Master's thesis - Master Sustainable Business and Innovation

A stakeholder perspective on overcoming governance gaps in order to create a climate-adapted landscape at the Utrechtse Heuvelrug

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Abstract

National Park Utrechtse Heuvelrug is a nature area that currently faces many challenges related to climate change. Climate adaptation (CA) is required to ensure that the Utrechtse Heuvelrug (UH) can fulfil its current functions relating to recreation, nature conservation, living, drinking water etc. This CA transition involves various stakeholders, who already play a role. However, the implementation of CA solutions proceeds slowly. This thesis researches the social-ecological system (SES) of the UH to analyse what acceleration possibilities exist for the transition towards a climate-adapted landscape.

This was done by conducting an actor-issue network analysis, which provides insight into the interconnectedness of actors and/or climate issues. The network was complemented by a power-interest matrix, showing the different levels of power and interest held by stakeholders, and by a PESTEL-analysis, which is a strategic planning tool that helps define key drivers for change (KDFC). The network and the power-interest matrix were developed based on data collected through desk research and 22 interviews. The PESTEL-analysis resulting in the KDFC was based on two workshops with relevant stakeholders.

12 KDFC were identified to accelerate the transition towards a climate-adapted landscape at the UH: 1) Set priorities and frameworks, 2) Strengthen governmental leadership (“regie”), 3) Invest in CSR, 4) Stakeholders should better argue what benefits their solution has, 5) Combine functions and always consider CA, 6) Work from intrinsic motivation, 7) Increasingly connect other stakeholders and boost CA solutions, 8) Seize opportunities, 9) Prioritise long-term solutions, 10) Establish an overarching research direction: measuring and monitoring, 11) Increase the capacity of municipalities, and 12) Better substantiate why stakeholders believe a project should proceed.

These results apply to the UH and while some KDFC may be useful to other national parks, the results cannot directly be generalised, due to different governance structures and climate issues. Implementing the KDFC can help to accelerate the transition toward a climate-adapted landscape. Various stakeholders have been identified to be responsible for implementing one or more KDFC. However, in the end, it is up to all stakeholders to collaboratively take responsibility in this transition.

Executive summary

Research aim

Climate change poses significant challenges to the Utrechtse Heuvelrug (UH), as extreme weather events occur more frequently, nature struggles because of the drought and desiccation, and (small) flooding occurs at the foot of the ridge. Although many climate adaptation solutions (CAS) are known and many stakeholders are working on the implementation of CAS, the transition towards a climate-adapted landscape has progressed slowly. This results in risks relating to the continuation of the functions that the UH currently provides, such as nature conservation, recreation, historical value (cultural heritage), drinking water supply, and living. Therefore, this research aims to answer the following research question: *How can different stakeholders at the Utrechtse Heuvelrug be enabled to accelerate the implementation of climate adaptation solutions to reach a climate-adapted landscape?* To answer this question, three sub-questions (SQ) were formulated: SQ1 focuses on mapping various stakeholders and climate issues at the UH: *What stakeholders and (potential) climate issues play a role in the social-ecological system for climate adaptation at the Utrechtse Heuvelrug?* SQ2 focuses on mapping the different governance gaps: *What governance gaps, caused by collaborative and integrative misfits, exist in the social-ecological system for climate adaptation at the Utrechtse Heuvelrug?* And SQ3 focuses on developing bridging measures to overcome the existing problems: *What bridging measures within the six PESTEL dimensions do stakeholders perceive as possible solutions to overcome existing governance gaps?*

Theory and methods

This thesis analysed the social-ecological system (SES) at the UH by developing an actor-issue network (Bergsten et al., 2019). This actor-issue network was complemented with a PESTEL (Political, Economic, Socio-cultural, Technological, Ecological, Legal) analysis of the existing problems in the SES and an analysis of the level of power and interest of stakeholders in a power-interest matrix. 22 interviews were conducted, transcribed, and coded to map the actor-issue network, provide an overview of the existing problems, and gain insight into the perceived level of power and interest of stakeholders. Based on the actor-issue network and the outdegree of climate issues, the most important governance gaps were highlighted. The stakeholders involved, including those with the highest betweenness centrality, were invited to two different workshops. During the workshops, stakeholders were challenged to come up with solutions to the known problems, which were categorised using PESTEL. Finally, for each solution, one or more stakeholders were named to be responsible. Based on the power-interest matrix, it was determined whether the selected stakeholder was the logical player to implement the solution.

Main results

23 different stakeholders working on climate adaptation (CA) at the UH were identified. The Province of Utrecht, water boards, and private landowners respectively have the highest betweenness centrality, making them important stakeholders to connect others (foundation National Park Utrechtse Heuvelrug ranked 9th). As NPUH is a collaborative organisation, it is important for them to have a systematic overview of the governance system. This could increase their betweenness centrality, and thus their role as a brokerage organisation.

Furthermore, 20 climate issues were identified. *Temperature rise* and *desiccation* have the highest outdegree, meaning that these climate issues have an impact on most other climate issues. Thus, addressing these issues potentially contributes to solving most other climate issues and may have the highest impact. Therefore, these climate issues were further investigated.

Several governance gaps (so-called integrative misfits) for *temperature rise* and *desiccation* were identified, involving six other climate issues and respectively seven and eight actors. Relevant stakeholders were invited to a workshop to find solutions to the PESTEL categorised problems. In total, this research found 27 distinct problems in the SES at the UH. During the workshops, 69 different solutions came up to overcome these problems. Twelve of these solutions were deemed to have the most impact, making them the key drivers for change (KDFC). These are: 1) Set priorities and frameworks, 2) Strengthen governmental leadership ("regie"), 3) Invest in CSR, 4) Stakeholders should better argue what benefits their solution has, 5) Combine functions and always consider CA, 6) Work from intrinsic motivation, 7) Increasingly connect other stakeholders and boost CAS, 8) Seize opportunities, 9) Prioritise long-term solutions, 10) Establish an overarching research direction: measuring and monitoring, 11) Increase the capacity of municipalities, and 12) Better substantiate why stakeholders believe a project should proceed.

One or more stakeholders were assigned responsibility for each of these solutions. Most of these responsible stakeholders are believed to have high power and interest, though not all. For example, Utrechts Particulier Grondbezit (UPG) is deemed responsible for KDFC 7, though the majority of stakeholders believe UPG to have low power and interest. It should be kept in mind that implementing solutions can become more difficult when a stakeholder has low power and/or interest.

Discussion and conclusion

By implementing the KDFC, stakeholders can accelerate the implementation of CAS to reach a climate-adapted landscape at the UH. To help responsible stakeholders having low power and/or interest with implementing the KDFC, collaboration is needed. Brokerage organisations could play an important role in this. It is now up to the stakeholders at the UH to implement the proposed KDFC. In the end, all stakeholders need to take responsibility in the CA transition.

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List of abbreviations

BC	Betweenness centrality
CA	Climate adaptation
CAS	Climate adaptation solutions
CSR	Corporate Social Responsibility
DC	Degree centrality
KDFC	Key drivers for Change
HDSR	Hoogheemraadschap De Stichtse Rijnlanden
NMU	Natuur en Milieufederatie Utrecht
NPUH	Nationaal Park Utrechtse Heuvelrug
PESTEL	Political, Economic, Socio-cultural, Technological, Environmental, Legal
SES	Social-Ecological System
SQ	Sub-question
sKBL	Stichting Kastelen, Buitenplaatsen, Landgoederen
UH	Utrechtse Heuvelrug
UPG	Utrechts Particulier Grondbezit
VRU	Veiligheidsregio Utrecht
V&V	Vallei en Veluwe

1. Introduction

There is scientific consensus that climate change will pose significant risks to ecosystems and communities in the coming century (Mclaughlin, 2011). Temperature rise and a change in water availability endanger biodiversity, food security, quality of land, and human health (IPCC, 2019). Despite the implementation of mitigation strategies, these risks cannot be prevented, which raises discussions on the need for climate adaptation (CA) (N. Adger, Huq, & Torok, 2009; N. W. Adger, Lorenzoni, & O'Brien, 2009). De Bruin et al. (2009) define CA as:

> "*adjustment in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects or impacts" (p24)*

Furthermore, failure to adapt to climate change can lead to economic risks. It is estimated that by 2040, the global economic costs of weather damage alone could reach over one trillion US dollars per year (Dlugolecki, 2008). By 2050, the costs of not adapting to climate change in the Netherlands are estimated to be between €77,5 and €173,6 billion (Rijksoverheid, n.d.).

Fortunately, there are many potential solutions available to ensure CA (De Bruin et al., 2009; Vos, van der Hoek, & Vonk, 2010; Voskamp & Van de Ven, 2015). These climate adaptation solutions (CAS) can be structural, social, or institutional (Van Loon-Steensma & Goldsworthy, 2021). For example, structural measures include green roofs or irrigation infrastructure, social measures can be raising awareness or monitoring, and institutional measures can include insurance schemes or land zoning laws.

In practice, governments are claimed to be the primary actor in CA planning, although literature suggests that both public and private actors should be involved (Mees, Driessen, & Runhaar, 2012; Vink, Dewulf, & Termeer, 2013). First, participation of various public and private actors is desirable, as this allows for sharing responsibilities and for exploiting all of society's resources (Mees et al., 2012). Second, IPCC suggested that evaluating the quality of CAS should include an analysis of multiple values and dimensions (Intergovernmental Panel on Climate Change (IPCC), 2001), framing CA as a dynamic social and institutional process (Munaretto, Siciliano, & Turvani, 2014). Thus, this involves rethinking the governance aspect of CA, including a focus on different stakeholders (van Nieuwaal, Driessen, Spit, & Termeer, 2009). According to Mees et al. (2012), active involvement of all societal actors may help overcome problems of inefficiency and raise the legitimacy of adaptation action. Therefore, it is relevant to examine the role of different stakeholders when researching CA strategies and their implementation. Besides this social factor, an ecological perspective is important as CA is needed for multiple environmental problems. Ideally, environmental problems should be managed as one ecological system instead of as a set of isolated factors (Bodin, 2017).

Because humanity fundamentally influences ecological systems, while simultaneously relying on them for supporting their needs (Barnes et al., 2019), understanding the social-ecological linkages is important for analysing almost any action related to securing a sustainable future. This complex interaction between social factors and environmental issues can be described using the social-ecological system (SES) perspective (Armitage, De Lö, & Plummer, 2012; Brondizio, Ostrom, & Young, 2009). Redman, Grove, & Kuby (2004) define SES as:

> *"a coherent system of biophysical and social factors that regularly interact in a resilient, sustained manner" (p163)*

Thus, understanding the SES is important when analysing the implementation of CAS to reach a climate-adapted landscape. However, this implementation faces several challenges (Buuren, Driessen, Teisman, & van Rijswick, 2014). First, CA requires polycentric governance, which can be defined as:

> "*A complex combination of multiple levels and diverse types of organisations drawn from the public, private, and voluntary sectors that have overlapping reals of responsibility and functional capacities"* (Mcginnis & Ostrom, 2012, p15).

In other words, effective CA governance depends on collaboration between governments and non-governmental organisations (Knieling & Filho, 2013). Not only do governments struggle with involving many stakeholders (Bauer, Feichtinger, & Steurer, 2012), but it also results in (too) many projects and activities operating at multiple scales (Ostrom, 2014). This makes CA a complex, multi-scalar problem that seems to lack direction (Buuren et al., 2014; Ostrom, 2001). Second, CAS are developed to respond to partly uncertain events (Buuren et al., 2014; Knieling & Filho, 2013). Relating to this, polycentric governance struggles to cope with the growing risks of rapid environmental and social change, causing problems such as high transaction costs, freeloading, unanticipated effects, inconsistences, gridlock, and implementation failure (Morrison et al., 2019). Third, CA requires a long-term commitment beyond the election terms of politicians, which can lead to inconsistent policies (Buuren et al., 2014; Ostrom, 2014). Both the second and third challenges make long-term planning difficult. Fourth, for CA to be legitimate, all stakeholders' interests and perspectives should be considered, which proves to be difficult due to the many stakeholders involved (Buuren et al., 2014). Finally, CAS need to be embedded or connected to other social issues, as they often compete. This horizontal integration across policy sectors is difficult for governments (Bauer et al., 2012; Buuren et al., 2014).

One SES in the Netherlands facing (some of) these challenges around implementing CAS is the Utrechtse Heuvelrug (UH), as it is an example of polycentric governance, a complex problem involving many stakeholders and climate issues, and it requires a long-term commitment. The UH has an urgent need for CA as it already faces the consequences of climate change. For example, droughts resulted in a water shortage and the withering of nature and green cultural heritage during the summers of 2018 and 2019 (Stichting Nationaal Park Utrechtse Heuvelrug, 2020). Furthermore, during the summer of 2021, extreme weather conditions occurred, like the katabatic wind in Leersum (Gemeente Utrechtse Heuvelrug, 2021; NOS, 2021). These events increase the pressure on several functions provided by the UH, such as nature conservation, agriculture, living, drinking water facilities, and recreation (Stichting Nationaal Park Utrechtse Heuvelrug, 2020).

To protect the UH and its various functions, a variety of stakeholders at the UH started collaborating on researching solutions that allow for better adaptation to the changing climate (Groenblauwe netwerken, n.d.; Huisje Boompje Beter, n.d.; Hydrologic & Acacia Water, 2021). A key stakeholder in this process is the foundation Nationaal Park Utrechtse Heuvelrug (NPUH), which aims for joining stakeholders' forces to ensure a future for nature, landscape, and cultural heritage (Stichting Nationaal Park Utrechtse Heuvelrug, n.d.-c). For example, NPUH initiated the "Blauwe Agenda" (Blue Agenda), a collaboration between several stakeholders at the UH (Hydrologic & Acacia Water, 2021; Stichting Nationaal Park Utrechtse Heuvelrug, 2020). Its goal is to create a future-ready water system, meaning that the current functions of the area should be sustained in the future, requiring some functions to adapt or move. Additionally, several organisations provide an overview of potential CAS for citizens (Huisje Boompje Beter, n.d.) and solutions at different levels (home, street, village), including measures focussing on water, heat, biodiversity, air quality, and energy (Groenblauwe netwerken, n.d.).

However, despite these developments, the implementation of CAS only proceeds slowly, increasing the pressure on the functions of the UH. Potentially, this leads to functions disappearing. This slow implementation process could be caused because the known challenges are a decade old and potentially outdated, or because literature does not provide answers on how to overcome these challenges. Therefore, to ensure a climate-adapted landscape at the UH, it is necessary to research what challenges relating to the implementation of CAS exist and how to overcome them. To do so, SES theory can be used by performing an actor-issue network analysis, which captures the intersection of actor collaborations and climate issue interdependencies (Bergsten et al., 2019). The actor-issue network is interesting to use, as it captures some of the known challenges by both reducing the complexity of the climate change issue by separating it into separate issues and acknowledging the many stakeholders involved.

The actor-issue network, developed by Bergsten et al. (2019) has, so far, hardly been applied to case studies, so this research aims to provide a scientific contribution by offering a practical application of this framework. Furthermore, the actor-issue network does not guide the transition towards a climate-adapted landscape, as it only states that bridging measures should be developed. Therefore, this research aims to expand and adapt the methodology developed by Bergsten et al. (2019) to develop a more solution-oriented approach to SES, which can be achieved by integrating a PESTEL (Political, Economic, Socio-cultural, Technological, Environmental, Legal) analysis to develop key drivers for change (KDFC) and a stakeholder analysis based on power and interest levels.

This combination can help overcome existing literature gaps, namely the lack of knowledge about implementing CAS and the lack of practical application of the actor-issue network. Furthermore, using the UH as a case study, this combination could potentially offer a valuable addition to improving the methodology of how the actor-issue network can be applied. From a more practical perspective, this research could provide insight into the institutional misfits at the UH that hinder CAS implementation and into each stakeholder's role and responsibility in the SES. This enables stakeholders to implement necessary changes to achieve climate-adapted landscapes, which may result in the functions currently offered by the UH being accessible in the future as well. This benefits nature, heritage, and humanity.

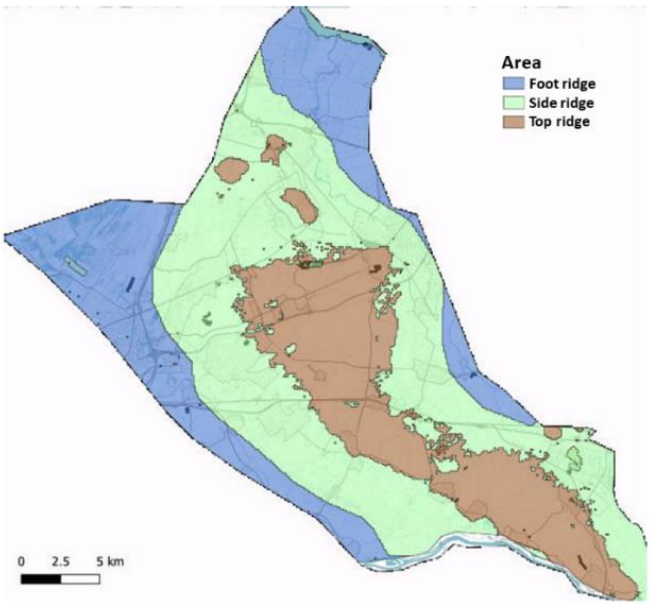

Figure 1: The different areas that are part of the Utrechtse Heuvelrug showing the geographical scope of this research (Hydrologic & Acacia Water, 2021)

Accordingly, this research aims to provide insight into the existing SES at the UH to enable stakeholders to implement CAS to reach a climate-adapted landscape. This requires strategies to be implemented at the foot, the side, and the top of the Heuvelrug, as shown in Figure 1. Therefore, the spatial scope of the "Blauwe Agenda" is used, in which the three aforementioned spatial areas are included (Hydrologic & Acacia Water, 2021). Because stakeholders will have to carry out the measures, only stakeholders that are currently active at the UH will be involved. This scope leads to the following research question:

> *How can different stakeholders at the Utrechtse Heuvelrug be enabled to accelerate the implementation of climate adaptation solutions to reach a climate-adapted landscape?*

To answer this research question, three sub-questions (SQ) are formulated. These are:

> *SQ1: What stakeholders and (potential) climate issues play a role in the social-ecological system for climate adaptation at the Utrechtse Heuvelrug?*
>
> *SQ2: What governance gaps, caused by collaborative and integrative misfits, exist in the social-ecological system for climate adaptation at the Utrechtse Heuvelrug?*
>
> *SQ3: What bridging measures within the six PESTEL dimensions do stakeholders perceive as possible solutions to overcome existing governance gaps?*

The answer to SQ1 maps the current system of stakeholders and (potential) climate issues at the UH, resulting in an actor-issue network. SQ2 allows for an interpretation of this network, guiding the direction of potential improvements in the system. SQ3 results in discovering potential measures that can help overcome governance gaps.

The UH and its background is introduced in section 2. Section 3 explains the theoretical framework based on the actor-issue network, PESTEL, and power-interest matrix. Section 4 elaborates on the methodology that was used, which is followed by the results in section 5. Finally, sections 6 and 7 are respectively the discussion and conclusion.

2. Background

2.1 The Utrechtse Heuvelrug

At over 100 km^2, the UH is the second biggest woodland in the Netherlands (Kaart van Nederland, n.d.; Stichting Nationaal Park Utrechtse Heuvelrug, n.d.-a). It is known for its hills, which were formed during an ice age over 150.000 years ago (Stichting Nationaal Park Utrechtse Heuvelrug, n.d.-a). In the Middle Ages, substantial parts of the forests were cut to make room for agriculture. A large-scale reforestation project, mainly for timber production, was initiated during the 19th and 20th centuries. More recently, nature conservation became important, focussing on creating a forest in which both plants and animals can thrive. These developments resulted in a wide variety of nature landscapes.

Besides the agriculture and nature conservation functions, which allow for recreation, the UH has historical value (Stichting Nationaal Park Utrechtse Heuvelrug, n.d.-b). This can, for example, be seen by the burial mounds (2500-2000 BC), ruins of Roman fortifications, war museums, and estates built by the Dutch elite (17th century). Furthermore, the UH provides drinking water, as there is a big 'water lens' in the ground from which drinking water is extracted (Hydrologic & Acacia Water, 2021). This water system, shown in Figure 2, has a substantial influence on the landscape at the UH. Finally, the UH has a living function for several settlements.

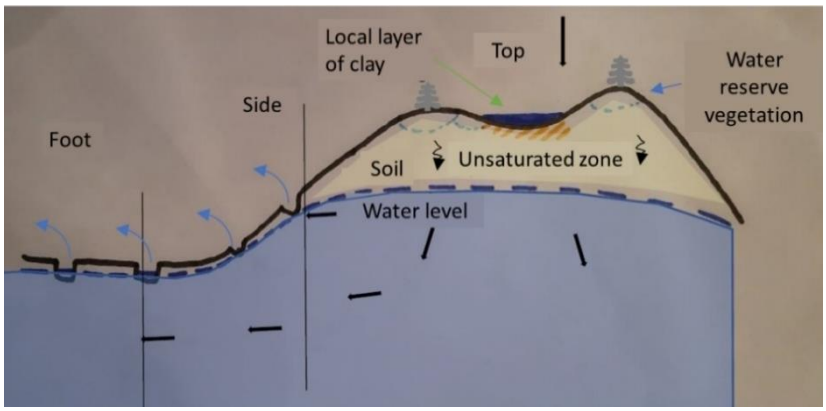

Figure 2: Schematic representation of the water system at the Utrechtse Heuvelrug (Hydrologic & Acacia Water, 2021)

2.2 Potential climate issues at the Utrechtse Heuvelrug

There is increasing pressure on the UH for several reasons (Hydrologic & Acacia Water, 2021; Stichting Nationaal Park Utrechtse Heuvelrug, 2020): both the water usage and population are growing, more people are visiting for recreational purposes, agriculture is intensifying, and climate change. This results in several potential climate issues.

Some climate issues directly link to the availability of water. The droughts during 2018 and 2019 put pressure on the forests and heathers (Hydrologic & Acacia Water, 2021; Stichting Nationaal Park Utrechtse Heuvelrug, 2020). Ponds are drying up, causing the disappearance of rare species and putting pressure on biodiversity. Furthermore, the withering of trees increases the risk of forest fires (Provincie Utrecht, n.d.-c). As the nature core is surrounded by agricultural land, dried-up soil may increase nitrate and phosphate run-off and reduce soil quality because micro-organisms become inactive (Hydrologic & Acacia Water, 2021). Thus, there is an increased risk of micro-pollutants, like drug residues, PFAS, and microplastics, harming nature and the water quality (Hydrologic & Acacia Water, 2021; Stichting Nationaal Park Utrechtse Heuvelrug, 2020).

The rising temperature has an impact as well. First, it can reduce water quality, as blue-green algae grow better (Provincie Utrecht, n.d.-a). Second, fungi, diseases, and plagues occur more often, although little is known yet about their impact and risks. Third, there is an increased chance of extreme weather events (Mirza, 2003; Stott, 2016), like heatwaves and short-term heavy rainfalls. This causes risks to biodiversity and life in the cities (Provincie Utrecht, n.d.-b), and results in a surplus of water (Hydrologic & Acacia Water, 2021; Provincie Utrecht, n.d.-c; Stichting Nationaal Park Utrechtse Heuvelrug, 2020). Due to urbanisation and the dried-up soil, this water runs to the foot of the UH and causes (small) flooding.

2.3 Stakeholders at the Utrechtse Heuvelrug

According to Freeman and McVea (1984, p190), a stakeholder is "*any group or individual who is affected by or can affect the achievement of an organization's objectives*". Following this definition, the UH has 23 stakeholders being directly involved in CA. These include governmental organisations, businesses, NGOs, landowners, nature managers, volunteering initiatives, citizens, and lobby groups. A description of all stakeholders and their role in climate-adaptive landscaping is included in Appendix 1.

3. Theoretical framework

SES theory is used to research the dynamic and complex system around the implementation of CAS at the UH. The SES is analysed using an actor-issue network (Bergsten et al., 2019). However, SES theory lacks a focus on transition, which is needed to make the UH climate-adapted. Moreover, while the actor-issue network approach results in bridging measures that can help overcome problems in the system, this final step is not guided by this approach. Therefore, this theory is complemented with a PESTEL-analysis. Finally, as both SES and PESTEL neglect the different levels of power and interest of stakeholders, a power-interest matrix is used. These theories will be explained in this section.

3.1 Social-ecological systems: actor-issue network

Managing sustainable development is a complex challenge because of the interdependency of environmental and societal issues (Bergsten et al., 2019). This complexity increases as sustainability issues are influenced by different stakeholders having various roles, capacities, and beliefs. This results in uncertainty about the societal dynamics of sustainability issues and about the relating responsibilities (Klijn & Koppenjan, 2000). Therefore, to operationalise adaptive governance, the social and environmental subsystems need to be considered in one system (Berkes, 2017). This interaction between environmental aspects and social interactions can be described using SES (Anderies, Janssen, & Ostrom, 2004; Armitage et al., 2012; Berkes, 2017; Brondizio et al., 2009; Ostrom, 2007). To visualise this interaction and to achieve collective action, Bodin (2017) developed a network approach to SES by claiming:

> *"Interdisciplinary research on collaborative networks demonstrates that which actors get involved, with whom they collaborate, and in what ways they are tied to the structures of the ecosystems have profound implications on actors' abilities to address different types of environmental problems." (p1)*

Bergsten et al. (2019) adopted this network approach and developed the actor-issue network. This network captures the intersection of the actor collaborations and the issue interdependencies. This way, the actor-issue network can help understand the complexity of SES and identify which specific actors and issues have a low institutional fit. This approach acknowledges that governance gaps arise when responsible actors fail to recognise how different issues and actors are interlinked.

Using the actor-issue network for the UH, a schematic representation of a network can be constructed, displaying three types of relations: 1) actor-actor relations showing the collaborations between different stakeholders that work on CA at the UH (actor-actor network), 2) issue-issue relations showing the interdependencies of climate issues relating to CA (issue-issue network), and 3) actor-issue relations which show what actors work on what climate issues (actor-issue network). This visualises the *integrative* and *collaborative misfits* at the UH. *Collaborative misfits* occur when different actors do not collaborate, even though they work on the same issue. *Integrative misfits* occur when issues are interdependent, though an actor only works on one of these issues. If there are many collaborative and/or integrative misfits, there is a high institutional misfit and vice versa.

The collaborative and integrative misfits are *governance gaps*, which need to be investigated to see how the institutional misfits hinder actors from achieving the intended sustainability outcomes (Bergsten et al., 2019). Thus, in the case of the UH, *governance gaps* are investigated to see how the institutional misfits hinder the implementation of CAS. To overcome these *governance gaps*, a transition is needed in the SES. This transition can be started by developing bridging measures. However, SES literature does not provide sufficient insight into how to develop these and lacks a focus on transitions. PESTEL is used to guide this final step of the actor-issue network approach.

3.2 PESTEL-analysis

The processes and outcomes of the involvement of (corporate) stakeholders in the CA transition at the UH should be examined (Banerjee, 2010), which can be done by using different models of strategic and operational planning, like Porter's five forces, SWOT analysis, VRIO framework, Value Chain Analysis, and PESTEL (Heischmidt & Gordon, 2020). Bryson, Edwards, & Van Slyke (2017) define strategic planning as:

> *"deliberative, disciplined effort to produce fundamental decisions and actions that shape and guide what an organisation (or other entity) is, what it does, and why." (p.317)*

Strategic planning can be applied to (parts of) organisations, inter-organisational networks, and places, and it can help understand how and under what conditions more effective governance can be encouraged (Bryson et al., 2017). Thus, for the UH, it can help understand how and under what conditions the transition towards a climate-adapted landscape can take place. As PESTEL takes most different aspects of a system into account, this framework was chosen.

A PESTEL-analysis assesses the Political, Economic, Socio-cultural, Technological, Environmental, and Legal factors in the macro-environment (Whittington, Regnér, Angwin, Johnson, & Scholes, 2020), as described in Table 1. Thus it underlines that both market and non-market aspects can influence the performance of either an organisation, industry, or sector (Itani et al., 2014). This strategic planning tool can help understand, assess, and evaluate the impact of these factors in the external environment of a system (Itani, O'Connell, & Mason, 2014; Rastogi & Trivedi, 2016). This way, a PESTEL-analysis can help capture and improve understanding of risks, problems, threats, and opportunities. Looking at the UH, the macro-environment influences the performance of different stakeholders that work on the implementation of CAS, which can be analysed using PESTEL to help overcome potential problems.

Table 1: Explanation of the six different factors of a PESTEL-analysis (Whittington et al., 2020)

Factor	Explanation
Political	This factor highlights the role of the state and other political factors.
Economic	This factor highlights macro-economic factors, such as the availability of funds, economic growth rates, and interest rates.
Socio-cultural	This factor highlights social and cultural aspects of the environment, which can both shape the innovativeness, power, and effectiveness of organisations and the demand and supply. Furthermore, organisational fields are highlighted, which is a group of organisations that collaborate more frequently with one another than with organisations outside of the organisational field.
Technological	This factor highlights areas of potential innovative activity that have a high impact also far beyond single industries, which can, for example, be indicated by research and development, patenting activities, and new product announcements.
Environmental	This factor highlights the 'green' macro-environmental issues, relating to climate and/or climate change. This could include dealing with direct pollution, product stewardship (managing ecological issues in the entire supply chain), or sustainable development (ensuring the development of the product in the future as well).
Legal	This factor highlights the legal aspects of the macro-environment, including topics like permits, taxation, and regulations.

An analysis of the PESTEL factors in a system can result in a long and complex list of problems (Whittington et al., 2020). To avoid being overwhelmed, KDFC should be identified. These are the factors that are likely to have a high impact on the organisation, industry, or sector, and on the success or failure of their strategies. Thus, if a list of potential problems that stakeholders experience when implementing CAS is developed for each PESTEL factor, solutions can be developed to overcome these

problems. The solutions that are likely to have the highest impact are the KDFC, making them the bridging measures in the actor-issue network approach. For example, if a problem turns out to be a lack of financial resources to implement CAS (Economic factor) and stakeholders think the solution with the highest impact would be to make more subsides available, this would be a KDFC.

In conclusion, the developed KDFC can help overcome problems in the macro-environment. Developing the KDFC using the PESTEL-analysis can help stakeholders in the system to focus on the most important solutions that should be addressed first (Whittington et al., 2020). Therefore, this PESTEL-analysis can help stakeholders take the right strategic decisions when dealing with problems relating to implementing CAS. A PESTEL-analysis can thus help conceptualise, understand, and promote a transition towards sustainability, like the transition towards a climate-adapted landscape at the UH.

3.3 Stakeholder analysis: power-interest matrix

The combination of the actor-issue network and PESTEL-analysis fails to provide insight into the different levels of stakeholders' agency regarding the problems relating to the implementation of CAS. This information could be valuable to get a clearer picture of the influence that stakeholders have on the development and implementation of CAS (Chinyio & Akintoye, 2008; Johnson, Scholes, & Whittington, 2008). For example, key stakeholders may be more important to focus on when implementing KDFC to reach a climate-adapted landscape at the UH.

Therefore, SES and PESTEL theory is complemented with a power-interest matrix, shown in Figure 3. This framework allows for gaining a further understanding of the relationships between different stakeholders at the UH by ranking stakeholders based on the level of power and interest they have (Johnson et al., 2008). Power can be defined as "*the ability of individuals or groups to persuade, induce or coerce others into following certain courses of action"* (Johnson et al., 2008, p160), thus being the ability of stakeholders to implement CAS. Interest is the extent to which stakeholders are likely to support or oppose certain CAS.

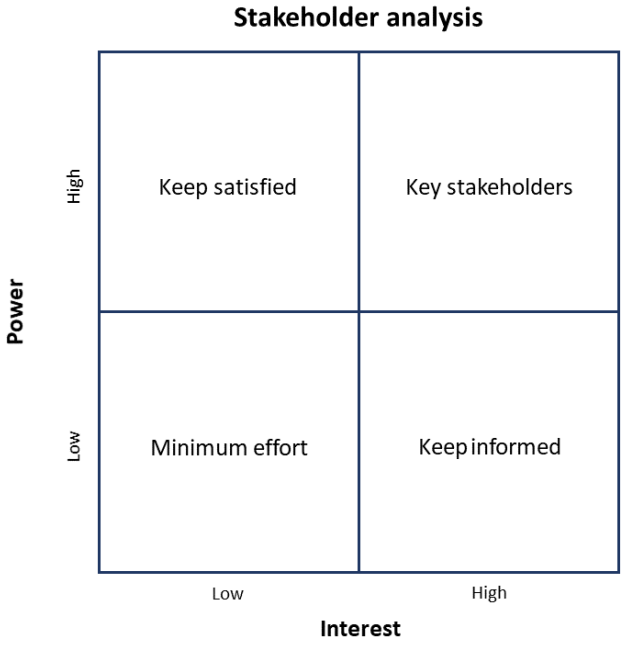

Figure 3: A power-interest matrix for the stakeholder analysis

3.4 The theoretical framework

The combination of the actor-issue network, PESTEL-analysis, and power-interest matrix is the foundation of the theoretical framework of this research, shown in Figure 4. The three theories allow for developing bridging measures (KDFC) that can be used to change the system for CA at the UH, which may empower different stakeholders to implement CAS at the UH to reach a climate-adapted landscape.

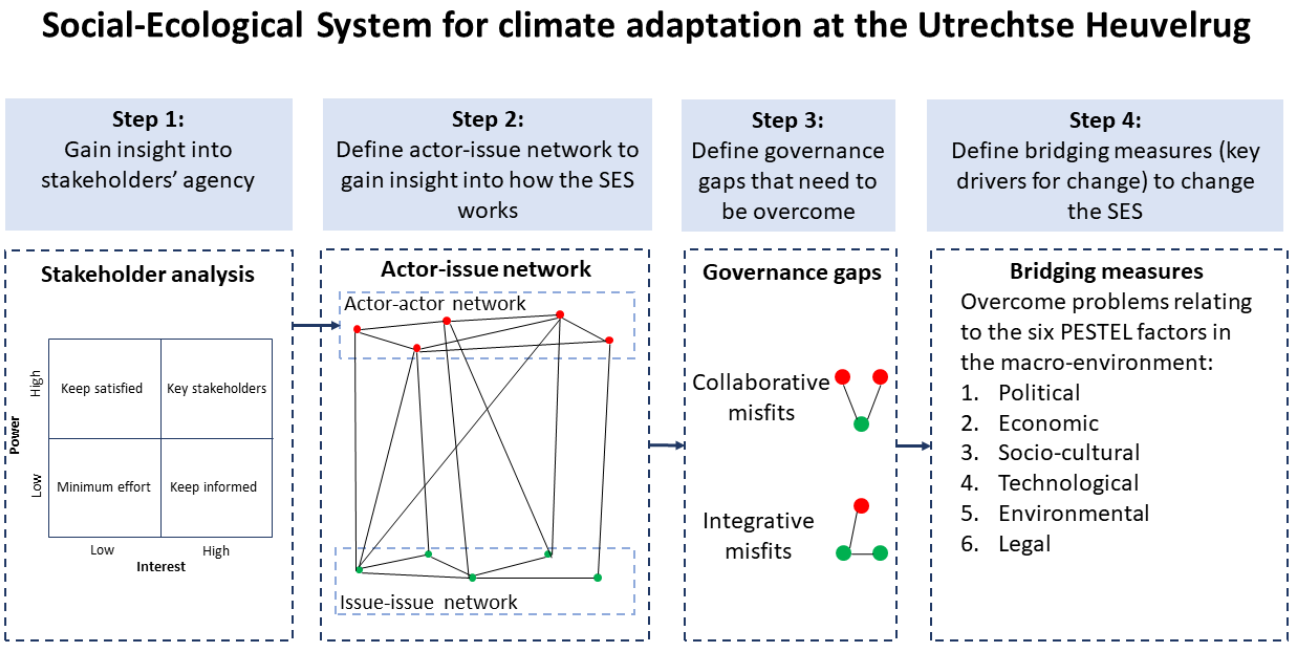

Figure 4: Theoretical framework used to develop measures to enable the implementation of climate-adaptive landscaping solutions

4. Methodology

4.1 Developing a draft actor-issue network

A draft actor-issue network was developed to gain an overview of the governance landscape at the UH. For the actor-actor network, scientific and grey literature and company websites were used to create a draft list of stakeholders and their collaborations. This overview was discussed with managers from NPUH, after which the actor-actor network was improved. The same process was carried out to define the issue-issue relations to create the issue-issue network.

The developed networks were used to formulate (open) questions for interviews with different stakeholders. The interview guide is provided in Appendix 2. The first interviewees were approached using contacts of NPUH. Other stakeholders were contacted based on the snowballing method. In total, 22 interviews were conducted with a duration between 30 and 70 minutes (Appendix 3). Due to the COVID-19 pandemic and the preferences of the interviewees, most interviews were conducted through videoconferencing.

Each interviewee was asked to sign an informed consent form (Appendix 4), giving consent to the interview being recorded, transcribed, and coded in NVivo. The coding process existed of open, axial, and selective coding, following the research design set out by Bryman (2012). First, during open coding, every sentence received a code, after which relationships were identified. Second, during axial coding, relationships among the codes were identified and an overview of the different concepts was made. Finally, during selective coding, the core variables were named and relating codes were identified. All used data was anonymised to ensure the privacy of the interviewees.

4.2 Developing the final actor-issue network

4.2.1 Defining the actor-actor network

For the actor-actor network, the relationships between different stakeholders were coded using a Likert scale, which was developed to measure 'attitude' in a validated and scientific manner (Joshi, Kale, & Chandel, 2015). The relationships were coded as 'Very often ((almost) daily)', 'Often (weekly)', 'Regularly (monthly)', 'Sometimes (a few times a year)', or '(Almost) never'. These codes received, respectively, a value from 5 to 1. A table was made in Excel to show the connections between the stakeholders. For each connection the highest value was selected as an interviewee of a certain organisation may not be fully aware of the frequency of collaborations that their colleagues have with other organisations. For example, if the interviewee from HDSR said they collaborated often (value of 4) with NPUH and NPUH said it was very often (value of 5), the connection received a value of 5.

Following, each link having a value below 3 was removed to simplify the final actor-actor network. The resulting table was uploaded to Ucinet, a software package for the analysis of social network data (Ucinet, n.d.). The resultant analysis was plotted using NetDraw, which was then used to calculate the betweenness centrality (BC) for each node. This represents a 'mediation' role in a network, meaning that other nodes will have to 'go through' a certain node to get in contact with one another (Zhang & Luo, 2017). This type of centrality was chosen because a high BC can be an indication of this node being important in a network for building connections (so-called brokerage) with and between stakeholders. As CA requires many stakeholders to be involved, this type of centrality is deemed to be valuable. The stakeholders with the highest BC were invited to a workshop, which will be elaborated on in section 4.4.

4.2.2 Defining the issue-issue network

Interviewees were asked to, based on their experiences in the work field, add other climate issues to the original list of climate issues. After conducting the final interview, a literature review was carried out to research the cause-effect relationships between the climate issues. This resulted in a table showing an overview of the causal connections between the climate issues. If a certain climate issue influenced another climate issue, the corresponding cell in the table received a 1. If not, the cell received a 0.

The resulting table was again uploaded from Excel into the application Ucinet, after which the resultant analysis was plotted using NetDraw, creating a directed graph of the issue-issue network. NetDraw was then used to calculate the degree centrality (DC) of each node, which indicates the relative importance of the specific climate issue within the network (Bródka, Skibicki, Kazienko, & Musiał, 2011), as it shows the total number of direct links a climate issue has with other climate issues.

Since the cause-effect relationships were researched, a separation between outdegree and indegree could be made (Brodka, Musial, & Kazienko, 2009). Outdegree represents the total impact of a climate issue, as it shows on how many other climate issues a certain climate issue has a direct impact. Indegree shows how many other climate issues can cause (or contribute to causing) a certain climate issue. By solving a climate issue that is a cause of another climate issue, that second climate issue is indirectly improved as well. Therefore, the outdegree will be looked at when deciding which governance gaps to focus on. Due to time constraints, only the two climate issues with the highest outdegree were chosen for this further investigation. As the second-highest and third-highest climate issues had the same outdegree value, the climate issue with the highest DC was chosen as this climate issue is better connected with the other climate issues.

4.2.3 Defining the actor-issue network

During the interviews, stakeholders were asked what climate issues their organisation worked on. If an organisation worked on a certain climate issue, this connection received a 1. If the organisation did not work on a certain climate issue, the connection received a 0. All values were merged into a table in Excel.

Then the tables showing the actor-actor, issue-issue, and actor-issue relations were merged into one master table in Excel, as illustrated in Table 2. This table was uploaded to Ucinet and the resultant analysis was plotted using NetDraw. All actors were marked red and moved to the top of the network and all climate issues were marked green and moved to the bottom.

Table 2: Set-up of the master table to create the final actor-issue network

	All actors	**All climate issues**
All actors	*Table developed in section 4.2.1 showing the actor-actor relations*	*Table developed in section 4.2.3 showing the actor-issue relations*
All climate issues	*All cells received a 0 (no connection)*	*Table developed in section 4.2.2 showing the issue-issue relations*

4.3 Visualising integrative misfits to bring together the right group of stakeholders

For both climate issues having the highest outdegree levels, first, the collaborative fit was mapped. This was done by including all actors that worked on the focal issue and mapping the relationships between these actors. However, as it turned out that the actor-actor network around these focal nodes was already quite dense (Appendix 5), the collaborative misfits were not further investigated.

Then, for both climate issues, the integrative fit was mapped. The same steps were followed for both climate issues. First, all stakeholders and climate issues that did not have a direct link with the focal issue were removed. Note that for the climate issues, the relationship should be interdependent, meaning that a climate issue should both have an impact on and be a consequence of the focal climate issue. Second, the actor-issue network was further simplified by removing all connections between different stakeholders and by removing all connections between different climate issues. The relationships between actors could be removed because this information is not needed when looking for integrative misfits. The relationships between climate issues could be removed because the relationship between each climate issue and the focal node was researched, instead of the relationships between the other climate issues. Finally, all stakeholders that had a link with all climate issues were removed because none of these stakeholders were part of an integrative misfit relating to the focal node. The final network around either one of the focal nodes resulted in a selection of a few stakeholders that were involved in an integrative misfit relating to the focal node.

4.4 Developing bridging measures to overcome the governance gaps

The second part of the research focused on developing bridging measures to overcome the governance gaps, which was done through two workshops. For both climate issues with the highest outdegree, a potential list of stakeholders was made. This list existed of the stakeholders that were involved in an integrative misfit and one stakeholder with a high BC. As some stakeholders could be invited to both workshops, which was to be avoided because this could cause an overrepresentation, the lists were discussed with managers from NPUH to make the most interesting combinations. The aim was to organise two workshops of four participants as this group size allows for all attending stakeholders to share their opinions on each topic (Bloor et al., 2012; Gill et al., 2008).

Workshops are generally used to collect information on stakeholders' collective views and the meaning behind those views (Gill, Stewart, & Treasure, 2008). By inviting several stakeholders to the workshop, insight could be gained into how the system at the UH functions and what reasons lie behind the existing governance gaps. Because it was assumed that all stakeholders have a certain level of interest (either low or high) in a climate-adapted landscape at the UH, as this allows for a continuation of the current activities of each stakeholder, it was believed that there would not be radical different opinions. This allowed for mixing different stakeholders during the workshop.

There is an ongoing debate about whether a focus group or workshop should be a pre-existing group or whether the participants should be strangers to each other (Bloor, Frankland, Thomas, & Robson, 2012). A pre-existing group has the advantage that it allows for interaction about shared experiences and challenges, and it makes recruiting participants easier. Since the contacts of NPUH were used to recruit participants, (some of) the participants were already acquainted.

As workshops are influenced by power dynamics, three strategies were used to minimise these dynamics to enable every participant to share their views (Ayrton, 2019). First, only one participant per stakeholder group was included in each of the three workshops to ensure a balance. Second, it was tried to create some homogeneity by emphasizing the common goal, namely, to reach a climate-adapted landscape at the UH. Finally, the researcher tried to exercise both covert and explicit control strategies, including directly challenging participants that had not shared their views yet.

Before the workshop, an overview of all problems was made based on the coded transcripts of all interviews. The same coding process was performed as described in section 4.1. The participants received this overview (Appendix 6, slides 7-12) and four questions for debate (Appendix 6, slide 6). Furthermore, all participants were asked to sign the informed consent form to give consent for recording the workshop.

During the workshop, solutions to the problems of each of the six PESTEL factors were discussed based on the four questions for debate. For each PESTEL factor, the participants were asked to first write down solutions by themselves after which the solutions were discussed. At the end of the discussion of each PESTEL factor, the participants were asked to stick their post-its on a sheet based on the level of impact that a solution could have. A schematic image of this is given in Figure 5. The solutions with the highest impact were seen as the KDFC. The researcher did not participate in the discussion, but only facilitated the workshop and regulated time management.

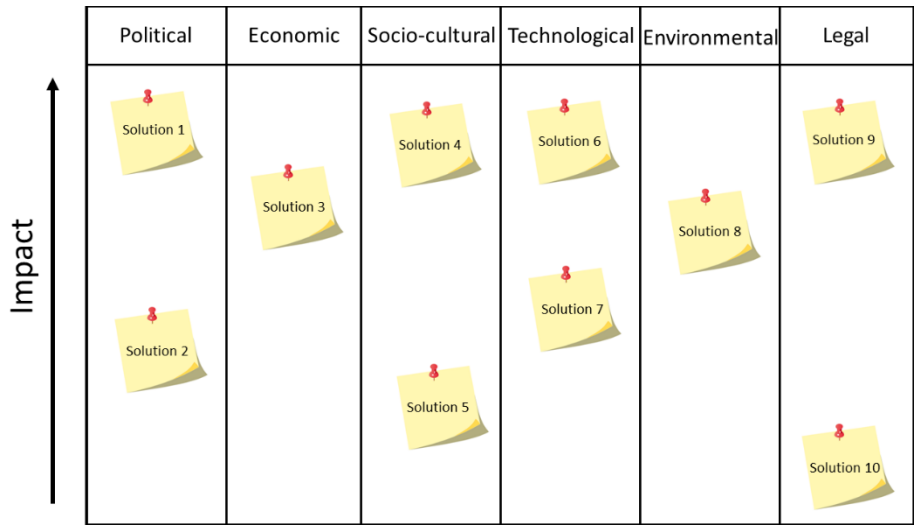

Figure 5: Illustration of sheet used in workshop to allow participants to rank the solutions they came up with based on the level of impact a solution could have.

After the workshop, the recording was transcribed and coded according to the same method as described in section 4.1. All recorded speech was transcribed where possible, so if more people were talking at once, not only the dominant voice was transcribed (Bloor et al., 2012). Thus, the transcript aims to reproduce as near as possible what happened during the workshop. The final codes were used to create an overview of potential KDFC, which were categorised per PESTEL factor. For each KDFC, special attention was paid to who should be responsible for implementing it and how opposing stakeholders could be convinced to support the KDFC.

4.5 Mapping stakeholders in the power-interest matrix

The stakeholders at the UH were mapped in a power-interest matrix as this allows for reflection on what it means if a certain stakeholder was assigned responsibility for a specific CAS. It could be easier for a stakeholder with a high power and interest level to implement CAS than it is for a stakeholder with low power and interest. These insights could be used to provide additional information about how to implement KDFC.

First, desk research was performed. Grey literature, scientific literature, and company websites were studied to define the power and interest of different stakeholders. This information was used to map stakeholders in the matrix, which was then discussed with managers from NPUH. The power-interest matrix was updated according to their input.

During the interviews, questions about the power and interest of stakeholders were posed. As this part of the interviews was transcribed and coded in the same way as described in section 4.1, the data could be used to improve the mapping of the stakeholders in the power-interest matrix. If there were opposing views relating to the power and/or interest of certain stakeholders, this was documented, though the majority's opinion was followed in the figure showing the power-interest matrix. Thus, the resultant power-interest matrix represents the power and interest level as perceived by the biggest share of stakeholders.

4.6 Reliability and validity of the data

To ensure internal validity, triangulation approaches were used whenever possible by combining data acquired by desk research, interviews, and workshops. Furthermore, the transcribing and coding of the interviews and workshop were done as objectively as possible, though it is known that this process may be influenced to some extent by the subjectivity of the researcher. Relating to the external validity of this research, one should be careful to generalise the findings as the research is focused on the UH.

5. Results

5.1 Stakeholders and their betweenness centrality

During the interviews, stakeholders were asked about their collaborations on CA at the UH. This resulted in an overview of all connections between the stakeholders, which was used to create the actor-actor network (Figure 6). The size of the nodes in Figure 6 corresponds with the BC of each stakeholder. An overview of the calculated BC value of each node is given in Appendix 7.

The Province of Utrecht and the water boards have the highest BC, meaning that they are the stakeholders that can best connect other stakeholders. Thus, their connections could be valuable for sharing new solutions for implementing CAS. Therefore, the Province of Utrecht and the water boards were invited to one of the workshops. This will be further described in section 5.4.

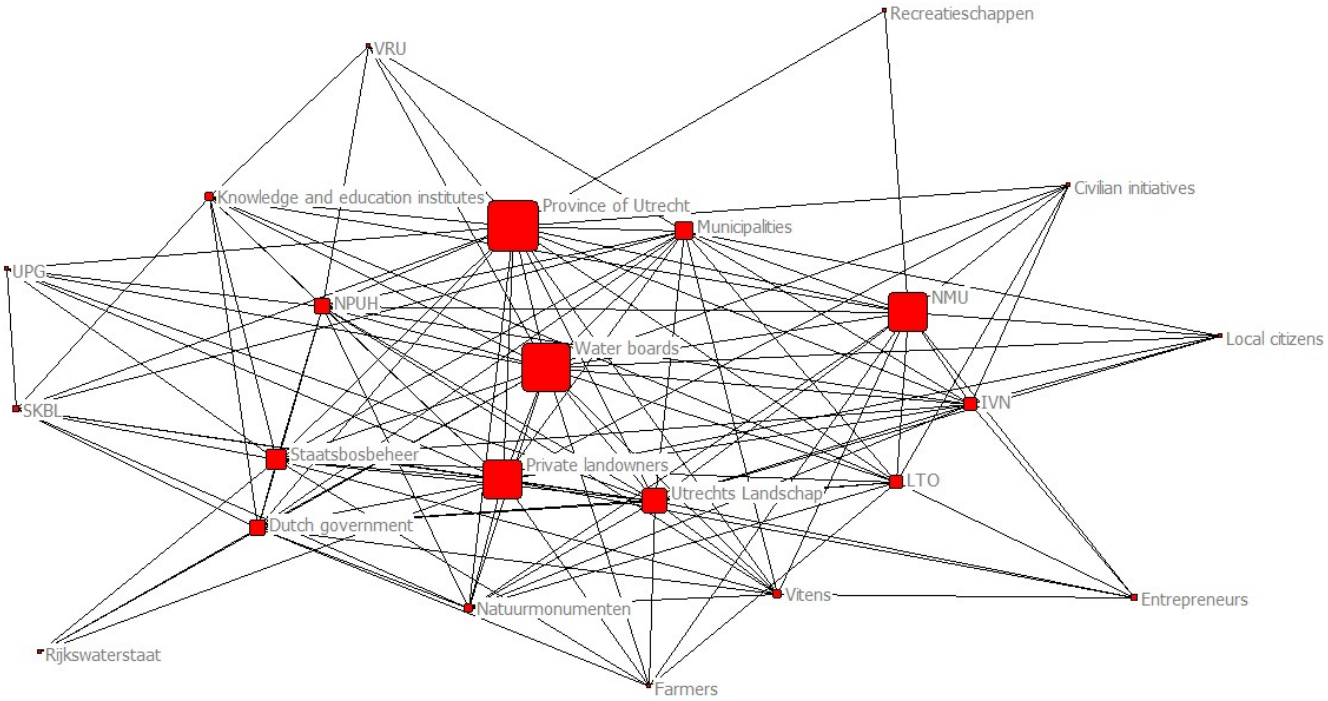

Figure 6: Actor-actor network showing collaborations around climate adaptation at the Utrechtse Heuvelrug. The size of the node corresponds with the betweenness centrality (BC) of the actors whilst links indicate collaborative relations. Specific BC values can be seen in Table 9 in Appendix 7.

5.2 Climate issues and their degree centrality

During the interviews, several climate issues were added to the original list of climate issues. In the end, 20 climate issues were identified: 1) Reduction or shift in biodiversity (potentially causing a mismatch in the food system / exotic plants), 2) Forest fires, 3) Drinking water shortage, 4) Drought, 5) Extreme weather events, 6) Heat waves, 7) Climate change, 8) Soil quality, 9) Micropollutants, 10) Nitrate and phosphate run-off, 11) Surface water dries up (ponds etc.), 12) Floods, 13) Increase in fungi, diseases, and plagues, 14) Damage agricultural crops, 15) Temperature rise, 16) Drying up of the soil, 17) Withering of nature, 18) Desiccation (lowering groundwater level/ seep pressure decreases), 19) Reduction in water quality, and 20) Pluvial flooding. An explanation of each climate issue is given in Appendix 8. A literature review resulted in an overview of cause-effect relationships between each climate issue. This overview, including the sources that were used, is shown in Appendix 8 as well.

Appendix 8 was used to create the issue-issue network at the UH, which is shown in Figure 7. The size of the nodes in Figure 7 corresponds with the outdegree of each climate issue. An overview of the calculated outdegree value of each node is given in Appendix 7.

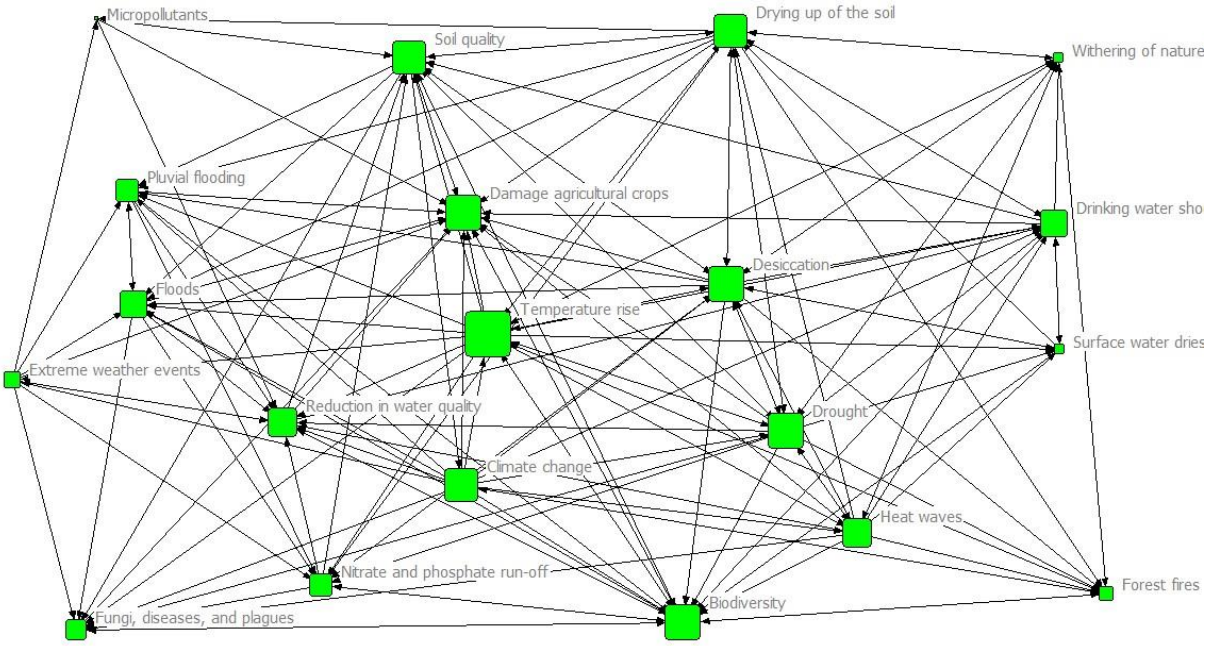

Figure 7: Climate issue network at the Utrechtse Heuvelrug. The size of the nodes represents the degree centrality of each climate issue. The arrows between nodes show which node is the cause and which node is a consequence of the relationship between both nodes.

As can be seen in Figure 8, *temperature rise*, *desiccation*, and *drought* are the three climate issues with the highest outdegree. Due to time constraints, only two climate issues could further be investigated. Thus, besides *temperature rise*, only *desiccation* or *drought* could be investigated. Because *desiccation* has a higher degree than *drought*, meaning it is better connected with other climate issues, it was decided to look further into *desiccation*.

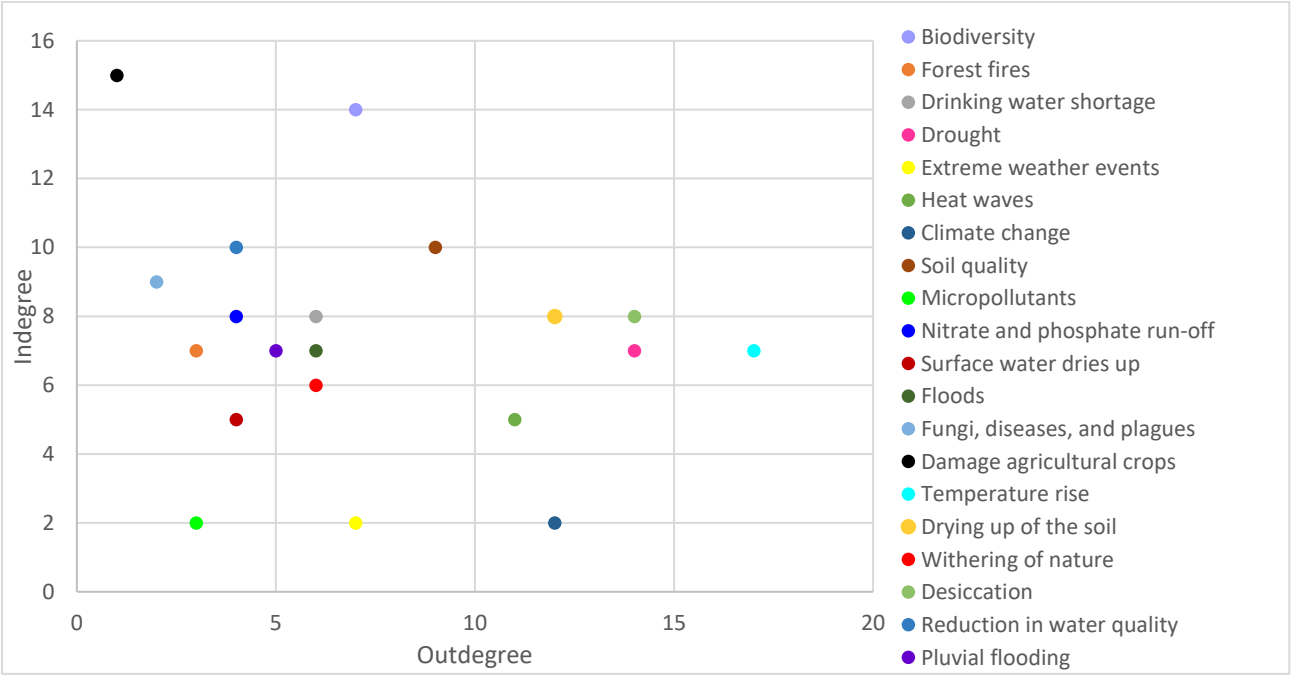

Figure 8: An overview of the indegree and outdegree of the climate issues at the Utrechtse Heuvelrug.

5.3 Defining the actor-issue network to look for governance gaps

Interviewees were asked what climate issues their organisation works on. These results, in combination with the results from sections 5.1 and 5.2, were plotted to develop the final actor-issue network at the UH. This is shown in Figure 9. As described in section 5.2, the governance gaps that potentially have the most impact relate to *temperature rise* and *desiccation*. Therefore, the actor-issue network is simplified around these two climate issues.

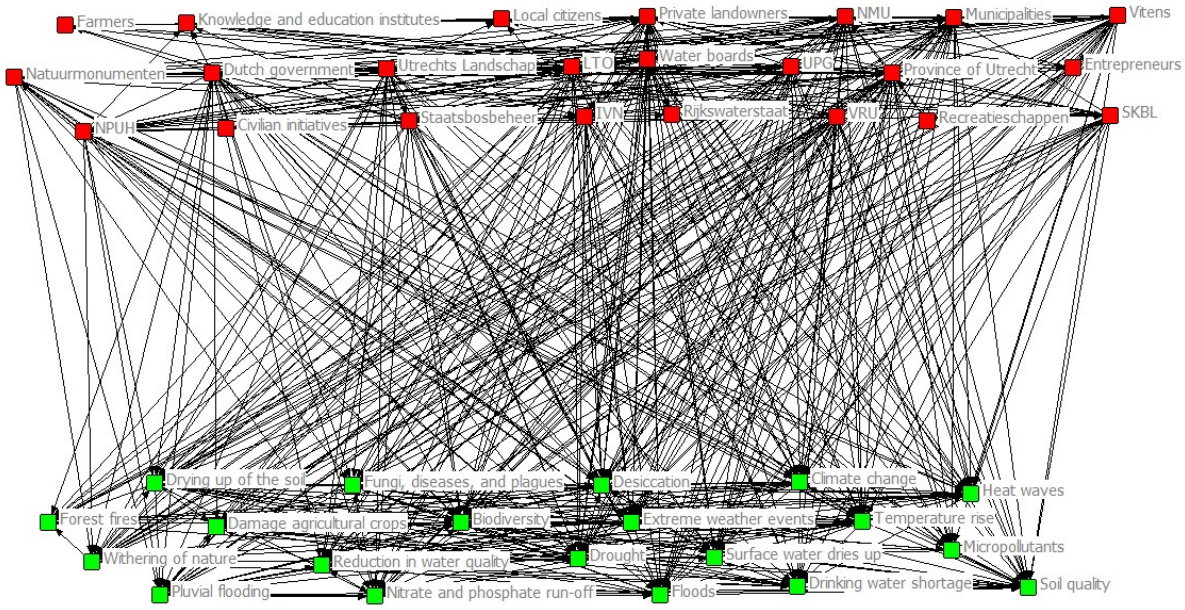

Figure 9: The final actor-issue network showing the collaborations between the actors, the interdependencies of the climate issues, and the connections between actors and climate issues

5.3.1 Temperature rise

Temperature rise was taken as the focal node and the network was simplified according to the steps described in section 4.3. First, all stakeholders and climate issues that did not have a direct link with *temperature rise* were removed. Second, all connections between different stakeholders and between climate issues were removed. The networks resulting from each of these steps are shown in Appendix 9. Finally, all stakeholders that had a link with all climate issues were removed, which resulted in Figure 10.

Seven stakeholders are involved in an integrative misfit relating to the climate issue *temperature rise* and a second climate issue. For example, there is a link between IVN and *temperature rise*, but not between IVN and *drying up of the soil*, even though *temperature rise* and *drying up of the soil* are interdependent, which is an integrative misfit. The stakeholders that are involved in integrative misfits relating to *temperature rise* are Vitens, IVN, NPUH, Utrechts Landschap, NMU, Natuurmonumenten, and sKBL.

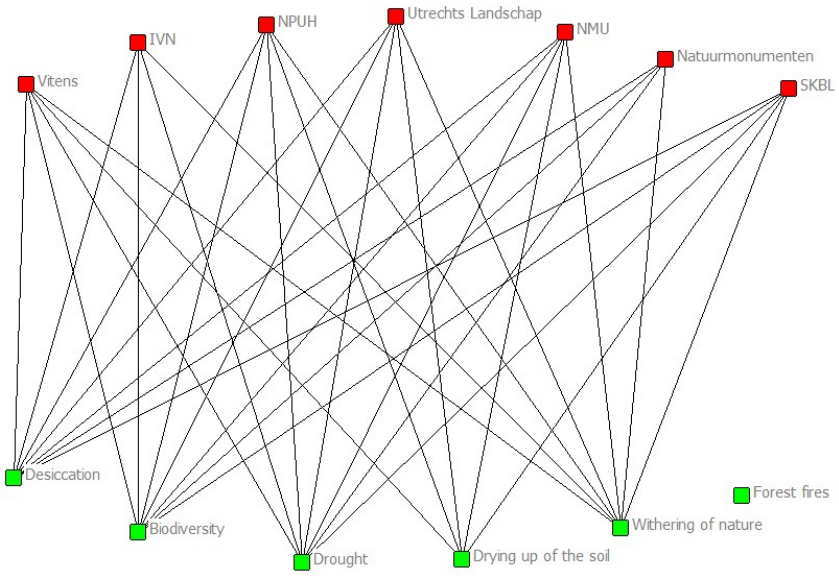

Figure 10: Integrative misfit having temperature rise as a focal node (not included in the figure)

5.3.2 Desiccation

Taking *desiccation* as the focal node, the same steps were followed as for the focal node *temperature rise*. The networks created in the first two steps can be found in Appendix 10. The network resulting from the final simplification step is shown in Figure 11. Eight stakeholders turned out to be involved in an integrative misfit relating to the climate issue *desiccation* and a second climate issue. For example, Staatsbosbeheer has a connection with *desiccation*, but not with *soil quality*, even though *desiccation* and *soil quality* are interdependent, which is an integrative misfit. The stakeholders that are involved in integrative misfits relating *desiccation* are UPG, IVN, LTO, NPUH, Natuurmonumenten, Entrepreneurs, Staatsbosbeheer, Utrechts Landschap.

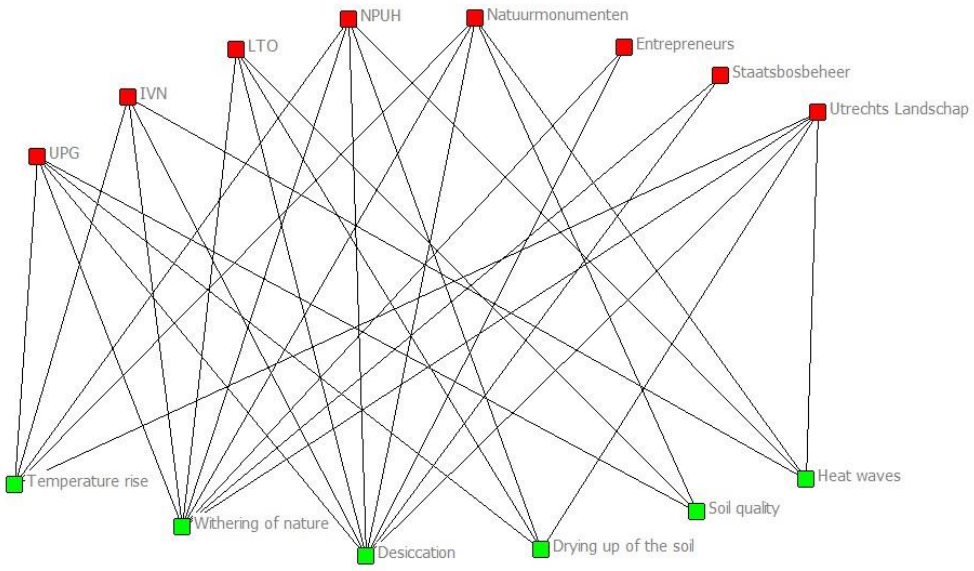

Figure 11: Integrative misfit having desiccation as a focal node (not included in the Figure)

5.4 Creating stakeholder groups for the workshops

Based on these results and in collaboration with NPUH, combinations of stakeholders were chosen for two workshops aimed at discussing the focal issues of *temperature rise* and *desiccation*. For the workshop *temperature rise*, NMU, Vitens, and sKBL were chosen. For the workshop *dessication*, Staatsbosbeheer, UPG and NPUH were chosen.

Owing to the important role of brokerage actors in sustainable management problems (Burt, 2004), stakeholders with high BC were also invited to each workshop. The water boards could not attend the workshop due to time constraints, thus private landowners were invited as they have the third-highest BC. The final overview of stakeholders that were in each workshop is shown in Table 3.

Table 3: Stakeholder groups for each workshop based on the results of sections 5.1-5.3. The stakeholders that are bold agreed to be part of the workshop. Due to unforeseen circumstances, the stakeholders in red had to cancel their participation last-minute.

Reason for participation in a workshop	Temperature rise	Desiccation
Involved in an integrative misfit	IVN	IVN
	Natuurmonumenten	Natuurmonumenten
	NPUH	**NPUH**
		Staatsbosbeheer
		UPG
	Utrechts Landschap	Utrechts Landschap
		LTO
	NMU	
	SKBL	
	Vitens	
		Entrepreneurs
High betweenness centrality	**Province of Utrecht**	**Private landowners** (instead of water boards)

5.5 Problems when working on climate adaptation at the Utrechtse Heuvelrug

During the interviews, stakeholders mentioned many different problems, which are summarised in Table 4. For each PESTEL factor, the problems that were mentioned most frequently will be discussed in subsections 5.5.1-5.5.6.

Table 4: The problems and challenges that stakeholders experience when working on the theme climate adaptation at the Utrechtse Heuvelrug.

Dimension	Problems/challenges mentioned during the interviews	Mentioned during number of interviews
Political	There is no leadership (“regie”)	12
	There is no unambiguous vision	7
	The process toward a climate-adapted landscape takes a long time	7
	Mostly short-term thinking	6
	Things don’t get on the agenda until there’s been a crisis	4
	Wrong policies are being carried out	3

	There is no discussion about the manufacturability of an area, while we should have this discussion	3
	There are not the right tools to change things	2
	Lack of transparency	2
	Climate adaptation is only linked to other policies, there is little policy purely focused on climate adaptation	2
	Getting (positive) media attention deemed to be (more) important	1
Economic	Shortage of financing / it is too expensive	9
	Costs and benefits are not equally shared (one party pays while everyone benefits)	2
	Follow the money: people/stakeholders are dependent on subsidies, making them not as independent as they should be	2
	Rules of the subsidies are limiting/wrong	2
	There is no revenue model behind climate adaptation (yet)	2
	There are many different money sources available, which makes it unclear what money is available and how to get it	1
Socio-cultural	There are contradicting interests between stakeholders	15
	People don't take responsibility	11
	There are too many different functions/people in a small place	7
	Everyone depends on each other	5
	Locked system: politicians depend on voters, companies are waiting for the politicians, and citizens are waiting for business/politics	4
	There are not enough people employed who have the right knowledge	2
	It's hard to keep people's attention	2
	It is unknown what others are doing	2
	Other stakeholders don't always have a positive outlook	2
	Not everyone can / want to collaborate	1
Technological	There are too many new solutions available	1
Environmental	There is too little knowledge on what the problem exactly entails and how we can solve it	14
	The future is still uncertain: it is unknown what the exact effects of climate change will be	5
	It is a complex problem to solve, as there are many different projects, initiatives and lobby groups	5
	The big scale of the problem makes it complex	3
	It is complex that different climate issues require (sometimes contradictory) solutions	1
	We don't tackle the core problem, as we only deal with some consequences of the core problem	1
Legal	It is difficult to get permits or licences / it takes a long time to get one / there are many restrictions	5
	It is difficult to move functions in the area as you cannot just move someone	1
	There is too little room to experiment	1

5.5.1 Political problems

The problem that was mentioned most often is the lack of leadership ("regie"), as one of the interviewees described it:

> *"A sort of leadership, that isn't there. So, there is not one organisation that says: 'these projects play a role in this area, and we will keep track of them and take a leadership role, and we will make sure that the money will go to the right places. […] I think that is really our biggest issue to deal with." (Interviewee 2)*

The second most frequently mentioned problem is the absence of an unambiguous vision, which was described by one interviewee:

> *"We should work towards that [an unambiguous vision], so a vision should be developed, especially for the Heuvelrug, for forestry, for agriculture, and for a new climate. And I think we have some steps to take to reach that [an unambiguous vision]." (Interviewee 3)*

Eight other problems were mentioned within the political factor. These are summarised in Table 4.

5.5.2 Economic problems

The economic problem mentioned most frequently is a shortage of money, as CAS are, in general, expensive. One interviewee said the following about this:

> *"It is mostly just about financing, that is a problem. So, for example, if we want to rearrange something to make it climate-adaptive […], that just requires money." (Interviewee 4)*

5.5.3 Socio-cultural problems

The socio-cultural problem that was mentioned most often, is the fact that there are contradicting interests between stakeholders. The example that was mentioned most often relates to the groundwater level. One interviewee explained this:

> *"One problem […] that you cannot agree on with some parties, especially when they are located right next to each other, is water. One [stakeholder] wants a higher ground water level, […] and the other [stakeholder] wants a lower water level, which is the farmer." (Interviewee 5)*

A second problem is that different stakeholders do not take responsibility for the impact they have themselves. Instead, people often point at others for being the cause of a certain climate issue or for being responsible to solve it. One interviewee described this as follows:

> *"I don't think everyone has the same awareness of the problem, that not everyone thinks he or she is responsible for the problem and that people very easily look at others to be the 'owner of the problem'. […] There are only a few people who can see their own contribution [to the problem]." (Interviewee 6)*

5.5.4 Technological problems

Only one stakeholder mentioned a technological problem, namely that there are too many different technological developments. In other words, there are too many new CAS. The interviewee elaborated on this:

> *"So, then you notice that there is something new, again. And that is not tangible yet or the effects are not yet completely clear, which makes it difficult to get support for it, as it is unknown if it is the best solution." (Interviewee 4)*

5.5.5 Environmental problems

Relating to the environmental problems, 14 interviewees named the fact that there is too little knowledge on what the problem exactly entails and how we can solve it. As one interviewee described:

> *"There are just many things for which we don't know exactly how things are. For example, what exactly happens at the Utrechtse Heuvelrug, what about the groundwater, how much soil moisture do farmers have?" (Interviewee 7)*

A second knowledge gap relating to the environmental factor is that the future is still uncertain, meaning that it is unknown what the exact effects of climate change will be. Without knowing this, it is difficult to take the right measures. One interviewee said the following about this:

> *"[…] because what consequences will climate change exactly have? Because if you talk about climate adaptation, that means that I want to take measures that deal with the effects of climate change, to temper them. But then I will have to know what the effects are, and we don't exactly know yet." (Interviewee 8)*

5.5.6 Legal problems

The legal problem that was mentioned most frequently, is the fact that it is difficult for stakeholders to get a permit for a new project or that it takes a long time to get it. And because of the many regulations, these permits are needed. One interviewee gave an example of this:

> *"I just mentioned the pilot of a climate-adapted forest. It takes quite some effort to get permissions from the province and municipalities for this […] because you are going to work with tree species that don't fit the original plan, and which could be invasive. So, most of our areas are nature, […], and there are quite some conservative, restrictive working frames about what it [nature] is now and how it [nature] should stay." (Interviewee 4)*

5.6 Solutions to overcoming the PESTEL problems

During the workshops, participants were asked to come up with potential solutions to the problems and to discuss these, after which they were ranked based on the potential impact. Table 5 shows an overview of all solutions that were mentioned during the workshops. Each solution is explained in Appendix 11. Sections 5.6.1-5.6.6 highlight one or more solutions for each PESTEL factor.

Table 5: Overview of the solutions that stakeholders came up with during the workshops. Cells that have the same colour are the same solution, meaning that this solution was proposed during both workshops.

Political solutions		
Impact ↑	**Workshop 1 – Temperature rise**	**Workshop 2 – Desiccation**
	Set priorities and frameworks	Strengthen governmental leadership (“regie”)
	Develop a vision of the manufacturability (“maakbaarheid”) of an area	Better share knowledge about leadership (“regie”) and visions
	Appoint an ‘area director’	Increase the focus on carrying out acts for the long term
	Share substantiations	Increase the capacity for carrying out climate adaptation solutions
	Leave the desk and go into the field	Give action perspective to climate adaptation solutions
	Strengthen governmental leadership (“regie”)	Appoint an ambassador in organisations
	Share negative outcomes of experiments as well	Set priorities and frameworks
	Enshrine a vision and measures for the area in the Omgevingswet (“environmental law”)	
	Make climate adaptation central at governments	
Economic solutions		
Impact ↑	**Workshop 1 – Temperature rise**	**Workshop 2 – Desiccation**
	Invest in corporate social responsibility	Stakeholders should better argue what benefits their solution has
	Develop different, fair business models	Use the right communication channels for sharing information about subsidies
	Give insights into the consequences on property and area level	Give insights into the consequences on property and area level
	Learn what people think is wrong with a subsidy	Make grant applications as accessible as possible
	Clarify the goal of a subsidy	Develop different, fair business models
	Create legislation to encourage sustainability	Install coaches that can help with measures for climate adaptation
	Seize opportunities relating to holistic (“integraliteit”) subsidies	
	Link action perspectives with the future of owners	
	Better inform the consumer about the costs of nature	
	Develop a knowledge base for an overview of the available financial resources	
Socio-cultural solutions		
Impact ↑	**Workshop 1 – Temperature rise**	**Workshop 2 – Desiccation**
	Combine functions and always consider CA	Work from intrinsic motivation
	Change the system where people feel the urgency	Start a conversation and search for common goals or share the ‘pancake’ based on prioritising
	Create legislation and enforce stakeholders’ responsibility	Focus on the behaviour of people and the management of properties
	Educate children on their responsibility for nature	Be transparent in weighting different interests

Impact ↑	Bring people together in projects	Be clear in what you expect from others
	Offer perspective to each stakeholder and share this	
	Use the dependency for more collaboration	
	Start a conversation and search for common goals or share the 'pancake' based on prioritising	
Technological solutions		
	Workshop 1 – Temperature rise	**Workshop 2 – Desiccation**
Impact ↑	Increasingly connect other stakeholders and boost climate adaptation solutions	Seize opportunities
	Arrange short-term and long-term solutions	Choose some climate adaptation solutions and focus on these
	Think sustainably	Provide insight into the consequences of each solution
	Give advice and coaching	
	Develop a knowledge database for climate adaptation solutions and measures	
Environmental solutions		
	Workshop 1 – Temperature rise	**Workshop 2 – Desiccation**
Impact ↑	Prioritise long-term solutions	Establish an overarching research direction: measuring and monitoring
	Erfgoeddeal ("Heritage deal")	Scale down
	Coordination during the planning phase	Adaptive approach
	Scale down	Make decisions based on facts
	Strengthen governmental leadership ("regie")	Keep the core problem in mind when working on different problems
	Focus more on sharing knowledge	
	Establish an overarching research direction: measuring and monitoring	
	Just start, for example with pilots	
Legal solutions		
	Workshop 1 – Temperature rise	**Workshop 2 – Desiccation**
Impact ↑	Increase the capacity of municipalities	Better substantiate why stakeholders believe a project should proceed
	Simplify the licensing system	Increase the capacity of municipalities
	Strive for a more holistic approach ("integraliteit") at the government	Don't move functions, but adapt them
	Connect to the right advisors	
	Allow pilot projects outside of the law	
	Substantiate restrictions	
	Land pool ("grondpool")	
	Offer perspective	

5.6.1 Solutions to the political problems

Two solutions that were mentioned during the workshops are that 1) governmental leadership ("regie") should be strengthened, and 2) knowledge about visions and ambitions etc. which provide direction should be shared better. Thus, on the one hand, stakeholders think governmental organisations provide little leadership or direction, though, on the other hand, stakeholders think that there is direction, which is not shared among all stakeholders sufficiently. As one stakeholder put it:

> *"[…] there is an ambition document of the Blauwe Agenda. That is just a vision of the water system at the Utrechtse Heuvelrug. […] and there is an Omgevingsvisie. I admit, it is still quite conceptual, but there are choices made concerning climate adaptation. […] So, I think we should share this better." (Interviewee 1)*

Setting priorities and frameworks is something that links to several solutions, as this can help set a vision, create a long-term focus, provide substantiations, and provide action perspectives. During both workshops, this solution was mentioned, though the perceived relative impact of the solution differs.

5.6.2 Solutions to the economic problems

Most of the solutions are either focused on the landowner and project initiator that need financial resources or on the government and subsidy provider that have financial resources available. For the first category, different solutions are proposed, including developing fair business models (mentioned in both workshops), seizing opportunities relating to holistic ("integraliteit") subsidies, creating a knowledge database of potential financial sources, creating more insight into the consequences of CAS both on property and area-level (mentioned in both workshops), and improving the stakeholders' argumentation for how their solution will contribute to solving a certain problem.

For the second category, solutions are proposed, including prioritising investments in corporate social responsibility (CSR), learning from stakeholders about what they think is wrong or limiting to a subsidy, developing legislation to stimulate sustainability, using the right communication channels, and making grand applications as accessible as possible. One interesting solution that seems both easy to implement and that combines both categories is having CAS implementation coaches. One stakeholder explained how this is already done at some farms:

> *"The Province of Utrecht has […] agricultural coaches. […] They just ask [the farmer]: "Can I visit to talk about what we can do for you and how we can help with applying for subsidies?" And we see that people often think 'well, yes, please'. […] So, that helps." (Interviewee 1)*

5.6.3 Solutions to the socio-cultural problems

One socio-cultural solution was mentioned in both workshops: start a conversation and search for common goals or share the 'pancake' based on prioritising. Several other solutions link to this, as they focus on bringing people together, collaboration, being clear in what to expect of others, and creating and sharing perspectives for each stakeholder.

'Responsibility' is another frequently mentioned term among the different solutions. Different solutions were proposed, including educating children on their responsibility, enforcing responsibility by legislation, focusing on people's behaviour and the way they manage their property, and being clear in what you expect of others to encourage them to take responsibility. One participant explained:

> *"[…] in Germany, you have a subject [in school] called 'forest pedagogy' […], people are educated at a high level to explain [to children] how nature works, why it is important, and that people are responsible for it. That is a big difference in how you deal [with responsibility for nature] as a society." (Interviewee 13)*

5.6.4 Solutions to the technological problems

Though only one technological problem was found during the interviews, there were eight different solutions proposed. One practical solution is developing a knowledge database which shows an overview of all potential CAS, including an analysis of which solution is interesting for which problems. Some other solutions link to this knowledge database, as it provides insight into the consequences of CAS, it allows choosing a few CAS to focus on, and it can rank short-term and long-term CAS.

Though the stakeholders during this workshop agreed on the value of developing this knowledge database, they disagreed on who should be responsible for this. One stakeholder named NPUH, as this organisation can have an integrated approach towards this. However, another stakeholder thought a bigger organisation was needed, as it is quite a lot of work. Another stakeholder added to this:

> *I would say the one responsible is, because it is quite technical, the one who carries it [the project for climate adaptation] out. So, I think that are the water boards. […] Simultaneously, a province could do it as well. They may not work in a very integral way, but they do have different programmes. So, yes, maybe they could work integral on this. (Interviewee 14)*

5.6.5 Solutions to the environmental problems

Several environmental solutions relate to the knowledge aspect of CA. Scaling down makes it easier to understand the problem; sharing knowledge in an improved way allows for more stakeholders to know about CAS; creating an overarching research line in which monitoring and measuring play an important role results in new knowledge being developed; carrying out pilots creates new, practical knowledge; and making decisions based on facts is only possible if the right knowledge is available.

One interesting solution to highlight is scaling down, as it was mentioned during both workshops. In the first workshop, it was mentioned that the government, research institutes, and cooperative organisations were responsible for doing this. In the second workshop, however, it was said that everyone should be responsible for this. An example of this was given by one of the participants:

> *If you make something [projects about climate adaptation] very big […], then you will end up at a standstill. So, scaling down is essential. […] You can think it is up to the government to do something [about climate adaptation], but it is up to everyone. If you have a small garden and think 'well, what can my garden add to the climate adaptation solution?', if we all think that, […] we will get nowhere. So, the idea that everyone can do something, even if it is just on a small scale, […] that is how we can get there. (Interviewee 15)*

5.6.6 Solutions to the legal problems

Except for one solution, all legal solutions are deemed to be the responsibility of the government. Thus, the government is believed to be responsible for increasing the capacity of municipalities, simplifying the licensing system, creating a holistic approach ("integraliteit"), improving the connection with advisors, deciding which pilot projects will be allowed outside of the law, substantiating restrictions, managing a land pool, offering perspective to other stakeholders, and adapting existing functions.

The one solution that is not the responsibility of the government, is to better justify why stakeholders think a project should proceed. This will make it easier for a governmental organisation to approve a project, as one participant explained:

> *"You can only spend money once […]. It is difficult to decide […] what the best choice is for spending money on if everyone comes up with their solution. […] [A solution is] to better substantiate what their [a stakeholder's] solution contributes to solving a problem." (Interviewee 1)*

5.7 Developing bridging measures: key drivers for change

During the workshop, all proposed solutions were ranked based on the level of impact a solution potentially has on changing the system to enable stakeholders to accelerate the implementation of CAS to reach a climate-adapted landscape. The data collected during the workshop resulted in two sheets showing an overview of the perceived impact level of the solutions, which is shown in Appendix 12. For each PESTEL category, one solution per workshop was named to have the most impact, resulting in two KDFC per PESTEL category. These are explained in Table 6. For each solution, the responsible stakeholder was named and potential opponents were identified, including how to overcome their objections.

Table 6: Key drivers for change. For each of the workshops, the solution which was perceived to have the highest level of impact per factor is seen as a key driver of change. If a cell is green, this means the solution was mentioned in both workshops; if a cell is blue, the solution was only mentioned in the workshop *temperature rise* (1); if a cell is red, the solution was only mentioned in the workshop *desiccation* (2).

PESTEL factor	Work-shop nr.	Key drivers for change (bridging measure)	Responsibility	Opponents and overcoming their objections
Political	1	Set priorities and frameworks	All stakeholders together	No opponents identified
	2	Strengthen governmental leadership (“regie”)	Government (national, province, municipality)	No opponents identified
Eco-nomic	1	Invest in corporate social responsibility	Government, business and society	Stakeholders (e.g. company owners) who are impacted by this may oppose this. overcome this by collaboratively creating a system in which we can work on CSR in its entirety.
	2	Stakeholders should better argue what benefits their solution has	Stakeholder who wants to have a subsidy	Depends on the type of pilot/project. Take situation-specific measures.
Socio-cultural	1	Combine functions and always consider CA	No responsible stakeholder identified	No opponents identified
	2	Work from intrinsic motivation	Stakeholders leading a project	No opponents identified
Techno-logical	1	Increasingly connect other stakeholders and boost climate adaptation solutions	Organisations like UPG	No opponents identified, but if there are, convince them by showing the relevance of the measure and by acknowledging someone’s resistance
	2	Seize opportunities	Every stakeholder that wants/ needs to work on CAS	No opponents identified
Environ-mental	1	Prioritise long-term solutions	Government (national, province, municipality)	Stakeholders focused on short-term profits may oppose this. Convince via legislation or rewards structures.
	2	Establish an overarching research direction: measuring and monitoring	No responsible stakeholder identified	No opponents identified
Legal	1	Increase the capacity of municipalities	Municipality	No opponents identified
	2	Better substantiate why stakeholders believe a project should proceed	Stakeholder who wants to carry out a pilot/project outside of the law	Potential opponents depend on the type of pilot/project. Take situation-specific measures.

5.8 Next implementation steps

The KDFC need to be implemented for the overall system in which stakeholders work on CAS at the UH to change. Participants of the workshop were asked what the next steps were that they were going to take. Stakeholders believed that the 'next step' was to just continue what they were already doing:

> *"I think it is very difficult to name things that we don't already do. […] It is good to stay aware of it [the need for collaboration], even though we already do this." (Interviewee 13)*

> *"I don't know right now. […] We should seize opportunities, I think, but we already try doing so in our projects." (Interviewee 15)*

> *"There is already happening a lot. There are already many initiatives, we must finish these well." (Interviewee 1)*

Some steps that stakeholders thought they could implement are 1) lobbying with the government for a holistic view ("integraliteit"), 2) being more transparent, 3) creating more political decisiveness, and 4) improving education and information provision, especially related to sharing what nature costs and changing the image of private landowners as wealthy, white men (as many of them are not). However, participants of the workshop claimed to be doing these things up to a certain level already.

5.9 Power-interest matrix of the stakeholders at the UH

Each stakeholder's level of power and interest differs based on three aspects. First, the location where the CAS are implemented. For example, a private landowner may have more power and interest when CAS are implemented on their land than when it is on the land of their neighbours. Second, the level of power and interest may differ during different phases of the project. For example, the Province of Utrecht may have more power during the 'vision development phase' than during the 'implementation phase'. Third, it depends on the type of project. For example, water boards have more power and interest in CA projects relating to water than they have in CA projects relating to, for example, biodiversity.

While taking this into account, stakeholders were placed in the power-interest matrix and interviewees were asked which stakeholders they would move to other quadrants and why. The final matrix is shown in Figure 12. Some stakeholders disagreed with the level of power and interest of other stakeholders, which is elaborated on in sections 5.9.1 and 5.9.2. An overview of this disagreement is given in Appendix 13. Section 5.9.3 elaborates on the level of power and/or interest stakeholders believe they have themselves compared with the level of power and/or interest other stakeholders think they have. An overview of this is given in Appendix 13 as well.

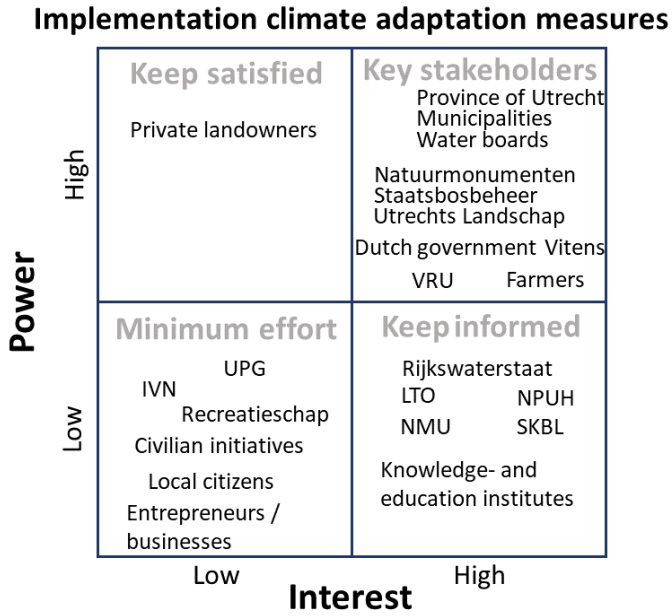

Figure 12: Power-interest matrix showing the relative power and interest of the stakeholders working on climate adaptation at the Utrechtse Heuvelrug

5.9.1 Power level as perceived by others

For some stakeholders, all interviewees agree on the level of power. These are NPUH, the Dutch government, the Province of Utrecht, municipalities, water boards, Vitens, VRU, NMU, sKBL, IVN, and knowledge- and education institutes. Therefore, it can be assumed that the power level of these stakeholders is true as shown in Figure 12.

Most stakeholders agreed as well on the power level of Rijkswaterstaat, Staatsbosbeheer, Utrechts Landschap, Natuurmonumenten, private landowners, local citizens, civilian initiatives, entrepreneurs, and businesses. For these, only one, two, or three interviewees disagreed. Therefore, it can again be assumed that the power level of these stakeholders is true as shown in Figure 12.

Three stakeholders are worth highlighting when looking at the power level as perceived by others. First, five interviewees thought UPG to have high power, as one interviewee described:

> *"I think that they [UPG] are a key stakeholder because they act as an advocate […] in my projects." (Interviewee 9)*

Second, seven interviewees thought farmers to have low power. One interviewee explained clearly why:

> *"We look at farmers because they have […] land. […] They can all do something, but they depend on other parties to change the market for getting more money for their products so that they [farmers] have more money to do something for nature. I think they depend on other parties for that now." (Interviewee 10)*

Third, seven interviewees thought LTO to have high power. One interviewee explained why:

> *"We often speak with LTO because it is an organisation that represents farmers, and in that way, they have way more power, because they represent one big group." (Interviewee 1)*

UPG, farmers, and LTO are still shown in Figure 12 in the quadrant where the majority of interviewees believed them to be. However, it is important to keep in mind the varying opinions about the power level of these three stakeholders.

5.9.2 Interest level as perceived by others

For some stakeholders, all interviewees agreed on the level of interest. These are: NPUH, the Dutch government, Rijkswaterstaat, the Province of Utrecht, municipalities, water boards, Vitens, VRU, Staatsbosbeheer, Natuurmonumenten, NMU, and sKBL. Therefore, it can be assumed that the interest level of these stakeholders is true as shown in Figure 12.

Most stakeholders agreed as well on the interest level of UPG, local citizens, civilian initiatives, entrepreneurs /businesses, farmers, LTO, IVN, and knowledge and education institutes. For these, only one, two, or three interviewees disagreed. Therefore, it can again be assumed that the interest level of these stakeholders is true as shown in Figure 12.

One stakeholder is worth mentioning when looking at the interest level as perceived by others: six interviewees thought private landowners to have high interest. One of the interviewees gave the following reasoning for this:

> *"I think that private landowners can also have a high interest because landowners also worry quite a lot about nature on their land." (Interviewee 11)*

In Figure 12, private landowners are still shown in the quadrant where the majority of interviewees believed them to be, though it is important to keep in mind the varying opinions about the interest level of the private landowners.

5.9.3 The level of power and/or interest stakeholders give themselves compared with what other stakeholders give them

Stakeholders were asked to place themselves in the power-interest matrix as well. Nine stakeholders placed themselves in the same quadrant as shown in Figure 12. These are: NPUH, the Dutch government, the Province of Utrecht, municipalities, water boards, Vitens, VRU, Utrechts Landschap, and NMU.

Seven stakeholders believed they had a different power and/or interest level. Staatsbosbeheer and Natuurmonumenten believe to have low power since they both argue to be dependent on other parties, as they mostly follow policies set by governmental organisations.

UPG and sKBL think they have high power, as they both claim to be an initiator of CA projects that would not have started without them. Thus, they can convince other stakeholders to participate. Both UPG and the private landowners believe to have high interest because private landowners care for the land they own and UPG advocates for this. One interviewee described the interest of private landowners as follows:

> *"They [private landowners] always say that they do it [forest management and nature development] for the next generation […]. They [private landowners] say that they do not own the ground, but they look after it for the next generation. So, they want to pass it on as good as possible" (Interviewee 12)*

One of the private landowners believed to have low power, as this landowner claimed to be fully dependent on the policies made by governmental organisations. In contrast, LTO thought to have more power, as they represent a large group of farmers. Finally, IVN believed to have more interest, as they put CA as a priority topic on their agenda.

6. Discussion

Implementing KDFC can help stakeholders at the UH accelerate the implementation of CAS, contributing to reaching a climate-adapted landscape. This is both relevant for the stakeholders involved in implementing CAS and society because with the predicted climate change and associated challenges, creating a climate-adapted landscape will increase the chance of maintaining the various functions currently provided by the UH. In other words, nature conservation, housing, recreational space, drinking water extraction, and other functions can be maintained. Failing to implement CAS could result in damage to nature, landscape, cultural heritage, infrastructure, etc.

SQ1 of this thesis was: *What stakeholders and (potential) climate issues play a role in the social-ecological system for climate adaptation at the Utrechtse Heuvelrug?* Examining the SES for CA at the UH resulted in an overview of 23 different stakeholders and 20 climate issues. Among the stakeholders, the Province of Utrecht, waterboards, and private landowners respectively have the highest BC, making them important for connecting stakeholders. Among the climate issues, *temperature rise* and *desiccation* have the highest outdegree, meaning that these climate issues influence most other climate issues.

Zooming in on the stakeholders, it is interesting to note that there is considerable consensus among stakeholders on the level of power and interest held by other stakeholders. However, when it comes to their power and interest levels, almost half of the stakeholders placed themselves in different quadrants of the power-interest matrix than most other stakeholders thought them to be. This difference could be explained by the self-knowledge bias, which claims that people tend to misjudge their abilities because they, for example, attribute successes or failures in a self-serving manner, create self-serving definitions of competence, or test hypotheses in a self-enhancing way (Karpen, 2018; Strube, Lott, Lê-Xuân-Hy, Oxenberg, & Dechmann, 1986). This gap can create friction between the level of responsibility stakeholders are able or willing to take and the level of responsibility others expect them to have. Therefore, using this knowledge and discussing what this means for projects is helpful for future stakeholder collaborations.

Furthermore, governments are claimed to be the primary stakeholder in CA planning (Mees et al., 2012). However, this research shows that many stakeholders are involved in this process, making CA a form of polycentric governance. This difference could be explained by the fact that the research by Mees et al. was conducted in 2012 and CA has become increasingly important in many organisations over the past decade.

SQ2 was: *What governance gaps, caused by collaborative and integrative misfits, exist in the social-ecological system for climate adaptation at the Utrechtse Heuvelrug?* Since the actor-actor network at the UH is rather dense, meaning that there is a lot of collaboration already, collaborative misfits were not further investigated. Looking at the integrative misfits around the focal nodes *temperature rise* and *desiccation*, several integrative misfits were found, involving six climate issues and respectively seven or eight actors. These integrative misfits are the so-called governance gaps.

To build the actor-issue network, interviews and desk research were done. Although this is still a quite novel approach to building a social-ecological network, it is, according to a review of 22 analyses of social-ecological networks by Sayles et al. (2019), a more frequently used research approach. They concluded that most studies rely on a combination of field work and desk research to collect data. Thirteen of these studies mentioned the use of interviews in their methodology for developing (a part of) the social-ecological network.

However, since this research is one of the first applications of the actor-issue network (Bergsten et al., 2019), new insights were gained relating to the application of the network to formulate bridging measures. This relates to SQ3: *What bridging measures within the six PESTEL dimensions do stakeholders perceive as possible solutions to overcome existing governance gaps?* Bergsten et al. (2019) state that after detecting structural governance gaps, two more steps follow: 1) assess the impact of low fit, and 2) take bridging measures. However, no guidance is given on how to perform these steps. This thesis attempted to offer a scientific contribution by developing a methodology to perform these steps. For the first step, the climate issues with the highest outdegree were further investigated, as governance gaps associated with these focal issues are assumed to have the highest impact. For the second step, first, the existing problems in the system should be known, which were collected through interviews. Then, KDFC were developed collaboratively by inviting the stakeholders involved in the most impactful governance gaps to a workshop. Furthermore, as there were many different measures, this research tried to expand the methodology of Bergsten et al. (2019) by adding a PESTEL-analysis of the potential problems and solutions, which could help guide the discussion during the workshops and create a clear overview. The insights gained by this application and adaption of the methodology developed by Bergsten et al. (2019) can help future researchers to investigate different actor-issue networks, leading to insight into SES that can help improve these systems.

Furthermore, this research recognised that developing KDFC does not directly lead to action. Therefore, the methodology was complemented with an analysis of the power and interest levels of stakeholders. However, workshop participants found it difficult to decide who should be responsible for a particular solution, as often it was 'just' the government, all stakeholders, or a combination of stakeholders. This makes it more difficult to start implementing the solutions. For one solution, 'organisations like UPG' were named to be responsible. While these organisations can greatly contribute to achieving a climate-adapted landscape, it is important to remember that, for example, UPG is believed to have low power and interest. This could make it more difficult for UPG to lead the implementation of the solution. The same could be a problem for solutions which the 'stakeholder leading a project / wanting a subsidy' is assigned responsibility for, as these stakeholders could have low power and/or interest. This difficulty could be addressed by ensuring that, for example, a brokerage stakeholder that does have high power and interest supports the stakeholders with low power or interest. This enlarges the need for collaboration on CA.

Finally, the main research question was: *How can different stakeholders at the Utrechtse Heuvelrug be enabled to accelerate the implementation of climate adaptation solutions to reach a climate-adapted landscape?* This can be done by implementing the 69 solutions identified in this research, especially the KDFC, to overcome the 27 identified problems relating to the implementation of CAS. The found problems were consistent with existing literature in several aspects. For example, both this research and literature indicate that polycentric governance, resulting in the involvement of many stakeholders, projects, and activities, makes CA a complex and multi-scalar problem (Bauer et al., 2012; Buuren et al., 2014; Knieling & Filho, 2013; Ostrom, 2001, 2014). Furthermore, both identify the problem relating the uncertain developments and polycentric governance struggling to cope with the growing risks of rapid change (Buuren et al., 2014; Knieling & Filho, 2013; Morrison et al., 2019). Moreover, both recognise the problem of the need for long-term commitment and the problem of the need for CAS to be embedded or connected with other social issues (Bauer et al., 2012; Buuren et al., 2014; Ostrom, 2014).

However, there were differences between this research and existing literature as well. First, this research did not identify a problem relating to the legitimacy of CA, as was identified in literature (Buuren et al., 2014.). Although this research showed that there are many different stakeholders

involved, the question of legitimacy was not mentioned as a problem by any of the interviewees. This difference could be explained as Buuren et al. (2014) put a specific focus on legitimacy in their research, which was not done in this thesis. A second difference with existing literature is that this research identified many more problems relating to the implementation of CAS and polycentric governance. This could be explained because of the different methods because this research specifically focused on creating an overview of existing problems in an SES, which was needed to develop solutions.

6.1 Limitations of this research

A first limitation relates to several interviewees indicating that they thought it was quite difficult to estimate the frequency of collaboration with other stakeholders. For this reason, there were some differences in the estimated frequency of interactions between two interacting stakeholders. For this research, the highest (most frequent) estimate was selected, as discussed in section 4.2.1. However, if an average of both estimates was chosen, this could have resulted in different outcomes. Relating to this, some private landowners collaborated with a specific stakeholder, while other private landowners did not. Each time, the highest estimate was selected. However, this could have resulted in a higher BC of the private landowners than it actually is, potentially distorting the picture of the actor-actor network.

A second limitation relates to the coding process. While trying to be as objective as possible, there is still a certain degree of subjectivity that cannot be overcome. For example, when considering the socio-cultural problem of conflicting interests between stakeholders, the interviewees gave two main examples. There is a conflict of interest between farmers and nature owners regarding the ground water level, or a conflict of interest between nature and cultural heritage. In this research, these were merged into one general problem to keep the list of problems from getting too long. However, keeping them separately may have resulted in more practical solutions specifically focused on overcoming either one of these contradictions.

Finally, two workshops with four participants were planned. However, due to force majeure, one participant of the first workshop and two participants of the second workshop cancelled last-minute. Since not all stakeholders who were involved in a particular governance gap attended and fewer different perspectives were now part of the workshops, this could have resulted in a different outcome of the workshops.

6.2 Recommendations for future research

During both workshops, despite finding solutions to the problems and reflecting on their role in each solution, participants indicated that, as a next step, they would continue with their current activities without a change. While their current efforts certainly contribute positively to achieving a climate-adapted landscape and the associated impact should not be minimalised, this attitude will not solve all problems. Therefore, future research could focus on how to change this attitude. This could, for example, be done by organising a final workshop to which all participants are invited, during which all potential solutions are ranked in one overview and stakeholders can discuss the responsibility for each solution.

Moreover, this research focused solely on CA related to climate issues. However, climate change has an impact on several other concepts, such as cultural heritage, health, infrastructure, and the energy transition. Thus, CA is intertwined with these concepts as well. Regarding cultural heritage, some general recommendations for archaeologists and funding entities on how to address climate-based threats to cultural heritage are known and a decision support tool for CA planning of coastal, historic buildings is developed (Hambrecht & Rockman, 2017; Li, Xiao, & Seekamp, 2022). These could be further researched for the cultural heritage at the UH.

In terms of health and the energy transition, some stakeholders were excluded from the actor-issue network. One interviewee identified the GGD and health care locations at the UH as important stakeholders, for example relating to heat waves and heat stress. However, since this is more about the relationship between CA and human health (rather than climate issues in nature), this was left out. Another interviewee listed Stedin and Tennet as important stakeholders because, for example, the location of high-voltage cables influences which plants can be grown somewhere. However, as this relates more to arranging the environment, instead of to climate issues in nature, these stakeholders were again excluded. Furthermore, infrastructure was not considered to be nature, therefore, damage to infrastructure caused by climate change was not included as a climate issue in the issue-issue network. Nevertheless, a more integral approach may be desirable as CAS, health facilities, the energy transition, and infrastructure need space, which requires high-over planning due to limited space being available. Therefore, future research could take a more integral approach to investigate how these concepts can coexist and reinforce each other at the UH.

Finally, the KDFC could help other national parks implement CAS. However, due to the different governance structures of national parks, different stakeholders are involved. Moreover, different climate issues play a role in other national parks. For example, Nationaal Park Duinen van Texel is battling salinization (Paulissen et al., 2011). Thus, while some solutions may also work for other national parks, the differences could lead to different problems and different KDFC. It may be valuable to research this for more national parks.

7. Conclusion

This thesis set out to answer the research question: *How can different stakeholders at the Utrechtse Heuvelrug be enabled to accelerate the implementation of CAS to reach a climate-adapted landscape?* To answer this, desk research, 22 interviews, and two workshops were conducted. This resulted in the development of an actor-issue network, the highlighting of two focal issues around which the most impactful governance gaps were identified, a list of problems in the SES at the UH, and twelve KDFC which can help overcome the governance gaps. The KDFC are: 1) Set priorities and frameworks, 2) Strengthen governmental leadership (“regie”), 3) Invest in CSR, 4) Stakeholders should better argue what benefits their solution has, 5) Combine functions and always consider CA, 6) Work from intrinsic motivation, 7) Increasingly connect other stakeholders and boost CAS, 8) Seize opportunities, 9) Prioritise long-term solutions, 10) Establish an overarching research direction: measuring and monitoring, 11) Increase the capacity of municipalities, and 12) Better substantiate why stakeholders believe a project should proceed. Together, these twelve KDFC can change the SES in which stakeholders work on CA at the UH. Therefore, implementing the KDFC helps accelerate the implementation of CAS to achieve a climate-adapted landscape. Additionally, several stakeholders were assigned responsibility for implementing one or more of these KDFC, though it is important to keep in mind the power and interest levels of each stakeholder, as this influences the implementation process.

In conclusion, this research is an illustration of the challenges climate change poses. If we do not adapt to this changing climate, we are at great risk. We risk losing critical nature, valuable cultural heritage, and our access to clean drinking water and we endanger human health and safety. To prevent this from happening, CA is required. However, the SES in which stakeholders work on this theme does not yet allow for the transition to take place in time. By integrating the social and environmental aspects of the SES for CA at the UH, creating an overview of problems, defining stakeholders’ power and interest levels, and developing KDFC, this thesis showed how to accelerate the transition toward a climate-adapted landscape. It is now up to the different stakeholders to implement these solutions because, in the end, all stakeholders need to contribute to the CA transition.

8. Bibliography

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Appendix 1: Overview of the stakeholders at the UH

Table 7: Overview of the stakeholders at the UH and their role concerning climate-adaptive landscaping

Stakeholder	Description stakeholder	**Role stakeholder relating climate adaptive landscaping** (Stichting Nationaal Park Utrechtse Heuvelrug, 2020)
National Park de Utrechtse Heuvelrug	NPUH has the goal to combine the forces of different stakeholders to ensure a healthy future for nature, landscape, and cultural heritage at the UH (Stichting Nationaal Park Utrechtse Heuvelrug, n.d.-c). They bring parties together, are the driving motor behind projects, lobby, share knowledge, and actively look for opportunities to realise projects.	Contribute knowledge and offer input for developing a climate-adaptive landscaping strategy.
Rijk (Dutch government)	The Dutch government needs to prepare the Netherlands for the consequences of climate change (Rijksoverheid, n.d.). To do so, the government developed the National Climate adaptation Strategy	The Dutch government mostly has a coordinating and stimulating role. It provides direction and money for stakeholders to implement climate adaptation solutions.
Rijkswaterstaat	Rijkswaterstaat researches the level of climate adaptation of networks of roads, waterways, water, and track (Ministerie van Infrastructuur en Waterstaat, 2022). It also is responsible for carrying out the policies about climate adaptation for these networks.	As Rijkswaterstaat is the executive organisation for infrastructure and water networks, it contributes to implementing CAS around projects they are responsible for.
The Province of Utrecht	The province is responsible for many topics, including nature. The province wants to create the right balance between nature, agriculture, water, historical culture, landscape, and recreation (Provincie Utrecht, n.d.-e). The province wants to enable everyone to enjoy it now, but also in the future.	Contribute knowledge and offer input for developing a climate-adaptive landscaping strategy from a province perspective.
Municipalities	The UH is located at several municipalities that collaborate on several topics relating the UH, including climate adaptive landscaping (Provincie Utrecht, n.d.-d). These municipalities are: Rhenen, Leusden, Soest, Baarn, De Bilt, Zeist, Utrechtse Heuvelrug en Woudenberg.	Contribute knowledge and offer input for developing a climate-adaptive landscaping strategy from a municipality perspective.
Water boards	Water boards ensure water security, clean water, and that there is sufficient water to meet the demand (Waterschappen, n.d.). There are two water boards at the UH, called the Vallei en Veluwe (V&V) and Hoogheemraadschap De Stichtse Rijnlanden (HDSR) (Stichting Nationaal Park Utrechtse Heuvelrug, 2020).	Contribute knowledge and offer input for developing a climate-adaptive landscaping strategy concerning the topic 'water'.
Vitens	Vitens is a drinking water company that uses the 'water bubble' in the ground at the UH to pump up drinking water, and therefore plays an important role in the water system (Hydrologic & Acacia Water, 2021; Vitens, n.d.-a)	As Vitens has a large influence on the water system, Vitens can influence the needed climate-adaptive landscaping strategy.
Veiligheidsregio Utrecht (VRU)	VRU is a partnership of all municipalities in the Province of Utrecht (Veiligheidsregio Utrecht, n.d.). The organisation takes care of the safety of the people living and staying in the Province of Utrecht.	As the VRU is also responsible for crisis management, the VRU will be involved when, for example, forest fires or flooding occur. Therefore, VRU will face the consequences of poor climate adaptation.

Staatsbosbeheer	Staatsbosbeheer manages the 'green heritage' in the Netherlands, thus at the UH as well (Staatsbosbeheer, n.d.). Therefore, it has a lot of knowledge about what nature needs.	Contribute knowledge and offer input for developing a climate-adaptive landscaping strategy.
Utrechts Landschap	Utrechts Landschap is a foundation that tries to protect nature and cultural heritage by improving the quality of the landscape in Utrecht (Utrechts Landschap, n.d.). The foundation owns and manages over 5800 ha of nature, and therefore has influence when deciding what happens to the area.	As a landowner, Utrechts Landschap has a large influence on the implementation of a climate-adaptive landscaping strategy.
Natuur-monumenten	The association Natuurmonumenten strives for giving nature and animals more space. Together with their 760.000 members and volunteers, they take care of the existing nature and cultural heritage and create new nature. They also lobby, for example, against intensive agriculture to save the insects (Natuurmonumenten, n.d.).	Natuurmonumenten can provide knowledge and offer input for developing a climate-adaptive landscaping strategy, which is supported by its members.
Natuur en Milieufederatie Utrecht (NMU)	NMU strives for a beautiful, healthy, and sustainable Province of Utrecht (Natuur en Milieufederatie Utrecht, n.d.). The organisation strives for a beautiful landscape, a rich nature, and a clean environment in which people live and work sustainably.	NMU creates collaborations and initiates collaborations that make the province more sustainable, which contributes to climate adaptation.
Stichting Kastelen, Buitenplaatsen, Landgoederen (sKBL)	sKBL tries to get people excited about the historical and green heritage of the Netherlands by providing information, organising lectures, and organising educative events (Stichting Kastelen Buitenplaatsen en Landgoederen, n.d.-a). sKBL also tries to strengthen the connections between owners of castles and estates by sharing experiences and knowledge.	sKBL initiated the Knowledge program "Klimaatbestendige Kastelen, historische Buitenplaatsen en Landgoederen" in collaboration with several partners, which has the goal to map the consequences of climate change on the castles and estates, share knowledge and experience on potential measures, and influence climate policy (Stichting Kastelen Buitenplaatsen en Landgoederen, n.d.-b).
Utrechts Particulier Grondbezit	Utrechts Particulier Grondbezit (UPG) unifies private owners of estates, agricultural land, forests, and nature reserves (Utrechts Particulier Grondbezit, n.d.).	UPG can both offer knowledge input and provide direction in choosing a climate-adaptive landscape strategy.
Private landowners	There are many private landowners at the UH, of which some are estates. Some of these are private, but many can be visited. For example, Landgoed Eyckenstein can be visited (Landgoed Eyckenstein, n.d.).	As private landowners own land, they have a large influence on what climate-adaptive landscaping measures are or are not implemented.
Local citizens	As there are many people living in the different municipalities at the UH, some area is urbanised (Stichting Nationaal Park Utrechtse Heuvelrug, n.d.-c). Climate change increases the pressure on urban areas, which results in new challenges (While & Whitehead, 2013). This can also be seen at the UH, for example, with the increased pressure on the water system in the cities (Hydrologic & Acacia Water, 2021).	As local citizens own land (house and/or garden), they influence what climate-adaptive landscaping measures are or are not implemented.
Civilian initiatives	There are many different civilian initiatives at the UH that contribute to climate adaptation. Some examples are:	As civilian initiatives can bring different people together and

	Zustertuinen, Heuvelrugtuinen and Goedvolk. Via these initiatives, people can contribute to a solution to climate issues.	create a movement that supports certain climate adaptation solutions to be implemented.
Entrepreneurs / businesses	There are many different entrepreneurs, ranging from producers of local products to owners of holiday parks, to garden centres, to businesses located at business parks around the Utrechtse Heuvelrug (Green Spirit Parken, n.d.; Nationaal Park Utrechtse Heuvelrug, n.d.).	The role relating to climate adaptation differs per entrepreneur: some producers of local products strive towards sustainable production, some use local resources, and some own land and can therefore influence what climate adaptation solutions are (or are not) implemented.
Farmers	As it is assumed that the current strategies used by farmers to cope with weather conditions will not suffice in the future due to climate change (Berger & Troost, 2014), farmers may increasingly feel the need to implement climate-adaptive landscaping strategies. At the UH, most agricultural land is located at the foot of the ridge (Hydrologic & Acacia Water, 2021).	As farmers own the land, they have a large influence on what climate-adaptive landscaping measures are or are not implemented.
LTO	The Netherlands Agricultural and Horticultural Association (LTO) represents agricultural entrepreneurs and employers, including farmers at the UH (LTO, n.d.).	As a representer, LTO can provide knowledge and offer input for developing a climate-adaptive landscaping strategy.
IVN Natuureducatie	IVN Natuureducatie wants people to experience how fun, healthy and important nature is (IVN Natuureducatie, n.d.). They do so by organising nature activities, courses, projects, and campaigns.	IVN Natuureducatie is an educator and the organisation educates people on (among other things) climate adaptation.
Knowledge and education institutes	There are several knowledge and education institutes involved at the Utrechtse Heuvelrug. Examples of education institutes are Utrecht University, Wageningen University & Research, Delft University of Technology, Aeres university of applied sciences, Inholland university of applied science. Examples of knowledge or advising institutes include, for example, Deltares.	Knowledge and education institutes contribute knowledge and can advise all stakeholders on how to proceed and what to do. In this way, they can support new policies about climate adaptation or help stakeholders to implement the right measures.
Recreatieschappen	Recreatieschappen develop, manage and maintain areas for outdoor recreation on behalf of municipalities and the province (Provincie Utrecht, n.d.-f).	As the recreatieschap at the UH is about to be dissolved, most tasks related to climate adaptation have been moved to other stakeholders. However, the recreatieschap can still contribute knowledge on the relationship between climate adaptation and recreation at the UH.

Appendix 2: Interview guide

During the interview, the interviewee will see some images, which can be found at the end of this interview guide. This interview guide is translated from Dutch.

Introduction

1. Could you tell a little bit about yourself and your role within organisation X?
2. What is the role of organisation X at the Utrechtse Heuvelrug? And in particular, what is the role of organisation X concerning climate adaptation?

Stakeholders and collaborations *(Figure 13)*

3. Do you think the overview of stakeholders is complete or are there more stakeholders that work on climate adaptive landscaping at the Utrechtse Heuvelrug? If so, which ones?
4. *(Figure 14)* How often do you collaborate with each stakeholder related to climate adaptation at the Utrechtse Heuvelrug? (*scale-question, choose one of the following answers*)
    a. Very often (e.g. (almost) daily)
    b. Often (e.g. weekly)
    c. Regularly (e.g. monthly)
    d. Sometimes (e.g. a few times a year)
    e. Never (e.g. (almost) never)
        i. If the interviewee mentioned another stakeholder at question 3, this one will also be questioned.
5. In general, what is the added value of collaborating with other stakeholders related to climate adaptation?

Stakeholders and their power and interest *(Figure 15 – a short explanation of the matrix will be given)*

6. *(Figure 16)* Some desk research and previous conversations resulted in this power-interest matrix of all different stakeholders. Do you agree with this overview or would you move one or more stakeholders?
    a. If the interviewee moved one/more stakeholders: Why do you think this stakeholder has this level of power and interest?
7. Where would you put your organisation?
    a. Why do you think you have a low / high power?
    b. Why do you think you have a low / high interest?

Climate issues at the Utrechtse Heuvelrug *(Figure 17)*

8. You see a list of potential climate issues which require climate adaptation at the Utrechtse Heuvelrug. Do you think this overview of climate issues at the Utrechtse Heuvelrug is complete? If not, which climate issues do you miss? Why?
9. If we go through this list, what climate issues does your organisation work on? Why?
    a. If the interviewee mentioned extra climate issues, also include these.

Finalising

10. If we look at climate adaptation in general, which problems do you or others in organisation X experience when you work on the theme 'climate adaptation'?
11. Is there anything else you want to add?
12. Can I reach out to you to participate in a workshop for this research as well?
13. Can you think of someone else I should interview?
    a. If the interviewee mentioned a new stakeholder group, these contact details are specifically asked for.

Overview of stakeholders	
Nationaal park Utrechtse Heuvelrug	Natuur en Milieufederatie Utrecht (NMU)
Province of Utrecht	IVN Natuureducatie (IVN)
Municipalities	Knowledge- and education institutes
Water boards (Vallei en Veluwe & Hoogheemraadschap De Stichtse Rijnlanden)	Stichting Kastelen, Buitenplaatsen en Landgoederen (SKBL)
Vitens	Entrepreneurs / businesses
Veiligheidsregio Utrecht (VRU)	Farmers
Land- en Tuinbouworganisatie Nederland (LTO)	Local citizens
Utrechts Particulier Grondbezit (UPG)	Dutch government
Private landowners	Rijkswaterstaat
Natuurmonumenten	Civilian initiatives
Staatsbosbeheer	Recreatieschappen
Utrechts Landschap	

Figure 13: First image used during the interview showing an overview of the stakeholders at the Utrechtse Heuvelrug

Overview of stakeholders	
Nationaal park Utrechtse Heuvelrug	Natuur en Milieufederatie Utrecht (NMU)
Province of Utrecht	IVN Natuureducatie (IVN)
Municipalities	Knowledge- and education institutes
Water boards (Vallei en Veluwe & Hoogheemraadschap De Stichtse Rijnlanden)	Stichting Kastelen, Buitenplaatsen en Landgoederen (SKBL)
Vitens	Entrepreneurs / businesses
Veiligheidsregio Utrecht (VRU)	Farmers
Land- en Tuinbouworganisatie Nederland (LTO)	Local citizens
Utrechts Particulier Grondbezit (UPG)	Dutch government
Private landowners	Rijkswaterstaat
Natuurmonumenten	Civilian initiatives
Staatsbosbeheer	Recreatieschappen
Utrechts Landschap	

A) Very often (almost daily)
B) Often (weakly)
C) Regularly (monthly)
D) Sometimes (a few times a year)
E) (Almost) never

Figure 14: Second image used during the interview showing both an overview of the stakeholders at the Utrechtse Heuvelrug and the scale showing the intensity of the collaboration.

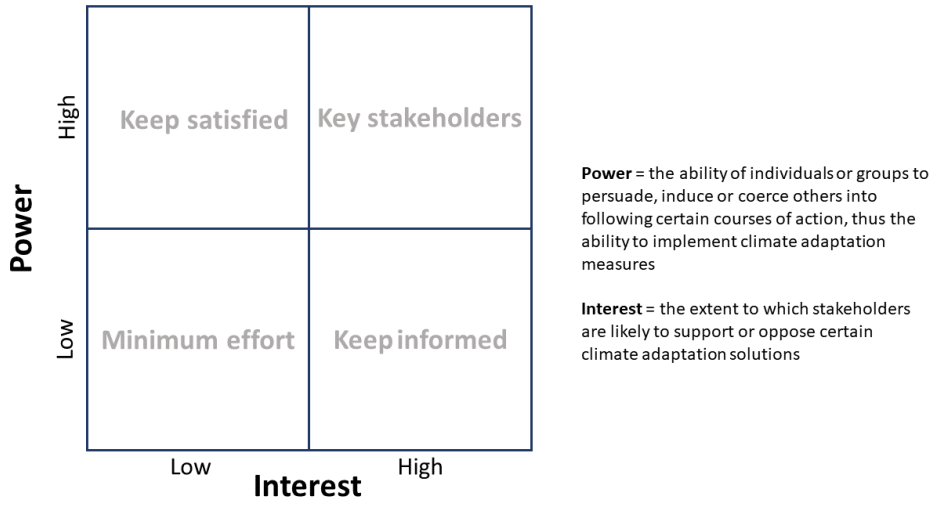


Figure 15: Third image used during the interview showing the power-interest matrix that is used to explain the model.

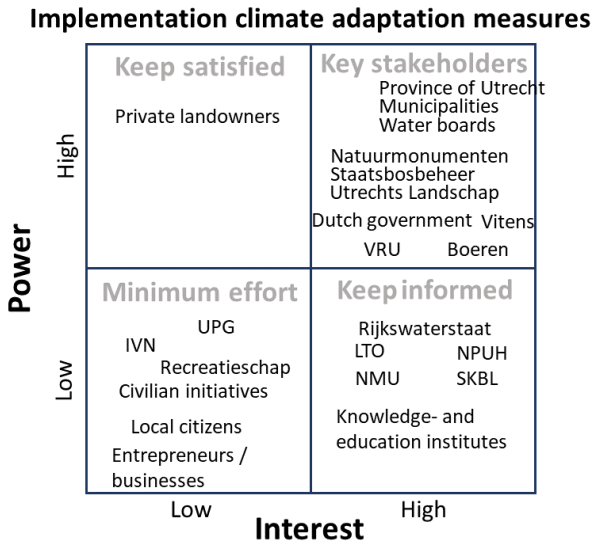


Figure 16: Fourth image used during the interview showing the power-interest matrix including all the stakeholders. The stakeholder that was being interviewed was not shown in the figure during the interview. So, if for example UPG was interviewed, the interviewee would see this image without UPG in it.

Overview (potential) climate issues at the Utrechtse Heuvelrug	
Climate change	Surface water dries up (ponds etc.)
Temperature rise	Drying up of the soil
Heat waves	Decreased soil quality
Extreme wather events	Nitrate and phosphate run-off
Floods	Micropollutants (PFAS, drug residues, microplastics etc.)
Pluvial flooding	Reduction/shift in biodiversity
Drought	Increase in fungi, diseases, and plagues
Desiccation	Reduction in water quality (e.g. blue-green algae)
Drinking water shortage	Forest fires
Withering of nature	Damage agricultural crops

Figure 17: Fifth image used during the interview showing an overview of the potential climate issues at the Utrechtse Heuvelrug.

Appendix 3: Overview of the interviewees

Table 8: Overview of the number of interviews per stakeholder category and whether the interview was conducted through videoconferencing (online) or at a location (offline).

Stakeholder	Number of interviewees	Online/offline
National Park de Utrechtse Heuvelrug	*1*	*Offline*
The Province of Utrecht	*1*	*Online*
Municipalities	*2*	*Online*
Water boards (Vallei en Veluwe & Hoogheemraadschap De Stichtse Rijnlanden)	*2*	*Offline & Online*
Vitens	*1*	*Online*
Veiligheidsregio Utrecht (VRU)	*1*	*Online*
Land- en Tuinbouworganisatie Nederland (LTO)	*1*	*Online*
Utrechts Particulier Grondbezit (UPG)	*1*	*Online*
Private landowners	*4*	*Offline & Online*
Natuurmonumenten	*1*	*Online*
Staatsbosbeheer	*1*	*Online*
Utrechts Landschap	*1*	*Online*
Natuur en Milieufederatie Utrecht (NMU)	*1*	*Online*
Stichting Kastelen, Buitenplaatsen en Landgoederen (SKBL)	*1*	*Online*
IVN Natuureducatie (IVN)	*1*	*Online*
Entrepreneurs	*1*	*Online*
Farmers	*0*	-
Local citizens	*0*	-
Dutch national government (Ministry of LNV)	*1*	*Online*
Rijkswaterstaat	*0*	-
Civilian initiatives	*0*	-
Total	**22**	

Appendix 4: Informed consent form

Utrecht University

INFORMED CONSENT FORM for participating in:

A stakeholder perspective to overcoming governance gaps in order to create a climate-adapted landscape at the Utrechtse Heuvelrug.

To be completed by the participant:

I confirm that:

- I am satisfied with the received information about the research;
- I have been given opportunity to ask questions about the research and that any questions that have been risen have been answered satisfactorily;
- I had the opportunity to think carefully about participating in the study;
- I will give an honest answer to the questions asked.

I agree that:

- The interview will be recorded. The recording will be used to transcribe the interview. The recording will be deleted after the completion of the thesis;
- The data to be collected will be obtained and stored for the duration of this thesis research;
- The collected, completely anonymous, research data can be shared with the thesis supervisor of Utrecht University if this is needed for the completion of this thesis research.

I understand that:

- I have the right to withdraw my consent to use the data;
- I have the right to see the research report afterwards.

Name of participant: _____

Signature: _____ _____ Date, place: __/__/___, _____

Appendix 5: Networks showing the collaborative fit of the focal nodes ‘Temperature rise’ and ‘Desiccation’

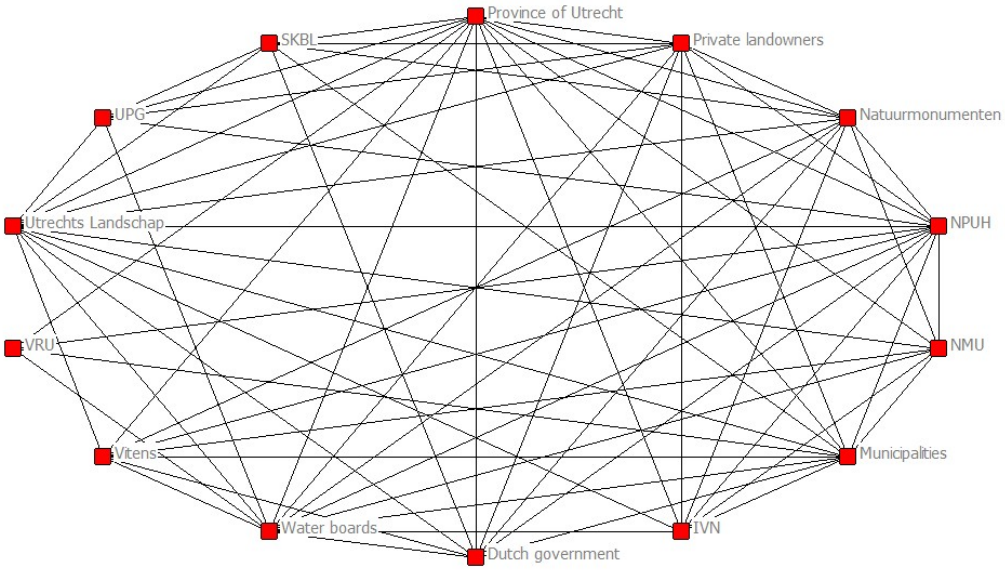


Figure 18: Network showing the collaborative fit around the focal node 'Temperature rise'

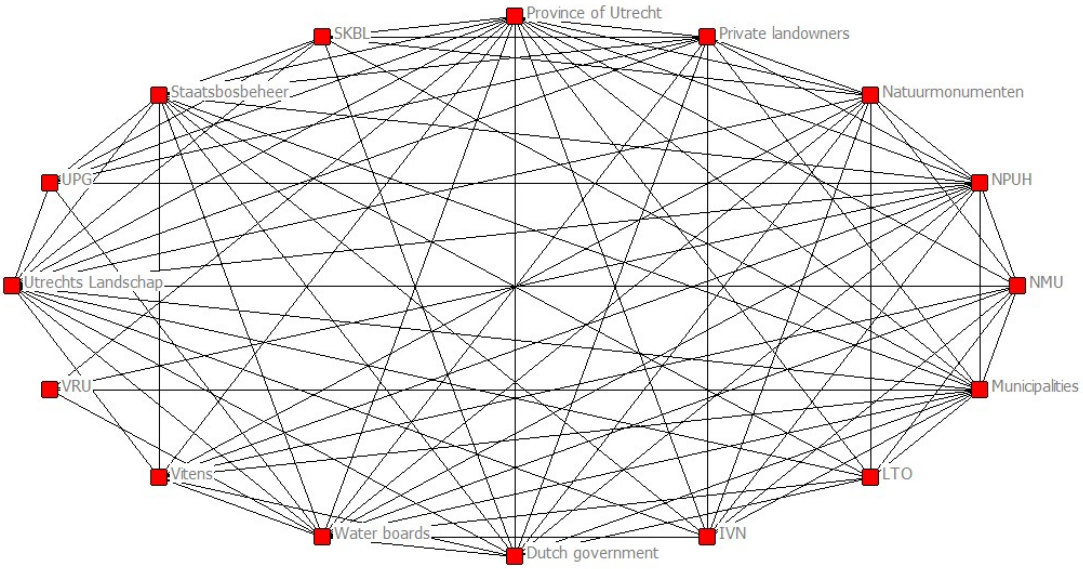
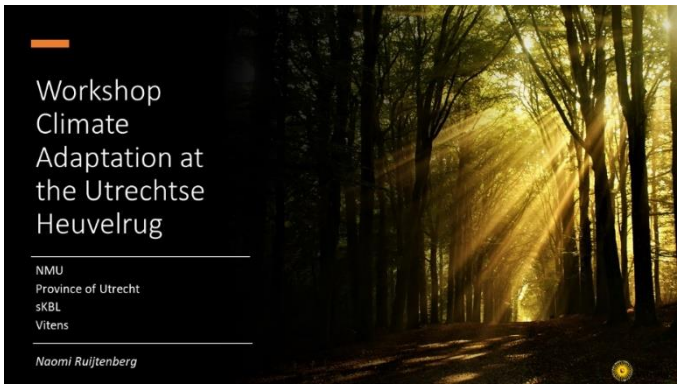
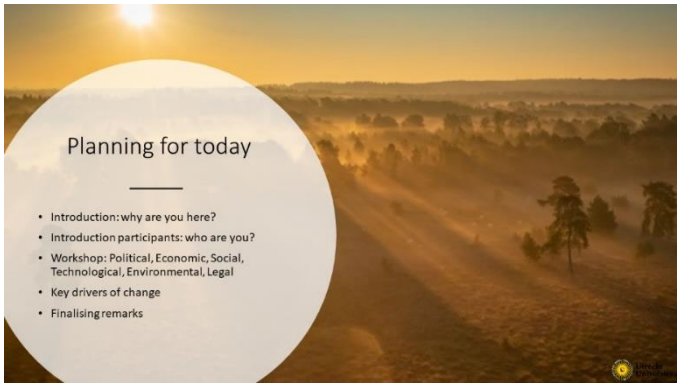


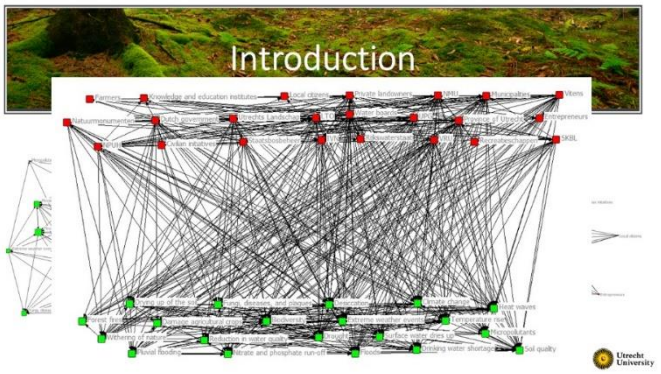
Figure 19: Network showing the collaborative fit around the focal node 'desiccation'

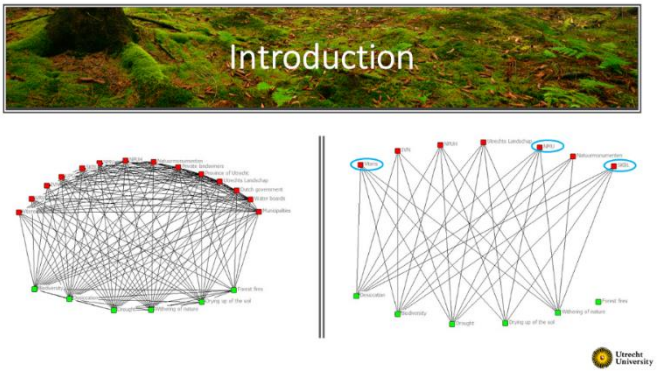
Appendix 6: Slides used during the workshop

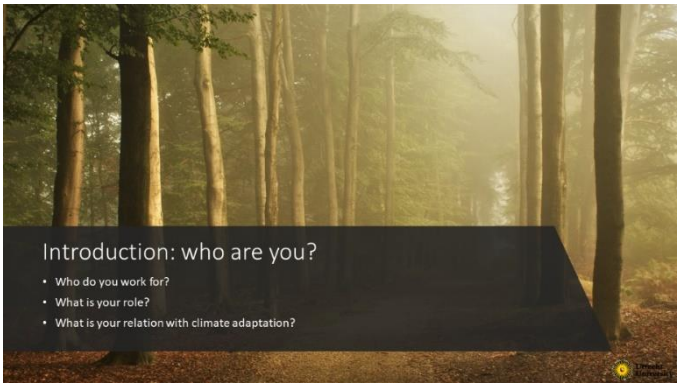
In this Appendix, you will find the slides that were used during the workshop around the focal node *temperature rise*. The slides of the workshop around *desiccation* were the same, except that the introduction slides showed the network figures relating to *desiccation*. Note that the slides during the workshop were in Dutch, so these slides have been translated.

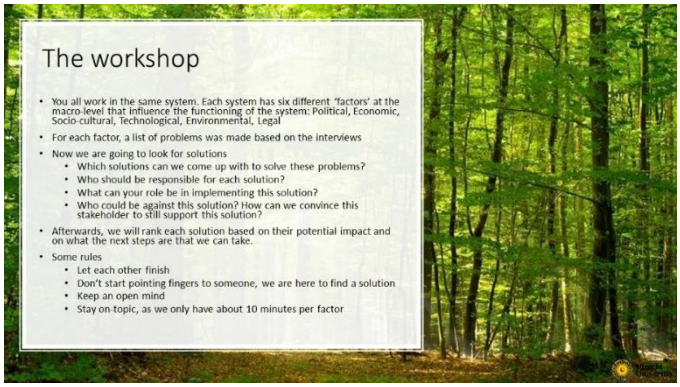


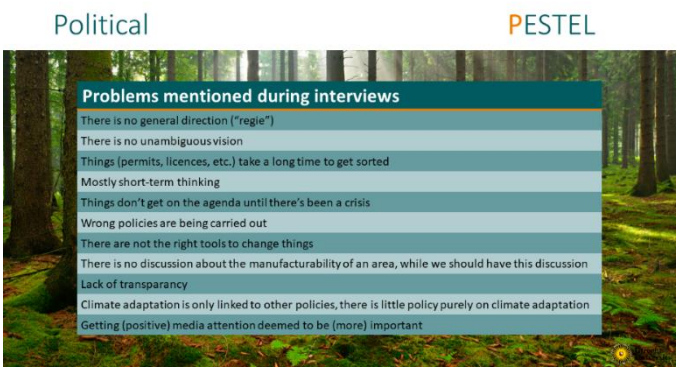


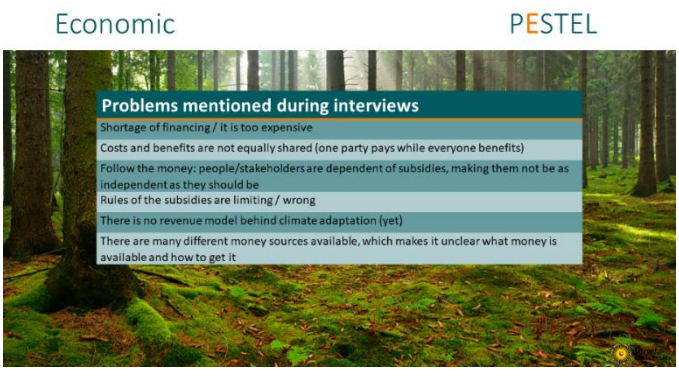






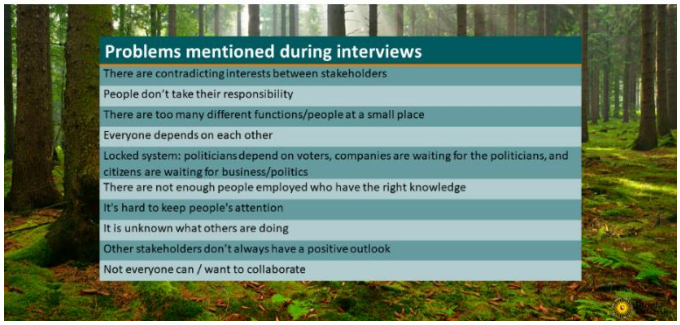






Socio-Cultural

PESTEL

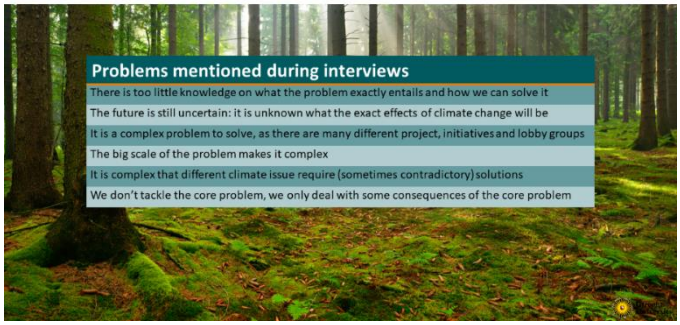


Technological

PESTEL

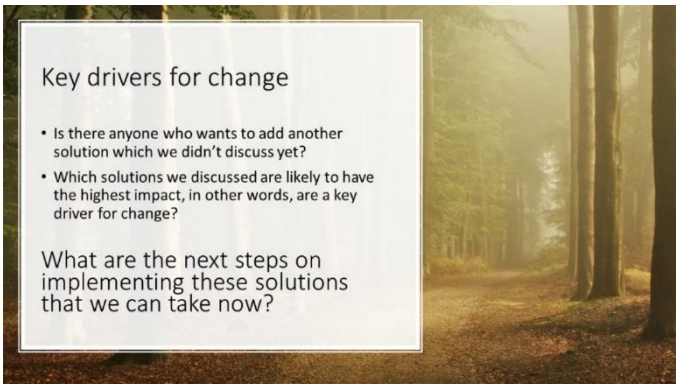
Environmental

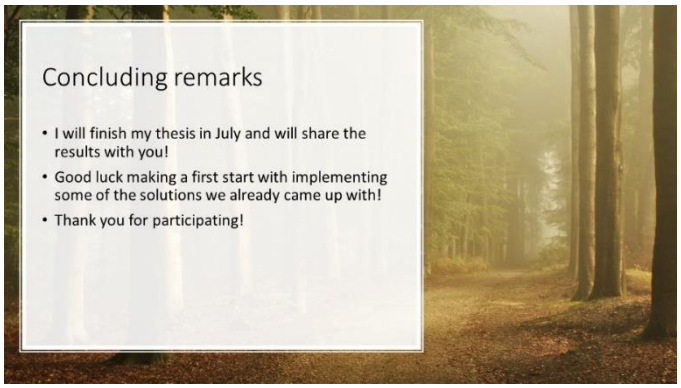
PESTEL



Legal

PESTEL





Appendix 7: Centrality levels

Table 9: Betweenness centrality of each actor

Actor	Betweenness centrality
Province of Utrecht	22.147
Water boards	21.017
Private landowners	17.021
NMU	16.083
Utrechts Landschap	10.353
Staatsbosbeheer	7.969
Municipalities	6.434
Dutch government	5.919
NPUH	5.136
LTO	4.850
IVN	3.978
Knowledge and education institutes	2.549
Vitens	1.861
Natuurmonumenten	1.853
SKBL	1.146
Entrepreneurs	0.619
Farmers	0.374
Civilian initiatives	0.285
UPG	0.222
VRU	0.100
Local citizens	0.083
Rijkswaterstaat	0.000
Recreatieschappen	0.000

Table 10: An overview of the degree, indegree, and outdegree of the climate issues at the Utrechtse Heuvelrug.

	Outdegree	Indegree	Degree
Micropollutants	3	2	***5***
Extreme weather events	7	2	***9***
Surface water dries up	4	5	***9***
Forest fires	3	7	***10***
Fungi, diseases, and plagues	2	9	***11***
Nitrate and phosphate run-off	4	8	***12***
Withering of nature	6	6	***12***
Pluvial flooding	5	7	***12***
Floods	6	7	***13***
Drinking water shortage	6	8	***14***
Climate change	12	2	***14***
Reduction in water quality	4	10	***14***
Heat waves	11	5	***16***
Damage agricultural crops	1	15	***16***
Soil quality	9	10	***19***
Drying up of the soil	12	8	***20***
Biodiversity	7	14	***21***
Drought	14	7	***21***
Desiccation	14	8	***22***
Temperature rise	17	7	***24***

Appendix 8: Climate issues and the relationships between them

Table 11: Overview of the (potential) climate issues at the Utrechtse Heuvelrug

Climate issue	Meaning and potential impact
Reduction or shift in biodiversity (potentially causing a mismatch in the food system / exotic plants)	This can either mean a reduction in biodiversity or a shift of species that can exist at a certain location (Swingland, 2001). For example, (invasive) exotic species could become better adapted to the new climate. This could potentially lead to a mismatch in the existing food system.
Forest fires	A forest fire is an unplanned and uncontrolled fire in a nature area, which can cause damage to property, nature, and human life (Hutto, 2008). However, naturally occurring wildfires may also have beneficial effects on some native vegetation, ecosystems, and animals.
Drinking water shortage	Below the Utrechtse Heuvelrug, there is a 'water lens' which drinking water is extracted from (Hydrologic & Acacia Water, 2021). We currently extract so much water that the 'water lens' decreases in volume. As our water consumption is still increasing, especially during hot summer days, a water shortage may be a climate issue in the future if the average temperature increases, potentially harming human life, ecosystems, and nature.
Drought	Drought is a longer period in which there is a water shortage, whether surface water, groundwater, or atmospheric (Mishra & Singh, 2010). This could, for example, be caused by a longer period in which there is (almost) no rainfall. Droughts can have a substantial impact on ecosystems.
Extreme weather events	An extreme weather event includes heavy rainfall within a short time, potentially leading to a (temporary) surplus of water (Stephenson, 2008).
Heat waves	Climate change can cause heat waves, which is a period that is characterized by exceptionally high temperatures, potentially causing heat stress (Meehl & Tebaldi, 2004).
Climate change	A change in climate (over time) which is either caused by natural variability or a result of human activity (Pielke, 2005).
Soil quality	Soil quality, which is defined as the degree of soil pollution, also takes into account the capacity of the soil to function within land-use and ecosystem boundaries to maintain the quality of the environment, sustain biological productivity, and promote the health of plants and animals (Bünemann et al., 2018). The quality of the soil may decrease, for example causing a reduction in the humus layer, caused by contamination by human-made chemicals, alterations in the natural soil environment, or salinisation.
Micropollutants	Micropollutants are synthetic or natural compounds that end up to aquatic environments (Chavoshani, Hashemi, Amin, & Ameta, 2020).
Nitrate and phosphate run-off	Due to the intensification of agriculture, there is a surplus of nitrate and phosphate. This can potentially end up in nature, which could disturb the ecosystem (Almasri & Kaluarachchi, 2004).
Surface water dries up (ponds etc.)	Due to a water shortage, the water level may decrease. This could result in ponds and other surface water areas drying up, having an impact on nature and animals that depend on this water for survival (Yang & Liu, 2020).
Floods	A flood is a surplus of water that reaches land when certain water bodies, like rivers, lakes, or the ocean overflow. Floods can potentially harm human life, animals, nature, and ecosystems (Yang & Liu, 2020).
Increase in fungi, diseases, and plagues	Due to climate change, fungi, diseases, and plagues may appear more often (Stenseth et al., 2006). This increase can cause harm to nature, agriculture, ecosystems, animals, and human life.

Damage agricultural crops	According to interviewee 1, climate change may decrease the quality of the circumstances for agricultural crops to grow. This can result in agricultural crops being damaged, potentially causing a food shortage.
Temperature rise	Global warming is a well-known issue when talking about climate change, as an increase in temperature has many different impacts around the world (P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, 2022).
Drying up of the soil	A dried-up soil is the consequence of a water deficit, which will have a damaging impact on the plants growing and crop production on the land (Davies & Zhang, 1991).
Withering of nature	The withering of nature means that plants (trees, bushes, flowers, crops, etc.) dry up, shrink and wilt (interviewee 1). This, of course, can be the result of a natural process, though it can also be caused by climate change. The withering of nature has a direct effect on nature itself and the relating animals and ecosystems.
Desiccation (lowering groundwater level/ seep pressure decreases)	According to interviewee 1, desiccation is either the process of extreme drying or the state of extreme dryness. It is a long-term form of drought, which happens, for example, when the groundwater level is permanently low due to the water system not being sufficient. Desiccation has an impact on nature, ecosystems, and animals.
Reduction in water quality	The quality of water can decrease because of many different aspects (Beck, 1987). An example could be that due to an increase in temperature, the circumstances for blue-green algae to grow improve. A reduction in water quality can have an impact on nature, ecosystems, and animals.
Pluvial flooding	A pluvial flood occurs when extreme rainfall causes a surplus of water in an area, which creates a flood (Falconer et al., 2009). Often this is caused because the drainage system or sewer reached its maximum capacity. This is independent of the overflowing of a water body like a river, lake, ocean, etc.

Table 12: Overview of the links between different climate issues. A '1' indicates that a link was found during the literature review, a '0' indicates that no link was found. The colours refer to the used source, which can be found in the legenda below this table

	Reduction or shift in biodiversity	Forest fires	Drinking water shortage	Drought	Extreme weather events	Heat waves	Climate change	Soil quality	Micro-pollu-tants	Nitrate and phosphate runoff	Surface water dries up	Floods	Increase in fungi, diseases, and plagues	Damage agricultural crops	Temperature rise	Drying up of the soil	Withering of nature	Desiccation	Reduction in water quality	Plurial flooding
Reduction or shift in biodiversity (potentially causing a mismatch in the food system / exotic plants)	X	1	0	0	0	0	0	1	0	1	0	0	1	1	1	0	0	0	1	0
Forest fires	1	X	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Drinking water shortage	1	0	X	0	0	0	0	1	0	0	1	0	0	1	0	1	1	0	0	0
Drought	1	1	1	X	0	1	0	1	0	1	1	0	1	1	1	1	1	1	1	0
Extreme weather events	0	0	0	0	X	0	0	0	1	1	0	1	1	1	0	0	0	0	1	1
Heat waves	1	1	1	1	0	X	0	0	0	0	1	0	1	1	0	1	1	1	1	0
Climate change	1	0	1	1	1	1	X	0	0	0	0	1	1	1	1	0	0	1	1	1
Soil quality	1	0	0	1	0	0	1	X	0	0	0	1	1	1	0	1	0	1	0	1
Micropollutants	0	0	0	0	0	0	0	1	X	0	0	0	0	1	0	0	0	0	1	0
Nitrate and phosphate run-off	1	0	0	0	0	0	0	1	0	X	0	0	1	0	0	0	0	0	1	0
Surface water dries up (ponds etc.)	1	0	1	0	0	0	0	0	0	0	X	0	0	0	0	1	0	1	0	0
Floods	1	0	0	0	0	0	0	0	0	1	0	X	1	1	0	0	0	0	1	1
Increase in fungi, diseases, and plagues	1	0	0	0	0	0	0	0	0	0	0	0	X	1	0	0	0	0	0	0
Damage agricultural crops	0	0	0	0	0	0	0	1	0	0	0	0	0	X	0	0	0	0	0	0
Temperature rise	1	1	1	1	1	1	0	1	0	1	1	1	1	1	X	1	1	1	1	1
Drying up of the soil	0	1	1	1	0	0	0	1	1	1	0	1	0	1	1	X	1	1	0	1

Withering of nature	0	1	0	1	0	1	0	0	0	0	0	0	0	0	1	1	X	1	0	0
Desiccation (lowering groundwater level / seep pressure decreases)	1	1	1	1	0	1	0	1	0	1	1	1	0	1	1	1	1	X	0	1
Reduction in water quality	1	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	X	0
Pluvial flooding	1	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	1	X

Legenda: the colours used in this Table correspond with different sources in literature. An overview of the matching literature is given below:

Title source	APA reference	Title source	APA reference
Klimaat en bodem (WUR)	(Wageningen University & Research, n.d.-c)	Klimaatadaptatiedialoog Natuur 2019: Opgaven, bestuurlijke dilemma's en elementen voor een actieprogramma	(Uitvoeringsprogramma Nationale Klimaatadaptatiestrategie (NAS), 2019)
De hittegolf	(Nuijten, 2016)		
Klimaatverandering en ziekten en plagen in het bos, kunnen we daarop anticiperen?	(Kappers, 2019)	Kris Piessens: gevolgen droogte voor de bodem	(Beek, n.d.)
Droogte en verdroging	(Informatiepunt Leefomgeving, n.d.)	Verdroging zuid europa	(KNMI, n.d.)
Monitoring forest fires and their consequences using MODIS spectroradiometer dat	(Martyn, Petrov, Stepanov, Sidorenko, & Vagizov, 2020)	The Relationship between Winter Temperature Rise and Soil Fertility properties	(Guoju, Qiang, Jiangtao, Fengju, & Chengke, 2012)
Gewassen en bodemleven hebben invloed op bodemkwaliteit	(Biokennis, 2017)	Environmental assessment of anaerobically digested sludge reuse in agriculture: Potential impacts of emerging micropollutants	(Hospido et al., 2010)
Nationale klimaatadaptatiestrategie	(Rijksoverheid, 2016)		
Bodem als buffer	(STOWA, n.d.)	Integraal model voor bodem en waterkwaliteit	(Wageningen University & Research, n.d.-b)
Sources mentioned in background chapter 2.2	(Hydrologic & Acacia Water, 2021; Mirza, 2003; Provincie Utrecht, n.d.-a, n.d.-b, n.d.-c; Stichting Nationaal Park Utrechtse Heuvelrug, 2020; Stott, 2016)	Effecten klimaatverandering op landbouw	(STOWA, 2021)
		Biodiversity improves water quality through niche partitioning	(Cardinale, 2011)
		Impacts of climate change on the future of biodiversity	(Line Bellard, Bertelsmeier, Leadley, Thuiller, & Courchamp, 2012)
Achtergrondinformatie overstroming	(Kennisportaal Klimaatadaptatie, n.d.)	Biodiversiteit (WUR)	(Wageningen University & Research, n.d.-a)
Verband tussen zuidelijke droogte en extreme hittegolven in Europa	(Wageningen University & Research, 2019)	A regional comparison of the effects of climate change on agricultural crops in Europe	(Iglesias, Garrote, Quiroga, & Moneo, 2012)
Effect van een hittegolf op de waterkwaliteit van de Rijn en de Maas	(Zwolsman & Vliet, 2007)	Planning support system for climate adaptation: Composing effective sets of blue-green measures to reduce urban vulnerability to extreme weather events	(Voskamp & Van de Ven, 2015)
Waterschaarste in Nederland niet ondenkbaar: actie is nodig	(Drinkwaterplatform, n.d.)		
An Underground Revolution: Biodiversity and Soil Ecological Engineering for Agricultural Sustainability	(Bender, Wagg, & van der Heijden, 2016)	Impacts of climate change on surface water quality in relation to drinking water production	(Delpla, Jung, Baures, Clement, & Thomas, 2009)
Forest fires and climate change: causes, consequences and management options	(Aponte, de Groot, & Wotton, 2016)	Uitspoeling nitraat naar grondwater gestegen, vermoedelijk als gevolg van droogte	(RIVM, 2021)
Hittegolven heter door droogte, maar minder dodelijk	(Wageningen University & Research, 2022)	Biodiversiteit als dam tegen overstromingsschade	(Be Biodiversity, n.d.)
Watervraag uitgelicht	(Vitens, n.d.-b)	Water Shortages and its Environmental Consequences within Tigris and Euphrates Rivers	(Al-Ansari, Adamo, & Sissakian, 2019)

Appendix 9: Integrative (mis)fit using temperature rise as a focal node

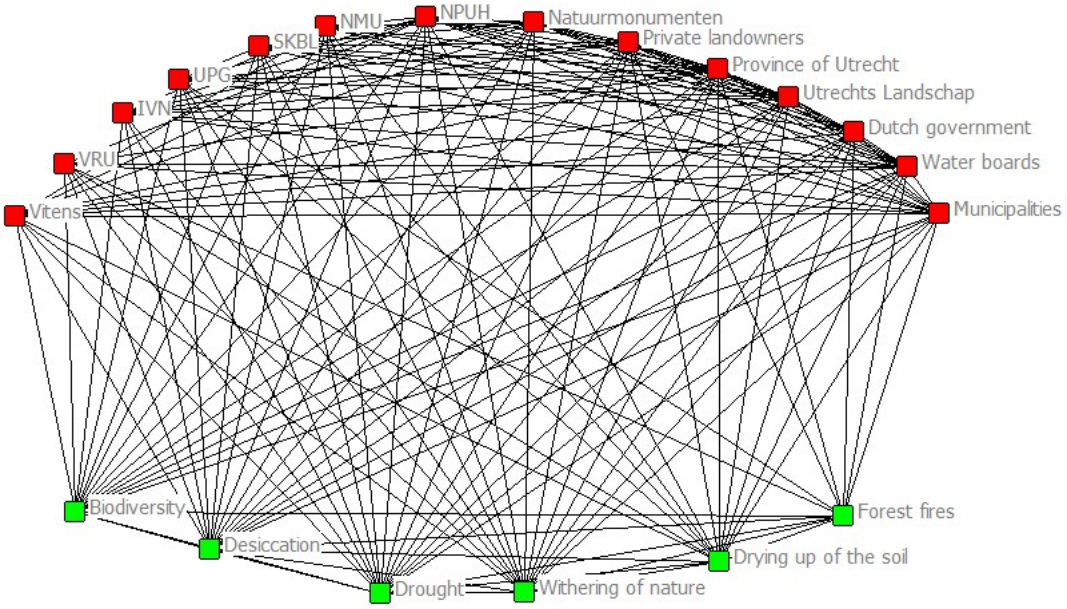


Figure 20: The network showing all actors and climate issues that have a direct link with the climate issue temperature rise and the relations between these actors and climate issues.

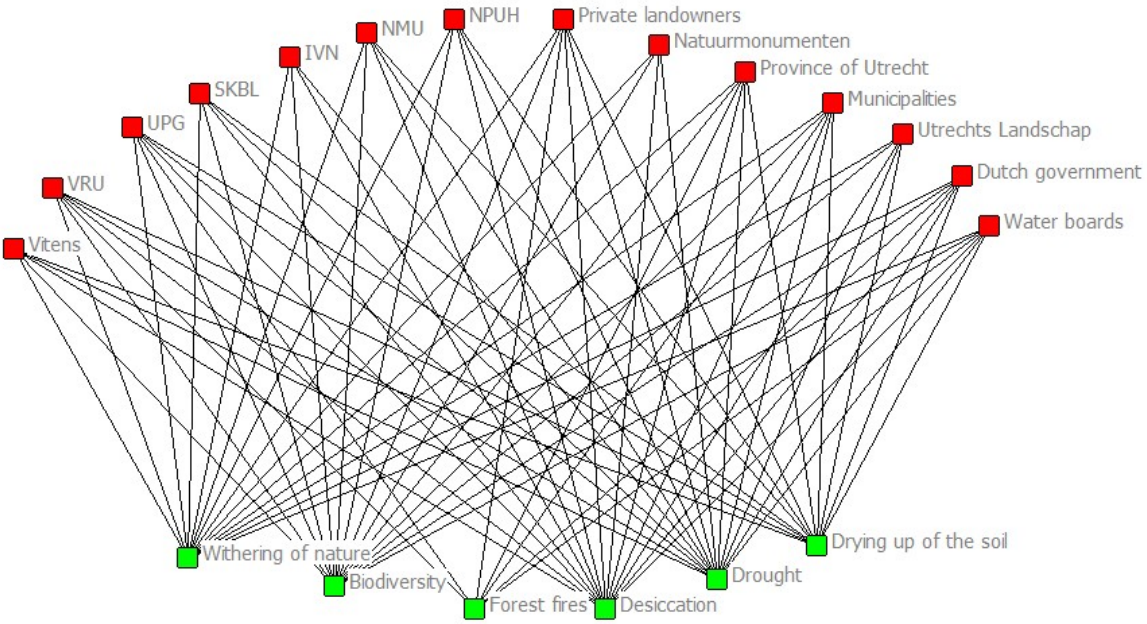


Figure 21: The network showing all actors and climate issues that have a direct link with the climate issue temperature rise and the relationship between an actor and climate issues.

Appendix 10: Integrative (mis)fit using desiccation as a focal node

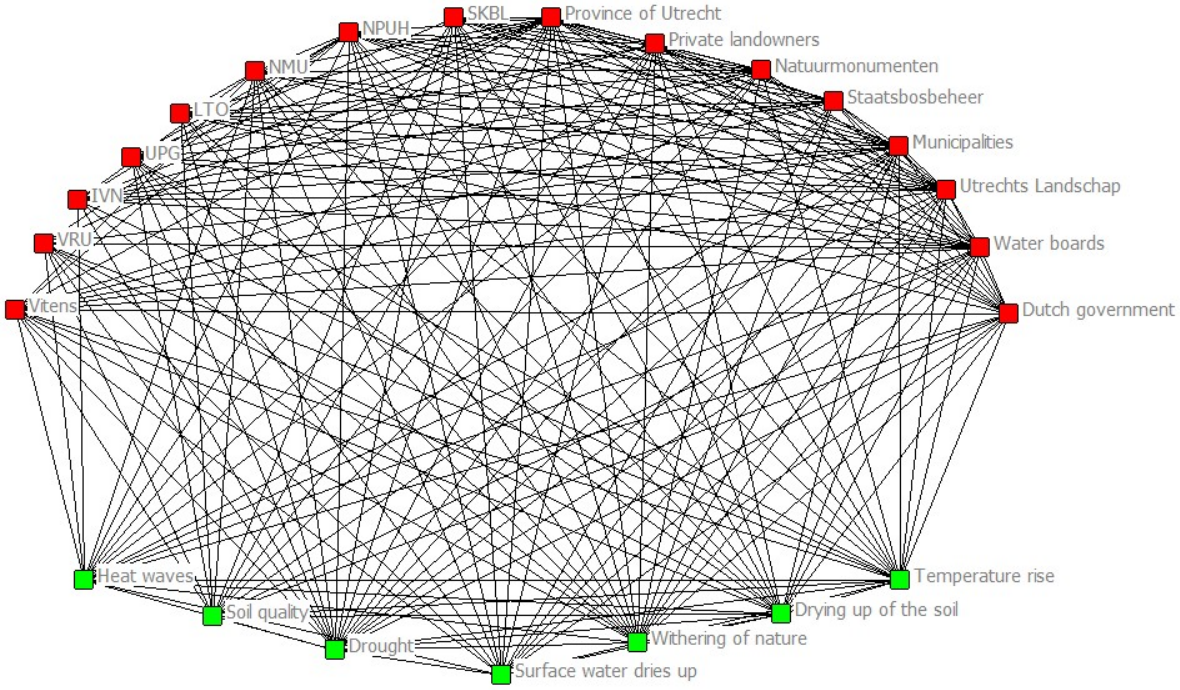


Figure 22: The network showing all actors and climate issues that have a direct link with the climate issue desiccation and the relations between these actors and climate issues.

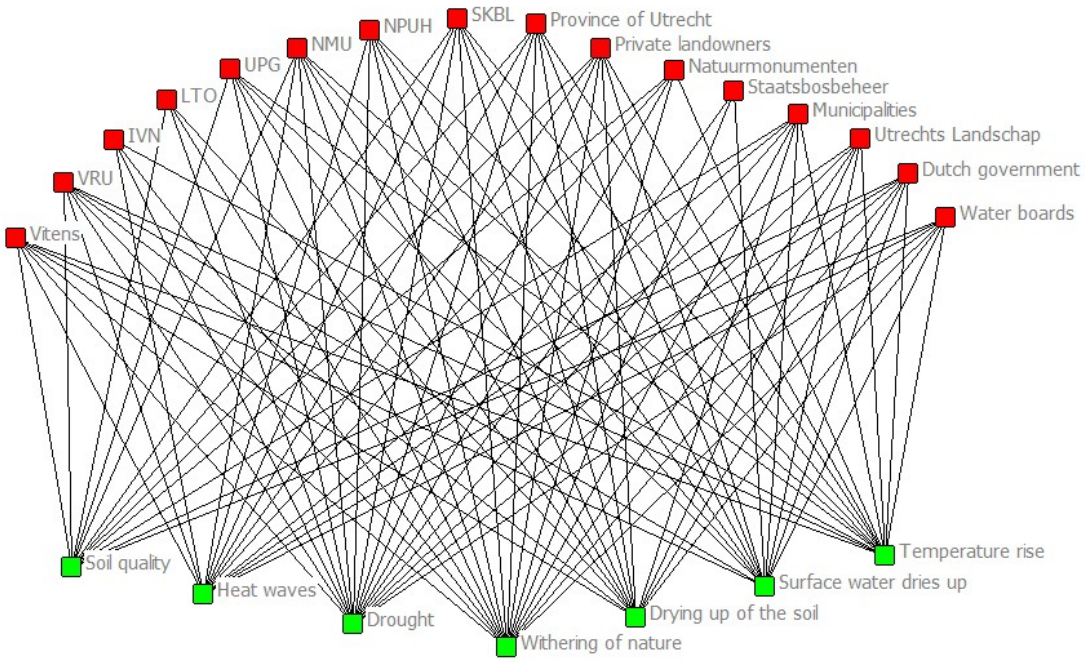


Figure 23: The network showing all actors and climate issues that have a direct link with the climate issue desiccation and the relationship between an actor and climate issues.

Appendix 11: Explanation of the solutions that came up during the workshops

Table 13: Explanation of the solutions. Cells in blue represent the solutions proposed during the workshop *temperature rise*, cells in red represent the solutions proposed in the workshop *desiccation*, and cells in green represent solutions that were mentioned in both workshops.

Political solutions	
Set priorities and frameworks	Setting priorities and establishing frameworks creates a vision for the area, increases the general leadership role of the government and ensures that long-term thinking becomes more central.
Develop a vision of the manufacturability ("maakbaarheid") of an area	A vision must be created on the manufacturability of an area, including where the boundaries of that manufacturability lie.
Appoint an 'area director'	An area director is someone who knows which processes are taking place in an area. Preferably, this is an organisation, ensuring that there is no dependency on one person.
Share substantiations	Share substantiations – both technical, emotional and political – for why there is short-term thinking, why issues do not get on the agenda before a crisis, what wrong policies are and why they exist. This creates an action perspective for other stakeholders.
Leave the desk and go into the field	Knowledge and expertise must be shared with multiple/all stakeholders so that not just one party is responsible. This requires people to "get away from their desks" and go into the field.
Strengthen governmental leadership ("regie")	The government should take more control. The provinces and municipalities must be made aware of their responsibility for this by the national government. The national government must take control better to guide the provinces in their responsibility.
Share negative outcomes of experiments as well	Make sure that organisations can also publicly share the negative results of projects (e.g. what failed). In this way, others can learn from their 'mistakes'.
Enshrine a vision and measures for the area in the Omgevingswet ("environmental law")	In the "Omgevingswet", you can establish a joint vision for the area and decide on who is in charge and who is responsible for what. In addition, you can simplify the licensing process, because you have already established the frameworks in advance.
Make climate adaptation central at governments	If climate adaptation is put central in governments, more policies will be made around this theme. This requires a push from the national government toward the provinces and municipalities.
Better share knowledge about leadership ("regie") and visions	There are several visions and ambitions etc. at the Utrechtse Heuvelrug that provide direction, such as the Blauwe Agenda and the Omgevingsvisie. Stakeholders should better share this so that everyone is aware of it. In first instance, it is up to the Province of Utrecht to do so, though at a certain moment that responsibility lies with all stakeholders.
Increase the focus on carrying out acts for the long term	There are long-term visions, though more action needs to be taken. Thus, more focus should be placed on this and the focus must be maintained.
Increase the capacity for carrying out climate adaptation solutions	It is difficult to move from ambitions or visions to action. More capacity is needed for the implementation of visions etc. The responsibility for this lies with all partners involved.
Give action perspective to climate adaptation solutions	Actions need to focus on what people can do. Thus, climate adaptation solutions should have an action perspective. The responsibility for this lies with the executor of the action.
Appoint an ambassador in organisations	To ensure that everyone is aware of what is happening in the area, especially with a focus on shared visions and direction, an ambassador can be appointed within each organisation, who can serve as a point of contact for people who have questions about a certain theme.
Economic solutions	
Invest in corporate social responsibility	Because there is too little money for climate adaptation and the Netherlands faces a great risk (due to sea level) and because there is too little space, we must realize that we have to invest, especially in corporate social responsibility. We must be smart, think further, look at the long-term, and look across national borders for solutions.
Develop different, fair business models	We have to develop different business models to ensure that the ones who work hard for, for example, a forest or agricultural area are also ones who earn money. Some business models could be: 1) better prices for agricultural products, 2) the polluter pays, 3) nature tax, 4) public has to pay for a visit to nature areas, 5) true pricing, and 6) ecosystem services.
Give insights into the consequences on property and area level	Because climate adaptation solutions do not have a profit model, it is wise to give insight into what the changes are in costs, benefits and (future) savings, both on property and area levels. Especially because climate adaptation solutions can prevent future costs. People who face the risk of implanting climate adaptation solutions may be against this. They can be convinced by sharing the risk with other stakeholders or the government.

Learn what people think is wrong with a subsidy	A subsidy provider should try to understand what people think is wrong or limiting about a certain subsidy.
Clarify the goal of a subsidy	A subsidy provider should clarify what a certain subsidy is meant for and what not. This way, fewer people may think a subsidy is wrong or limiting.
Create legislation to encourage sustainability	Use legislation to oblige stakeholders to use sustainable alternatives, which can stimulate the use of these products, or prohibit non-sustainable options.
Seize opportunities relating to holistic ("integraliteit") subsidies	You often have to attribute to a grant or fund. This ensures that you take certain aspects into account that you would not have considered otherwise. This makes a project more integral and better. In addition, more different subsidies will become available for more integrated projects.
Link action perspectives with the future of owners	Link technical, innovative action perspectives with the desire or the future of land owners. Thus, what does a land owner want and is this possible? If not, explain why.
Better inform the consumer about the costs of nature	If a consumer knows what he pays for, he is likely to be willing to pay more. Thus, a consumer that knows what it costs to maintain nature and what value nature has, is likely to be willing to pay more for this.
Develop a knowledge base for an overview of the available financial resources	To create a better overview of which financial resources are available, a knowledge bank could be developed in which this information is gathered. This could be done by NPUH.
Stakeholders should better argue what benefits their solution has	There is a lot of money available for climate adaptation, but to get this money, stakeholders should argue what a potential solution/project will contribute to solving a certain problem. Stakeholders that apply for a certain subsidy will be responsible for this.
Use the right communication channels for sharing information about subsidies	Subsidy providers have to communicate in the right way to prevent stakeholders losing overview of available financial resources. To do so, subsidy providers must use the right communication channels which are directed at the right target audience.
Make grant applications as accessible as possible	To deal in the right way with a subsidy that is wrong or limiting, a grant application should be as accessible as possible, potentially including good examples of how to apply for the subsidy.
Install coaches that can help with measures for climate adaptation	Many stakeholders, for example, farmers, are willing to implement climate adaptation solutions, though often they do not know which ones or how to access financial help. Coaches can help them with this. This already happens on a small scale for farmers with agricultural coaches.
Socio-cultural solutions	
Combine functions and always consider CA	You can combine different functions in an area, though climate adaptation should always be considered as a condition. In contrast to the current situation, in which there is mostly a focus on one primary function in the area.
Change the system where people feel the urgency	You should not want to change the entire system at once, but look for the places in which the urgency for change is felt most. You can change the system at these places with as little energy as possible.
Create legislation and enforce stakeholders' responsibility	If stakeholders do not take responsibility themselves, this can be enforced with legislation.
Educate children on their responsibility for nature	Start at a young age with educating children about nature, as they do, for example, in Germany. If it is clear what responsibility for nature people have from a young age onwards, people will take care of nature in an improved way.
Bring stakeholders together in projects	If you bring stakeholders together in a project, they can share their interests. Then everyone knows why and how things will happen, you can discuss this and increase support for certain measures. Furthermore, the project can serve as a flywheel which allows stakeholders to easily participate.
Offer perspective to each stakeholder and share this	Offer a perspective to each stakeholder and share this perspective, which allows the urgency to be maintained and/or shared. Give space and recognition for everyone's resistance and interests. This way, you prevent stakeholders from only acting in their interest and you can jointly look at how a project benefits everyone's agenda.
Use the dependency for more collaboration	Use the dependency as a driving force to collaborate. This requires the dependency to be named, which allows for deciding how you can benefit each other.
Start a conversation and search for common goals or share the 'pancake' based on prioritising	Start a conversation, during which you jointly look for a common (sub-)goal. Take the steps you can already take. If there is no common (sub-)goal, share the 'pancake' based on prioritising.
Work using intrinsic motivation	To ensure to keep the attention of people, try to make them work using intrinsic motivation. Someone that carries out a project is responsible for finding this intrinsic motivation.
Focus on the behaviour of people and the management of properties	To correctly deal with the many functions available in an area, functions should not be moved, but adaptations should be made in behaviour and management of properties. For example, a different way of farming (instead of intensive agriculture) could be strived for.

Be transparent in weighting different interests	There are often contradictory interests and sometimes you cannot change this. In this case, it is important to be transparent about why a certain choice is made. This way, opponents can understand the choice.
Be clear in what you expect from others	If you are clear in why you expect from others, then it is easier for these stakeholders to take their responsibilities.
Technological solutions	
Increasingly connect other stakeholders and boost climate adaptation solutions	Different stakeholders must be connected and stimulated to implement climate adaptation solutions. The responsibility for this lies with organisations like UPG.
Arrange short-term and long-term solutions	Better ranking short- and long-term measures is necessary. In doing so, it is made clear what the shortest blows are that can be done now, i.e. what the low-hanging fruit is, but it also clarifies what needs to be done now for the longer term. That way, a shift towards the long term can be made. The person responsible for this is the person who carries out a project, such as the water board. There may be measures or solutions that are annoying for someone if they are applied at a certain location, which could cause resistance. This opposition must be recognized and a measure-dependent solution must be sought, for which it is in any case important that the costs and benefits are made transparent in both the short and long term.
Think sustainably	Thinking sustainably, thus focused on the long term, must become the norm. Investors with a short-term profit motive could oppose this transition, but through legislation, they should be stimulated (or forced) to take the long-term into account in their investments.
Give advice and coaching	Ensure that there is sufficient advice and guidance for stakeholders working on climate adaptation. The responsibility for this both lies with the landowner that seeks advice and the government that wants certain transitions/things to happen. It can also be a shared responsibility between both.
Develop a knowledge database for climate adaptation solutions and measures	Develop a knowledge base in which all (new) solutions and measures are gathered, including an analysis that shows which measures are interesting for which problems. The knowledge database must have an integral focus. The responsibility for this could be with NPUH, the water boards, or the province.
Seize opportunities	If an opportunity arises to do something with climate adaptation, a stakeholder should seize it. It is pointless to wait for the ‘perfect solution’ to pass.
Choose some climate adaptation solutions and focus on these	There are many solutions/measures available. It is impossible to do something about that. It is up to the stakeholders to ‘just’ choose a few measures and to focus on these. Looking for the perfect solution and making lists of potential solutions will cause a standstill.
Provide insight into the consequences of each solution	To have a better overview of which measures should be implemented at a certain moment, it is important to create insight into the consequences of each measure.
Environmental solutions	
Prioritise long-term solutions	To correctly deal with contradicting issues and the core problem, it is important to jointly set the right priorities. Long-term solutions are most important for this, thus stakeholders have to look forward. The government has a leading role in this. Opponents of this long-term vision could be forced by legislation or convinced by different reward systems.
Erfgoeddeal (“Heritage deal”)	Projects, like the Erfgoeddeal, can bring complex problems with many different projects, initiatives, lobby groups, and stakeholders together. This way, these projects can contribute to an improved implementation of climate adaptation solutions. The Province of Utrecht should be responsible for this. Potentially, many people could oppose this. Therefore, it is important to set up a broadly supported project team in which everyone feels heard and in which incentives are sought for everyone.
Coordination during the planning phase	To prevent stakeholders from working past each other and implementing contradicting solutions, it is important to seek coordination during the planning phase. This way, you can see from the start how things are complementary, what contradictions exist and how to deal with these.
Scale down	To deal correctly with the large scale of the problem, the boundaries of the problem must be mapped out properly. When possible, the scale must be reduced and opportunities seized, but an overview must be maintained to prevent the creation of all kinds of 'loose islands'. Responsibility for this lies with the government, research institutes and collaborative organisations. However, it can also be said that the responsibility lies with anyone, for example, people owning a garden who can contribute to implementing climate adaptation solutions.
Strengthen governmental leadership (“regie”)	The province and municipalities should indicate better which direction they want to go. In addition, different departments must improve their collaboration to develop a more integrated vision of the future.

Focus more on sharing knowledge	There is a lot of knowledge, though this is not always shared as well as could be. Thus, it is important to start sharing this knowledge in a better way, for example via one central knowledge database. The more often this database is used, the better choices can be made.
Establish an overarching research direction: measuring and monitoring	To correctly deal with the big scale and complexity of the climate change/ climate adaptation problem, an overarching research direction could be set up. This research line could be supported by measuring and monitoring the area, which can help understand developments.
Just start, for example with pilots	You can never know everything, so sometimes it is just a matter of starting. This can, for example, be done via pilots in which the effects of the implemented measures are monitored. If something does not go well, it is possible to adjust it. A land owner is responsible for this.
Adaptive approach	Adopt an adaptive approach, in which you respond on all kinds of levels to the consequences of climate change that are important at a certain moment.
Make decisions based on facts	If different climate issues require contradicting solutions, you have to make a choice based on facts in which the costs and benefits are measured.
Keep the core problem in mind when working on different problems	Solely working on the core problem may be too big of a challenge. So, it is good to work on the consequences of the core problem. However, it is important to always keep in mind the core problem. If a stakeholder does so, he/she is doing well.
Legal solutions	
Increase the capacity of municipalities	Municipalities should get more capacity. Currently, they mostly approach their work from a legal or political point of view and there is too little knowledge and expertise at municipalities to explore certain matters in depth. This results in municipalities following the letter of the law, rather than the thought behind it. To change this, more capacity is needed.
Simplify the licensing system	The licensing system is too complicated and should, simply put, be simplified. This is a task for the government. There could be resistance in the beginning, because a system change is difficult. Though in the long term, everyone will benefit. Thus, that is something that should be communicated well to opponents of this change.
Strive for a more holistic approach (“integraliteit”) at the government	The province and municipalities should be guided from the top to create a more integrated approach. The province itself could be against this because they think a holistic approach is complicated. This can be overcome by creating a ‘consultancy experience’ in the government.
Connect to the right advisors	It is valuable for landowners to be connected with the right advisors that are also trusted by the government. Thus, there should be a permanent team of governmental organisations and external advisors that collaborate. This prevents that for each new question the right people need to be gathered.
Allow pilot projects outside of the law	In some cases, it can be good to allow certain pilots, even when the law prohibits it. This way, stakeholders can experiment with new solutions. People who fail to have a pilot approved may be against this, as they also want an exception status. To prevent this, a food system should be designed that coordinates this.
Substantiate restrictions	There is a big difference in knowledge and expertise between different stakeholders. The longer someone is involved in a project, the more he/she knows, though someone new knows less. The government should therefore better substantiate why certain restrictions exist to clarify this for everyone. The substantiation should be made by the province or municipalities.
Land pool (“grondpool”)	A ‘land pool’ should be developed, which is a kind of land exchange system with a broad area vision. Purchased land can then be redistributed based on this vision. In addition, the area vision should be leading, and things should not ‘secretly’ be carried out if it does not match the vision. The government is responsible for managing this properly. There could be a lot of resistance to this from, for example, stakeholders who are forced to relocate. To get them on board, the benefits should be shared and these stakeholders should be offered a perspective/alternative.
Offer perspective	All changes are scary unless it creates something positively. Thus, this should be shown. Therefore, the government should offer more perspective about, for example, different business models, changes or what good things it produces.
Better substantiate why stakeholders believe a project should proceed	If a stakeholder substantiates well why a certain pilot/experiment should be carried out, then this is possible. However, the stakeholder is thus responsible to offer sufficient substantiation.
Don’t move functions, but adapt them	It is difficult to replace a function. So, to still solve issues in an area, the government can try to adapt functions. For example, change intensive farming to extensive farming.

Appendix 12: Ranking of different solutions during two workshops

Figure 24: All solutions proposed during the first workshop ranked on their perceived level of impact

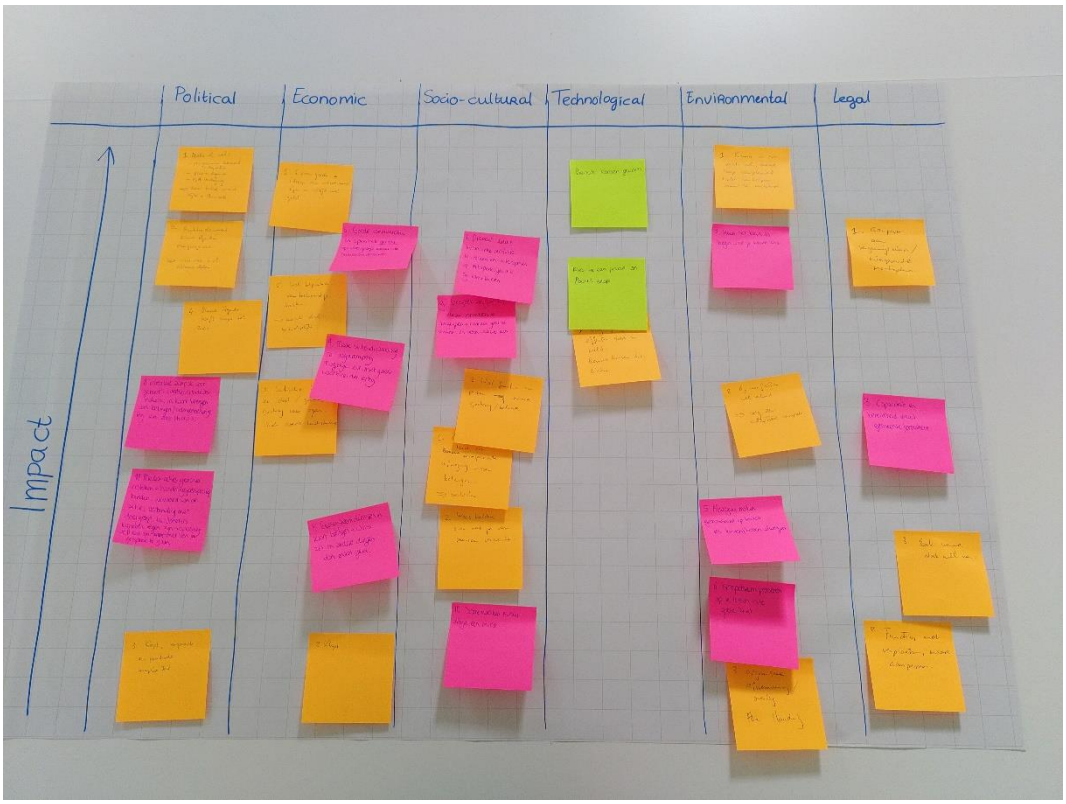


Figure 25: All solutions proposed during the second workshop ranked on their perceived level of impact

Appendix 13: Different levels of power and interest

Table 14: The number of interviewees that disagreed with the power and/or interest level of a certain stakeholder as was shown in the power-interest matrix

Stakeholder	Number of interviewees saying that there is a different power level	Number of interviewees saying that there is a different interest level
National Park de Utrechtse Heuvelrug		
Dutch government (Rijk)		
Rijkswaterstaat	1x higher power	
The Province of Utrecht		
Municipalities		
Water boards		
Vitens		
Veiligheidsregio Utrecht (VRU)		
Staatsbosbeheer	2x lower power	
Utrechts Landschap	2x lower power	
Natuurmonumenten	2x lower power	
Natuur en Milieufederatie Utrecht (NMU)		
Stichting Kastelen, Buitenplaatsen, Landgoederen (sKBL)		
Utrechts Particulier Grondbezit (UPG)	5x higher power	2x higher interest
Private landowners	1x lower power	6x higher interest
Local citizens	3x higher power	3x higher interest
Civilian initiatives	1x higher power	3x higher interest
Entrepreneurs / businesses	1x higher power	2x higher interest
Farmers	7x lower power	2x lower interest
LTO	7x higher power	1x lower interest
IVN Natuureducatie		1x higher interest
Knowledge and education institutes		1x lower interest

Table 15: The beliefs of stakeholders relating their own level of power and interest. If a "X" is placed in the second column, this means that the stakeholder put himself in the same quadrant as is shown in Figure 12. If a "-" is placed, this means that there are no interview data about this stakeholder available. If in the column "power level" or "interest level" the word "less" or "more" is placed, this means that this stakeholder believed himself to have less/more power and/or interest. As four private landowners were interviewed, (1/4) and (4/4) is written down to show how many of the private landowners believed to have more/less power and/or interest.

Stakeholder	Same place	Power level	Interest level
National Park de Utrechtse Heuvelrug	X		
Dutch government (Rijk)	X		
Rijkswaterstaat	-	-	-
The Province of Utrecht	X		
Municipalities	X		
Water boards	X		
Vitens	X		
Veiligheidsregio Utrecht (VRU)	X		
Staatsbosbeheer		Less	
Utrechts Landschap	X		
Natuurmonumenten		Less	
Natuur en Milieufederatie Utrecht (NMU)	X		
Stichting Kastelen, Buitenplaatsen, Landgoederen (sKBL)		More	
Utrechts Particulier Grondbezit (UPG)		More	More
Private landowners		Less (1/4)	More (4/4)
Local citizens	-	-	-
Civilian initiatives	-	-	-
Entrepreneurs / businesses	-	-	-
Farmers	-	-	-
LTO		More	
IVN Natuureducatie			More
Knowledge and education institutes	-	-	-