong preferences for existing practices and it can be expected that many small rather than drastic measures will be taken, and innovation will be rather feature smart combinations than structural integration of entirely novel nature management practices.

The frame analysis revealed that provinces and water board can be expected to remain important actors for facilitating and initiating adaptation in this domain, since their responsibility frames, contrary to most other actors, revealed a clear sense of urgency. Provinces and water board identified greatest risks in the water domain and both recognized substantial risks for species. Moreover, these actors intended to take short term action, and the responsibility frame pointed to their resources necessary for steering regional adaptation. Their leadership was furthermore

legitimized by the majority based on these resources and ability for long term strategizing and bridging local interests, and the water boards' expertise on climate change, ecology and the water system. It can be expected that these actors will mostly invest in the development of water quantity measures via the NLP, DHZ and landscape zones[23]. Conservation agencies are less likely to steer the initiation phase of adaptation in this domain. Despite conservation agencies concerns about severe water problems, they currently lacked a sense of urgency as climate change was generally not considered a risk, as long as adaptation would take a natural approach. Furthermore, these actors awaited policy action rather than developing initiative on their own.

The potential of farmers to block action could be derived from solution frames since measures often depended on farmers' adjustment of water levels and as suppliers of space. Adaptation conflicts may emerge on the short term with individual farmers regarding these issues however structural adaptation stalemate seems highly unlikely since working relations were constructive and the water board is unlikely to support measures that gravely disadvantage farmers or lack their support. Due to farmers and private owners' awareness of their bargaining power and critical role as land suppliers, as well as due to their demands for compensation, it is unlikely that adaptation by farmers and private owners within the context of their nature management will be based on voluntariness, and possible water damage requires compensation. In addition, adapting nature conservation to climate change was not on their agenda since farmers and private owners neither saw climate change as a risk for nature and *if* it would become a reality, species would adapt and possible problems could be solved via technology. This lack of urgency is likely to lead to postponement of adaptation. Abstract modelling data is unlikely to convince these actors of the need for adaptation in this domain, yet field observations and stakeholder knowledge inclusion were positively appreciated. Furthermore, no-regret oriented win-win measures for both agriculture and nature have their regard, and although the association of private owners did not consider this an issue to be picked up by their association, individual private owners may be open for negotiations.

4.6. Concluding remarks

In conclusion, adaptation was mainly understood as a matter of drought and flooding and would preferably be facilitated by natural and technical adaptation approaches, which imply for adaptation that these will be the primary focal areas and ways of adaptation. This may lead to conflicts with individual farmers, most likely regarding water levels and spatial claims; although the natural and technical approach need not be incommensurable and the identified beneficial working relations make structural stalemate less likely. In this case, the importance of problem ownership of the provinces and water board as main initiators and planners of adaptation in this domain was established since other practitioners are unlikely to develop action independently on the short term. Likewise, the study demonstrated the need for compensation of adaptation for farmers and private owners in case of land claims, higher water levels or adaptation via their nature management since there was no support for voluntary adaptation. The contemporary focus on water quantity and existing practices will likely make it more difficult to develop adaptation in other domains that lack support and resources.

[23] The NLP aims to contain more water and alleviate drought, via supplementary drainage and farmer weir management. Likewise, the Deltaplan Hoge Zandgronden has many water quantity related aims. Furthermore, the province of Limburg aims to develop landscape zones where higher water levels will be the norm.

5. CASE STUDY BAAKSE BEEK

5.1. Introduction

This chapter will be organised in a similar fashion as the previous chapter: firstly the frames are described in terms of content, secondly a more abstract analysis of the ways in which practitioners frame consequences and preferred solutions are presented and thirdly the expectations for adapting conservation to climate change in the Baakse Beek will be presented. For a list of interviewees see Appendix A.

The Baakse Beek stream originates in the Korenburgerveen, flows towards the Ijssel and the catchment includes the Veengoot stream. The stream is approximately 30 km long, 8-10 metres wide and periodically runs dry (meeting CARE-project, 2012). The stream valley serves a vital function for discharging agricultural water, Ruurlo is an important agricultural production area and certain historical country estates[24] encompass critical nature and landscape values (Wardenaar et al., 2006). Under the supervision the water board Rijn en IJssel and province of Gelderland, various sectors jointly aim to establish a development perspective for the Baakse Beek via the Baakse Beek. Currently there are no Natura2000 nature areas within the stream valley, yet there is ongoing discussion regarding the extension of the National Nature Network to create a more robust nature network in the Baakse Beek (Gebiedsproces Baakse Beek, 2013). Furthermore, Knowledge for Climate has ongoing climate adaptation research in the area. Climate change is an important theme within the area development process for the different sectors, an ongoing subject of debate within the stakeholder commission (Baakse Beek stakeholder meeting, 2012).

Map 2. Baakse Beek catchment area

source: wwww.baaksebeek.nl

[24] Huis te Ruurlo, De Wiersse, Kasteel Vorden, Hackfort, Suideras.

5.2. Framing consequences for nature conservation: problems and vulnerability

In this section research question 1 will be answered for the Baakse Beek case study, by regarding the content of problem and causal frames. Overall, the following problem frames were distinguished: impacts on the water system, species and nature conservation (see Figure 10). The water (quantity) frames were dominant, water quality problems and effects on species stressed less frequently. The accounts of farmers and private owners in general were less detailed, foreseeing fewer problems and opportunities for nature (conservation) than the other respondents.

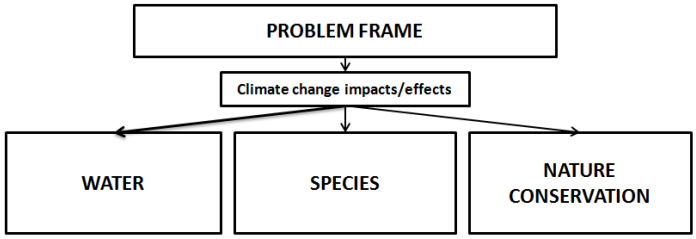

Figure 10. Summary of the problem frame

5.2.1. The water related problem frame

That drought in nature areas could be aggravated by climate change was acknowledged by nearly all respondents, see Table 11. A proportion of farmers and private owners nevertheless placed the problem of drought in an agricultural rather than nature context, in the latter domain effects were not clearly described as problematic or as an opportunity. Extremes in precipitation were not explicitly linked to impacts on nature by the majority of farmers or private owners. Drought would become a greater problem for nature than flooding according to conservation agencies, province and water board, since more flood than drought amelioration knowledge was available. Some of these respondents pointed to expected water quality deterioration (see Table 11) yet no farmers or private owner mentioned effects on water quality.

Table 11. The water related problem frame

Water related frame (N=8)		Examples of statements
Water is crucial 4 Conservation agencies		• "The water issue is most important" • "The first things that need to be adjusted concern the water system" • "Water is the origins of the problem"
Drought **6**	1 Province 1 Water board 1 Farmer 3 Conservation agencies	• Stream valleys can run dry periodically • Estate Wildenborch: ground water levels will lower further • Wolfersveen: lower water levels and poor absorption of water • Drought in nature greatest climate change problem due to lack of knowledge how to solve it • Elevated sandy soils lack absorptive capacity, thus difficult to conserve water
Flooding **6**	1 Province 1 Water board 1 Farmer 3 Conservation agencies	• Flooding and more extremes will affect nature negatively • Baakse Beek plateau will experience water nuisance • The flooding of Lichtenvoorde in 2010 showed the consequences of flooding for nature
Water quality **5**	1 Water board 3 Conservation agencies 1 Province	• Polluted flooding via sewers • Increase of algae blooms • Oxygen depletion due to a decrease in water temperature

Although farmers and private owners in general were reported less concerned about climate change, this did not apply to interviewed farmers and private owners, although they were more concerned about agricultural than about nature (conservation) effects. Their frames were more general, whereas the provinces, conservation agencies and particularly the water board expressed greater detail concerning the local effects. The water board pinpointed climate change water effects per area (Plateau, country estates region, Wolfersveen etc.).

5.2.2. The species related problem frame

Nearly all interviewees predicted (potentially negative) climate change effects on species such disappearing species, see Table 12. However, only one conservation agency and private owner predicted mass extinctions in case no measures would be taken. The majority did not foresee dramatic effects due to high levels of uncertainty. Few responses explicated which individual species would be affected[25], revealing generic thinking about impacts on species. One of the conservation agencies furthermore argued that effects on species will become relevant on a 50-150 year term, therefore currently not considered a risk. Incidentally mentioned were opportunities for biodiversity stemming from new species, effects on phenology, physiology and invasive species. This analysis reveals that frames regarding species generally remained on the surface and did not contain doom scenarios.

[25] Beech tress may disappear, aquatic species may face difficulties, as stated by 2 conservation agencies and a private owner.

Table 12. The species related problem frame

Species related frame (N=8)		Examples of statements
Challenges for individual species 6	2 Conservation agencies 1 Farmer 1 Private owner 1 Province 1 Water board	• Some species may disappear if they cannot adapt, but in general species have some buffering capacity, although the speed of change may be too high
Species migration 6	3 Conservation agencies 1 Private owner 1 Province 1 Farmer	• If species cannot adapt to locally changed climates, they will migrate • If nature areas are fragmented then species may not be able to migrate
Effects on species highly uncertain 6	2 Conservation agencies 1 Farmer 1 Province 1 Private owner	• Difficult to predict the balance of species • Consequences of invasive species not known
New species 3	1 Farmer 1 Private owner 1 Conservation agency	• Opportunities for local biodiversity will present themselves
Phenology 3	2 Conservation agencies 1 Farmer	• Life events starting earlier in the year such as reproduction and birth, plant flowering
Physiology 3	1 Province 1 Farmer 1 Private owner	• Growthrates of plants will increase
Invasive species 2	1 Farmer 1 Conservation agency	• More intensive nature management will be necessary • Invasive species will increase but this is more a problem for humans than nature since nature will adjust itself

5.2.3. The nature conservation opportunities frame

Respondents asserted negative consequences were emphasized too much, possible opportunities of climate change for nature (conservation) too little. Table 13 reveals opportunities related to enhancing intersectoral cooperation, realizing more robust nature and funding for adaptation. Particularly conservation agencies assumed greater farmer awareness of climate change would fuel cooperation that would benefit both sectors. Furthermore, two conservation agencies and the province saw opportunities for robust nature. Similarly as in the Tungelroyse Beek, respondents assumed that larger and better connected nature would be better equipped to deal with climate change. One of the conservation agencies assumed nature could buffer negative climate change effects of flooding on urban and agricultural areas, particularly via water containment, thereby increasing support for nature protection. Furthermore, funding could be supplemented by combining nature and water adaptation goals.

Table 13. The nature conservation opportunities frame

Nature conservation opportunities frame (N=8)		Examples of statements
Cooperation **3**	2 Conservation agencies 1 Farmer	• More cooperation between nature, water and agricultural sectors • Once the agricultural sector becomes more aware of drought problems it will be easier to facilitate cooperation between the nature and agricultural sector, sharing the burdens of the drought problem, and benefits of drought related solutions
Robust, dynamic nature **3**	2 Conservation agencies 1 Province	• Adaptation allows for more robust and dynamic nature, as more space for natural processes is required to deal with climate change • Via the creation of robust nature where space is provided to water, nature can be of service to agriculture and safety of residence
Funding **2**	1 Province 1 Conservation agency	• Combining nature with water goals to generate funding, climate effects on water have been formulated as a policy problem and therefore are better supplied with funding

In order to involve various sectors in the adaptation of conservation, many asserted the necessity to focus on multi-sector opportunities, rather than solely pointing to climate problems, which would not motivate for action. Overall, the most opportunities were identified by the province and conservation agencies, few examples were provided by farmers, private owners and the water board (although several agricultural adaptation opportunities were provided).

5.2.4. The causal frame

A number of vulnerabilities were identified, regarding current nature problems and lack of public support and knowledge as well as coping capacity sources (see Figure 11).

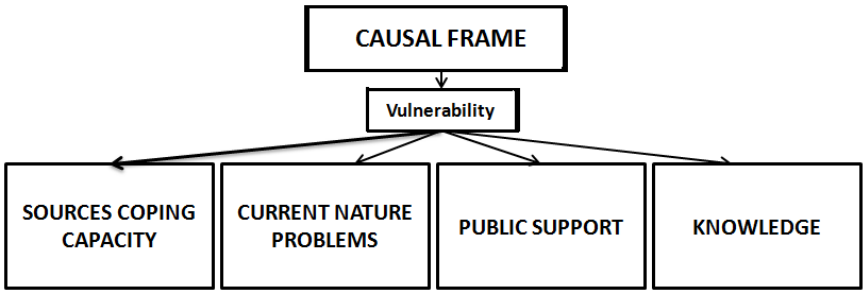

Figure 11. Summary of the causal frame

Many of the practitioner identified vulnerabilities were water related (see Table 14). Half of the respondents (conservation agencies, province and water board) considered contemporary agricultural drainage patterns a significant vulnerability factor for aggravating climate induced drought. Similarly, farmer resistance against rewetting would hamper effective adaptation, according to the province and a conservation agency, whereas multi-sector, integral adaptation would strengthen coping abilities. In addition, fragmentation of nature was often mentioned as a source of vulnerability (Table 14).

Table 14. The causal frame

Causal frame (N=8)		Examples of statements
Sources of coping capacity **5**	1 Farmer 1 Private owner 2 conservation agencies	• Ability of species and nature in general to adapt • Some integral water projects strengthen the capacity to deal with climate change • Nature values in some areas quite good, although unique nature is vulnerable for flooding
Current nature problems **6**	2 Conservation agencies 1 Province 1 Farmer 1 Water board 1 Private owner	• The water system needs to be adapted since contemporary drainage patterns will further enhance climate induced drought • Fragmentation of nature enhances difficulties of for species to migrate, currently nature is too fragmented
Public support **2**	1 Conservation agency 1 Province	• The resistance against higher water levels to adapt nature to climate change will complicate adequate climate adaption in the nature areas of the Baakse Beek • There is too much support for measures such as drainage and pumping, although this will work counterproductive
Knowledge **2**	1 Province 1 Water board	• Lack of knowledge for drought abatement • Lack of knowledge species protection

Overall, greatest consensus existed between the province, water board and conservation agencies regarding low water levels and fragmentation as chief vulnerability causes and less agreement by farmers and private owners on these aspects. The causal frame illustrated faith in various adaptation measures, except for drought, as conservation agencies and the province warned for easy fixes (irrigation, pumping) solving other sectors' problems but which would aggravate drought in nature. Furthermore, the water board experienced great knowledge gaps regarding drought alleviation, and similarly the province pointed to (lacking) knowledge for local species protection. Since many Dutch non-profit nature foundations devoted to individual species (such as butterflies and birds) engage in field observations, they are a vital source of adaptation knowledge that in the contemporary situation remains scattered, according to the province.

5.3. Framing desired ways of adaptation: goals, strategies, actions and responsibilities

In the next sections the goals, strategies, actions and responsibilities connected to nature related adaptation are presented, thereby answering research question 2 for the Baakse Beek case.

5.3.1. Goals

Two types of goals were distinguished, a mixed and a flexible approach, see Figure 12. Content wise these frames entail the same as chapter 4 goal frame.

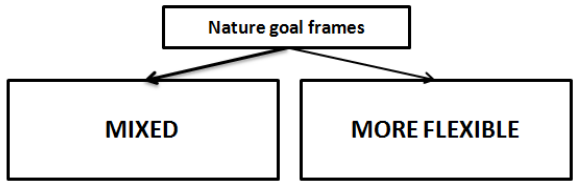

Figure 12. Summary of the goal frame

A mixed approach was advocated by the province and conservation agencies, the latter assumed unique and vulnerable nature would require intensive protection in an altered climate, therefore goals related to unique nature should not be made more flexible (see Table 15). Furthermore, risk assessments at the species specific level were lacking, making it more difficult to abandon the nature goals. Less valuable nature however could be dealt with more leeway and serve other sector's adaptation goals: water containment for agriculture or urban safety, nevertheless non-negotiable regarding special nature. Farmers opposed fixed goals, once described nature goals as "wishful thinking" and regardless of the climate scenario, these goals should be regarded flexibly. A reason concerned the important Baakse Beek agricultural areas whose goals should take preference over nature goals. Another motive concerned the various external factors lying beyond the nature managers influence, making it impossible to maintain all contemporary species or extremely costly in a changed climate.

Table 15. The goal frame

Goal frame (N=8)		Examples of statements
Mixed approach **3**	1 Province 2 Conservation agencies	• Critical and special nature types and species require protection, in addition to the aim of robust systems
More flexibility **2**	2 Farmers	• More effective to focus on systems rather than individual species or nature types • Flexible approach by definition better as nature goals should be seen as wishes rather than fixed in nature

A reluctance to provide clear stances regarding nature goals was discerned among private owners and the water board, which may relate to the sensitivity of the matter or due to a lack of knowledge. Whereas conservation agencies and the province wanted to focus on "soft goals" for a robust system, farmers wanted clarity and hard nature goals, such as embedded in the National Ecological Network. Farmers argued that many agrarians considered soft goals such as robust nature too vague.

5.3.2. The strategy frame

Just as in the Tungelroyse Beek four main strategies were identified: integral, natural, technical and no-regret approaches, see Figure 13 and Table 16.

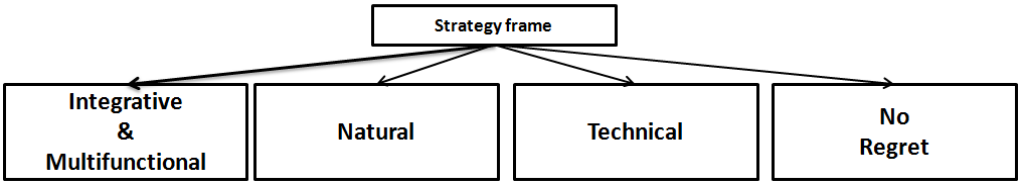

Figure 13. Summary of the strategy frame

Table 16. The strategy frame

Strategies related frames (N=8)		Examples of statements
Integrative and multifunctional **7**	1 Farmer 1 Private owner 1 Province 3 conservation agencies 1Water board	• It is crucial to consider the entire system with all functions to identify shared climate induced problems and solutions • Adaptation responses from different sectors affect one another, therefore consider each other's interests • Best to combine goals to get more support for measures
Natural strategy **4**	3 Conservation agencies 1 Province	• When adapting to climate change its is most effective to stay close to the natural system and its functioning as this will require less energy • Climate change illustrates the limited controllability of the system, not all functions can be maintained at current locations • Higher dikes or more pumping/ technical fixes cannot solve the problems for nature
Technical strategy **2**	1 Farmer 1 Private owner	• Locally customized technical solutions can be used to deal with flooding and drought, no need for drastic rearrangements of system
No regret **2**	2 Farmers	• Better take small measures that fit any climate scenario due to the high levels of uncertainty involved

The integral frame was by far the most prevalent and supported by all conservation agencies, province, water board and a private owner, and was described as the need to integrate adaptation goals with other policy aims and thereby to look beyond sector interests to the bigger picture of how climate change affects the system. The integral approach was considered necessary yet complicated due to different sector interests regarding water levels and land claims. Utilizing natural processes for adapting nature to climate change was advocated by half of respondents, the conservation agencies and the province. Restoring the system to its historical conditions and reviving natural processes would enhance nature's capacity to cope with water excess and shortage, and require less energy than merely resorting to technical strategies. Nevertheless, natural system recovery may not always be possible and technical solutions required: Technical and natural approaches therefore are not entirely excluding one another. The technical approach was advocated by a farmer and private owner, opting for small scale technical fixes. The water board took a middle position between technical and natural approaches, as will be explained in the (water) actions frame.

The no-regret frame was voiced by farmers, arguing for locally customized measures suitable under any climate scenario rather than a thorough water system rearrangement while climate change uncertainties remain high. In addition, area process aims were described as creating combinations of existing solutions and plans supported by sectors rather than developing new solutions.

5.3.3. The action frame

The most often mentioned solutions pertained to water quantity measures, other types of frames related to species migration and communication (see Figure 14).

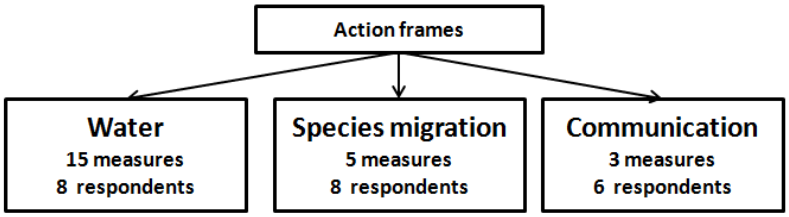

Figure 14. Summary of the action frame

5.3.3.1. The water related action frame

Water conservation was widely supported and the majority of water related measures concerned quantity rather than quality (see Table 17). Measures regarding *higher water levels* evoked controversy. Although water quality measures were sparsely advocated, the province, a conservation agency and the water board referred to solutions preventing sewer overflow. Conservation agencies and the province agreed that, depending on circumstances, (temporary or structurally) higher water levels were required to ameliorate foreseen drought. *Restoring the absorption capacity of soils* and *supplementary drainage* were not expressed as controversial during interviews.

Table 17. Promoted water related action

		Province (1)	Water board (1)	Conservation agencies (3)	Private owners (1)	Farmers (2)	Nr of resp.
	WATER QUANTITY						
1	Water containment	1	1	3	1	2	8
2	Climate/water buffer	-	1	3	-	1	5
3	Restoring sponge function	-	-	2	1	-	3
4	Supplementary drainage	-	1	-	-	1	2
5	Temporary water storage	1	1	3	-	2	7
6	Elevate water ways	1	1	1	-	-	3
7	Adjustment mowing waterways	-	1	-	-	1	2
8	Widen waterways	-	-	-	-	1	1
9	Farmers as water managers	-	1	-	-	2	3
10	Higher water levels	1	1	3	1	1	7
11	Compensating water damage	1	1	3	-	2	7
12	Ground water bubble	1	1	1	-	-	3
	WATER QUALITY						
13	Sewer adjustment	1	1	1	-	-	3
14	Reduction nutrients	-	-	1	-	-	1
	GENERAL						
15	Water as a steering mechanism	1	1	3	-	-	5
	Nr of water solutions	7	12	10	3	9	

Raising water levels, *water storage* and *sprinkler irrigation* evoked discussion pertaining to differing effects on sectors. Although not all farmers rejected higher water levels, strong resistance had developed among Baakse Beek farmers and residents due to fear for water damage, which was similarly distinguished by Weerkamp (2013). A farmer considered raising water levels non-negotiable because effects were far greater than acknowledged by the water board: loss of grass production, loss of grazing space and damage to crops and this view was shared by more farmers in the region. Another farmer assumed higher water levels had potential if more attention was paid to ways in which implementation could aid agriculture, for instance by maintaining discharge capacity by *widening water ways*. Such advantages should be communicated more effectively. Despite wide support for *temporary water storage* (Table 17), "who" and "how" evoked discussion. Conservation agencies feared contaminated water would seriously degrade vulnerable nature types, therefore were reluctant to store water in valuable nature areas. Similarly, it was assumed by these respondents that agricultural adaptation via an increase of sprinkler irrigation would enhance drought in nature areas. Conservation agencies nevertheless acknowledged agriculture's reliance on sprinkler irrigation thus considering farmers interests.

A *ground water bubble* could boost biodiversity under climate change, supported by the province, water board and a conservation agency, these three groups likewise advocated that water system conditions should steer spatial developments.

Overall, all groups supported water containment, temporary water storage and water quality measures lacked farmer support, and although a farmer supported higher water levels, a substantial part of Baakse Beek farmers and residents did not. They however would support technical measures such as supplementary drainage, adjustment of mowing water ways, farmers' weir management, widening water ways. The water board was both in favour of technical water management measures and creating more space for water via water buffers and applying water as a steering mechanism, thus revealing middle way between a technical and natural approach.

5.3.3.2. The migration related action frame

An altered climate would increase the necessity for facilitating species migration, as a majority agreed upon, see Table 18. Most often proposed were the National Nature Network, ecological connections, development of robust nature and landscape elements. The National Nature Network and ecological connections were considered of great significance for species migration, farmers supported the former's current set up and better maintenance however not its expansion. Achterhoek farmers revealed substantial support for (general and adaptation related) landscape care although compensation for time and investments would be required.

Table 18. Promoted species migration related measures

		Province (1)	Water board (1)	Conservation agencies (3)	Private Owner (1)	Farmers (2)	Nr of total respondents
	Facilitate migration	1	1	3	1	1	7
1	National nature network	1	1	2	-	1	5
2	Robust, large nature	1	1	3	-	-	5
2	Ecological connections	1	1	2	1	1	6
3	Landscape elements	-	-	1	-	1	2
4	Compensation nature management	1	1	1	-	1	4
5	Sodding	1	-	-	-	-	1
	Nr of migration solutions	5	4	4	1	4	

Overall, the research shows support for the National Nature Network, ecological connections and landscape elements; however, extra space for adaptation measures at the cost of agricultural lands would lead to resistance, although compensation would allow for negotiation.

5.3.3.3. The communication related action frame

Several respondents pointed to communication problems during the area development process and the ways in which communication should be improved. One of the suggestions concerned the need to raise more awareness among the practitioners. A coherent story, explicitly visualising climate change impacts on nature, agriculture, recreation, water management and interlinkages was deemed

a good way of increasing awareness (see Table 19). The water board coordinated the story development and farmers, private owners and conservation agencies expressed willingness to communicate this story to their constituency. In addition, particularly farmers assumed raising water levels would require better communication and they referred to an LTO confidante report (Weerkamp, 2013). This report identified that increased farmer distrust regarding adaptation stemmed from the presentation of the communication process as "innovative decision making with the local stakeholders via open dialogue". Farmers disputed the existence of an open dialogue since they had learned of Aaltense Goor plans late in the plan phase. The report asserted that stakeholders considered themselves to be ill-informed regarding Aaltense Goor project. In addition, these higher water level plans used indiscriminate water management terminology: retention, water containment, restoring the sponge function and whether this would pertain to surface or ground water was left vague. Farmers therefore urged for clearer communication of goals, actions and consequent terminology and clarification of the ways in which agriculture would be affected by adaptation measures for nature (see Table 19).

Table 19. Promoted communication measures

		Province (1)	Water board (1)	Conservation agencies (3)	Private Owner (1)	Farmers (2)	Nr of total respondents
	Better communication	1	1	2		2	6
1	Develop story	-	1	1	1	1	4
2	Consistent terminology	-	-	-	-	1	1
2	Practical implications other sectors	1	1	-	-	2	4
3	Clarity plans and goals	1	1	-	-	2	4
	Nr of communication solutions	3	3	2	1	2	

Table 19 shows the attributed importance of communication within the adaptation process and need for improvement; the fact that farmers and the water board have the most concrete ideas can be connected to the conflict.

5.3.3.4. The responsibility frame

In general, three frames could be distinguished: the government as facilitator and land users as executors of adaptation measures that together share the responsibility of adaptation, see Figure 15.

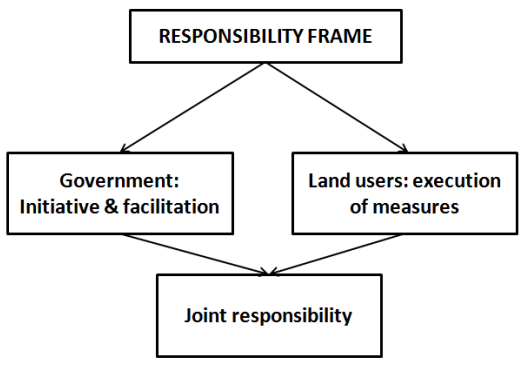

Figure 15. Summary of the responsibility frame

There was a distinct agreement that the organisation of adaptation for nature should not solely be the government's responsibility but civil organisations, farmers and citizens should equally be involved, their interests likely to be affected. Farmers wanted to take more responsibility for nature in terms of landscape protection, however, market pressures to scale up and lack of compensation would complicate farmer intentions. In Table 20 the self-attributed responsibilities are displayed.

Table 20. The self- attributed responsibilities of practitioners

	Province (1)	Water board (1)	Conservation agencies (3)	Private Owner (1)	Farmers (2)	Roles mentioned
Agenda setting	1	1	3	-	1	6
Knowledge creation	1	1	1	-	1	4
Stimulate international adaptation efforts	1	-	-	-	-	1
Stimulate (inter-) provincial adaptation efforts	1	-	-	-	-	2
Stimulate regional adaptation	1	1	3	1	2	8
Formulating an adaptation vision	1	1	-	-	-	2
Formulating solutions and strategies	1	1	3	-	2	7
Initiating adaptation	1	1	-	-	-	2
Spatial & legal instruments	1	-	-	-	-	1
Executing adaptation management	-	-	3	-	1	4
Risk assessment	1	1	-	-	-	2
Nr of tasks	10	7	5	1	5	

Nearly all respondents had experience with climate adaptation projects for nature areas, except for farmers and private owners. None of the organizations, except the province and water board, had explicitly formulated adaptation goals. Apart from the private owners, becoming more engaged in adaptation was considered feasible by all. Private owners supported adaptation yet considered it a task of the government, not of the individual owner. In general parties looked towards the government for initiative; regional parties found that taking the initiative for adaptation was too risky and uncertain without the government providing some form of support. All, including the province and water board, considered the province and water board key players. The water board was seen as a critical initiator and the water board similarly considered itself a leading organisation in the development of adaptation. The water boards' main aim was to generate far more awareness among the various practitioner groups and restore trust between parties. More intensive interprovincial cooperation with the provinces with similar problems related to elevated sandy soils and stream valleys was considered critical by the province of Gelderland, to learn from each other's experiences. Noord-Brabant, Gelderland and Limburg already cooperated on this subject; however, it was still very

uncertain whether the provinces of Overijssel and Drenthe would be motivated to prioritise adaptation of nature conservation and join interprovincial cooperation.

Table 20 shows the province and water board attributed themselves the most responsibilities. The former displayed willingness to play a facilitating role, once regional parties made their adaptation goals more explicit. Overall, farmers considered their main roles to engage in adaptation implementation and regional cooperation regarding nature conservation, however did not make concrete specifications regarding their responsibilities. Conservation agencies saw their main role in the implementation phase, yet as Table 20 shows these actors had several ideas for the ways in which they could contribute, if given the means to do so, which offers opportunities for involving them throughout the process.

5.4. Discussion of results

This section will provide explanations why practitioners framed adaptation in particular ways, and ascertain whether there is a meta-framing or practitioner related frame patterns.

PROBLEM & CAUSAL FRAMES Most of the climate change problems, opportunities and vulnerabilities for nature were water dominated, which can be connected to the following factors: the water boards´ role, financial opportunities and policy formulation, and specific soil and water related case characteristics. Regarding the latter aspect the water board, and province and two conservation agencies explicitly projected other nature conservation areas were likely to experience different problems than stream valley areas which have infiltration problems. This reveals the local contingency of frames. Agricultural drainage was considered an additional stress factor in times of climate change, frequently mentioned. The water board played a central role due to their climate change modelling, area development process management, raising climate change awareness and conflict mediation. Importance of policy formulation was stressed by conservation agencies and the province: the explicit formulation of water related climate change problems as policy issue endowed it substantial policy support and budget. Acquiring funding for nature related adaptation was considered difficult; the central government prioritized adaptation focused on water security rather than adaptation issues connected to nature, although this seemed to change slowly. Therefore water quantity related frames seem better developed at the policy level, compared to other adaptation issues.

The lacking awareness among (part of) farmers regarding climate related drought, flooding and water quality impacts on nature amongst others seems connected to information reception and credibility. Some farmers feared the “climate agenda” hid a “nature agenda” conflicting with their interests. Furthermore, farmers argued that climate information was often too abstract, insufficiently linked in a practical sense to their interests, incorporated insufficient local knowledge and modelling information ran counter to local experiences and sometimes lacked credibility among farmers. This underlines the importance of communication and information. At the Baakse Beek stakeholder meeting which I visited, none of the present farmer representatives questioned climate change, although it was argued farmers were generally more occupied with daily operations than climate change and some farmers in the region had expressed their doubts about climate change.

SOLUTION FRAMES Nature goals in general and adaptation related revealed subject of heated debate and strategic framing, making it difficult to ascertain positions. Furthermore, the water board,

private owners and one of the conservation agencies were reluctant to take a clear stance which can be related to debate about hard or soft nature goals. A meta-frame could be distinguished in the solution frame, revealing preferences for either a "natural or technical approach", or a combination of both, as the frames of the water board showed. This meta-frame showed conflicts regarding the natural system approach urging for more room for water and nature, which was not supported by farmers and private owners. The latter generally relied on small technical solutions, which would maintain current water and spatial arrangements. These practitioners asserted that increased flooding and drought risk for nature should be accepted, rather than radically altering the system (functions). Adherents of the natural approach advocated the opposite: functions should be re-arranged to fit the climate altered system. The water boards' preferences showed a combination of the natural and technical approach.

Overall, several solution frame elements signalled a frame conflict. A "dialogue of the deaf" had involved non-negotiable issues, a lack of trust, the prior stalemate and practitioners talking past each other[26]. Stalemate about higher water levels and removing of weirs in the Aaltense Goor endured approximately two years[27], the water board postponed adaptation plans to create more stakeholder support. The plan to raise water levels revived memories of the Lichtenvoorde flooding, which had caused considerable agricultural damage. Several respondents similarly attributed farmer resistance to land scarcity and farmer competition, EU milk quota being abolished which urged scaling regional milk production. At the end of 2013 the immediate conflict was resolved by bringing in new findings into the adaptation process. The water board assembled a local stakeholder working group which re-assessed the water system's functioning, combined local knowledge and water board data. Field work showed that extreme precipitation would lead to quickly rising water levels and poor infiltration; water levels were higher than the water board previously asserted. Rather than raising water levels, blue grass nature development was framed as the new Aaltense Goor project goal. Despite conflict resolution, trust remained fragile.

The strategy and action frames displayed strong preoccupations with sector and status quo interests, and a tendency towards financial and organisational risk avoidance. Nature management awaited greater drought problem awareness, whereas farmers considered nature management insufficiently aware of possible agricultural water damage of climate change and raising water levels, these differing sector oriented problem frames complicated the practical realisation of integral adaptation. Practitioners furthermore mainly proposed common nature management practices (provinces, conservation agencies) and solutions upholding the water and spatial distribution (farmers), novelty was aimed for by combining politically feasible, existing practices rather than developing entirely new measures (water board). Likewise the solution frame showed dominance of the water quantity issues, which can be linked to the certainties this domain offers in terms of available financial and policy resources. This frame dominance could as well be connected to greater climate change related scientific, political and financial uncertainty experienced in other impact domains (species, forest fires, soil).

RESPONSIBILITY FRAMES This frame pointed to difficulties of allocating the responsibility for potential damages of adaptation, the lack of trust between sectors and who should bear the risk of

[26] A farmer stated it was time people started talking with instead of about each other.

[27] A report by the area development confirmed the strong aversion among farmers against measures that aim to raise the water level or decrease drainage (Weerkamp, 2013).

adaptation investment. According to Weerkamp (2013) farmers considered provincial funds offered for adaptation related water damage compensation and agricultural structure improvement as "bribery" and a lack of genuine interest in agriculture, which shows how lacking trust between sectors can render compensation measures ineffective for securing farmer support. Dependence on the province and water board for adaptation initiation can be explained by organisational risks being perceived as too high by conservation agencies and farmers. The former stated to lack capacity (manpower and funds), whereas the latter pointed to difficulties of breaking even via contemporary agricultural nature management, which make adaptation in this context unattractive.

An overarching meta-frame could be distinguished, summarizing the way in which practitioners generally framed climate adaptation as a "matter of drought and flooding", these issues abundantly represented in the problem, causal and solution frame elements. However, conflict and a lack of agreement were visible in most frame elements. On the one hand specific frames were solidified and revealed non-negotiable issues yet on the other hand frames showed switching of positions and reluctance to take clear positions regarding nature goals. The frame analysis revealed that the area process moved too quickly from problem analysis to solution implementation without reaching sufficient consensus regarding the urgency of problems and solutions acceptable for the affected sectors.

A number of frame patterns specific to respondent groups could be identified. Farmers and private owners framed water quantity changes in nature areas as inevitable climate change consequences, the phenomenon itself accepted. This acceptance could not be generalised to the farmer population, certain Baakse Beek farmers and private owners were assumed to be climate change sceptics and the farmer majority thought to be more occupied with daily agricultural operations. Interviewed farmer respondents furthermore argued that increased drought and flooding risks should be accepted by nature conservation, prevention would become too costly. Farmer frames revealed status quo preferences conflicting with adaptation measures rearranging the contemporary spatial division, higher water levels considered non-negotiable by a number of farmers. Conservation agencies mainly framed climate adaptation as the need for adapting the water system in nature areas. The water boards' frames showed clear problem ownership and the same can be stated of the province. The former however mainly prioritized water quantity measures, whereas the province displayed broader long term ambitions with regards to specific species protection[28].

5.5. Consequences for adapting Baakse Beek nature conservation to climate change

This section will be devoted to the answering of research question 3 and projecting the possible ways of adapting Baakse Beek nature conservation to climate change by assessing the degree of consensus, sense of urgency and whether influential actors support or block adaptation action and how this may affect adaptation.

[28] The province aimed to generate individual species risk assessments, stimulate the development of international climate corridors with Germany to allow greater species migration, facilitate knowledge exchange about individual species, which is scattered between nature interest organisations, by hosting a climate adaptation symposium.

The analysis of problem and solution frames revealed an overall lack of a clear consensus among practitioners although a meta-frame could be identified: “adaptation as a matter of drought and flooding”. Greatest agreement existed regarding the problem of drought and its alleviation between the province, conservation agencies and water board. Conservation agencies and the province preferred a more natural approach to adaptation, compared farmers and private owners who were more occupied with possible agricultural effects and generally preferred technical (water quantity related) solutions. Therefore the development of adaptation is likely to predominantly focus on water quantity related measures, subsequently elaborated upon. Future broad coalitions are not self-evident due to the lack of trust between sectors. The water board has potential to play a vital bridging function because of its intermediary position (understanding the technical and natural approach and intent to increase support for nature related adaptation among farmers and private owners). In addition, adaptation can be expected to strongly rely on existing frameworks, since conservation agencies, the province and water board frequently advocated existing nature management practices, and farmers and private owners favoured no-regret approaches which maintain the contemporary spatial and water division.

The province and water board were the most important actors for short term adaptation efforts due to their sense of urgency, knowledge and intent to facilitate adaptation. Of all practitioners, the water board and province displayed the greatest sense of urgency to develop adaptation, most of all regarding climate aggravated drought and flooding, drought considered the greatest problem. The province had the most elaborate and comprehensive risk frames, and intended to take short term action[29] by prioritising drought alleviation and the completion of the National Ecological Network. Conservation agencies, although revealing considerable agreement with the province and water board, are less likely to play a great role on the short term. These actors stated to be more policy following than initiating, and of the two conservation agencies displaying urgency one argued to lack the financial and organisational means to develop adaptation independently or lead adaptation, as process management was considered costly. In addition, contemporary issues were often deemed more urgent by farmers, conservation agencies and private owners.

Farmers can be assumed to play a key role in adaptation due to their ability to block adaptation. Pursuing higher water levels could lead to prolonged stalemate with farmers. Land claims could equally lead to conflict with individual farmers but were negotiable. Overall, the association of private owners are unlikely to play a major role in initiating adaptation, primary lobbying for greater freedom of land ownership and land use which prevents them from directing their individual members. Moreover, adaptation within private nature management was not considered the responsibility of individual private owners but of the government. Furthermore, voluntary adaptation via these actors is unlikely to develop on the short term and in a structural sense. Nevertheless, on an individual level these actors can be expected to be open to negotiation regarding technical, small-scale, no regret adaptation, as well as adaptation via landscape care as long as sufficient compensation is provided.

[29] Drought and forest fires were assumed to pose high risks, species in general and nutrient poor environments would be at risk whereas flooding, water quality and soil would provide less risks, an adequate risk assessment for individual species currently was lacking.

5.6. Concluding remarks

This analysis revealed apparent agreement between problem owners and conservation agencies but less so with agrarians and private owners. Although recently the conflict was mediated, the existence of non-negotiable issues and brittle trust between sectors is likely to slow down the development of adaptation. Content related disagreement played a role but process and relational aspects (trust, communication and stakeholder involvement) impeded practitioners from meeting one another on the middle ground. This case study however showed the potential role that the water board can play in mediating conflicts and raising awareness.

6. CASE COMPARISON

In this chapter the frame patterns of the two case studies will be compared regarding similarities and differences in terms of frame content, consensus, sense of urgency and the degree to which adaptation measures in this domain were met with support or conflicts.

6.1. Similarities

Although in each of the cases a similar meta-frame could be identified which illustrated practitioners primarily framed climate adaptation as “a matter of drought and flooding”, in both cases the consequences of climate change for conservation were differently assessed in terms of severity and preferred solutions, revealing an overall lack of consensus. In both cases, the most significant frame discrepancies existed on the one hand between the frames of conservation agencies, provinces and water boards, and those of farmers and private owners on the other hand. Whereas the former groups considered drought as the main climate change problem for elevated sandy soils and therefore focused mostly on drought amelioration and secondly on flooding, farmers and private owners’ frames were overall less detailed. In both cases farmers (and farmers in general) were generally reported to have little attention for climate change effects on nature, which could be explained by their pre-occupations with daily agricultural operations. And if climate change was considered a realistic development, the potential effects on agriculture rather than nature were prioritized by these groups.

In either of the cases, a solution related meta-frame could be identified, “the natural versus the technical adaptation approach” which affected the ways in which certain practitioner groups perceived climate change risks for nature conservation. The natural approach, the utilization of the natural (water) system and creating additional space for water and nature to absorb climate change impacts was generally preferred by conservation agencies and provinces. None of the farmers and private owners opted for a natural approach and this group commonly was more technology oriented. A certain degree of compatibility between these approaches was visible in the intermediate position of the water boards and their potential to bridge these ways of working. Furthermore, this meta-frame revealed how farmers and private owners trust in technical adaptation solutions lowered their risk perceptions, and the majority of conservation agencies risk perceptions decreased by trust in the success of the natural approach. Provinces and water boards more often warned for overestimating the effects of climate adaptation, as it was asserted that nature targets were often far from realised.

A focus on existing and the more politically and financially secure adaptation measures for future adaptation was seen in both cases. This expressed itself in the frame dominance of climate change problems with greater perceived scientific, financial and political certainty, particularly visible in the meta-frame climate adaptation as “a matter of drought and flooding”. In this domain practitioners identified more resources and policy to facilitate adaptation of nature conservation, whereas measures regarding water quality, individual species, fire risks for nature areas and soil were assumed to lack general political support and resources. This pattern was similarly visible in farmers and private owners’ preferences for working with the existing measures respecting the status quo water and land division rather than developing novel measures. Similarly, in their daily practices conservation agencies were more occupied with addressing contemporary environmental stresses

than the ways in which ecosystems would respond to climate change. This preoccupation with contemporary nature management and novelty of climate adaptation may explain why, when asked for their preferred ways of adaptation the standard nature management solutions were proposed by this group: enlargement and increasing connectivity. Another explication concerns the lack of available risk assessments regarding localized species specific adaptation. Furthermore, improving contemporary (a)biotic environmental conditions was assumed to decrease the vulnerability to climate change. The novelty of climate adaptation may explain why conservation agencies had not formulated ways of dealing with nature goals.

In both cases, the **sense of urgency to take action** was lacking among private owners, farmers and some of the conservation agencies. These practitioners had not yet clearly defined their responsibilities, regarded other contemporary issue more urgent and awaited policy and other ways of facilitation. Conservation agencies were policy-following and dependent on governmental facilitation, and lacked either resources or urgency to take leadership, or develop adaptation independently of other parties. In addition, farmers and private owners revealed reluctance to realise adaptation in nature management on a voluntary basis[30]. Provinces and water boards generally revealed the greatest urgency and willingness to initiate adaptation and acted as problem owners. They were also seen by other practitioners as the legitimate parties to initiate adaptation due to their assumed impartiality, regional overview and resources. Moreover, the perceived legitimacy of water boards leadership was strongly connected to respondents framing climate adaptation as a water quantity issue and practitioners' acclaims of the water board's climate change expertise. In both cases, the role of land owners and users was mainly defined as implementers of adaptation, although it was considered logical that these actors would be consulted regarding their interests from the beginning of the adaptation process. In practice this appeared more complicated to realize as section 6.2 will show.

The results indicate that in each of the cases private owners and farmers similarly displayed little support for alternate land and water divisions, which was reported to represent the view of the many farmers and private owners in these regions. The research showed that a lack of support for nature conservation was not the root of potential conflict or resistance, but rather the fear for water damage and reluctance regarding farmers role of sole land suppliers for urban, nature and infrastructural developments. Pilot projects showcasing the effects of higher water levels were lacking, making it more difficult for the provinces to show to what extent agricultural water damage could be expected. Nevertheless, differences regarded the degree of conflict potential, which can be explained by several case characteristics, further debated in the next section.

6.2. Differences

Although in both cases a potential for conflict for could be recognized, evolvement of future climate adaptation for nature into full-fledged stalemate was more evident in the Baakse Beek than in the Tungelroyse Beek. Several local factors can explain this: degree of trust and communication between sectors, land use, and hydrological circumstances. The importance of trust and beneficial working relations was illustrated in both cases. In the Tungelroyse Beek area respondents often referred to constructive cooperation between the agriculture and nature sector. Even during prior budget cuts

[30] Compensation could be financial but also a relaxation of business taxes, manure surplus rules or allowing project development in specific areas in return for developing nature related adaptation.

on nature conservation of the Bleker administration. On the contrary, because of the lacking governmental drive in this period the discussions between sectors about adaptation of nature conservation came to a halt. One of the farmers: “If there are no concrete and tangible goals from the central government for nature why should we keep talking?” General talks about climate adaptation continued but nature interests were, largely, left out of the equation. This seemingly had less to do with support for nature but rather the way prior conflicts gave farmers the idea that their interests were not considered. Distrust between sectors impeded conflict mediation via compensation, yet a process of bringing in new evidence via practitioner involvement allowed novel discussions about adaptation plans. Nevertheless, trust was reported to remain brittle, which could explain why farmers urged for “hard” rather than “soft” norms (i.e. robust nature).

Other factors contributing to the stalemate were land use/division and hydrological characteristics. The fact that Baakse Beek agricultural land was divided among a few farmers with large parcels, the opposite pattern in the Tungelroyse Beek, was reported to increase the bargaining power of Baakse Beek farmers, and thereby their ability to block adaptation plans involving higher water levels. In addition, Baakse Beek farmers felt the urge to scale up due to the European Union’s milk quota repeal and looked for additional space, rather than expressing willingness to provide land for adaptation. Tungelroyse Beek agricultural land division was characterised by small scale, mixed agricultural production and farmers expressed eagerness to cooperate with water board and conservation agencies to develop extensive farming via agricultural nature management. A Tungelroyse Beek farmer and a province assumed that it was therefore possible to surpass the few farmers resisting nature conservation plans.

In terms of urgency for adapting nature conservation to climate change and general awareness of climate change certain differences could be identified. Firstly, Baakse Beek conservation agencies displayed greater urgency than their colleagues in the Tungelroyse Beek, nevertheless, lacked the capacity to translate this urgency to action. Secondly, farmers and private owners in the Baakse Beek did not question climate change as much as their Tungelroyse Beek counterparts and the former seemed to considered climate change more as a given fact. Thirdly, although all provinces showed more urgency than most conservation agencies, farmers and private owners, there was also a clear difference in adaptation ambition level between the three provinces. Whereas one of the provinces expressed that they did not consider themselves frontrunner in the field of adaptation, two other provinces displayed great ambition for adapting Dutch nature conservation to climate change on the short term.

The prominence of adaptation in the Baakse Beek area development process and Knowledge for Climate research could explain why farmers and private owners were generally more aware of climate change. Likewise, the flooding of Lichtenvoorde in 2010 could have contributed to climate change awareness. In the Tungelroyse Beek there was no area development process in which regional parties structurally debated climate change and sectors goals for the area and climate change research has a shorter regional history. Nevertheless, greater climate change awareness among Baakse Beek farmers and private owners did not result in problem awareness regarding impacts on nature. It rather increased fear for agricultural water damage and contributed to greater urgency to adapt agriculture to climate change, thus greater climate change awareness does not necessarily translate into support for multifunctional, nature inclusive adaptation.

7. DISCUSSION

This chapter firstly features a discussion of general methodological considerations. Thereafter the main findings are compared with adaptation literature, followed by an examination of the findings generalisability regarding the adaptation of Dutch nature conservation and what may be expected in terms of consequences within the next decade.

7.1. Methodological considerations

7.1.1. Data collection

In the first stage of the research the choice was made to operationalize Entman's frames for achieving greater content validity (according to Vliegenthart & Zoonen, 2011; Matthes & Kohring, 2008). A more elaborate analytical framework could have provided additional insights, however was unfeasible given the timeframe. During data collection two factors could have affected the validity of findings: the data collection process (Schreier, 2012) and social desirability (van Gorp, 2007; Schreier, 2012). Data were collected by different interviewers (Van Kouwen and Van Dijk collected initial Baakse Beek data) at alternate times (2010 and 2013). Given the dynamic nature of frames, practitioners' views about climate change could have altered. To warrant internal validity, the 2010 respondents were re-interviewed. This corroborated earlier data. In addition, the Van Kouwen and Van Dijk interview questions served as a basis for my interview questions. Furthermore, socially desirable answers were assumed regarding part of the responses about nature goals. Therefore, the possibility of social desirable answering was explicitly mentioned in the relevant section. Socially desirable responses nevertheless could have remained undetected, although respondents generally answered in a candid manner. The interview questions are added in Appendix B to ensure reproducibility and data collection reliability.

7.1.2. Data analysis

In the stage of the data analysis the following aspects could have affected the data interpretation: researcher bias, the data categorization and extrapolation of findings (Schreier, 2012). Frame analysis is sensitive for researcher bias and may lead to discovering frames one is looking for (Van Gorp, 2007). Therefore the structure of Entmans frame elements was used. Based on Schreier's advice, the number of frame categories was minimized since working with more than 60 categories invites for errors. With the amount of data (19 interviews of approximately 1,5 hour each) loss of detail is unavoidable. Content validity was warranted by providing respondents with interview summaries and the opportunity to correct findings, all except for 2 respondents replied. This led to adjustments on detail level yet overall, respondents approved the summaries. Personal scrutiny nevertheless remains inevitable in frame analysis as Van Gorp and Schreier argue. Furthermore, latent or ambiguous meaning can complicate placing text units under one rather than multiple categories (Schreier, 2012), for instance when respondents took a conditional stand, such as not clearly having a preference for either a technical or natural approach. A solution was found by debating conditional stances in the discussion of results sections. Although the re-interviewing of 2010 respondents did not reveal changed views, in theory frames may change over time as Schreier (2010) states, therefore extrapolation is limited to the next decade.

7.2. Discussion of the main findings

The research presents three main findings:

1. Climate adaptation was framed as a water quantity issue, in this domain the most problems, vulnerabilities, solutions and resources were identified by the majority of practitioners.
2. Water and land claims to adapt nature to climate change were recognized as sensitive issues that could lead to conflicts or stalemate with agriculture.
3. Although considered a shared responsibility of practitioners, a clear allocation was discerned: the provinces and water boards as initiators and land owners and users as implementers of adaptation.

The consecutive steps were taken to assess what these results imply. Firstly, in the next section adaptation research is compared with practitioner frames, to ascertain whether practitioners' views are corroborated by research and what can be expected for the Dutch practice. Literature review furthermore will indicate whether these findings constitute novel, conflicting or corroborating insights. Secondly, the study's generalisability will be discussed. Lastly, the potential consequences for Dutch nature conservation are explored and hypotheses for further research presented.

7.2.1. Climate adaptation as a water quantity issue

In this section the finding that climate adaptation was largely regarded as a water quantity issue will be discussed.

7.2.1. State of the art adaptation research

Climate change related risks and opportunities for Dutch nature have recently been explored in a governmentally commissioned risk assessment preparing the 2016 National Adaptation Strategy (Braakhekke et al., 2014). This risk assessment offers general, nation-wide and regionally anticipated risks. The "elevated soils" regions were considered the most vulnerable for altered precipitation and evaporation patterns. These climate change variables are projected to exacerbate contemporary drought, flooding and water quality deterioration. The elevated sandy soils' vulnerability to climate change assumingly are increased due to agricultural drainage, irrigation and straightening of many stream valleys (Braakhekke et al., 2014; see also Blom et al., 2009). Furthermore, large scale forest fire risks are expected to increase substantially (Braakhekke et al., 2014), the highest risks are predicted for elevated sandy soils (for the majority of Dutch forests: medium to low risks[31], see Verkaik et al., 2009). Loss of genetic diversity and species extinction risks apply for the whole of the Netherlands (Braakhekke et al., 2014; Cobben et al., 2012; PBL, 2010), although considerable uncertainty on a local species specific level exists (Cobben et al., 2012; Bodegom et al., 2013). Water quality and quantity related risks generally urge for concern (PBL, 2012; Vos et al., 2007; Van Bodegom et al., 2013), particularly combinations of extremes as drought and oxygen stress[32] can be fatal for ecosystems (Van Bodegom et al., 2013).

The importance of water related problems and solutions are clearly explicated in literature. Manifold water quantity and quality solutions are critical according to Braakhekke et al. (2014), and a hydro-

[31] Ecosystems in the Netherlands can generally recover from small fires, yet large scale fires, in combination with a fragmented nature can create substantial ecosystem damage (Verkaik et al., 2009).

[32] A rise in temperature induces lower aquatic oxygen levels, thereby negatively affecting aquatic life, also considered a high risk in the Netherlands (Verweij et al., 2010).

ecological adaptation approach is considered necessary (Van Bodegom et al., 2013) for successful adaptation. Moreover, water and nature management integration should be a key priority of Dutch adaptation strategies (de Bruin et al., 2009). The role of contemporary environmental stresses urges for addressing contemporary nature problems by improving the abiotic conditions (Heijmans & Berendse, 2009; Vos et al, 2007; PBL, 2012). The improvement of nature areas' connectivity and size are measures advocated in Dutch and international literature (Braakhekke et al., 2014; PBL, 2012; Vos et al., 2007; Opdam & Washer, 2004; Heller & Zavaleta, 2009; Millar et al., 2009). In addition, three ways of approaching nature goals are identified: species and habitat specific nature goals, more flexible goals and a mix of these approaches (Millar et al., 2009; Heller & Zavaleta, 2009). Braakhekke et al (2014) urge for a flexible approach.

Similarities between practitioners' frames[33] and adaptation research concern: the focus on water problems and solutions, uncertainties regarding localized species specific impacts and the need for increased area enlargement and connectivity. The main differences involve practitioners' general and specific risk assessment, and nature goals. Whereas studies generally express high risks for nature in general (Vos et al., 2007; Van Bodegom et al., 2013; Braakhekke et al., 2014; PBL, 2012; Heijmans & Berendse, 2009), practitioners frequently expressed more urgency regarding contemporary nature issues. Furthermore, risk perceptions (by land owners and users) were frequently tempered by a-priori assumptions of adaptation success. O'Brien, Sygna & Haugen (2004) warn for unwarranted optimism based on a priori assumptions about adaptation goal achievement as climate change may develop more rapidly and with unexpected consequences. Furthermore, risks regarding water quality, genetic diversity loss and forest fires were overlooked by practitioners. Whereas in literature high levels of uncertainty were an argument for abandoning species and habitat specific nature goals (Kramer & Geijzendorffer, 2010; Millar et al., 2009), practitioners frequently advocated a mixed approach due to species specific uncertainty. What these similarities and differences between practitioners and the scientific perspective are expected to mean for the Dutch adaptation practice will be debated in section 7.2.3.

7.2.2. Generalisation

Although other Dutch regions have not been investigated, water related adaptation can be expected to be a main focus within the broader Dutch nature conservation and adaptation context. Firstly, this study illustrated that climate change effects and local vulnerability factors posing substantial risks need not necessarily be recognised by practitioners. And as Wildavsky (1979) argued, solutions in seek of problems may steer political action. Nonetheless, abovementioned research illustrated that water related impacts indeed pose significant problems for Dutch nature and ditto solutions are urgently needed. Secondly, the logic behind organising provincial adaptation of nature conservation in water rather than ecological departments is telling: these departments offered more innovation, funding and supporting policy opportunities than the ecology departments. Furthermore, several respondents suggested a greater preoccupation by the national government with water security adaptation than adaptation of nature. Thirdly, literature and policy documents suggest that water issues are nowadays and in the future the key priorities in Dutch adaptation efforts, both nationally and locally.

[33] This similarity relates to the abstract level and not the detailed level where practitioners did not agreed on severity and solution types.

The assessment of European national adaptation strategies (Mickwitz et al., 2009) revealed that Dutch national policy makers mainly framed adaptation as a subject of water management and overlooked domains as agriculture, nature or tourism. Biesbroek et al. (2010) similarly established water management as a priority in the Dutch National Adaptation Strategy (see Table 2, p. 443) whereas biodiversity and nature conservation were lower on the priority list. Furthermore, Hoppe et al. (2014) argued that the Dutch Delta-program was largely considered in terms of water safety and fresh water, the water focus explained by the traditionally strong Dutch water sector and available water resources. Furthermore, the Rijksnatuurvisie (De Groot, 2014), the Natuurambitie Grote Wateren (Dijksma, 2015) and the OECD report "Water Governance in the Netherlands, fit for the future?" (OECD, 2014) urge to couple nature adaptation as much as possible to water related adaptation plans. This fits within a general tendency of coupling nature conservation to water developments, set in motion[34] amongst others because of the large number of planned water projects (Hattum et al., 2014). Local Dutch adaptation initiatives, infrequently empirically investigated, often revolve around water management whereas other adaptation subjects have not yet been picked up structurally (Exeter et al., 2014; Van den Berg, 2011; Hoppe et al., 2014). As Berg states regarding the municipal level "Adaptation is now heavily dominated by the water department, while spatial planning and the environment are only limitedly involved" (Van den Berg & Coenen, 2012, p. 441).

7.2.3. Expected consequences

Based on the urgency expressed in Dutch adaptation research regarding the need to address water quantity and quality issues, practitioners focus on water quantity matters and the availability of water related adaptation plans and resources, the following hypothesis was formulated:

Hypothesis 1: Climate adaptation of Dutch nature conservation is likely to focus on water issues

This hypothesis raises the question to what extent a water focus will benefit adequate adaptation of Dutch nature conservation. On the one hand, a water oriented approach is supported by practitioners and studies pointing to manifold water related climate change impacts that substantially harm biodiversity and ecosystem functioning (Van Bodegom et al., 2013; De Bruin et al., 2009; Braakhekke et al., 2014) and water related funding and policy opportunities (Van Hattum et al., 2014; Hoppe et al., 2014) that the nature sector may not provide. Furthermore, a water oriented adaptation approach may allow for greater inclusion of nature interests in water management in relation to agricultural water claims. On the other hand, the differences between practitioner frames and academic perspectives shows that a water dominated approach may not generate sufficient action for other impact domains representing significant risks (e.g. forest fires or genetic diversity loss). The water focus could lead to a reductionist manner of understanding climate adaptation causing other adaptation issues to be obscured (Hoppe et al., 2014). This possibility of risk obscurement may be enhanced by the reliance on the success of adaptation in advance. No stance is taken regarding the issue of nature goals, yet this thesis indicates that more risk knowledge regarding climate change effects on local species and ways of adaptation are required for practitioners to determine adequate species specific approaches and a clear strategy regarding nature goals.

[34] This development however was delayed during the Bleeker administration (Van Hattum et al., 2014).

7.3. Water and land claim related conflicts

In this section the finding that water and land claims for Dutch adaptation of nature conservation can lead to conflicts with agriculture will be discussed.

7.3.1. State of the art adaptation research

Tensions and conflicts between the agricultural and nature sector regarding water and land claims are common within Dutch nature conservation (Smit et al., 2008) and prior conflicts between these sectors are presumed to complicate multifunctional adaptation (Braakhekke et et al., 2014) particularly expected in relation to future water management and spatial planning (Schaap et al., 2014). Furthermore, climate adaptation can amplify existing conflicts (Adger et al., 2005). Factors that can aggravate conflict are a further intensification of agricultural land and water use which can be expected to pose challenges for spatial and water needs of nature. Most future scenario's until 2050 anticipate Dutch agriculture to remain the largest land using sector and an increasing intensification of land and water use (Bleumink, 2014).

This thesis illustrated the ways in which prior and contemporary conflicts between nature and agriculture can affect adaptation of Dutch nature conservation (similarly pointed to by Braakhekke et al., 2014), and corroborates research by Bleumink (2014) and Schaap et al (2014) pointing to potential conflicts regarding water and land claims. The expected consequences are debated in 7.3.3.

7.3.2. Generalisation

For several reasons it can be expected that adaptation related water and land claims will generally be sensitive issues within the adaptation of Dutch nature conservation. First of all, because several practitioners, including senior advisors of the farmer interest organisation LTO[35] asserted a widespread fear of agricultural water damage among Dutch farmers. This fear can lead to resistance when adaptation measures are *believed* to cause agricultural water damage, which is a novel finding. Similarly, a reluctance of Dutch farmers regarding their role as sole land supplier for various urban, nature and infrastructural developments was asserted by interviewed farmers and their interest organisation. Secondly, the abovementioned studies in the fields of agriculture, water management and conservation pointed to the likeliness of water and land related conflicts between the nature and agricultural sectors.

Local factors however will determine whether conflicts will lead to stalemate, or can be prevented or mediated: the novelty of measures in the region, lack of pilot projects showcasing effects on other sectors (Braakhekke et al., 2014) and trust between sectors (Van Hattum et al., 2014). Another option for mediation involves making diverging sector related land and water claims more commensurable, for instance "water as a steering mechanism", described in literature as "spatial function follows water level" (Bleumink, 2014; Grandiek, van Herk & Cronenberg, 2007; Grashof-Bokdam, Raymakers & Tersteeg, 2007; Brouwer & Huitema, 2007). The use of less valuable nature for water containment can also strengthen societal support for the adaptation of nature

[35] Given the central positions and familiarity with the general Dutch situation of LTO senior policy advisors interviewees, as well as similar views expressed by interviewed farmers, this view is considered credible.

conservation, which would decrease climate change induced agricultural water damage, according to practitioners.

7.3.3. Expected consequences

Based on the role that water and land claim conflicts nowadays play in Dutch nature conservation, and projections from literature the following hypothesis was generated:

Hypothesis 2: If the adaptation of Dutch nature conservation requires structural changes in agricultural land and water use, conflicts between the agricultural and nature sector can be expected to develop or aggravate.

This suggests a need for conflict prevention and mediation to establish nature related adaptation goals. This empirical study contributes to research stipulating the importance of trust between sectors for nature-inclusive multifunctional adaptation (Braakhekke et al., 2014), which is similarly argued to be critical for the coupling of nature interests to water developments (Van Hattum et al., 2014). Moreover, trust between sectors may be a more determining factor as motivator for adaptation and conflict mediation than compensation, as the case study showed[36]. In addition, closer cooperation between sectors is required for developing commensurating solutions. Furthermore, given the expected importance of future water related climate change impacts, and thereby water management and water related funding and resources, the water boards can be expected to play an important role in conflicts. This case study showed how the water boards aimed to bring parties together and mediate conflicts however also a reluctance[37] to push solutions that are not supported by farmers or alter spatial functions (which is a provincial discretion). This shows that balancing competing nature and agricultural interests may pose a challenge for water boards, which seems to be a challenge in the present situation (Smit et al., 2008; Havekes, 2009). The importance of water boards' role in conflict prevention and mediation regarding water and spatial claims for adaptation of nature conservation thereby is an important contribution to literature and the Dutch adaptation practice.

7.4. Dutch provinces and water boards as main problem owners

In this section the finding will be discussed that provincial and water boards problem were considered the main initiators of Dutch nature conservation adaptation, whereas land owners and users were assumed to take primary responsibility for implementation.

7.4.1. State of the art adaptation research

There is a lack of empirical research investigating practitioners' preferences for responsibility allocation within Dutch nature conservation. In other domains of Dutch adaptation similar patterns of responsibility allocation between public and private partners were identified, for instance by Mees et al. (2012) in the domain of Dutch urban adaptation. Planning and goals setting of adaptation was mainly done by governmental organisations rather than by a cooperation of public and private parties (Mees, 2014; Mees et al., 2012). Braakhekke et al (2014, p.56) state that "many climate

[36] Without trust, compensation was considered bribery.
[37] A similar reluctance was identified by Smit et al (2008) among water boards in case of the implementation of ecological KRW and Natura2000 goals.

change problems in the Netherlands express themselves via water" and "fresh water management is a crucial success factor in Dutch adaptation involving considerable funding (...)". They however question whether the contemporary regional input by water boards is adequate for adapting problems transgressing the regional scale.

Braakhekke et al. (2014) furthermore identified that nowadays conservation organisations are primarily considered implementers and not (yet) as equal partners of the different government organisations within adaptation, which coincides with conservation agencies role definitions in this thesis. Nevertheless, conservation agencies also showed willingness to take up other tasks if sufficient means are available. No study to date has investigated how land owners and users themselves regard their responsibilities in this domain; thereby this study offers novel insights. Braakhekke et al. (2014) moreover argue importance of shared public and private responsibilities throughout the adaptation process and beyond the nature sector, but as subsequently discussed, the development of such a responsibility allocation is not self-evident.

7.4.2. Generalisations

Subsequently each of the practitioner groups involved in Dutch nature conservation and adaptation are discussed with regards to the extent the findings in the case study may apply on a national scale.

Central Dutch government

Due to the fact that Dutch nature conservation largely is decentralised, the main focus pertained to the regional level. This however provided indications regarding the (desired) role of the central government from the regional perspective. Provinces assumed that their adaptation ambitions would reach a ceiling if central government's facilitation would not increase[38]. The Deltaprogram provided opportunities for adapting nature to climate change, however was believed insufficient for realizing provincial nature related adaptation ambitions. Furthermore, it was stated that the central government was more occupied with water security than nature's adaptation interests relating to other aspects. To get an insight into the national ambitions of the central government, the project manager of the Rijksnatuurvisie was interviewed. The central government saw itself as facilitator of agenda setting, research, (supplementary) funding and enabling spatial policy nevertheless the provinces were considered the main initiators for goal setting and realising adaptation in this domain (personal communication Rutten, 2013).

Land owners and users: conservation agencies, farmers and private owners

The investigated conservation agencies mostly followed provincial policy which can be expected to be their general modus operandi, provinces setting nature goals and providing nature management funds. In addition, conservation agencies interviewees placed question marks regarding their financial and organisational capacities to lead adaptation in this stage, contemporary nature problems requiring most of their resources. Braakhekke et al. (2014) argue that conservation agencies are ready for adapting Dutch nature conservation to climate change. This case study nevertheless shows that this readiness is conditional of provincial leadership and the provided funding. Furthermore, the majority of conservation agencies did not yet have explicit and structural climate change goals moving beyond the project level of Coalition Climate Buffers, nor transcending

[38] International climate corridors funding, flanking policy, more NNN hectares, manure policy restrictions.

what can be done within contemporary Dutch nature management via the National Nature Network realisation.

Farmers and private owners' action within multifunctional adaptation can be anticipated within certain limits and conditions. Due to the diversity of private ownership[39] and farmer and private owners interest organisations claiming to be unsuited for steering large scale farmer or private owner action[40], nature inclusive adaptation by these actors therefore will be the case of individual farmers and private owners and their choice of adaptation and collaboration, which may vary. The case study however showed an interest in adaptation within agricultural nature management if compensation for implementation efforts is provided. Bleumink (2014) illustrated that despite low climate change awareness in parts of agriculture, Dutch farmers generally were interested in implementing adaptation when this would offer business opportunities. The abovementioned suggests that farmers and private owners are more likely to play a critical role in the implementation phase rather than initiating the adaptation of Dutch nature conservation[41] yet voluntary climate adaptation for nature is less apparent, particularly when adaptation (is believed to) affect agricultural water and spatial needs.

Provinces and water boards

The research clearly indicated provincial and water board problem ownership, particularly in the role of facilitators rather than implementers yet it is unclear whether other provinces have similar nature related adaptation ambitions. A key objective concerned the development of closer cooperation with other provinces having similar climate change problems (connected to elevated soils and stream valleys). As argued by the provinces, it is uncertain whether interprovincial collaborations will develop, since not all provinces may consider adapting Dutch nature conservation to climate change a priority. Nonetheless, this study illustrates the potential of provinces to lead and initiate adaptation.

Investigated water boards considered themselves as initiators and facilitators of a multi-functional adaptation process rather than implementers of adaptation. Whether other water boards share similarly broad ambitions including nature or will mostly focus on water related rather than ecological adaptation goals cannot be predicted. Some practitioners argued that although their own water boards used a broad approach, a general tendency was discerned among water boards to focus on "kerntaken". This entails the focus on core water management tasks and less focus on ecological goals surpassing the legal requirements. This core tasks discussion is also debated by Havekes (2009). Whereas Braakhekke (2014) and De Bruin (2009) implicitly refer to the role of water boards by pointing to the importance of fresh water management and the integration of water and nature management, this thesis contribution lies in an explicit assertion of the elementary roles that water boards are likely to play within the adaptation of Dutch nature conservation. Regardless of water boards willingness to take responsibility for adapting Dutch nature conservation, which cannot be predicted, water boards will inevitably play a critical role, either by 1) inaction, 2) facilitating

[39] Private ownership varies from large pension funds and estate owners to small scale ownership.
[40] These organisations lack a centrally steered structure that allows for top down steering of members regarding policy issues.
[41] Nevertheless, agriculture's water and spatial needs may be steering, as argued in prior sections.

narrow adaptation 3) facilitating broad nature inclusive adaptation, and as mentioned by the degree to which they can prevent and mediate conflicts.

7.4.3. Expected consequences

Based on the abovementioned, the following hypotheses are formulated:

Hypothesis 3: If compensation or assurances of investments are not provided to implementing parties, climate adaptation requiring additional efforts and investments is unlikely to be developed by private parties and conservation agencies

Hypothesis 4: If provinces and water boards do not take up a leading and initiating role then it can be expected that the adaptation of Dutch nature conservation will not develop structurally in the next decade.

If all provinces are equally ambitious as two of the interviewed provinces, little concern would be warranted of whether adaptation would be picked up structurally within Dutch nature conservation, with the central governments' support on the background. Provincial ambitions however remain an uncertain factor and, as the Court of Audit (2012) argued, potentially leaving gaps in adaptation. Furthermore, a purely regional input of adaptation may leave risks transgressing this level unattended (Braakhekke et al., 2014). The results suggest that waiting for private initiative and voluntary adaptation in this domain will unlikely lead to a thriving start of adapting Dutch nature conservation. Due to interlinkages of agricultural and ecological systems and potential sector related conflicts, it can be questioned to what extent it is useful if land owners are mainly regarded as implementers rather than as partners throughout the adaptation process. To date no study has identified the unlikely success of voluntary adaptation within Dutch nature conservation, which is an important contribution both to literature and the Dutch policy practice.

7.5. Limitations

This research focussed on the regional level as this decision making level will be the most influential in Dutch nature conservation and adaptation, limitations concern the European and municipal level. EU nature policies such as Natura2000 and the Birds and Habitats Directives make few references to climate adaptation and leave responsibility to Member States in this domain (Verschuuren, 2013; Verschuuren, 2010). As for Dutch nature conservation, the main responsibilities lie at the provincial level (IPO, 2013) rather than the municipal level.

8. CONCLUSION

As Trouwborst (2009) argued, the extent to which nature will be impacted by climate change depends on how adequate nature conservation is adapted to climate change. Despite significant risks for Dutch ecosystems and species (PBL, 2012), structured and planned revisions of decentralized Dutch nature conservation have not yet been realised (Kramer & Geijzendorffer, 2009; Vonk et al., 2010; Netherlands Court of Audit, 2012) and no study to date has investigated how the practitioners that should facilitate or support such adaptation approach the issue. The present study therefore was designed to explore practitioners' climate adaptation frames, revealing their understanding, urgency and preferences for solutions. This chapter will answer the main research question: *What are the implications of the ways in which practitioners frame climate adaptation for the expected way in which Dutch nature conservation may develop in the next decade with regards to climate adaptation?* To this aim, 19 interviews were conducted with regional nature managers, senior policy advisors of the LTO and water boards, provincial decision makers, regional board members of the Federatie Particulier Grondbezit and farmers to provide a comprehensive overview of the practitioner perspective. Data analysis was carried out by means of content analysis.

8.1. Synthesis of results and implications

The main empirical findings were summarized within chapter 4, 5 and 6 of the thesis. This section will synthesize the empirical findings to answer the study's three research questions and based on these frames, can be expected with regards to adapting Dutch nature conservation to climate change.

The first research question concerned the assessment of how practitioners involved in regional Dutch nature conservation framed the ways in which climate change may affect Dutch nature and its conservation, and the involved causal mechanisms. Climate change effects on nature were often considered less urgent compared to contemporary environmental stresses, the latter increased the natural system vulnerability to climate change, inviting a logic to prioritize contemporary (a)biotic conditions over anticipated post climate change impacts. Furthermore, practitioners' generally experienced greater certainty of water quantity related climate change effects than being able to ascertain how local species would be affected by long term fluctuations in precipitation, evaporation, air flow patterns and other climatic variables. Those involved in nature management frequently mentioned a lack of localized species specific risk assessments. Generally, no mass extinctions were expected. The second research question concerns the assessment how practitioners involved in regional Dutch nature conservation frame the desired ways of adapting Dutch nature conservation to climate change. A similar pattern could be identified as in the problem frames: practitioners experienced more uncertainty regarding the most effective solutions for local species specific adaptation than compared to water quantity adaptation measures. Due to the understanding of climate adaptation in terms of water quantity and the large number of planned water projects and water boards resources, water boards were considered the logical party to lead adaptation together with the provinces. Land owners and users were assumed to have greater responsibilities for the implementation of adaptation.

The third research objective related to the assessment of the level of agreement, sense of urgency and conflict potential as derived from the practitioner frames. Drought and flooding problems and solutions were omnipresent in practitioner frames, hence the discovery of a water quantity meta-frame, yet disagreement concerned the impact severity and practical measures. The majority of the farmers opted for status quo water technology, the nature sector generally advocated an alternate water division. Disagreement and potential conflict regarded measures involving higher water levels and land claims, frequently presumed at odds with agricultural interests. In both cases provinces and water boards acted as problem owners, displaying the greatest sense of urgency albeit with varying levels of adaptation ambitions.

The results led to the formulation of 4 hypotheses that, despite the need for further testing, present a perspective on the ways in which Dutch adaptation of nature conservation is likely to develop.

- **Hypothesis 1:** Climate adaptation of Dutch nature conservation is likely to focus on water issues
- **Hypothesis 2:** If the adaptation of Dutch nature conservation requires structural changes in agricultural land and water use, conflicts between the agricultural and nature sector can be expected to develop or aggravate.
- **Hypothesis 3:** If compensation or assurances of investments are not provided to implementing parties, climate adaptation requiring additional efforts and investments is unlikely to be developed on a voluntary basis by private parties and conservation agencies
- **Hypothesis 4:** If provinces and water boards do not take up a leading and initiating role then it can be expected that the adaptation of Dutch nature conservation will not develop structurally in the next decade.

A water oriented adaptation focus may be required to address urgent contemporary and future climate change effects within Dutch nature conservation, to quote conservation agencies: “(...) water is the origins of the problem” and “(...) the water issue is the most important”. A water oriented approach however can equally invite for the obscurement of other climate related risks and overtly relying on a-priori adaptation success of adjusting the water system. In this respect and adaptation of nature conservation in general, the second hypothesis raises practical questions or illustrates potential challenges in terms of competing land and water claims. This thesis however also showed that these issues need not necessarily turn into stalemate, if commensurating solutions are found. Furthermore, the research places critical questions regarding private parties’ willingness for voluntary adaptation when additional efforts beyond daily operations are required, or are believed to affect agricultural land or water interests, which is a novel insight. Moreover, the study suggests the critical importance of provincial and water boards’ adaptation initiative, the latter of which has not yet been debated in literature. In addition, a lack of provincial and water board input could lead to gaps in adaptation of nature conservation on a national scale. These findings can be used by decision makers to ascertain if foreseen developments are applicable and desirable. Overall, this studies significance lies in providing a broad overview of Dutch practitioners’ adaptation perspectives from different sectors (nature, water and agriculture), which to date have not been explored regarding the ways in which nature conservation should anticipate a changing climate.

8.2. Policy recommendations and suggestions for further research

The research presents the following policy recommendations for adapting Dutch nature conservation to climate change:

- Central government and provinces:
    - Increase attention for climate change effects and adaptation solutions that are not or indirectly related to water quantity policy or management, to prevent that urgent climate change risks for nature will be obscured.
    - Stimulate Dutch inter-regional cooperation to deal with climate change problems and opportunities that transcend the regional level and prevent regional gaps in adaptation.
- Water boards:
    - Aim for multifunctional, nature inclusive adaptation.
    - Investigate the ways in which future conflicts between nature and agriculture can be mediated, for instance by locally suited adaptation solutions that make diverging land and water claims more commensurable.
- Provinces and water boards: Invest in greater participation of land owners and users throughout the process of adapting of Dutch nature conservation to climate change, rather than base nature related adaptation policies and management on voluntary adaptation.
- Land owners and users:
    - Raise awareness regarding climate change effects on Dutch nature areas among own constituency and assess in which ways nature inclusive climate adaptation goals can fit into own organizational goals and activities.
    - Engage in adaptation transcending sector related interests and clearly explicate necessary conditions for participating in broad, nature inclusive adaptation to parties initiating adaptation.

The following recommendation for further research is provided:

- More research needs to be developed regarding localized species adaptation in the Netherlands and investigated how and to what extent various non-profit nature foundations that aim for particular species or habitat protection can be involved and can contribute to risk assessments and formulation of adaptation approaches.

Appendix A: Respondents per case study.

Table 21. Respondents overview

Respondent groups	Interviewees case 1	Interviewees case 2
Conservation agencies	Managers: • Staatsbosbeheer • Natuurmonumenten • Brabants Landschap • Limburgs Landschap	Managers: • Staatsbosbeheer • Natuurmonumenten • Geldersch Landschap en Kasteelen and 12 Landschappen
Private owners	Board members: • Limburgs Particulier Grondbezit • Noord-Brabants Particulier Grondbezit	Board members: • Gelders Particulier Grondbezit
Water boards	Senior policy advisor: • Water board Peel en Maasvallei	Senior policy advisor: • Water board Rijn en IJssel
Provincial policy makers	Senior policy advisors: • Province of Noord-Brabant, departments water and ecology • Provincie Limburg, departments water and ecology	Senior policy advisors: • Provincie Gelderland, departments water and ecology
Famer organisations	Senior policy advisor: • LLTB Board member: • Agro-environmental collective Bronsgroen	Senior policy advisor: • LTO Board member: • Agro-environmental collective Berkel en Slingeland

Appendix B. Interview questions

1. What does your organisation see as the determining factors until 2050 for Dutch nature conservation?
2. Do you consider climate change as a determining factor for Dutch nature conservation?

Presentation of climate change scenarios, see Appendix C, to stimulate thinking about climate change.

3. Which aspects or impacts of climate change could influence nature in the [Baakse Beek/Tungelroyse Beek] and nature conservation in general?
4. How will climate change affect the following aspects and to what extent are these considered risks within your organisation:
    a. Species and biodiversity
    b. The water system
    c. The soil system
    d. The ecosystem in general
5. To what extent does uncertainty regarding climate change effects play a role in your organisation in terms of taking adaptive action?
6. Which factors could increase nature's vulnerability or robustness to climate change?
7. To what extent is your organisation already taking adaptive action? Compared to contemporary issues, to what extent is the adaptation of Dutch nature conservation a priority within your organisation?
8. Does your organisation have specific goals or plans for the adaptation of nature conservation?
9. In terms of nature goals, which types of nature goals do you think would be most effective for adapting Dutch nature conservation to climate change?
    a. Fixed goals (the preservation of specific species and habitats in designated geographic locations)
    b. Flexible goals (focus more on natural system preservation than individual species and habitas)
    c. Mix of fixed and flexible (preserve specific areas and species yet depending on the local circumstances to allow for more flexibility)
    d. Other?
10. Which strategies and measures do you consider best for adapting Dutch nature conservation to climate change?
11. In terms of the allocation of responsibilities, who/which actors should take adaptive action for adapting Dutch nature conservation and how can this division of responsibility be arranged?
12. What can your own organisation contribute to adapting nature to climate change, given their expertise and interests?

Appendix C. Climate and Socio-economic scenarios.

Table 22. Climate Scenarios G and W+

		G	W+
General	Global temperature rise	+1°C	+2°C
	Changes in air flow patterns	no	yes
Winter[3]	Average temperature	+0,9°C	+2,3°C
	Coldest winter day per year	+1,0°C	+2,9°C
	Average amount of precipitation	+4%	+14%
	Number of wet days (≥ 0,1 mm)	0%	+2%
	10-day precipitation sum that is exceeded once per 10 years	+4%	+12%
	Highest day average of wind speed per year	0%	+4%
Summer[3]	Average temperature	+0,9°C	+2,8°C
	Warmest summer day per year	+1,0°C	+3,8°C
	Average amount of precipitation	+3%	-19%
	Number of wet days (≥ 0,1 mm)	-2%	-19%
	Precipitation day sum that is exceeded once per 10 years	+13%	+10%
	Potential evaporation	+3%	+15%
Sea level	Absolute rise	15-25 cm	20-35 cm

Source: KNMI, 2006

Table climate change in the Netherlands in 2050 [1] compared to the base year 1990 [2] according to the G and W+ KNMI'06 climate scenarios

[1] data about the changes in2100 can be found at www.knmi.nl/klimaatscenarios
[2] the climate in the base year 1990 is described with data from 1976 until 2005
[3] 'winter' is here understood as December, January and February; 'summer' equates June, July en August

Table 23. WLO scenarios Global Economy and Regional Communities

	1971-2001	GE 2002-2040	RC 2002-2040
Population growth*	0.7	0.2	0.0
Population 2040 (x million)	-	17.1	15.8
Labour supply growth*	1.1	0.0	-0.4
Labour productivity growth*	1.9	1.9	1.2
Employment growth*	0.9	0.0	-0.5
Unemployment level**	5.5	4.6	7.3
GDP growth*	2.6	1.9	0.7
GDP per capita growth*	1.9	1.7	0.7
GDP per capita 2040 (2001=100)	-	195	133
Demand for residential land***	-	47	11
Demand for commercial land***	-	23	-2
Demand for recreational land***	-	22	12
Demand for nature***	-	98	123

Source: WLO, 2006

Table with selected macro-economic indicators for WLO scenarios
* Mutations per year in %
** Average level in % of potential workforce
*** Demand for additional land in 2040 (x 1000 hectares).

Appendix D. Literature study

This exploration of climate change effects, vulnerabilities and adaptation solutions is by no means complete and merely aims to provide an overview of international adaptation literature in this domain.

Climate change effects on species

How species respond to climate change is a major concern in the field of ecology and biology. Their reproduction can occur earlier in the year due to climate change (phenology) and can cause mismatches in food webs for new born species. The physical development of species can also change (Heymans & Berendse, 2009). Bioclimate envelope models predict comprehensive species distribution shifts as a result of altering climate zones (Thuiller et al., 2005). The latter can make habitats unlivable for specific species, requiring relocation to more suitable habitats (Heijmans & Berendse, 2009; Vos et al., 2007), yet this migration requires specific landscape requirements in terms of abiotic conditions (Williams et al., 2008). Due to climate induced species dispersal more biological invasions will occur, which can provide opportunities for biodiversity but can also feature harmful exotics (Walther et al., 2009). On the other hand, species may survive in localized microclimates that are not incorporated in bioclimate models (Pearson, 2006). According to Parmesan (2006, p. 637) "predator-prey and plant-insect relations have been disrupted when interacting species have responded differently to warming". These impacts on species can affect biodiversity (Heijmans & Berendse, 2009; Parmesan, 2006; Thuiller et al., 2005; Vos et al., 2007). For the 21st century, an overall decline in the number of species is forecasted, climate change adding to threats of extinction (Thomas et al., 2004). Furthermore, genetic diversity can decrease as a result of species' changing distribution, differing per species. Genetic diversity is deemed critical for the survival of species in general and for adaptation to climate change, thus a decrease of genetic diversity enhances extinction risk (Cobben et al., 2012).

Climate change is deemed to be the next greatest challenge for (global) biodiversity (Solomon et al., 2007) and concerns a high extinction risk for species (Maclean & Wilson, 2011). Global extinctions are fewer than regional/local ones since local extinctions do not automatically lead to global extinctions (Bellard et al., 2012). However, these risk perception are accompanied by substantial uncertainty. Uncertainty stems from a certain degree of imprecision of global climate and climate envelope models (Hampe, 2004) and the lack of knowledge about species adaptability (Bellard et al., 2012), microclimates and local climate impacts (Pearson, 2006). Furthermore, regional and local predictions vary in the sense that both losses and gains can be expected, thus on a local scale biodiversity can also benefit from climate change (Bellard et al., 2012).

Climate change effects on the water system

Climate change can have profound impacts on water systems (Verweij et al., 2010). The causal relationship between a rise in air temperature and consequently in water temperature is widely acknowledged in literature (Verweij et al., 2010). Furthermore, climate change leads to changes in ice cover, stream flow, snowfall, evapotranspiration (Arnell, 1999), ground water level (Jyrkama & Sykes, 2007) and stream flow or run-off (Maurer & Duffy, 2002). The main effects of climate change have an effect on water quantity and quality. Water quantity (and thereby the quality of soils) can also be affected by climate change (Witte et al., 2012). For instance, drought and flooding are commonly

recognized impacts of climate change, and can lead to plant mortality (Verweij et al., 2010). Furthermore, in summer time small pools and streams can run dry, having a detrimental effect on biodiversity (Vos et al., 2007).

Water quality can decline via different mechanisms. Climate change accelerates nutrient cycling (Verweij et al., 2010) and contributes to nutrient overloading (Jeppesen et al., 2011). It can also enhance eutrophication, salinization (Verweij et al., 2010) and acidification (Feely et al., 2008; Verweij et al., 2010). Furthermore, the flooding of sewers and by effluent water decreases water quality (Verweij et al., 2010). Climate change can also increase the amount of harmful cyanobacterial algae blooms that impede water quality and human and animal health (Verweij et al., 2010) as they can cause damage to liver, metabolic functioning, nerve system and to skin, even result in death (Paerl & Huisman, 2009). It is also claimed that due to a rise in water temperature, the self-purification ability of water systems decreases (Kundzewicz & Krysanova, 2010).Higher water temperatures reduce the amount of dissolved oxygen, whereas on the other hand the extraction of oxygen by cold-blooded water species increases. This is called the "oxygen squeeze": an increased need for oxygen is met by a decreasing availability of oxygen (Verweij et al., 2010).

High risks can be distinguished for both water quantity and quality however these depend on local/regional circumstances. Uncertainty is substantial and relates to the downscaling of global climate change model data to regional hydrological impacts (Arnell, 1999).

Climate change effects on soil

Soils can be defined as part of the water system but also as separate systems, therefore an analytical distinction is made. Soil erosion is likely to increase substantially (Solomon et al., 2007; Nearing, Pruski & O'Neill, 2004), especially if combined with drought elicited vegetation cover loss (Nunes et al., 2012). On the other hand erosion can also be enhanced due to increased precipitation (Nearing, Pruski & O'Neil, 2004). In addition, climate change can lead to soil degradation and desertification (Nunes et al., 2012). Furthermore, the decrease of soil organic matter due to climate change has been discussed in literature; however the degree and mechanisms of response is not yet understood (Conant et al., 2011).

Climate change effects on ecosystems

Due to the abovementioned climate impacts ecosystem's structure, function and provided ecosystem services can change (Heijmans & Berendse, 2009). In some instances ecosystems may no longer be able to perform certain functions nor provide particular ecosystem services (Kramer & Geijzendorffer, 2012). Biome shifts may also lead to an altered ecosystem structure and functioning (Bellard et al., 2012), for instance with regards to nutrient availability, water retention, plant productivity and carbon storage (Parr, Gray & Bond, 2012).

The effects of climate change on ecosystems is referred to Bellard et al. (2012) as a "black box"), yet particular risks have been projected. Biome shifts can affect large proportions of terrestrial ecosystems (Bellard et al., 2012). For example substantial parts of Amazonian rainforests can become savannas by 2100 (Bellard et al., 2012). Uncertainties regarding eco-hydrological models (Witte et al.,

2012) and downscaling (Wiens & Bachelet, 2010) make it difficult to assess the consequences of climate change on nature. Furthermore, biochemical feedbacks and events at the microbial level resulting from climate change are inadequately understood (Peñuelas et al., 2013). Furthermore, climate change can increase plant productivity or net primary production (NPP)[42] of ecosystems as a result of increased photosynthesis and nutrient availability; however, it can also decrease due to a decrease of soil moisture and increased plant respiration, or remain the same. This depends on the type of ecosystem (Melillo et al., 1993).

Climate change vulnerabilities

A differentiation can be made between immediate causes of climate change impacts (climate change) and the indirect reasons for climate change vulnerability (O'Brien et al., 2004). Vulnerability is a function of a systems exposure to climate change impacts as well as the sensitivity and adaptive capacity of a system to those climate change impacts it is exposed to (Gallopin, 2006). As the vulnerability framework of Füssel (2007) indicates, the causes of vulnerability originate from both internal and external characteristics of the system under investigation, and their interactions. These internal and external characteristics concern biophysical and socio-economic factors (Füssel, 2007). Subsequently, it shall be explicated how these factors can make nature more or less vulnerable to climate change.

Examples of **external biophysical factors** inducing vulnerability are climate change and natural hazards (Füssel, 2007), in this instance climate change is the main area of concern. Immediate causes of climate change are both natural and human induced by the emission of green house gases. These lead to changes in temperature, precipitation patterns, snowfall, higher atmospheric pressure resulting in altering wind patterns, extreme weather events, and greater variability of the climate (Van den Hurk et al., 2006). Modern science increasingly acknowledges the phenomenon of (anthropogenic) climate change (Doran & Zimmerman, 2009) and a review of 1,372 climate researchers 'publications shows that 97–98% agrees with the main claims of the IPCC (Anderegg, Prall, Harold & Sneider, 2010). An analysis of climate skepticism reveals that the views of conservative media and politicians and business lobbies do not match those of climate skeptic scientists, whom nowadays focus more on the discussion of whether climate change is caused by humans and if mitigation action is useful (Schmidt, 2010). The idea that climate change can alter biophysical and social systems generally is accepted in literature (Rosenzweig et al., 2008).

Internal biophysical factors likewise contribute to vulnerability (Füssel, 2007) and pertain to the vulnerability of natural systems. Causes of species vulnerability have been linked to species responses to climate change, their sensitivity and adaptive capacity (Williams et al., 2008; Bellard et al., 2012). Examples of species characteristics that increase sensitivity are species thermal limits (Williams et al. 2008), having very specific habitat preferences for habitats and sensitivity to environmental change (Dawson et al., 2011). In addition, slowly reproducing and poorly dispersing species are at greater risk of extinction, and if they have limited competition ability (Kramer & Geijzendorffer, 2010). Adaptive capacity furthermore depends on their ability to adjust behaviour or physiology and adapt genetically (Bellard et al., 2012). Fragmentation of nature and habitat loss also contributes significantly to species vulnerability (Thomas et al., 2004; Opdam & Wascher, 2004).

[42] Net primary productivity is a critical terrestrial ecosystem parameter, encompassing vegetation activity, biogeochemical cycling and ecosystem services.

External socio-economic factors can contribute to vulnerability, for instance international laws (Füssel, 2007). International conservation laws could[43] make nature more vulnerable to climate change, if they are ill-suited to climate change (Kramer & Geijzendorffer, 2010; Trouwborst, 2009). Laws aimed at preserving specific species and habitats at particular locations could hamper migration to more suitable habitats (Kramer & Geijzendorffer, 2010). In fact, an analysis of EU and international species and biodiversity conventions reveals that migration issues are not addressed in these laws (Trouwborst, 2009). Such rigidness of laws is also stated to be applicable in national conservation laws (Trouwborst, 2009;Kramer & Geijzendorffer, 2010), hence an internal socio-economic vulnerability factor.

Internal socio-economic factors relate to laws and regulations (Füssel, 2007). Regulation (Trouwborst, 2009) and institutional characteristics can contribute to systems vulnerability (O'Brien et al., 2004). Institutions are "a set of prescriptions and constraints that humans use to organize all forms of repetitive and structured interactions" (Ostrom, 2005, p. 3). Institutional capacity concerns wealth, resources, learning ability (Adger & Kelly, 1999; Tompkins & Adger, 2005) and flexibility (Tompkins & Adger, 2005). If these are lacking then this increases vulnerability (Adger & Kelly, 1999; Tompkins & Adger, 2005). In nature conservation and adaptation literature the issue of lacking institutional capacity is identified (Lawler, 2009; Millar et al., 2007; Mawdsley et al., 2009). Nevertheless, a meta-study of Heller and Zavaleta (2009) shows that of all investigated adaptation articles only 12% points towards policy or institutional factors as issues of concern. Land use is another factor that can make nature more vulnerable to climate change (Dawson et al., 2011) for instance if it enhances the fragmentation of nature and habitat destruction which makes species more vulnerable to climate impacts.

Between these internal, external biophysical and socio-economic factors interactions can occur, enhancing the vulnerability of the system (Füssel, 2007). In this respect substantial uncertainty exists, for instance regarding interactions of abiotic factors (Bellard et al., 2012). Furthermore, feedback loops can reinforce or ameliorate climate impacts and thereby affect the vulnerability of systems (Pahl-Wostl, 2007).

Nature conservation goals and adaptation

In general, three types of nature conservation goals can be discerned in conservation adaptation literature, those aimed at restoration, resilience or facilitating change. In general adaptation approaches that aim to maintain the status quo or restore historical conditions (restoration) can be distinguished from those allowing some degree of change (resilience and facilitation) (Millar et al., 2007; Kramer & Geijzendorffer, 2010). Traditionally, goals of restoring historic habitats and specific species have been the dominant paradigm in conservation literature (Lawler, 2009). Restoration uses knowledge about historical system conditions to recover systems that have suffered damage and brings these back as much as possible to this historical frame of reference (Jackson & Hobbs, 2009). Fixed goals are set to preserve a specific type of nature or species in a certain area which fits the resistance goal (Kramer & Geijzendoffer, 2010). Resistance strategies are typically risk averse in concentrating on preserving as much area, species and habitats as possible and require intensive management (Heller & Zavaleta, 2009). However, in case of (drastic) climate change this will require

[43] This is however still a matter of debate.

substantial investments and historical ecosystem functioning may offer a poor guiding lines in case of transformed ecosystems (Millar et al., 2007; Jackson & Hobbs, 2009). Overall, in this perspective nature is often considered as brittle and static, vulnerable for environmental change in the form of disruption and external shocks (Kramer & Geijzendorffer, 2010).

Conversely, resilience theory perceives environmental change and external shocks as inherent to and sometimes necessary for ecological functioning (Folke et al., 2002; Folke et al., 2005). Therefore the goal should not be to conserve nature as it currently is or was but aim at creating resilient systems. Ecological resilience[44] is "the magnitude of disturbance that can be absorbed before the system changes its structure (…)" (Gunderson & Holling, 2002, p. 2). Overall, goals aim to preserve ecosystem functions instead of specific species or habitats (Kramer & Geijzendorffer, 2010). Resilience approaches and adaptive management typically use experimentation to learn about climate change effects while they occur (Lawler, 2009). In general they aim to enhance learning, self organization and capacity to absorb shocks, essential being the monitoring of critical thresholds/ tipping points (Nelson, Adger & Brown, 2007). Furthermore, one must learn from crises (this can mean doing nothing) and local knowledge (Berkes, 2007). Therefore, participatory approaches are advocated since social systems also need to become resilient, requiring stakeholder involvement in adaptation processes (Berkes, 2007; Tompkins & Adger, 2004). This enhances the strengthening local social networks and social acceptation of adaptation measures (Tompkins & Adger, 2004).

Nevertheless, resilience may not always be attainable (Millar et al., 2007) and novel ecosystems may emerge with unknown functions and services, which may urge for a facilitation goal. The facilitation goal aids nature in its transition to other ecosystem functions, services and species assemblages and thereby is considered the most risky as one does not know in advance how the system and its components may change (Harris et al., 2006). The goals of resilience and facilitating approaches are incremental and flexible and both of these approaches involve more risk since crises can lead to the loss of species or ecosystems (Millar et al., 2007).

Nature management actions

In terms of practical measures, climate adaptation for nature policy and management can use a wide array of currently already applied activities (Mawdsley et al., 2009). Many of the activities are not solely connected to one of these approaches: Whereas 70% of examined studies by Heller & Zavaleta (2009) advocate a resilience strategy, in practice most studies advocate control oriented practical measures aimed at preserving specific species and habitats. Many of the measures aim at stimulating species migration by creating buffers zones and migration corridors (Vos et al., 2008; Opdam & Wascher, 2004), enlarging nature areas and connectivity (Mawdsley et al., 2009; Millar et al., 2007; Vos et al., 2008; Heijmans & Berendse, 2009). One of the most controversial options is assisted

[44] The notion of resilience is closely related to the following terms: adaptability, coping ability, management capacity, stability, robustness, flexibility (Carpenter et al., 2001). Rather than having a single equilibrium to which a system returns after disturbance (as conceptualized in the resistance approaches, that lead to a fragile stability of nature), resilience theory assumes that systems are flexible via multiple equilibriums, thus multiple stable states in which stability can vary (Scheffer et al., 2001; Van de Koppel & Rietkerk, 2004). Thus, a resilient system can move from one equilibrium to another without losing its essential features (Carpenter et al., 2001). However, beyond a tipping point, the system moves to an alternative state with different ecosystems functions and services (Folke et al., 2003).

migration. Whereas some argue that it might be necessary to save specific species from extinction, others warn for the unknown effects on ecosystems (Millar et al., 2007; Minteer & Collins, 2010).

Furthermore, besides species oriented measures, literature also points to water management measures for nature areas. Water storage in nature areas can harbour flooding water, however, contamination with sewer and waste water is a danger for biodiversity (Vos et al., 2007). Another measure proposed to enhance water quality is nutrient management (Kundzewics & Krysanova, 2010). In addition, measures for climate affected soils are proposed, for instance by anti-erosion measures that concern strategic placement of natural barriers for erosion and trees can also decrease erosion (Rojas Blanco, 2006). Measures to make natural systems stronger are also advocated, for instance reducing present environmental stresses is (Heller & Zavaleta, 2009; Mawdsley et al., 2009; Lawler, 2009) or restoring system dynamics via enhancement of natural processes (Lawler, 2009).

Besides these practical measures, literature also pays attention to instruments for climate adaptation. The general Dutch adaptation focus has been clearly connected with spatial planning (Biesbroek et al., 2010). Furthermore, the integration of adaptation goals and measures into the policy of different sectors ("mainstreaming") is advocated, since this prevents the issue from becoming isolated from other policy developments (O'Brien et al., 2004). Regional institutional coordination is also advocated (Heller & Zavaleta, 2009). Besides available legal instruments (spatial plans, water level decrees, subsidies, taxes and legally required environmental assessments) more flexible tools such as communication (Schueler et al., 2010) can be used. Furthermore, it has been argued that European and national conservation policy and goals require more flexible goal setting (Heller & Zavaleta, 2009; Mawdsley et al., 2009; Kramer & Geijzendorffer, 2010; Schueler et al., 2010).

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