Landowners Facing Water Problems on the Utrechtse Heuvelrug

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Group 12:

Celine Klooster (2906406)	Sustainable Development - International Development
Hanae ben Allal (1016830)	Sustainable Development - International Development
Katharina Mono (1480073)	Sustainable Development - International Development
Pia Winckler (5450233)	Sustainable Development - Environmental Change and Ecosystems
Tim Elderman (3610403)	Sustainable Development - Environmental Change and Ecosystems
Maxim Boven (6272215)	Sustainable Development - Earth System Governance

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Nationaal Park Utrechtse Heuvelrug (NPUH)

Coach

Dr. Joost Vervoort

Course Coordinator

Dr. Paul Schot

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Executive summary (English)

The national park Utrechtse Heuvelrug (NPUH), its ecosystem and landowners are subject to the negative effects of water stresses, such as water scarcity, droughts, and floods. However, there is a lack of research on how landowners perceive to be included in adaptation practices to water challenges, how research conveys ecosystem services (ES), possible financing options to combat water stress and what the Stichting Nationaal Park Utrechtse Heuvelrug (SNPUH) can do to support landowners. Therefore, this research aimed at answering the following main research question: "How can the SNPUH better support different types of landowners in overcoming the problems they face in their work to maintain the quality of both nature and cultural heritage with a focus on water-related issues?"

To answer this research question systematic literature reviews and in-depth semi-structured interviews with stakeholders and experts were conducted. To answer the research question we evaluated the current water situation in the NPUH and the water-problems that landowners of the Utrechtse Heuvelrug (UH) experience. Furthermore, it was identified how far the SNPUH's ES research is developed, and what adaptation practices for the water problems and the limitations landowners face. It further examined the inclusiveness of adaptation practices for the water problems these landowners face. Moreover, financing options surrounding ES were examined. Lastly, what role the SNPUH can play in supporting landowners facing these water problems was discussed.

This resulted in important results that aided in answering the main research question. Eight different water problems in the UH were identified: groundwater availability, water infiltration, lack of precipitation, biodiversity and cultural heritage from vegetation, wildfire protection, water availability for agriculture, clean water availability, and depleting groundwater levels for cultural heritages.

Moreover, five main adaptation practices were identified. Firstly, regreening roofs, sand paths, roads and the citizen-initiative Heuvelrugtuinen. Secondly, the detachment of rainwater from the sewage system. Thirdly, digging ditches so excess water can flow to these ditches. Fourthly, planting and restoring native trees in the UH by planting small plants and shrubs under the trees. And lastly, the creation of food forests to fight drought that is currently happening in the agricultural sector. Three limitations were also identified: willingness, encouragement, and lack of collaboration.

In the UH multiple institutions engaging in knowledge provision, information sharing, educational workshops and conversations aiming to be inclusive were found. However, not all landowners feel represented in these processes. They perceive a power imbalance between different landowners, depending on resources (land, money, expertise, networks) available, causing differences in decision-making abilities and partaking in adaptation practices. Many landowners perceive lacking communication and cooperation whilst some institutions perceive this to be inclusive and successful. Thus, there are differences in

perception of landowners on how inclusive and equal current processes are. If however, one landowner does not feel included in processes, one cannot speak of inclusive practices.

ES are generally free and could be disappearing due to ecosystem degradation that is caused by water problems. Therefore, the SNPUH should identify which ES are present, estimate their quantity and quality, and who the ES beneficiaries are. The SNPUH has done so partially, but needs to further develop research. Only one ES has been adequately researched. Multiple cultural ES, provisioning ES and regulating ES have not been researched, or not researched adequately. Payments for ecosystem services (PES) are more likely to have success if these are better researched.

Landowners were in many cases not implementing financial models on their estate to finance their adaptation practices. For most landowners there was a general lack of knowledge on the availability of options and some landowners stated they had no desire to further financially exploit their estate. The landowners indicated about the SNPUH`s role that they should take the lead in undertaking actions on the UH, spread knowledge, enhance communication, function as a linking point for discussions and connect the landowners.

To conclude, this research has six recommendations for the SNPUH: (1) improve inclusion of different landowners, (2) appreciate and value all individual landowners, (3) improve awareness of water issues, financial options, and what the SNPUH can do, (4) transfer knowledge by developing programs and sharing ideas on how landowners can address their water problems, (5) further develop research on the ES of the UH, and (6) lobby more for ES to increase subsidy availability for payment for ES. Lastly, it needs to be remembered that four limitations were encountered: social desirability bias, language barrier, time frame, and conflicting information between different interviewees.

Samenvatting (Nederlands)

Het nationaal park Utrechtse Heuvelrug (NPUH), zijn ecosysteem en zijn grondeigenaren worden blootgesteld aan de negatieve effecten van waterstress, zoals waterschaarste, droogte en overstromingen. Er is echter een gebrek aan onderzoek naar hoe landeigenaren denken te worden betrokken bij aanpassingspraktijken aan wateruitdagingen, hoe onderzoek ecosysteemdiensten (ED) overbrengt, mogelijke financieringsopties om waterstress te bestrijden en wat de Stichting Nationaal Park Utrechtse Heuvelrug (SNPUH) kan doen om landeigenaren te ondersteunen. Daarom is dit onderzoek gericht op het beantwoorden van de volgende hoofdonderzoeksvraag: "Hoe kan de SNPUH verschillende typen grondeigenaren beter ondersteunen bij het oplossen van de problemen die zij ondervinden bij hun werk om de kwaliteit van zowel natuur als cultureel erfgoed te behouden, met een focus op watergerelateerde vraagstukken?".

Om deze onderzoeksvraag te beantwoorden is een systematisch literatuuronderzoek en zijn semi-gestructureerde interviews met belanghebbenden en deskundigen uitgevoerd. Om de onderzoeksvraag te beantwoorden zijn de huidige watersituatie in het NPUH en de waterproblemen die grondeigenaren van de Utrechtse Heuvelrug (UH) ervaren geëvalueerd. Verder is vastgesteld in hoeverre het onderzoek naar ES) van de SNPUH is ontwikkeld, en met welke aanpassingspraktijken voor de waterproblemen en de beperkingen landeigenaren worden geconfronteerd. Ook is gekeken naar de inclusiviteit van de aanpassingspraktijken voor de waterproblemen waarmee deze grondeigenaren worden geconfronteerd. Bovendien werden de financieringsmogelijkheden rond ED onderzocht. Ten slotte is besproken welke rol het SNPUH kan spelen bij de ondersteuning van grondeigenaren die met deze waterproblemen worden geconfronteerd.

Dit leverde belangrijke resultaten op die hielpen bij het beantwoorden van de hoofdvraag. Er werden acht verschillende waterproblemen in de UH geïdentificeerd: beschikbaarheid van grondwater, waterinfiltratie, gebrek aan neerslag, biodiversiteit en cultureel erfgoed door vegetatie, bescherming tegen bosbranden, beschikbaarheid van water voor de landbouw, beschikbaarheid van schoon water, en uitputting van het grondwaterpeil voor cultureel erfgoed.

Bovendien werden vijf belangrijke aanpassingspraktijken geïdentificeerd. Ten eerste het vergroenen van daken, zandpaden, wegen en het burgerinitiatief Heuvelrugtuinen. Ten tweede, het afkoppelen van regenwater van de riolering. Ten derde, het graven van sloten zodat overtollig water in deze sloten kan stromen. Ten vierde, het planten en herstellen van inheemse bomen in de UH door kleine planten en struiken onder de bomen te planten. En ten slotte, de aanleg van voedselbossen om de droogte te bestrijden die zich momenteel in de landbouwsector voordoet. Er werden ook drie beperkingen vastgesteld: bereidheid, aanmoediging en gebrek aan samenwerking.

In de UH zijn meerdere instellingen aangetroffen die zich bezighouden met kennisverstrekking, informatiedeling, educatieve workshops en gesprekken die gericht zijn op inclusie. Niet alle grondeigenaren voelen zich echter vertegenwoordigd in deze processen. Zij zien een machtsonevenwicht tussen de verschillende grondeigenaren, afhankelijk van de beschikbare middelen (grond, geld, deskundigheid, netwerken), wat leidt tot verschillen in besluitvormingscapaciteit en deelname aan aanpassingspraktijken. Veel grondeigenaren vinden dat het ontbreekt aan communicatie en samenwerking, terwijl sommige instellingen dit als inclusief en succesvol ervaren. Er zijn dus verschillen in de perceptie van grondeigenaren over hoe inclusief en gelijkwaardig de huidige processen zijn. Als een grondeigenaar zich echter niet bij de processen betrokken voelt, kan er geen sprake zijn van inclusieve praktijken.

De ES van de UH zijn over het algemeen gratis voor iedereen en zouden kunnen verdwijnen door aantasting van het ecosysteem als gevolg van waterproblemen. Daarom moet de SNPUH vaststellen welke ES aanwezig zijn, de kwantiteit en kwaliteit ervan ramen en nagaan wie de ES-begunstigden zijn. Het SNPUH heeft dit gedeeltelijk gedaan, maar moet het onderzoek verder ontwikkelen. Slechts één ES is voldoende onderzocht. Meerdere culturele ES, leverende ES en regulerende ES zijn niet of onvoldoende onderzocht. Betalingen voor ecosysteemdiensten hebben meer kans van slagen als deze beter worden onderzocht.

Landeigenaren implementeerden in veel gevallen geen financiële modellen op hun landgoed om hun aanpassingspraktijken te financieren. Bij de meeste grondeigenaren was er een algemeen gebrek aan kennis over de beschikbaarheid van opties en sommige grondeigenaren verklaarden dat zij geen zin hadden om hun landgoed verder financieel te exploiteren. De grondeigenaren gaven aan dat de SNPUH het voortouw moet nemen bij het ondernemen van acties op het gebied van de UH, kennis moet verspreiden, de communicatie moet verbeteren, als verbindingspunt voor discussies moet fungeren en de grondeigenaren met elkaar in contact moet brengen.

Concluderend heeft dit onderzoek zes aanbevelingen voor de SNPUH: (1) de integratie van verschillende landeigenaren verbeteren, (2) alle individuele landeigenaren waarderen en waarderen, (3) het bewustzijn van de waterproblemen, financiële opties en wat de SNPUH kan doen verbeteren, (4) kennis overdragen door programma's te ontwikkelen en ideeën te delen over hoe landeigenaren hun waterproblemen kunnen aanpakken, (5) onderzoek naar de ES van de UH verder ontwikkelen, en (6) meer lobbyen voor ES om de beschikbaarheid van subsidies voor betaling voor ES te vergroten. Ten slotte mag niet worden vergeten dat zich vier beperkingen voordeden: sociale wenselijkheidsbias, taalbarrière, tijdsbestek, en tegenstrijdige informatie tussen verschillende geïnterviewden.

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List of Abbreviations

Nationaal Park Utrechtse Heuvelrug	**NPUH**
Utrechtse Heuvelrug	**UH**
Stichting Nationaal Park Utrechtse Heuvelrug	**SNPUH**
Blue Agenda	**BA**
Ecosystem service(s)	**ES**
Payment for ecosystem services	**PES**
Utrechts Particulier Grondbezit	**UPG**

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1. Introduction

The National Park Utrechtse Heuvelrug (NPUH) is located in the province of Utrecht (Netherlands) and forms the largest connecting forest area of the whole 'Randstad'. The Utrechtse Heuvelrug (UH) consists of 20.000 hectares of contiguous forest and heathland and including the flanks, it consists of 40.000 hectares of natural landscapes including valuable wet natural ground. The southern part of the UH (around 10.000 hectares) has had the status of being a 'National Park' since 2003 (Nationaal Park Utrechtse Heuvelrug, 2022a).

Figure 1. Utrechtse Heuvelrug (Google Earth Pro, 2021).

Current droughts and floods in the UH are putting forests and heathlands under pressure (H+N+S Landschapsarchitecten, 2022). The Stichting Nationaal Park Utrechtse Heuvelrug (SNPUH) is a foundation aiming to "combine the strengths through collaboration between different stakeholders and thus ensure a healthy future for nature, landscape, and heritage on and around the Utrechtse Heuvelrug" (NPUH, 2022). At the initiative of the SNPUH, different parties involved at the SNPUH (the water board Hoogheemraadschap De Stichtse Rijnlanden, the water board Vallei en Veluwe, drinking water company Vitens, site managers, municipalities and the Province of Utrecht) have developed the Blue Agenda (BA). The BA entails agreements that were made to address problems caused by water shortages and flooding in and around the UH (Nationaal Park Utrechtse Heuvelrug, 2022b). The goal of the BA is to create a robust and future-ready water system. It consists of four main building blocks: to infiltrate more water, to retain water for a longer period of time, to integrate water solutions, and to have cleaner water.

In literature, it becomes apparent that droughts and floods are increasingly affecting the natural areas of the park (H+N+S Landschapsarchitecten, 2022; Hydrologic, 2021). Both vegetation on the plateau and the high flanks are dependent on rainfall, and long-term lack of rain is already leading to drought problems on the plateau, which results in a decrease of biodiversity (H+N+S Landschapsarchitecten, 2022). Moreover, floods cause water problems in the lower-lying villages because the water cannot sink properly into the soil, since it is largely covered with stone, asphalt, and buildings (Gemeente Utrechtse Heuvelrug, 2022). Water also pushes upward from below in the lower lying parts of the area due to the gradient created by the higher groundwater levels in the ridge (Nationaal Park Utrechtse Heuvelrug, 2022b).

The UH as a natural reserve is not owned and governed by a single organisation, but consists of private landowners, municipalities and nature management organisations (National Park Utrechtse Heuvelrug, 2022), all with different capabilities, knowledge and ways they perceive what needs to be done. Private landowners can be further categorised in two distinct types: small landowners and organisational landowners, from individual landowners to a cultural and historic estate employing dozens of people. Inaction of one stakeholder can worsen the water issues for the surrounding areas. Therefore, it is of importance that all stakeholders act to collectively address the water issues on the UH.

The SNPUH, being a landless organisation, wishes to better support the different landowners in facilitating adaptation practices against water stresses to maintain its nature, landscape, and cultural heritage. The term ‘supporting’ in this research is understood as providing assistance to the landowners in deciding on how to manage their land in a sustainable manner and how to go about it in detail. This can occur for example through financial support, facilitating collaborations between relevant stakeholders around a specific topic, management aid, and sharing knowledge. Through multiple subquestions, this main research question will be answered using literature reviews, expert interviews and stakeholder interviews.

The landowners in this research are divided into three categories: private landowners, nature management organisations (Staatsbosbeheer, Utrechts Landschap, Natuurmonumenten), and the government (municipalities and Rijkswaterstaat). Adaptation is crucial in decreasing exposure and vulnerability to climate change and can occur within ecological and human systems. It does not need to be facilitated through human intervention, ecological systems and species adapt to changes in the climate too, e.g. as plants blooming earlier in the year due to sooner spring temperatures. The focus in this research, however, lies solely on the options humans have to adapt to changes in the UH. So when referring to adaptation, this means “the process of adjustment to actual or expected climate and its effects [...] to moderate harm or take advantage of beneficial opportunities" (IPCC, 2022, p. 5).

1.1 Problem description

The national park and its ecosystem are subject to the negative effects of water stresses, such as water scarcity, droughts and floods. According to the United Nations (2022) water scarcity is considered to be a relative concept: “the amount of water that can be physically accessed varies as supply and demand changes”. Water scarcity intensifies as demand increases and/or as water supply is affected by decreasing quantity or quality. Whilst according to Wanders (2022) a drought is an extreme hydrological event and climate change is affecting its occurrences. A drought is defined by water availability being below normal for an extensive amount of time. Originally, droughts are a natural phenomena, namely deviations in weather patterns that are naturally occurring. For our analysis, the concept of hydrological drought which refers to overall reduced water in the system which can be seen in low river water levels or groundwater levels is important (van Loon, 2015). This can be caused or further influenced by lacking precipitation, water loss through evaporation due to heat and low soil moisture. It is crucial to note that nowadays humans are using water unsustainably, which is officially called water scarcity and droughts come on top of these events. A social ecological drought is impacted by humans, more specifically when groundwater is exploited or mismanaged (Wanders, 2022). Anthropogenic droughts can thus be understood as a “combination of natural water variability, climate change, human decisions and activities, and altered microclimate conditions due to changes in land and water management” (AghaKouchak et al., 2021, p. 1). Floods can be defined as “an overflow of a large amount of water beyond its normal limits, especially over what is normally dry land” (Oxford Languages, 2022). It can be distinguished between coastal, pluvial, fluvial, flash and groundwater floods (HKV, 2022). These droughts and floods affect both the natural and cultural heritage of the national park.

Natural and cultural heritage are considered as “irreplaceable sources of life and inspiration” and the protection and preservation of it worldwide is of outstanding value to humanity and world heritage belongs to all humankind (UNESCO, 2022). The convention concerning the protection of the world cultural and natural heritage by UNESCO (1972) defined cultural and natural heritage. Cultural heritage is divided into three aspects namely monuments, groups of buildings, and sites. More specifically monuments, are “architectural works, works of monumental sculpture and painting, elements or structures of an archaeological nature, inscriptions, cave dwellings and combinations of features, which are of outstanding universal value from the point of view of history, art or science” (UNESCO, 1972). Moreover, groups of buildings, defined as “groups of separate or connected buildings which, because of their architecture, their homogeneity or their place in the landscape, are of outstanding universal value from the point of view of history, art or science”, whilst sites are defined as “works of man or the combined works of nature and man, and areas including archaeological sites which are of outstanding universal value from the historical,

aesthetic, ethnological or anthropological point of view" (UNESCO, 1972). Natural heritage can be divided into natural features, geological and physiographic formations and natural sites. More specifically, natural features consist of "physical and biological formations or groups of such formations, which are of outstanding universal value from the aesthetic or scientific point of view" (UNESCO, 1972). Geological and physiographical formations and precisely delineated areas "constitute the habitat of threatened species of animals and plants of outstanding universal value from the point of view of science or conservation" (UNESCO, 1972). Lastly, "natural sites or precisely delineated natural areas of outstanding universal value from the point of view of science, conservation of natural beauty" (UNESCO, 1972).

Moreover, hydrological stresses are exacerbated by climate change and can therefore be expected to increase in the future (H+N+S Landschapsarchitecten, 2022). This would have serious environmental, social, and ecological consequences. Over the past years, the available subsidies to address the issues of the national park from the Dutch government has been declining as the central authorities decrease direct involvement in the maintenance of the heritage of these lands (Vijn & Borgstein, 2015). This results in challenges for the landowners in the area, as they need new financial avenues to address the increasing water stresses. If landowners are to improve their situation in the face of water stress on the land, the specific problems as well as support and adaptation options need to be clearly identified and matched to the SNPUH's capacities.

1.2 Knowledge gap

Research about water-related problems of landowners, and possible adaptation strategies targeted towards preserving ES in the UH exists. However, there is a lack of research on how landowners perceive to be included in adaptation practices to water challenges, What possible financing options exist to combat water stress. What research has already been conducted by the SNPUH 'Kennisbank' about which ecosystem services are present, what their significance is and who profits. Furthermore, what should be researched by the SNPUH to enhance chances of success for payment for ecosystem services. And, finally. what the SNPUH can do to support landowners.

1.3 Relevance of problem for the client

The SNPUH focuses on how to best support the different landowners in the UH in relation to climate adaptation to water problems resulting partly from climate change with the purpose of ensuring a sustainable future for nature, landscapes and cultural heritage (Nationaal Park Utrechtse Heuvelrug, 2022). Therefore, it is crucial for the SNPUH to understand the details of existing problems. The goal of the SNPUH is to improve collaboration, yet landowners are the stakeholders who are responsible for the

maintenance of their land and are the stakeholders who need to be empowered to implement adaptations. Therefore, it is essential for the SNPUH to specifically identify the perspective of the landowners. Furthermore, having a good overview of possible adaptation strategies to water-related effects of climate change, information distribution strategies targeted to stakeholders, support strategies for existing collaborative measures and financing strategies, are essential for the SNPUH to support the landowners adequately. Gaining this knowledge will therefore aid the SNPUH to achieve its goal of improving collaboration between all stakeholders in maintaining the natural systems on their lands.

Moreover, to achieve sustainable development, from which the conservation of ES is ensured, adaptations (i.e. both in human and ecological systems) are required. An important example of an adaptation is implementing a more robust water system in and around the UH through the BA. An important part of the BA is to create awareness among residents and stakeholders about the necessity and possibilities to use water in a smarter way (Nationaal Park Utrechtse Heuvelrug, 2022). Thus, engaging in participatory research with the landowners, may contribute to greater knowledge and awareness among the interviewed landowners as well as contributing to existing literature, aiding the SNPUH to achieve the goals of the BA.

Lastly, according to the SNPUH, there is a large financial deficit per hectare in climate adaptation action. Thus, it is already evident that to achieve any maintenance or adaptation to combat the water issues in the area, more financing is needed. This research will explore how to achieve this, either by engaging not yet included stakeholders that benefit from the UH's ES, or through alternative ways for landowners to finance the maintenance of their lands. By addressing the financial need of landowners, the SNPUH can collaborate better with their stakeholders to combat water issues.

1.4 Research questions

Central research question:

How can the SNPUH better support different types of landowners in overcoming the problems they face in their work to maintain the quality of both nature and cultural heritage with a focus on water-related issues?

Sub Questions:

1. What water-related problems do landowners face with increasing droughts and floods concerning ecosystem services in the Utrechtse Heuvelrug?
2. What adaptation practices (both bottom-up and top-down) are in place allowing landowners to better maintain both natural and cultural heritage in an area influenced by water issues?
3. How do landowners perceive to be included in adaptation practices to water challenges they experience, in the Utrechtse Heuvelrug?

4. How far is the SNPUH's 'kennisbank' research in identifying the significance of ecosystem services of the UH as well as in identifying who profits from them?
5. What are possible options for financing ecosystem services which can support landowners to combat water stress?
6. What role can the SNPUH take in supporting landowners in their practices to combat water-related problems?

2. Theoretical framework

In the following paragraphs the relevant theoretical backgrounds will be presented. To analyse the water related problems (SQ1) and the role of the SNPUH (SQ6) no theoretical framework is necessary. The water problems will be a summary of findings from previous research on the topic and the organisation's role will be defined from statements of the SNPUH and their representatives in the results section.

2.1 Adaptation Practices to Water Problems

"In its broadest sense, adaptation means 'modification' or 'fitting to suit'. In the context of climate change, adaptation is taken here to mean the task of modifying ecological and social systems to accommodate climate change and accelerated sea-level rise so that these systems can persist over time" (Barnett, 2001, p.7). Consequently, we should not only look at the ecological changes happening in the landscape, but also include social systems in adaptation practices. Shifts have occurred in these adaptation practices, mostly from a technocratic to an integral and participative perspective (Van den Brugge et al., 2005). In this transition not only bottom-up, but also top-down adaptation practices are included.

2.1.1 Top-down adaptation practices

On one hand in the top-down approach the decision-making process occurs at the highest level, for instance by governmental organisations and is generally constructed by downscaling climate projections under a range of emissions scenarios to estimate potential impacts and to analyse adaptation measures (Caballero et al., 2007; Dessai et al., 2005; Sperna-Weiland et al., 2012; Milano et al., 2012). Subsidies for climate adaptation strategies can be seen as a top-down adaptation practice to support landowners to adapt to the water problems they face (Hoogheemraadschap de Stichtse Rijnlanden, n.d. The water boards in the UH support initiatives that contribute to increase water awareness and sustainable water management (Hoogheemraadschap de Stichtse Rijnlanden, n.d.). An example of such a subsidy is the regional water and soil partnership subsidy scheme (Subsidieregeling Regionaal Partnerschap voor Water en Bodem), which focuses on water quality and soil conditions, or the Impulse Regulation for Climate Adaptation

(Impulsregeling Klimaatadaptatie) which focuses on decreasing floodings, droughts and inundation (van Baar et al., 2021).

In the literature, the top-down approaches by the government are quite scarce and the approaches that are examined are mostly researched by means of policy documents. Subquestion 2 will therefore add to this existing research by means of interviews with experts and governmental organisations.

2.1.2 Bottom-up adaptation practices

On the other hand in a bottom-up approach, local responses and participatory practices are being studied to define locally suitable adaptation strategies (Bhave et al., 2014; Gerrits et al., 2022; Girard et al., 2015; Pulido-Velazquez et al., 2022). Unlike the top-down approach, the bottom-up approach relies on possibilities defined by local stakeholders instead of probabilities defined by governmental organisations (Blöschl et al., 2013). Adaptation practices by means of a participatory approach and implemented by local people, for instance, the landowners of UH, are examples of a bottom-up approach. A useful adaptation measure to fight drought is infiltration of rainwater (Warmerdam et al., 2022). Also, the implementation of buffer zones were deemed to be promising to store excess water during wet periods and to provide water during drier periods (Warmerdam et al., 2022).

In the literature, only the aforementioned bottom-up approaches are deemed useful by stakeholders. Other adaptation approaches provided by documents, vegetation that matches the groundwater situation and sprinkling methods, are not regarded as useful by stakeholders. Thus, it is important for subquestion 2 to examine more of these bottom-up approaches and to provide a clear overview of bottom-up approaches available to fight the water problems landowners face.

2.2 Inclusion and power dynamics

Next to examining top-down and bottom-up approaches it is crucial to evaluate how landowners are included in processes and the power dynamics that underlie this inclusion. According to representatives of the SNPUH, they are interested in bringing all stakeholders together since their environmental management strategies and adaptation practices are issues reaching across properties. Therefore, if the goal is to make the UH climate-adapted, all landowners must be involved. This is also underlined by the fact all landowners have the decision-making power on their land. Further, in their literature overview on environmental management practices, Reed (2008) concludes that stakeholders bring a lot of important knowledge about their land to the table. Cortés-Capano et al. (2020) have shown that conservation goals in cultural landscapes need to account for existing local environmental stewardship regarding conservation to

enable meaningful action. From this research it can be concluded that including the landowners as stakeholders in the UH is important in actions on water-related problems.

2.2.1 Inclusion and Participation

Inclusion will be assessed by the extent that landowners can participate in problem solving and adaptation practices**.** We follow Few's et al. (2011, p.3) definition of participation as "securing the active involvement of a broad range of stakeholders in decision-making and action". According to Reed (2008) the complex and dynamic nature of environmental problems asks for transparent decision making embracing diverse knowledge and values. Stakeholder participation in climate adaptation practice is overall crucial for successful outcomes (Few et al., 2011). More specifically, if participation only means consultation, and not active involvement in decision making processes, it is not deemed to be meaningful participation (Few et al., 2011). Participation should be characterised by "empowerment, equity, trust and learning" (Reed, 2008, p.1) and to assess whether these aspects are being met, the landowners' own perception on being included must be explored.

2.2.2 Financial Inclusion

There are many facets of inclusion, but contextually one important dimension of inclusion are financial capabilities (Ozili, 2020). Being able to finance adaptation practices is not necessarily equal for all stakeholders, potentially excluding some from implementing solutions. Financial inclusion is defined as "ease of access to, and the availability of, basic financial services to all members of the population" (Ozili, 2020, p. 1). Since according to a representative of the Nationaal Park Utrechtse Heuvelrug (2022) financing adaptation practices appears as a relevant issue of the landowners, it is crucial to not only discuss inclusion but more specifically discuss the financial inclusion of landowners in the UH.

2.2.3 Power Influence

Farr (2017) explores power and participation in co-production and co-design processes which enables collaboration between different stakeholders. Power dynamics always play a role and need to be constantly reflected upon to facilitate equality and therefore also participation. Ruijtenberg (2022) mapped those stakeholders in the Heuvelrug that are involved in implementing climate adaptations, depending on their level of interest as well as their power (Figure 2). Previous research identified that social actors possess different means and access to participating in decision making processes and that pre-existing power differences influence the decision making processes and outcomes (Bloomfield et al., 2001; Hillier, 2003). The differences in power may stem from "hierarchical structures, social inequalities and service users'

dependence on organisational services" (Farr, 2017, p. 640). Power is here understood as "the ability of individuals or groups to persuade, induce or coerce others into following certain courses of action" (Johnson et al., 2008, p. 160) following Ruijtenberg's conception (2022). This will be used to compare stakeholders' participation and perceived inclusion and their contextual position in the matrix. If these power relations or other factors lead to stakeholders feeling excluded in adaptation practices this is relevant knowledge for the NPUH and could enable them to increase equity and facilitate participation of all landowners.

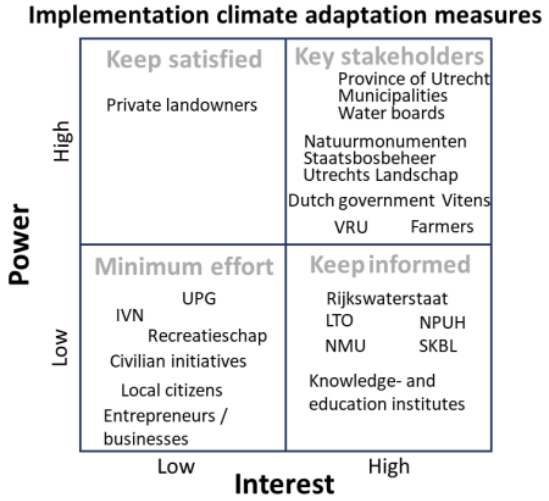

Figure 2. Power-interest matrix showing the relative power and interest of the stakeholders working on climate adaptation at the Utrechtse Heuvelrug (Ruijtenberg, 2022, p. 28).

This subquestion aims to contribute to answering the main research question, by assessing the landowner's perspective on being included and participating in the process of developing and implementing adaptations. Therefore, this can inform the SNPUH's actions on the solving of water-related problems, specifically by focusing on the inclusion of all landowners in the process.

2.3 Ecosystem services

To connect governmental and financial aspects with the natural, a social-ecological context is required. To make that connection, we have chosen to go deeper into the concept of ecosystem services. To combat water problems and to finance them by the ones who are benefiting now, but could lose their benefits, it is crucial not only to identify the ES of the UH. But also evaluate the significance of their worth and who exactly is profiting from them. Overall, the concept of ES is a way to value and define processes of ecosystems that benefit the Earth, specifically the human sphere (Daily, 2008). The conceptualisation

was chosen in this research to enable a systematic exploration of the ecosystem and how it is impacted at the UH. Four types of ES can be differentiated, according to the millenium ecosystem assessment sponsored by the UN (Millennium Ecosystem Assessment, 2005). These are first 'provisioning services' which describe the supply of crucial things such as drinking water, building materials and food. Second, 'regulating services', are functions that affect, regulate or dampen events such as droughts, floods and the process of water purification. Third, 'cultural services' refer to more metaphysical benefits to humans such as inspiration from nature and recreation. Last, 'supporting services', relate to the most crucial processes such as photosynthesis and soil aggregation which provide oxygen and healthy, fertile ground. Humans may be able to shape their environment and adapt to the climate to a certain extent independently from these services through technological solutions, but are ultimately dependent on the ES for survival. The conceptualisation of ES enables recognition of the importance of ecosystem conservation as it fits into the language of western economics, specifically with the term "natural capital" (Daily, 2008). Climate change acts as a stressor on ecosystems by impacting single species but also systems as a whole and thus impairing their services (Mooney et al., 2009). Further, adaptations to climate change effects can on the one hand positively reinforce ecosystem functionings and services but on the other hand might impact them negatively if e.g. the protection of private property from floods leads to the fragmentation of the landscape (Verburg et al., 2012).

2.4 Financing options to support landowners

Besides the social and ecological perspective it is crucial to look at the issues at hand with a focus on finances. In the past decade, financial support from the central government towards national parks has been declining, resulting in a deficit for the national park of roughly 200 Euros per hectare (Provincie Utrecht & Gemeente Utrechtse Heuvelrug, 2021). Over the years, those who govern the areas of national parks have been forced to find new ways to finance the maintenance of their lands. Among those are the private landowners who hold much of the area that the NPUH covers.

Kamerbeek writes in his book "Ondernemen met natuur'' about 350 possible ways landowners could make money with their estate and its nature (Kamerbeek & Stichting Matrijs (Utrecht), 2015). Among them are some of the more obvious ways, such as implementing paid parking, or setting up products from the unique region, but these also go into more niche examples, such as educational tours, providing mental care through animals for the neurodivergent, or even natural burials. Kamerbeek (2015) argues that as much as nature is of all those who enjoy it, it is essential to create economic resiliency to maintain its status, as political changes may decrease the resources available to maintain it and climate change increases the environmental pressures which deteriorate it. Kamerbeek (2015) refers to it as the multifunctionality of

nature; the more economic uses nature has, its dependency on subsidies decreases. Additionally, it allows for landowners to not just their financial concerns, but a moral one: the decreased awareness of the necessity of nature conservation and the benefits it provides society.

3. Methods

3.1 Case study: Utrechtse Heuvelrug

This research focused on the UH (Figure 3). The UH consists of areas with an official status of natural park (dark green), nature area that is directly connected with the natural park (light green), total work area of SNPUH, on top of the green area (beige), water (blue) and urban area (light beige).

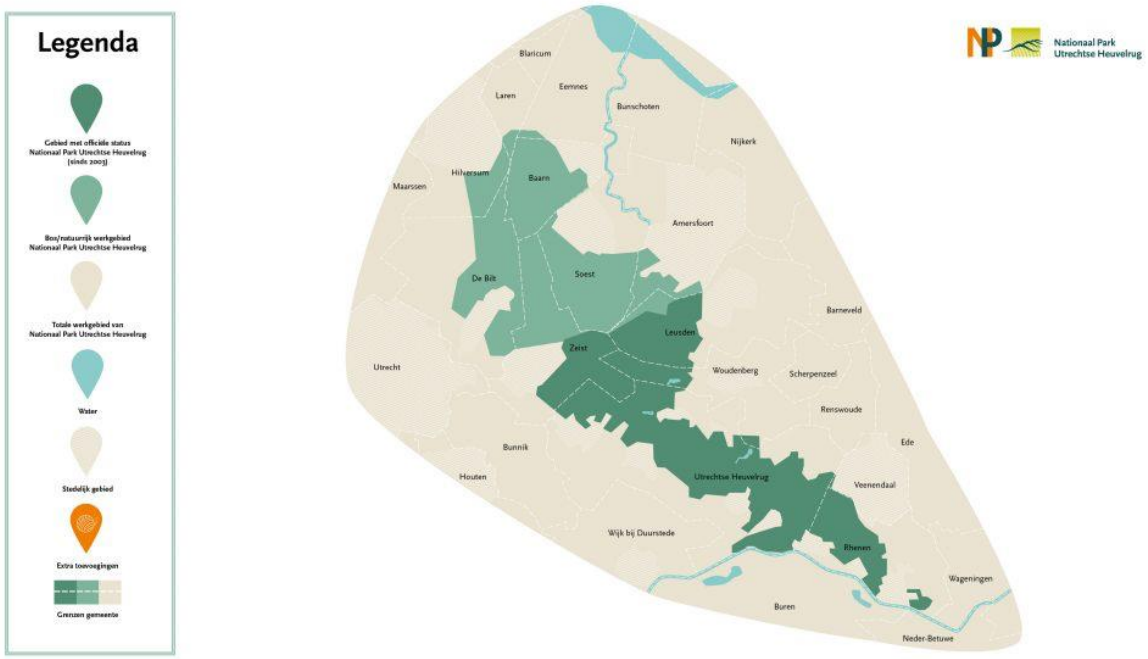

Figure 3. Map of Utrechtse Heuvelrug. Source: Nationaal Park Utrechtse Heuvelrug (2022c).

3.2 Systematic literature review

To examine what water problems the landowners faced, a systematic literature review was conducted for subquestions 1 and 4. For subquestion 1, the literature review looked at the current water situation in the NPUH and especially the water-problems that occurred for these landowners. Much literature research has already been done on these water-problems and we therefore analysed and structured

these water-problems to connect these to the landowners in the UH. Moreover, before being able to answer the remaining subquestions it was necessary to identify the water problems landowners face.

To conduct the water stress literature review, Google Scholar and 'Kennisbank' of SNPUH were used to identify research articles surrounding the topic. A list of keywords used for this literature review is provided in Table 1, including the search engine(s) and title(s) found with these keywords.

Table 1. Keywords used for literature review for subquestion 1.

Keywords	Search engine(s)	Author(s)
Utrechtse Heuvelrug grondwater	Google	H+N+S Landschapsarchitecten, 2022
Blauwe agenda	Google	Hydrologic BV & Acaciawater, 2020
Ecosystem services	Google Scholar	Lee & Diop, 2009
Wildfires Utrechtse Heuvelrug	Google	Lorier, 2019
Wildfires Utrechtse Heuvelrug	Google	Onderzoeksresultaten brand Deurnsche Peel, 2020

To evaluate how far SNPUH's research is developed in the area of ES, a second literature review was conducted for subquestion 4. For this purpose all published articles in the SNPUH's 'Kennisbank' were first scanned to see whether they include information on an ES. In a second step the publications mentioning them (see Appendix A) were used to attempt answering the six key questions developed by Kettunen et al. (2009), presented in the following Table 2.

Table 2. Questions that need to be answered to prove enough knowledge is available on ES (Kettunen et al., 2009), own representation.

1	Is the ES present on the UH?
2	Have qualitative aspects of the ES on the UH been described?
3	Have the amounts of benefits acquired from the ES of the UH been estimated?
4	Is it possible to translate the previous two into monetary value, if yes, has an estimate been given?
5	Have stakeholders and ES beneficiaries been identified?
6	Has a scenario analysis been carried out of what would happen due to the disappearance of the ES?

Only if all six questions for an ES are addressed in literature from 'Kennisbank' it is sufficiently researched. If this is so, it means all knowledge that is required to have the highest chance of success for payment of ecosystem services systems, is present.

3.3 In-depth semi-structured interviews

3.3.1 Sampling

In-depth semi-structured interviews were conducted to address the research aim of this research and specifically subquestions 2, 3, 5 and 6. Before conducting the interviews, a consent form was signed by the interviewee (Appendix 8.2). Stakeholders from various groups were interviewed about the problems they faced with increasing droughts and floods, what ES they used to ease their water management, the inclusion of landowners, the governance system, and support systems.

An interview guide was created to address the research aim of this research (Appendix 8.3, 8.4, 8.5). The interview guide contained general questions for all the participants and specific questions for the three groups that were interviewed: landowners, municipalities and nature management organisations. After the first interview, the interview questions were improved to account for misunderstandings that occurred during the first interview.

To answer subquestions two, three, five and six, in-depth semi-structured interviews with eleven different key stakeholders about water problems landowners faced and how the SNPUH could support them to solve these problems were conducted. For sub-question two, both experts and landowners were interviewed to ask about the adaptation practices that were in place to better maintain both natural and cultural heritage in an area influenced by water issues. For subquestion three, landowners and experts were interviewed to examine the inclusiveness of adaptation practices for the water problems landowners faced. For subquestion five, the financing options surrounding these ES were examined by means of expert- and landowner interviews. For subquestion six, both experts, landowners and the SNPUH were interviewed to examine the role SNPUH can play in supporting landowners who faced water problems.

The aim was to interview landowners, municipalities, and nature management organisations to examine the various problems landowners face and what solutions there were to solve these problems. A list of stakeholders that were interviewed is provided in Table 3. Contacts were provided by SNPUH and were contacted by means of e-mail. Data was collected from 28 September 2022 to 31 October 2022.

Table 3. List of interviewees.

Name organisation or estate
Gemeente Zeist
Gemeente Soest & Baarn
Gemeente Rhenen
Estate Kasteel Amerongen-Lievendaal
Estate Dartheuvel
Estate Roghairsparren
Estate Zuylestein
Bed and Breakfast Rodenberg
Utrechts Landschap
Waterschap Vallei en Veluwe
Nationaal Park Utrechtse Heuvelrug

3.3.2 Data collection

In-depth semi-structured interviews were conducted to address the research aim of this research. Before conducting the interviews, a consent form was signed by the interviewee (Appendix B). Landowners, nature management organisations and municipalities were interviewed about the problems they faced with increasing droughts and floods, what ES they used to ease their water management, the inclusion of landowners, the governance system and support systems.

An interview guide was created to address the research aim of this research. The interview guide contained general questions for all the participants and specific questions for the three groups that were interviewed: landowners (Appendix C) , municipalities (Appendix D) , and nature management organisations (Appendix E). The guide was iterated upon after the first interviews to target it more specifically to the interviewees.

3.3.3 Data analysis

After conducting the interviews, the interviews were analysed by adding comments to each part of the transcript. The interviews were transcribed with the software program Trint, which aided in transcribing the interviews.

Table 4. Overview of sub-questions with methods.

Subquestion	Method
Sub-question 1: What water-related problems do landowners face with increasing droughts and floods concerning ecosystem services in the Utrechtse Heuvelrug?	● Literature review
Sub-question 2: What adaptation practices (both bottom-up and top-down) are in place allowing landowners to better maintain both natural and cultural heritage in an area influenced by water issues?	● Expert interviews ● Landowner interviews
Sub-question 3: How do landowners perceive to be included in adaptation practices to water challenges they experience, in the Utrechtse Heuvelrug?	● Expert interviews ● Landowner interviews
Sub-question 4: How far is the SNPUH's 'kennisbank' research in identifying the significance of ecosystem services of the UH as well as in identifying who profits from them?	● Literature review
Sub-question 5: What are possible options for financing ecosystem services which can support landowners to combat water stress?	● Expert interviews ● Landowner interviews
Sub-question 6: What role can the SNPUH take in supporting landowners in their practices to combat water-related problems.	● Expert interviews ● Landowner interviews

3.4 Flow diagram

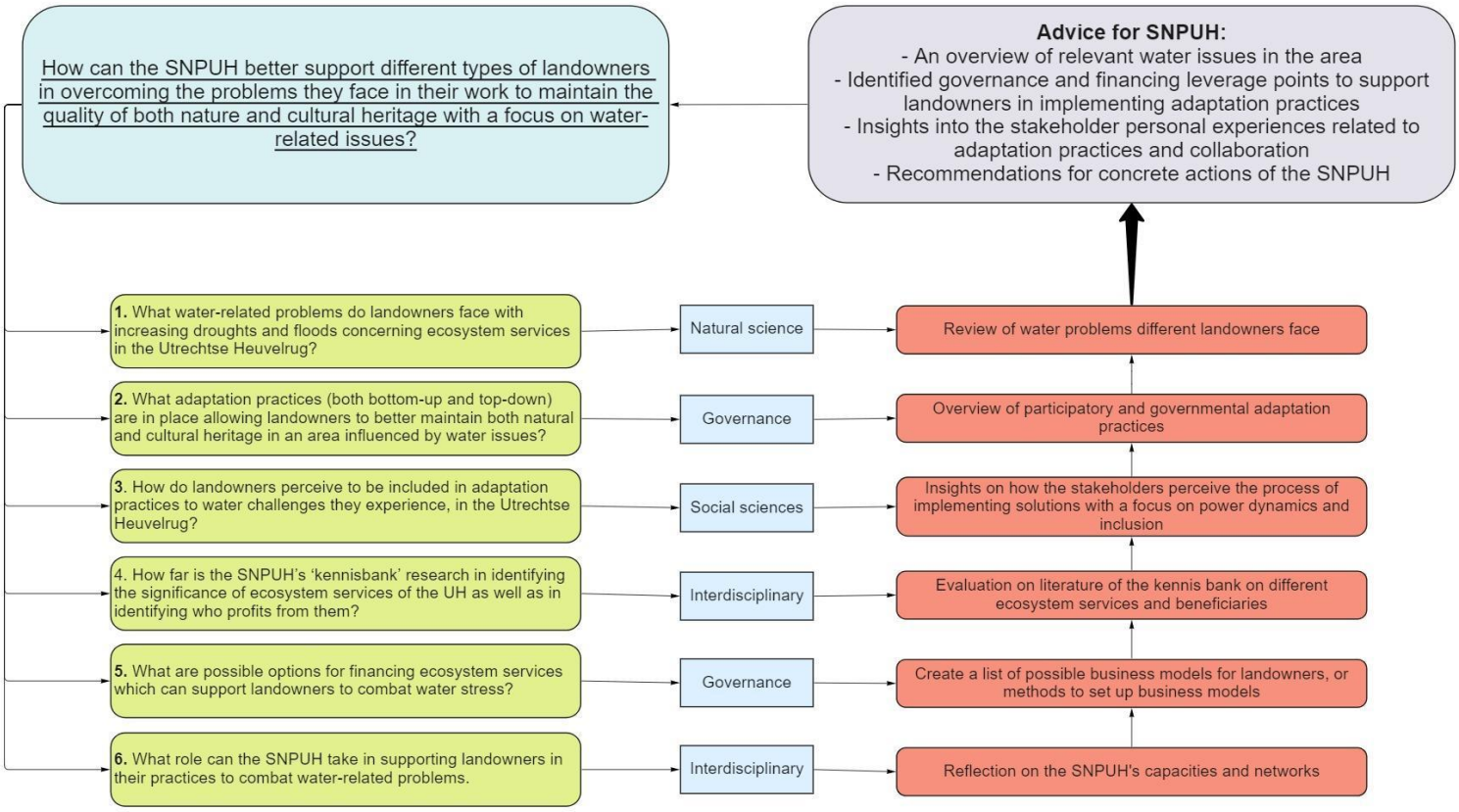

Figure 4. Set-up of this report.

The set-up of this report is illustrated in Figure 4. Subquestion 1 was addressed through a natural science approach to identify the water problems landowners faced. It has summarised previous research about the water problems different landowners faced. Subquestion 4 was addressed through an interdisciplinary perspective to examine how far developed the SNPUH's 'Kennisbank' is in conducting research on what the significance of the ES of UH's is as well as how far 'Kennisbank' is in answering who is benefitting from ES. This was done through a literature review of SNPUH's 'Kennisbank'. Subquestion 2, 3, 5, and 6 used semi-structured interviews to answer the questions. Subquestion 2 evaluated the various adaptation practices, both bottom-up and top-down, available to landowners, which were examined by means of a governance perspective. It gave an overview of the participatory and governmental adaptation practices. Subquestion 3 was addressed through a social science approach and tackled the question how landowners perceived to be included in adaptation practices. It gave insights into the perceived inclusiveness of landowners. Subquestion 5 was addressed through a governance perspective in order to

find out if landowners implemented financial exploitation of their lands and whether other landowners could learn. Subquestion 6 was addressed through an interdisciplinary approach and identified the role of the SNPUH and its capabilities. Finally, the answers to these questions were integrated and formulated into a well-defined set of recommendations.

3.5 End product

Our recommendations to the SNPUH are summarised in an infographic (see paragraph 5.6). In this infographic, the most important findings are shown, before presenting recommendations for the SNPUH on how to support the landowners in overcoming their water problems and simultaneously maintain the quality of both their cultural and natural heritage. This end product was already discussed with the client. For the client, the SNPUH, it was essential to have an easily accessible overview of the most important results and recommendations to send these to the stakeholders involved in and affected by the water problems.

4. Results

4.1 Water Problems in Utrechtse Heuvelrug

This paragraph aimed at answering the following subquestion: *What water-related problems do landowners face with increasing droughts and floods concerning ES in the Utrechtse Heuvelrug*? The UH has been impacted by extreme weather events in recent years (2018-2022) (KNMI, 2022). Summers have been warmer and drier than usual, and although in the same winters more precipitation has fallen, not enough precipitation has infiltrated to supply the groundwater stock (KNMI, 2022). Consequently, groundwater stocks have been in a net decline. (Hydrologics BV & Acaciawater, 2021). On the other hand, the net annual precipitation for the UH increased over the past years (2018-2021) (KNMI, 2022). To see the extent of their effect, different ES must be distinguished. The millennial assessment split the ES up into four broad categories: provisioning services (e.g. wood, fibre, etc.); regulating services (e.g. clean air, clean water, etc.); cultural services (education, recreation, etc.); and supporting services (e.g. water cycling, production). Supporting ES is the category of ES that is required to maintain ecosystems intact. Examples are photosynthesis and soil formation. Therefore, all other ES rely on the functioning of supporting ES. (Lee & Diop, 2009). Water problems lead to the degradation of ES because the required processes to maintain the ecosystem intact are affected by droughts. The ES, under which category they belong, the water problems and their causes are summarised in Table 4 at the end of this chapter.

Firstly, due to the geology of the land, water infiltration is an issue. From a geological perspective, UH is divided into three zones: the plateau, flank and foot (Figure 5). The plateau is the highest part of UH. Its soil is mainly sandy and is vegetated with a combination of coniferous and deciduous forests, mostly reliant on rainwater as groundwater levels lie 60 metres below ground level on some places of the plateau. This region faces mostly drought issues, as the soil has trouble holding rainwater for vegetation to use. The flanks have similar soil characteristics, nonetheless, precipitation disappears as run-off through ditches and streams, preventing water from infiltrating in the soil during heavy rainfalls. (Hydrologic BV & Acaciawater, 2021).

Secondly, soil infiltration of water is prevented by evapotranspiration that occurs through present vegetation. This leads to similar issues of drought and an inability to replenish the groundwater levels. The water that does infiltrate, does little to replenish the lowering groundwater, as it is used for freshwater supply of the province of Utrecht by Vitens, a drinking water company extracting more than a billion litre each year (H+N+S Landschapsarchitecten, 2022). More water needs to be extracted as urban populations rise, further depleting the groundwater levels, especially if climate change will continue to worsen (Rasifaghihi et al., 2020). Finally, the foot of the UH is close to groundwater levels, but most of this region is used for agriculture or urban purposes. These areas suffer from floods due to more extreme precipitation patterns in shorter time periods resulting from anthropogenic climate change. (Hydrologic BV & Acaciawater, 2021).

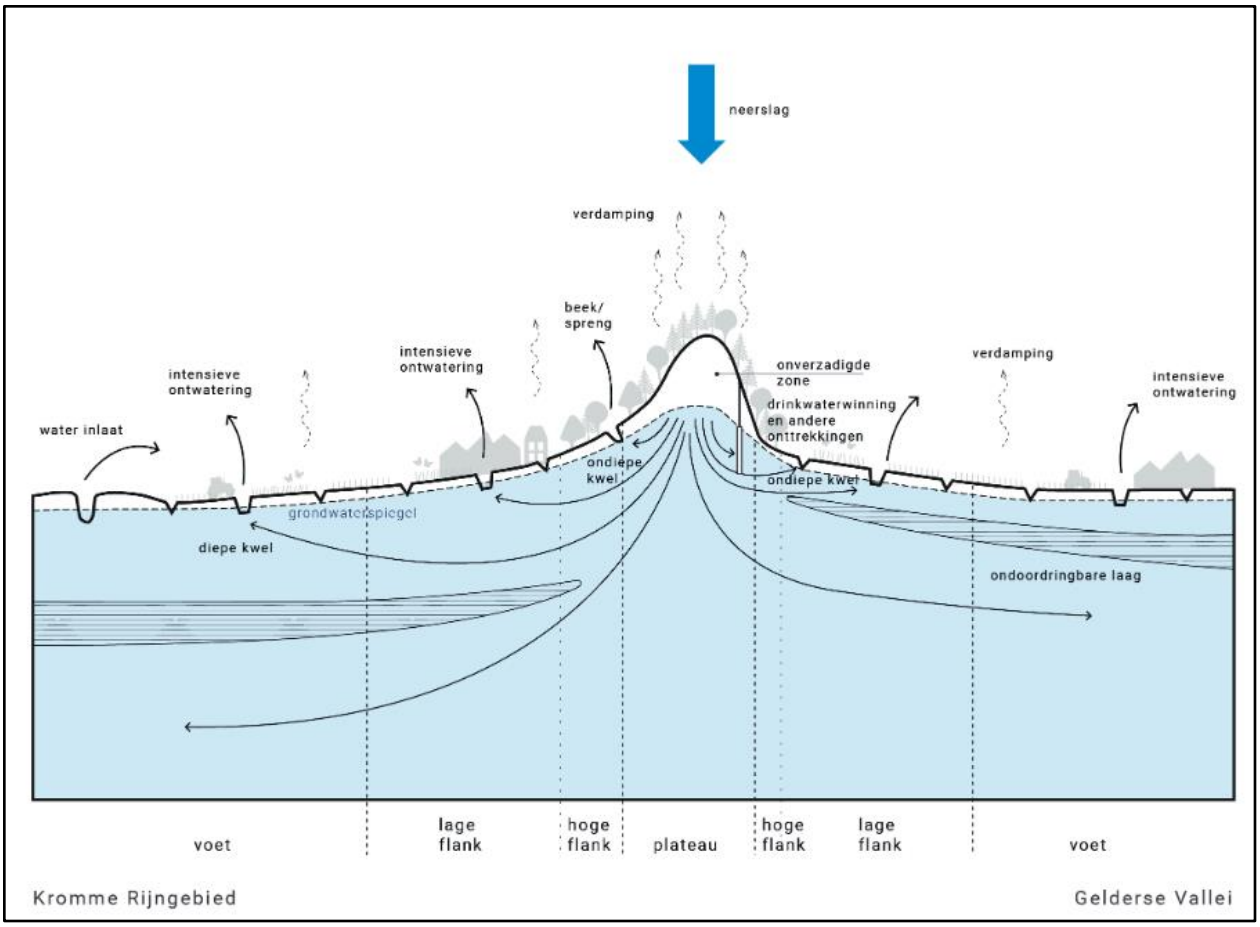

Figure 5. Side view of groundwater levels of the plateau, flanks and ground level of the Utrechtse Heuvelrug (H+N+S Landschapsarchitecten, 2022).

Thirdly, seasonal fluctuations in groundwater levels. During summer, there is little precipitation and high water evaporation, therefore groundwater levels are low in summer and droughts occur. In contrast, during autumn and winter, when there is more precipitation and less evaporation, groundwater levels are higher, and precipitation runs down the slope without infiltrating into the soil, leading to flood issues in urban areas at the foot of the UH (H+N+S Landschapsarchitecten, 2022; Hydrologics BV & Acaciawater, 2021).

Fourthly, due to the changes in both groundwater levels and precipitation patterns, flora of the UH is changing. Coniferous trees, which precipitate yearly more than deciduous trees (Camarero et al., 2017), are slowly dying off. This changes not only the iconic landscape of the UH and its cultural heritage, but also impacts the region's biodiversity of flora (Plicht, 2018). Many trees in the UH were manually planted and cared for, prompting trees to have shallow roots. Consequently, they predominantly rely on precipitation, which in summer months is less frequent, causing vegetation to die. Additionally, vegetation

in urban areas also deals with water shortage. As water becomes more scarce, municipalities forgo watering the vegetation, leading to possible die-off of vegetation in places that may need it the most (Plicht, 2018).

Fifthly, dead trees and other dried vegetation form a considerable risk for fires (Keating & Handmer, 2022). Based on vegetation moisture, temperature, wind and air humidity, Natuurbrandrisico confirmed in the summers of the past five years fire risk was at a level where landowners and nature organisations had to take precautions to limit the odds of wildfires occurring (Lorier, 2019). After a wildfire in Deurnsche Peel, it was noted that the UH does not have fire prevention as required by Natura 2000 guidelines (*Onderzoeksresultaten brand Deurnsche Peel*, 2020).

Sixthly, the waterbody located near the foot of the UH is used not only for nature, but also agriculture (H+N+S Landschapsarchitecten, 2022). Due to drought-related water shortages, agriculture struggles to get sufficient water to meet its demand and increases its uptake, leaving less for nature. Additionally, farmers try to supplement with river water. However, due to nitrogen pollution its quality is lower, since nitrogen pollution also seeps into the groundwater. This may cause issues when used for human consumption. (Hydrologic BV & Acaciawater, 2021).

Lastly, the water quality of the UH is declining. Acid rains as a result of nitrogen pollution and eutrophication of waterways as a result of manure impacting the groundwater. Additionally, artificial fertilisers, pesticides, and PFAS infiltrate the soil of agricultural lands and further pollute the groundwater (H+N+S Landschapsarchitecten, 2022).

Table 5. Overview of the water problems.

Ecosystem service	Ecosystem category	Water problem	Causes
Groundwater availability	Supporting	Lack of water infiltration to replenish groundwater	Water runs too fast to infiltrate down the slope, evapotranspiration of vegetation, and freshwater pumping for human consumption
Water infiltration	Supporting	Floods	During heavy rains, water running down the slope enter urban areas without the capacity to let it sink into the soil
Lack of precipitation	Supporting	Drought	Summers are warmer and rainfalls less frequent, leading to more water evaporating without being used by vegetation
Biodiversity and cultural heritage from vegetation	Provisioning, regulating, cultural	Death of vegetation	Lowering groundwater levels and drought
Wildfire protection	Regulating	Wildfires become more common	Dried up vegetation and low precipitation increase chances of wildfires occurring
Water availability for agriculture	Supporting	Demand exceeds availability	Lowering groundwater levels due to lack of

			infiltration and freshwater pumping for human consumption
Clean water availability	Provisioning	Water pollution	Nitrogen pollution causing acid rain,, manure runoff causing eutrophication, and chemical waste from PFAS, pesticides and fertiliser seeping into groundwater

4.2 Adaptation Practices For Landowners

This paragraph aims at answering the following subquestion: *What adaptation practices (both bottom-up and top-down) are in place allowing landowners to better maintain both natural and cultural heritage in an area influenced by water issues?*

4.2.1 Adaptation Measures

Both private landowners and municipalities mentioned a couple of adaptation measures to battle the water problems mentioned in sub question 1. The adaptation measures mentioned are both bottom-up and top down.

A first adaptation measure is regreening with four different options. First, a green roof, which works as a layer of vegetation planted over a waterproofing system on top of a roof. The green roofs have a layer of plant material that absorbs water like a sponge and when it rains, it captures this water and slowly releases it through evaporation and plant use. For instance, one municipality sometimes organises open days for such adaptation practices. For the green roofs, they organised a day when private landowners could gather free construction materials for green roofs. They say that this is a good way to encourage private landowners to implement certain adaptation practices. Second, for private landowners regreening the forest paths in the UH is important. Currently, these paths are made of sand, but these sand paths wash away with heavy rain. An alternative is therefore growing grass and other small plant species on the path to limit erosion. According to municipalities, a third option is regreening the area, especially roads and asphalt paths. These

regreened areas can infiltrate water into the soil, aiding in reducing flood risks in the area. The last option is the 'Heuvelrug tuinen', a piece of nature in citizens' gardens in order to regreen the neighbourhood of the UH.

Besides regreening, one top-down adaptation practise the municipalities mentioned is to use disconnection pipes to let rainwater flow into the soil, instead of the sewage system. The municipalities argue that detaching rainwater from the sewage system is an important adaptation to water problems. This assures that rainwater infiltrates the groundwater, avoids water nuisance in the sewage system and stores the water for drought periods. The landowners try to make this system less dependent on human actions, so the natural area can be self-dependent again. However, municipalities say that there is not always a possibility to infiltrate the water into the soil, since most land is covered with asphalt or stones.

A third adaptation option is implementing ditches. Municipalities and private landowners mentioned the use of ditches should be created in both urban and rural areas so excess water can flow to these ditches. Some landowners even argue that they should regreen these ditches, to create a biodiversity hotspot with native plants, but also to infiltrate water into the soil more easily. When municipalities and private landowners talk about biodiversity, they also refer to a fourth adaptation practice: planting and restoring native tree species in the UH and by planting small plants and shrubs under the trees. This adaptation practice ensures easier water infiltration into the soil and water availability for plants during droughts,

A fifth and last adaptation practice is a new way to agriculture. Municipalities and private landowners argue that in the Netherlands we should rethink our concept of agriculture by means of food forests. Landowners argue that currently in the Netherlands groundwater level is adjusted according to the threshold for agriculture. This has a negative effect on UH's nature, specifically the so-called *sprengen,* native pieces of nature. However, if the regional water authorities raise this water level, it will not only have negative effects on the productivity of farmers, but also on some of the newly built neighbourhoods in the UH. As one municipality mentions: *"if you go back to the groundwater levels from the seventies and earlier, there will be swamps. We don't want to live in a swamp."* Therefore, the landowners argue that there is a new way of sustainable farming: food forests. The food forests contain a diverse planting of edible plants to mimic ecosystems and patterns found in nature. Landowners perceive these food forests as a possibility to both fight droughts and floods by infiltrating and retaining water. Moreover, they also do not use any pesticides and insecticides, which improves biodiversity.

Table 6. Overview of adaptation measures.

Adaptation measures
Regreening: roofs, sand paths, roads, Heuvelrugtuinen
Detachment of rainwater from sewage system
Water ditches
Changes to the forest: new native plant species under trees and replacement of trees
Supplementary concept to agriculture: Food forests

4.2.2 Limitations to adaptation measures

Municipalities report that some private landowners are not willing to adapt to water problems. For instance, municipality Zeist said: *"Some people are like, well, climate change, this is a hoax, and I just need to park my car. So what are you saying, city council? I'll. I'll do my own thing"*. The landowners say that some other private landowners in the UH first need to experience the negative effects of climate change, before they believe it. They argue that the current water problems in the area are not major yet, but will have a significant effect on the whole area by 2050. Currently, the private landowners who should adapt to the water problems, have more important things on their minds. For instance, the current energy crisis in which private landowners invest their money since they directly experience the consequences, instead of on the water problems which are not experienced directly. Landowners argue that they try to tell other private landowners about the water problems and how this will get worse in the future, however, they argue that some of these private landowners will only believe it when they see it with their own eyes.

Moreover, private landowners say that they do not get encouraged enough to adapt to water problems. They argue that there are currently laws and regulations lacking to encourage landowners to adapt to water problems. An example is The Rainwater Regulation (Hemelwaterverordening), which requires landowners that rainwater is collected and processed on its own plot in newly built houses. Currently, when there is a new house built, people let the rainwater flow to the sewage system, instead of storing it on their land to use it during drought periods. Moreover, private landowners need resources and money to be able to adapt to water problems. Sometimes private landowners are given free construction materials, and although this is a great first step, this needs to be conducted on a larger scale.

Both municipalities and private landowners claim that adaptation practices are mostly limited to one area. Specifically, some landowners have the ability to execute adaptation practices. However, if these adaptation practices are only executed in one area, then this will not work for the whole area of the UH. The landowners, therefore, argue that there is a lack of collaboration between all the landowners. This is one of the roles of SNPUH, however, the landowners report that they are not aware of this. Moreover, the private landowners perceive that there is a lack of knowledge of these adaptation practices. Private landowners argue that they are not aware of any adaptation practices they can conduct and their land, especially because every land is unique and they need context-specific adaptation practices. This knowledge should be provided by the SNPUH, because they currently do not receive any knowledge and information about possible adaptation practices.

4.3 Inclusion

4.3.1. Existing Collaborations and Interactions

Municipalities report that currently institutions active in the UH attempt to include landowners through various actions, including information provision to local landowners (e.g. Heuvelrug Tuinen), local attempts to engage in conversation with landowners (private and institutions), water boards and the province about water problems. Moreover, surveys to gather opinions, information sharing and workshops are conducted. The Waterschap reports that educational programmes (e.g. “Knowledge programme climate robust estates") are provided to foster knowledge on actions landowners can take. Further, if new project ideas arise from the landowners, particularly private ones, the NPUH attempts to include private landowners in the process.

Besides this, there have been more attempts to include and cooperate to include especially private landowners in adaptation processes. Some municipalities aim to include people by investing money in specific neighbourhoods they feel have higher needs. Landowners receive subsidies for saving water in cooperation with water boards plans.

Despite these attempts, now the question arises, “How do landowners perceive to be included in adaptation practices to water challenges they experience, in the UH?”. This will be answered by looking at various aspects, namely land size, positionality, (lacking) collaboration, and financial resources influencing (power) differences between landowners.

4.3.2 Differences Between Landowners

Municipalities report differences in perception of problems and actions between private landowners, such as the perception of how pressing climate change is, with some landowners even denying its occurrence. Moreover, municipalities acknowledge that landowners have differing interests and thus want to make their own decisions and take action on their own.

A municipality recognised that the differences between sizes and lands between estates lead to perceived imbalances and a difference in representations in the Utrechts Particulier Grondbezit (UPG) and the UH. Private landowners state that people with bigger lands can create a greater impact. This is because large estates have organised further amongst themselves, creating a larger network and have direct contact to the province, which gives these landowners a different power position. Moreover, private landowners perceive land management organisations to possess a lot of land and political power. Besides this, private landowners experience that large private landowners are looking down on smaller landowners. A nature management organisation and private landowner report that small landowners may also require more help, have less of a voice in decision making, perceive to be less involved (since their land is not a business for them) and are thus less seen as conservation partners. Private landowners perceive that the economic use of the land is a predicament to be involved in decision-making.

4.3.3 Power Differences Between Landowners

Municipalities and private landowners recognise that institutional actors have cooperation advantages and thus more influence and greater power. Also, greater availability of resources and expertise leads to greater influence. A municipality reports that the province of Utrecht is the ‘natural leader’, due to its possession of resources, knowledge and a “level of abstraction” to act on the water issues . Moreover, private landowners view that the Staatsbosbeheer and Utrechtse Landschap have great resources and expertise, causing them to have greater influence. Private landowners perceive that the provinces do not have to report to anyone or own up to their mistakes (e.g. Natura 2000 programme). They are perceived to be the final decision makers, not revoking policies even if these have negative effects on landowners.

Generally, municipalities are capable of forcing the landowners into actions through enforcing regulations, but not through policies. For example, municipalities state that they cannot force private landowners to treat rainwater on their land separate from sewage. However, power differences are reflected in how processes occur. For instance, municipalities are first conducting research and only including landowners in the second step. Another example is that during the creation of the blue agenda, some private landowners report to not having been involved. The Waterschap states: ”When the Blue Agenda was

drawn up, I also noticed some friction between the UPG and the private landowners and how they want to participate in the blue agenda." Contrastingly, Utrechts Landschap states that the blue agenda brings stakeholders together and the NPUH also reports that landowners are highly involved in it.

Further, private landowners used to value autonomy and a personal connection (with Utrechts Landschap) but now feel dominated and perceive that "we are not actually allowed to do anything". For example, to build a shed, landowners have to go through a difficult and costly process by the municipality. According to a municipality, a contributing factor is limited resources for citizen engagement.

Decision making power on the water levels is also perceived to be unequal and is in fact determined by the farmers through their lobbies. They are lower than landowners would prefer according to a municipality. A private landowner mentioned that these disagreements do not only include farmers and private people but the water boards as well.

In general, the Waterschap regards collaboration as important. The problems and climate change adaptation that would be required are overwhelming for individual people. However, private landowners report no cooperation between the different landowners, one reason being that everyone is busy with financing and upholding their own estates. Further, some private landowners perceive that there is a lack of inclusion and cooperation between neighbours, Staatsbosbeheer, and Utrechts Landschap and thus it is impossible to have a meaningful impact with adaptation. Whilst a private landowner reported that this did not occur on neighbouring estates by nature organisations and private landowners, Utrechts Landschap states that they always approach neighbouring estates.

However, the Waterschap states that for some tasks or topics, specific people and their knowledge are necessary. Moreover, some private landowners act on their own and refuse to work with municipalities according to the latter. The Waterschap attributes this to mistrust, and previous experiences which keep landowners from cooperating with municipalities/water boards due to feelings of domination.

4.3.4. Financial Inequality

Private landowners and municipalities acknowledge that the management of the land is difficult for private landowners due to finances and not everyone being able to pay for the challenges of the future and little support is provided by 'Bosgroep'. Nevertheless, private landowners perceive that they are responsible for payment and are trying to find ways to finance the maintenance.

However, private landowners state that this financial struggle is not the same for all: some struggle more than others and some succeed in getting subsidies whilst others do not. Moreover, there are different capabilities to pay for monitoring the land, where most private landowners are unable to pay for 'buitengewoon opsporingsambtenaar (BOA)' hours.

4.3.5. Perceived Responsibility

On the one hand, some private landowners are lacking awareness and also perceive it not be important to understand what is being done with the water, and regard the waterboards as responsible (2022). On the other hand, the Waterschap reports that there is not too much initiative from landowners, except for some cases where they approach the water boards directly and try to collaborate. The Waterschap states: " they [private landowners] have to come up with it [solutions] themselves" (2022). Also, municipalities regard all landowners responsible for actions and problems, not just themselves (2022). Some private landowners report feeling included, due to for instance being informed before management on roads is being done (B&B, 2022).

4.4 Ecosystem services

This paragraph aimed at answering the following subquestion: *How far is the SNPUH's 'kennisbank' research in identifying the significance of ecosystem services of the UH as well as in identifying who profits from them?*

ES are the benefits of ecosystems for mankind. A key characteristic of ES is that they are public goods (Lant et al., 2008). Although both human well-being and economies greatly depend on ES, their value is not usually expressed in monetary terms. Nonetheless, ES are highly valuable externalities of ecosystems (Zhen & Zhang, 2011). The general public gains free finance, health and well-being benefits from ES. The landowners are responsible for the maintenance of their land but often lack the financial resources for adaptation practices which are necessary to buffer negative consequences for the ecosystems due to water stresses. If the ecosystems deteriorate they might lose the free ES benefits. Therefore, the question arises, whether it would be possible to engage people profiting from ES in political and financial support for landowners?

Payment for ecosystem services (PES) is a flexible instrument that compensates for this market failure. PES improves conservation and equity outcomes by compensating landowners who apply sustainable land management (Wegner, 2016). They can be compensated through three different mechanisms: the polluter pays principle, the user pays principle; and the beneficiary pays principle (Zhen & Zhang, 2011). Essentially, PES can be arranged in two ways. The first is top-down, which is based on Pigouvian tax, a compensation for negative externalities that are not included in the market price. For example, a company that causes environmental degradation is taxed. The second way of arranging PES is bottom-up and based on coasian transactions in which ES are bargained (Wunder et al., 2008).

To enable PES, it would not only need to be known which ES the UH provides but the amounts of benefits should be quantified. Further, who the ES beneficiaries are is of interest (Suwarno et al., 2016). Then, the worth of ES would be public knowledge and one could negotiate for a PES system. Previous research of the NPUH has already focused on UH's ES. A total of 31 researches on 'Kennisbank' go directly or indirectly into ES of the UH (Appendix 8.1). Nevertheless, the general public, who is profiting from ES (i.e. ES beneficiaries) are not fully aware of the fact that they are enjoying significant benefits from ecosystems and that the ecosystem from which they gain these are disappearing due to ecosystem degradation. Creating more awareness of the significance of the ES they are enjoying, could result in bottom-up engagement that can lead to political and financial support that landowners need (Suwarno, 2016).

Kettunen et al. (2009) have developed an evaluation method for the identification and valuation of ES of European ecosystems. This method can show which ES are present on the UH, what their socio-economic worth is, and who the ES beneficiaries of the ES on the UH are. Here, the SNPUH 'Kennisbank' will be tested on whether it contains enough knowledge on UH's ES to enable a comprehensive evaluation to develop PES. The evaluation method should later be carried out by the conservation practitioner.

The following table (Table 7) marks which of the six questions (Table 2) on the horizontal axis for each of the nineteen ES on the vertical axis can be answered with 'Kennisbank 'research. The red boxes mark lacking knowledge which should be addressed to enable meaningful ES evaluation and subsequently make PES possible. Green boxes show that the question can be answered with research from SNPUH's 'Kennisbank'.

Table 7. Research Evaluation on ES of the UH in the kennisbank.

Ecosystem service	Key questions:	1	2	3	4	5	6
Food production (8, 14, 25, 28						11	
Materials: wood (8, 14, 28, 29)						0	
Ornaments (No sources)						0	
Clean water (6, 8, 13, 15, 16, 23, 26, 27, 28)						9	
cultural heritage (5, 11, 19)						13	
Ecotourism (2, 8, 29, 30)						27	
Recreation (1, 2, 8, 9, 13, 15, 18, 20, 21, 29, 30, 31)						26	
Landscape & Amenity values (11, 16, 17)						0	
Air quality (8, 11, 15, 29, 30)						5	
Biodiversity: genetic diversity (no sources)						0	
Biodiversity: species diversity (2, 3, 7, 24)						0	
Carbon capture & storage (8, 11, 22, 24, 25, 26)						3	
Erosion prevention (no sources)						0	
Green livelihood (4, 8, 18, 26, 29, 30)						6	
Nitrogen buffer (8, 11, 29, 30)						5	
Pollination (8, 26, 29)						5	
Flash flood prevention (4, 16, 17, 29)						10	
River flood prevention (10, 16, 17)						0	
water purification and waste management (16, 17)						0	

The numbers in brackets after each ES refer to the relevant literature in the kennisbank from Table 7 in the appendix that answers one or more ES-specific questions. The numbers in the column of key question 5 represent the number of stakeholders and ecosystem beneficiaries that have been identified. As can be seen, only one ES, the provisioning of clean water, has been researched well enough to answer all six key questions. Moreover, there are four ES that are likely present on the UH that have not been researched: ornaments, genetic diversity, erosion prevention, water purification and waste management. Furthermore, six different ES have been researched to some extent, but can not answer more than 2 key questions. These are: wood production, landscape & amenity values, air quality, species diversity, nitrogen buffer, river flood prevention. Key question 6 has only been answered two times.

4.5 Financing Ecosystem Services

This paragraph aimed at answering the following subquestion: *What are possible options for financing ecosystem services which can support landowners to combat water stress?* Landowners seem to have vastly different perspectives on finance and its relation to how these ought to be generated to tackle water problems and thereby support the essential ES of the UH. The contrast is most notable between municipalities and private landowners. Below, multiple issues related to finance are laid out to determine possible ways of financing ES for landowners.

On the issue of availability of finance, a contrast between municipalities and private landowners is most notable. Municipalities argue that finances are not the main issue, but the human capital, or manpower is a bottleneck. They noted that financial resources for projects are already allocated and that making alterations to project scopes to facilitate green infrastructure is not significantly more in terms of financial costs. The issue rather lies in finding organisations with the knowledge to implement these within reasonable time frames. Granted, municipalities are more concerned with urban areas and their respective issues, mostly flooding as the urban areas lie on the foots or slopes of the UH, not on the plateau itself. Therefore, most of their resources are spent on adaptation in the urban areas, not in those closer to the plateau. Private landowners, on the other hand, argue about a shortage of funds to tackle the problems they have. They mention that currently, most finance comes from subsidies designated to keeping the cultural or historic landscape in order. However, this only covers the maintenance, but does not account for additional mitigation or adaptation practices necessary to preserve the cultural and historic landscape. Water issues threaten these, but landowners on the plateau of the UH do not have the resources to adequately combat these by themselves on their own land.

For both municipalities and landowners, additional sources of finance from their own land were not often implemented. For municipalities, land was usually sold to real estate agencies to build new development, given they complied with stricter sustainability standards. Beyond that, municipalities did not explore possible ways to financially exploit their lands. The spokespersons of the municipalities did however not know many options for exploiting land beyond the aforementioned and options like paid parking or selling timber. They mentioned however that they were unsure if private landowners were creative enough in finding other ways to get financing, noting that oftentimes landowners were limited by their location. Landowners confirm this, mentioning that either the size of the land or the cultural and historical landscape limit their options for financial exploitation.

Whereas small landowners are usually a single household managing a plot of land, organisational private landowners usually own larger plots of land, or have far more duties on a smaller piece of land, i.e. historic sites. Most small private landowners do not have swaths of unused land available and are limited

to only a few hectares. They do not wish to change the landscape to remove the elements which make it iconic. Their lands are eligible for subsidies to maintain the cultural heritage of the landscape through organisations such as Collectief Utrecht Oost, which can help with small-scale projects for adaptation to water problems or increasing biodiversity. However, much of the costs fall on landowners themselves. private landowners on small pieces of land did not know of many possibilities to generate finance to aid them in adaptation practices, but were also not actively seeking out options either. Private organisational landowners, on the other hand, receive subsidies for their cultural and historic significance, and changing the way their land is used could run the risk of not being eligible for these subsidies anymore and thus prevents them from doing so. Therefore, they limit their financial exploitation of the land, keeping it to already established models like entry tickets, renting out rooms for business meetings, organising cultural events like art exhibitions or concerts, or paid parking. Additionally, they receive inheritance or donations.

Finally, in some cases, private landowners did not want to exploit their land for extra financial gain at all, even if they noted that they needed it to address the water issues on their land. They noted how changing the land to create more financial safety would result in changes to the landscape they did not wish to see. Examples are high fences, more parking spots or generally more people in the woods which would in a way change their land into a "theme park". Additionally, even those that would have had plans, if they were given the necessary knowledge of how to implement any way to exploit their lands financially, their current tasks of either maintenance of the lands or their job would not give them the time to implement these. Some landowners have already implemented options, such as selling regional special products, but realised that the costs of operation outweighed the income. Thus, making it more of a hobby than a revenue stream. The spokespeople of the municipalities mentioned that they currently do not have ways to directly help transfer knowledge or experience to landowners who have ambitions to financially exploit their lands.

4.6 SNPUH's role

4.6.1 Familiarity with SNPUH

This paragraph aimed at answering the following subquestion: *What role can the SNPUH take in supporting landowners in their practices to combat water-related problems?* The landowners were asked questions about the SNPUH. Their answers showed that not everyone was familiar with the foundation. Strikingly, regarding the municipalities as landowners, three out of the four municipalities indicated that they are not very familiar with the foundation. However, besides one private landowner, the other landowners (private landowners and nature management organisations) were familiar with the foundation. After explaining what they do, the private landowners answered the question about the SNUPH's role in

the adaptation process by saying: *"willingness to talk on an equal level"*, because quite a few large organisations often suffer from *"rampant arrogance"* and do not want to enter into discussion with other stakeholders. Furthermore, one private landowner feels he has not been heard in seeking solutions to water problems. *"You just try to get money so you can keep your monument. Uh. Do you feel heard in that? No, because everyone is doing their own thing."* The other private landowners said to have some contact with the SNPUH but find the representation moderate. They don't know what the SNPUH's plans are to do something about the droughts, do not have the impression that solutions to the water problems are currently being sought, and some do not know what they can do by themselves to remedy these problems. Private landowners indicate that they mainly need advice on how to ensure a better water system. However, they also mentioned that it is nice that the SNPUH as an organisation can coordinate things, which is perceived as a good opportunity. The SNPUH acknowledged that the smaller private landowners probably do not have a good overview of what the SNPUH does, because *"usually we start talking to the bigger ones because they can have more impact"*. However, they argue that because everything is interconnected, the smaller landowners will also benefit from this.

4.6.2 SNPUH'S Role

Tackling climate change issues needs collaboration between stakeholders. The SNPUH tries to facilitate this collaboration between the landowners on the UH. The SNPUH says that it is their duty to give the landowners the tools they need and to facilitate the collaboration between them. Specifically, the organisation provides financial support, for example, by initiating projects to receive funding. However, the organisation also tries to obtain knowledge on different knowledge gaps that are present in the area, and they try to ensure that relevant subjects are on the political agenda. It is also mentioned that to facilitate collaboration, a good overview of the landowners' needs is necessary for the SNPUH to know what they can do for the landowners; in order to make the landowners feel included, it is important to ask them what they need. In this regard, the SNPUH says that *"the most important thing is that the landowners have to be treated as equal"*, because there are some topics that do not have consensus creating difficulties in the process. Also, as tackling climate change issues is a subjective matter, the SNPUH is aware that they need to make clear to the landowners that they do not want to change how the landowners manage their lands: *"we need to build a good foundation for the relationship which we are working on"*.

When asked about the SNPUH's role in solving the water problems and what they should do, the landowners mentioned a couple of things. First of all, the different stakeholders (with different interests) should all engage in conversation and think in terms of possibilities. For example, there is a lot of meltwater

coming to the Netherlands; how can it be buffered as much as possible? Quite a bit can be done that way, practical, manageable.

Secondly, it is not expected of the SNPUH to help with adaptation, but a helpful measure would be to guide the landowners in this by taking the lead to undertake measures throughout the area. The SNPUH could play a role in solving the water issues by involving all stakeholders; supporting water-related problems through knowledge transfer, for example, developing programs or sharing ideas on how a landowner can address his or her problems and evaluate different possibilities.

Thirdly, landowners mentioned that a bottom-up approach is much better than a top-down approach. However, there is also a need for larger overarching studies rather than smaller local pilots. It is important to have continuity in the SNPUH's (which is often lacking in other big organisations) and for them to know the area by heart. For example, by walking around in that area, and not just sitting behind a desk. It would be nice to have a knowledge-based organisation sharing information about what needs to be done, but also sharing the lessons learned from previous mistakes.

Fourthly, there is a need for some sort of "guerrilla action". More specifically, when considering water issues, the story (about these problems and the required adaptation measures) needs to be kept told in whatever way possible. If the SNPUH contributes to this, it will be able to play a role in supporting the landowners facing water problems. For example, the municipalities stated that they cannot do the latter by themselves; assistance from everyone who is available to help in this scenario is required.

Fifthly, enhanced communication via social media is of great importance; it is the least that can be done. Better social media communication is something that every organisation should at least try to achieve. It is known that the SNPUH is working on marketing and specific actions regarding water management (e.g., Heuvelrug Tuinen). However, since some landowners lack sufficient knowledge of SNPUH's organisation to determine whether they could play a larger role or not, they are unsure if the SNPUH is large enough to coordinate the tackling of regional water issues related to the national park.

Sixthly, the SNPUH could be seen as a linking pin for some discussions and topics. For example, one of the municipalities contacted the SNPUH in a policy plan when the SNPUH asked to get on board with the Blue Agenda. A role for the SNPUH could be to set up a platform with the landowners of the UH and talk about water problems and solutions; to make them aware of what is going on and facilitate the conversations.

Seventhly, for the SNPUH to make themselves known better, they should contact local politicians (councilmen and civil servants) and work more on advertisement and publicity. Climate change should be advertised as a common cause; the NPUH must show how they can be an asset to municipalities because

currently the municipalities on the UH also have water problems and only few people/resources to work on it.

Eightly, regarding how to approach the landowners, the municipalities say that you just need to find them; to get people on board or to talk to you. You have to have a common cause or some sort of incentive for why they would be interested; show them what they can get out of this. Landowners would like to be approached by the SNPUH in such a way that it is clearly stated what the profits are. *"Everyone is willing to invest time, it seems, as long as there is something to earn."*

Lastly, the SNPUH is seen as an umbrella organisation that can connect (the citizens, businesses, estates, nature organisations, municipalities, water boards) and perhaps speed things up. Another great umbrella organisation is the UPG which represents the estates (private landowners); they can speak on behalf of the parties and give things back, but they never speak on behalf of an estate. Thus, the UPG could help raise awareness of the SNPUH among private landowners.

4.6.3 Distrust

Some of the private landowners mentioned that there is a lack of trust in organisations like Staatsbosbeheer and Rijkswaterstaat; the private landowners perceive that these big stakeholders take individual action. Private landowners have no control over their activities and there is no equivalence. According to the private landowners, solving water problems has the attention of these parties. However, they believe that it is not the case that big stakeholders like Utrechts Landschap and Staatsbosbeheer will involve the (smaller) private landowners when looking into solutions to the water problems. The private landowners also mentioned that it is difficult to get in contact with these organisations. Moreover, bureaucracy (regarding the municipalities) is a hurdle and is slowing down the process.

5. Integration

5.1 Bottom-up, Top-Down and Power

Ruijtenberg (2022) outlined the relative power and interest of stakeholders working on climate adaptation at the UH (Figure 2). Ruijtenberg showed that private landowners have high power and low interest. This research can however not confirm this, since we found that different private landowners have varying availability of resources (financial, knowledge, expertise, land size, networks), which greatly impact the influence and power they possess (e.g. small private landowner vs. big municipality landowner). Such differences in power, influence, and ability to make decisions is then reflected in the capacity to know about adaptation practices to the water problems at hand and putting them into practice. Moreover, Ruijtenberg (2002) outlined in her power-interest-matrix that private landowners have little interest in climate adaptation. However, this is not reflected in our findings, since there are differentiating thoughts among landowners: all private landowners reported feeling high responsibility to manage their lands, but are oftentimes lacking resources to do so. Meanwhile, municipalities report that there is a lack of willingness from some landowners. They argue that only big landowners have the means to adapt to water issues.

This is enhanced by the fact that private landowners appear to only participate in bottom-up adaptation approaches. However, the SNPUH would like to work together with all stakeholders and jointly act on climate pressures. The municipalities have also addressed this for example for the rainwater sewage system. This clearly shows an unwanted lack of communication and cooperation between stakeholders of different power positions. Interestingly, municipalities and the waterschap regarded the private landowners to be included in top-down initiated processes, such as the BA, whilst the latter did not actually feel included in the process. Attention needs to be paid to the fact that stakeholders need to be actively participating in decision-making processes to achieve actual inclusion and meaningful participation (Few et al., 2011). If participation would be defined as having decision making opportunities in the logic of the more powerful organisations, these varying perceptions of who is included could be avoided. This further means that previous practices of surveying or information campaigns are not yet facilitating this participation.

Due to more resources and a subsequently higher power position, urban areas receive more meaningful attention and action through the municipality than other landowners can facilitate themselves. This is in accordance with Bloomfield et al. (2001) and Hillier (2003), who state that pre-existing power differences impact decision-making processes and outcomes. Farr (2017) identified that such power differences may originate from service users' dependence on organisational structures, which is applicable in the UH: private landowners depend on resource provision and organisational services of the municipalities, whilst municipalities and organisations depend on private landowners, who have the

decision-making power over their own land, to implement adaptation practices (if these are not enforced through policies).

5.2 Communication & Collaboration

Consequently, the question arises, what can be done to overcome the perceived and actual differences of the ability to act, to get involved and make decisions? A solution suggested by many landowners was to increase communication and collaboration amongst them to arrive at more efficient and inclusive processes. According to Ruijtenberg (2022) a lot of collaboration already exists between stakeholders. However, from our interviews it became clear that there is still the wish and need for more participation and collaboration of all stakeholders, especially the private landowners. It is crucial that participation does not only mean consultation, but rather active involvement in decision-making processes. Consultation and communication is a first and important step to achieve inclusive processes, however, Few et al. (2011) found that without active involvement in decision-making processes it is not deemed to be meaningful participation making active involvement in adaptation processes a crucial step.

Enhancing communication and collaboration between stakeholders, is a role the SNPUH aims to have. However, not all landowners were familiar with the SNPUH. Therefore, the NPUH needs to become more known among the landowners to then be able to facilitate communication and collaboration between the different landowners. According to Reed (2008) it is important to include stakeholders because they bring a lot of important knowledge about their land to the table. Furthermore, Cortés-Capano et al., (2020) show that if we want to conserve natural and cultural landscapes then local environmental stewardship needs to be regarded to enable meaningful action.

Moreover, private landowners reported lacking trust in the nature management organisations (Staatsbosbeheer and Utrechts Landschap) and the government (municipalities and Rijkswaterstaat), mainly due to a lack of transparency, inequality, poor accessibility, and bureaucracy.

In one instance it became clear that a nature organisation had the opposite view of how well cooperations with the private landowner on the neighbouring estate was working than the private landowner. These opposing perceptions are important to resolve through communication since otherwise working together is difficult.

In general collaborations are made difficult since responsibilities for action are often felt by private landowners for their own land but further than that unclear. This finding matches what stakeholders mentioned in previous workshops on adaptation practices (Ruijtenberg, 2022). Adaptation in general has been found to be more successful if all stakeholders are involved in the process (Few et al., 2011).

5.3 Financial support

Currently, the SNPUH has a knowledge database, but on financial options for landowners, it still lacks. While Kamerbeek's research (2015) is a good start to explore financial options for private landowners, this information needs to be easily digestible for them.Currently, these are not implemented by landowners in the UH. The role of the SNPUH could be expanded regarding this if the capacity for it exists.

The original idea of the Dutch government that landowners would find ways to finance the maintenance of their land has failed due to both a lack of knowledge on the issue from landowners and a lack of desire to further monetise. The general sentiment of landowners concerning finance of ecosystems of the UH is that it should be financed top-down through subsidies. However, it is not just a question of resources, but sentiment of landowners: at what point do landowners see it necessary to financially exploit their lands, perhaps at the cost of some of its heritage? Asking these difficult questions to landowners, combined with help in the forms of knowledge on which subsidies are available and practices to become more financially resilient could put the SNPUH in a unique position as the go-to for landowners when seeking advice for finance. Private landowners often struggle with these questions, and wish for better support.

Moreover, different stakeholders have differing interests, creating an issue: since municipalities are more concerned with urban areas and their respective issues, mostly flooding, private landowners in the NPUH are more concerned with problems occuring on their more rural private lands and in the nature surrounding it. This means that financial options mentioned by Kamerbeek (2015) for municipalities will likely not be spent on issues further up the plateau. However, to achieve inclusive processes one crucial aspect of it is financial inclusion (Ozili, 2020). Private landowners often struggle with financing the management and the implementation of adaptation practices. If the premise is to achieve financial inclusion among landowners in the UH, these financial needs must be covered. This would remove the financial barrier for involved stakeholders to implement required adaptation practices to combat the water issues at hand.

5.4 Bottom-up payments for ecosystem services are limited

While subsidies cover some costs, landowners are the ones who finance the conservation of the ecosystem that provide these free externalities. And as UH is confronted with water problems, the ones who profit from ES could be losing their free health, well-being and financial benefit.

Landowners noted that they felt that asking for finance from visitors was logistically difficult, but also that it would take away the idea that nature is for all to enjoy. Landowners thought they had either maximally financially exploited their lands within their cultural and historic limits, and were not too keen on any more as this may damage the natural and historic heritage. Vijn & Borgstein (2015) saw this in their research on finance options for landowners: there were more barriers than just knowledge, including the willingness of landowners. How they viewed their heritage was vital to the success of implementing finance options. Initially, the assumption was landowners had some financial models implemented which could help guide other landowners in the region. Our research however found that the biggest barrier was still knowledge for landowners of the UH as this turned out to not be the case. The in-depth research of Vijn & Borgstein (2015) could help in overcoming the barriers which arise when knowledge barriers are overcome.

Moreover, their knowledge on other ways to finance was limited. However, bottom-up payment for ES has successfully been implemented in Germany and the United States (Wunder *et al., 2008*). If landowners had a better understanding of both the details of the ES their lands provided and more knowledge on possible bottom-up financing options, their position to argue for subsidies or create their own means, the conservation of the UH could improve.

5.5 Recommendations for SNPUH

Recommendation 1: Improve inclusion of different landowners.

In our research, private landowners have mostly known of and described bottom-up practices, such as individual independent actions on their lands. These bottom-up approaches should be further informed and supported by the SNPUH. However, to arrive at more efficient processes, bigger-scale adaptation measures need to be implemented. Since landowners wish to maintain their decision-making on their land but are open to collaboration of top-down adaptation practices they must be included in the process of developing these. Therefore, it is important for the SNPUH to increase the collaboration between various stakeholders to jointly develop top-down adaptation practices to guide landowners collectively.

Recommendation 2: Appreciate and value all individual landowners.

To improve the feeling of inclusion and to motivate stakeholders to participate and collaborate, fostering better communication through forums or workshops and building personal relationships is recommended, Landowners mentioned their commitment, passion and long term perspectives were not matched by other organisations. Further, to enable actual participation, decisions should be made together to spread responsibility and make working together meaningful.

Recommendation 3: Improve awareness of water issues, financial options, and what the SNPUH can do.

The BA made general remarks on the inclusion of landowners and the creation of awareness and improving financial options for landowners. This report echoes and reinforces these points, and recommends better exposure to all stakeholders. The already existing UPG could be used as a communication channel to reach private landowners specifically, as several landowners were unsure what the SNPUH did or even that it existed.

Recommendation 4: Transfer knowledge by developing programs and sharing ideas on how landowners can address their water problems.

In the interviews, landowners were asked about the water problems they experienced and what adaptation measures they practise. Some private landowners report lack of knowledge and resources on water problems and adaptation measures to them. Moreover, landowners argue that these issues are context specific (e..g uphill vs. downhill areas in UH). Therefore, landowners argue that it would be helpful for the landowners if the SNPUH can set up a program or document with information about water problems and adaptation practices per area of the UH, instead of adaptation practices that are not context-specific. Additionally, knowledge on ES and financial resilience was relatively limited from interviewees. The SNPUH should ensure that the already available knowledge on creating economic resilience for landowners from Kamerbeek's book (2015) is made known amongst landowners, and encourage landowners to know more about their respective ES which can further strengthen bottom-up finance for conservation.

Recommendation 5: Further develop research on the ecosystem services of the UH.

While research on ES is available on the Kennisbank of the SNPUH, some knowledge on ES is too underdeveloped. The specifics on what exact shortcomings of knowledge per ecosystem service can be seen in Table 6. Having this information available would not only create awareness and help landowners understand what they provide for society better, but can also be a powerful asset when lobbying for subsidies.

Recommendation 6: Lobby more for ecosystem services to increase subsidy availability for payment for ecosystem services

Bottom-up financing options can only go so far, and the conservation and adaptation practices required to preserve the UH exceed what is possible through this method. Therefore, the SNPUH must lobby through whatever means to increase subsidies for conservation and adaptation, citing the ES that are threatened which many people enjoy but are not financing.

5.6 End product

How to support different landowners with their water-related problems

In the following document you will find our six most important recommendations that we aggregated from our research. We conducted reviewed literature and conducted interviews with the municipalities of Zeist, Soest & Baarn and Rhenen. Private landowners we talked to included Kasteel Amerongen-Lievendaal, Dartheuvel, Roghairsparren, Zuylestein and Bed and Breakfast Rodenberg. Further, we spoke to nature and water institutions, Utrechts Landschap, Staatsbosbeheer, Waterschap Vallei en Veluwe and you.

by Katharina, Hanae, Maxim, Tim, Celine & Pia (UU)

1. Improve inclusion of different landowners

In our research, private landowners have mostly known of and described bottom-up practices, such as individual independent actions on their lands. These bottom-up approaches should be further informed and supported by the SNPUH. However, to arrive at more efficient processes, bigger-scale adaptation measures need to be implemented. Since landowners wish to maintain their decision-making on their land but are open to collaboration of top-down adaptation practices they must be included in the process of developing these. Therefore, it is important for the SNPUH to increase the collaboration between various stakeholders to jointly develop top-down adaptation practices to guide landowners collectively.

2. Appreciate and value all individual landowners

To improve the feeling of inclusion and to motivate stakeholders to participate and collaborate, fostering better communication through forums or workshops and building personal relationships is recommended, Landowners mentioned their commitment, passion and long term perspectives were not matched by other organisations. Further, to enable actual participation, decisions should be made together to spread responsibility and make working together meaningful.

3. Improve awareness on water issues, financial options, and what the SNPUH can do

The Blauwe Agenda made general remarks on the inclusion of landowners and the creation of awareness and improving financial options for landowners. This report echoes and reinforces these points, and recommends better exposure to all stakeholders. The already existing UPG could be used as a communication channel to reach private landowners specifically, as several landowners were unsure what the SNPUH did or even that it existed.

4. Transfer knowledge by developing programs and sharing ideas on how landowners can address their water problems

In the interviews, landowners were asked about the water problems they experienced and what adaptation measures they practise. Some private landowners report lack of knowledge and resources on water problems and adaptation measures to them. Moreover, landowners argue that these issues are context specific (e..g uphill vs. downhill areas in UH). Therefore, landowners argue that it would be helpful if the SNPUH can set up a program or document with information about water problems and adaptation practices per area of the UH, instead of adaptation practices that are not context-specific. Additionally, knowledge on ecosystem services and financial resilience was relatively limited from interviewees. The SNPUH should ensure that the already available knowledge on creating economic resilience for landowners from Kamerbeek's book (2015) is made known amongst landowners, and encourage landowners to know more about their respective ecosystem services which can further strengthen bottom-up finance for conservation.

5. Further develop research on the ecosystem services of the UH

While research on ecosystem services is available on the Kennisbank of the SNPUH, some knowledge on ecosystem services is too underdeveloped. Having this information available would not only create awareness and help landowners understand what they provide for society better, but can also be a powerful asset when lobbying for subsidies.

6. Lobby more for ecosystem services to increase subsidy availability for payment for ecosystem services

Bottom-up financing options can only go so far, and the conservation and adaptation practices required to preserve the UH exceed what is possible through this method. Therefore, the SNPUH must lobby through whatever means to increase subsidies for conservation and adaptation, citing the ecosystem services that are threatened which many people enjoy but are not financing.

6. Conclusion

This research aimed to answer the following question: how can the SNPUH better support different types of landowners in overcoming the problems they face in their work to maintain the quality of both nature and cultural heritage with a focus on water-related issues? Consequently, six recommendations were formulated for the SNPUH. Firstly, landowners must be included in the development of top-down adaptation techniques because they want to maintain control over the decisions that are made on their property but are amenable to collaboration. In order to collectively develop top-down adaptation techniques that would collectively guide landowners, it is crucial for the SNPUH to improve the collaboration between diverse stakeholders. Secondly, it is advised to promote communication through forums or workshops and to develop personal ties to increase the sense of inclusion and inspire stakeholders to join and contribute. Thirdly, in addition to raising awareness and enhancing landowners' financial possibilities, the BA made general comments about including landowners. Given that some landowners were unaware of the SNPUH's existence and activities, this report reaffirms and reiterates these issues. Fourthly, private landowners claim to lack resources and understanding regarding water challenges and solutions, while others counter that these problems are context specific. Therefore, the SNPUH should establish a program or paper that provides details about water issues and solutions for each area of the UH. The interviewees' knowledge of environmental services and financial resilience was also not very extensive. The SNPUH should see to it that the knowledge that is presently accessible is disseminated among landowners and that they are encouraged to learn more about their own ecosystem services, which can strengthen bottom-up funding for conservation. Fifthly, the Kennisbank of the SNPUH has research on ES, but part of the information is still in its infancy. In addition to raising awareness and assisting landowners in better understanding what they provide to society, having access to this information could prove to be a potent tool when arguing for financial assistance. Lastly, bottom-up financing methods can only go so far, and the conservation and adaptation measures necessary to protect the UH exceed what is feasible using this method. The SNPUH must thus use all available channels to advocate for increased funding for conservation and adaptation, noting the ecosystem services that are in danger and that many people rely on but that are not being supported in (the process of) adaptation practices.

6.1 Limitations

This research was impacted by various limitations. Firstly, social desirability bias and the demand effect may have played a role when conducting the interviews, since these often occur in face-to-face interviews. Social desirability bias reflects the tendency to give answers that are assumed to be more socially accepted, whilst demand effects reflect the interviewees' idea of what the researcher would like to hear (Grimm, 2010). Many interviewees were representatives of a municipality or an organisation, such as the waterschap. Thus, when talking about a socially sensitive topic, such as inclusion, it needs to be kept in mind that the occurrence of such bias in the interviewees' responses may have occurred. Secondly, language barrier was an issue, since many interviewees preferred to conduct the interviews in Dutch due to lacking English vocabulary on technical terms. This led to two group members using translation software to understand the transcripts. Moreover, the time frame of the research project provided a barrier, since at the beginning interviews took a long time to respond to the emails. Calling potential interviewees was discovered to be a faster approach, but some time was lost whilst waiting for email responses. Third, there was some conflicting information between different interviewees. For instance, interviewees had a different perception on the willingness of different landowners. Some interviewees perceived some landowners as people who did not believe in climate change, but other interviewees argued that this was only due to the lack of resources. Last, during the interviews, topics of finance were sometimes sensitive or landowners did not have knowledge on the topic, and as such, not all interviews were able to address these topics. Due to this, there is a limited sample size, and so it remains inconclusive if this can be a general statement for landowners all around the UH.

6.2 Future research

Future research is needed to establish two points. First of all, in this research we have discovered that the SNPUH was sometimes not known by the landowners. This was mostly due to the lack of communication by SNPUH. However, future research could look more into ways to improve the exposure for SNPUH, for instance what kind of communication methods would fit the SNPUH and how other organisations like the UPG can help in increasing the exposure of the SNPUH. Second, future research can look into willingness and perceptions of landowners on climate change and water problems. Now, in our research it was sometimes unclear what the perception of these landowners was and whether they were willing to actually adapt to the water problems.

Third, the initial goal of this research question was to see whether landowners had implemented ways to exploit their lands financially which could help others to finance their adaptation to their water issues. However, the interviews showed a trend in landowners either not implementing them due to

potentially missing out on subsidies, being limited in possibilities or personally not agreeing with the possibility of further financial exploitation. This marks an issue that must be solved before talking about what possible financial exploitation could work: how landowners perceive possible financial exploitation and their reluctance or rejection of it even before knowing what the possibilities are.

Fourth, during our research, landowners noted not only that they did not know how to finance their own water adaptation practices, but were also lacking knowledge on where to learn about this. What subsidies apply and which organisation can grant what, is complex, and not all finance options are relevant for a particular landowner. While larger in scope than our research had time to cover, the details on how the SNPUH could address these and direct opportunities to specific landowners are worth exploring.

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8. Appendices

Appendix A

	Source	URL
1	Alberts, J., Groeneweg, T., & Nijhuis, E., (2021). *Het wegnemen van de door corona drukte verhoogde stress bij de ree.*	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/04/HSDR_Utrechtse-Heuvelrug-Adviesrapport.pdf
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3	Bekkering, S., Borst, L., van Cassel, S., Forgács, S., & Nguyen, D. T. (2021). *The effect of forest management strategies on forest health on the Utrecht Heuvelrug.* (Utrecht University student research). Retrieved from	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/04/Research-report_1A-Woody-plant-diversity_attempt_2021-06-21-16-39-11_1A_Report.pdf
4	Boukens, S. (2020). Utrecht parkinclusief! *Een verkennend onderzoek naar het nieuwe concept parkinclusief ontwikkelen.* (Hogeschool Utrecht student research)	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/04/Nieuw-2020_05_2020_Utrecht-parkinclusief-Sabine-Boukens-gecomprimeerd.pdf
5	Buring, L. (2022). *Cultural Heritage Buildings in the Circular Transition.* (Master Thesis)	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/10/Cultural-heritage-buildings-in-the-circular-transition.pdf
6	Bützow, J., Bekkers, N., van Amerom, O., van Elk, R., & van Gelderen, J. (2021). *The Effect of Urban Areas on Water Quality in Utrecht and its Surroundings.* (Utrecht University student research)	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/04/Research-report_3F-Water-quality-urban-areas-_attempt_2021-06-21-13-42-08_3F_report.pdf
7	Cirse, K., Sfakianaki, V., Salazzari, A., Granato, F., & Sandor, A. (2021). *Understanding the Impact of Forest*	https://www.np-utrechtseheuvelrug.nl/wp-

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8	Claassen, M. P., Heumakers, G. T. F., Velthuis, L., Meidane, K. A., & Bijsterveld (2022). *Van natuur naar geld. Een onderzoek naar de natuurlijke waarde van het Nationaal Park Utrechtse Heuvelrug.* (Utrecht University student research)	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/04/Van-natuur-naar-geld.pdf
9	Boer, R., Dick, A., Dick, T., de Leeuwe, R., & Ng, M. (2021). *Covid-19 and its implications on recreation in the Utrechtse Heuvelrug.* (Utrecht University student research)	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/03/Research-report_2A-Recreation-Inventory_attempt_2021-06-21-14-04-42_2A_Research-Report.pdf
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11	Delforterie, Ir. W. (2020). Kansen voor soortenrijk klimaatbos – *Ruimtelijke verkenning nieuwe klimaatbossen Kromme Rijn en Veenweidegebied.*	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/03/Rapport-Ruimtelijke-verkenning-soortenrijke-klimaatbossen.pdf
12	Drechsel, N., Hettinga, F., Boston-Mammah E., Strijbosch, J., & Tarullo, A. (2021). *The Future of the Utrechtse Heuvelrug as Imagined by its Residents.* (Utrecht University student research)	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/03/Research-report_6B-The-future-as-imagined-by-Utrechtse-Heuvelrug-key-stakeholders_attempt_2021-06-21-16-12-01_6B-Report.pdf
13	Driessen, J., Grünewald, I., Haze, N., Lorteije, R., van der Hooft, S., & Meijer, A. (2021). *Het opzetten van een heuvelrugmonitor voor natuur, landschap en recreatie.* (Utrecht University student research)	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/03/2021_04-15_Heuvelrugmonitor_NPUH_UU.pdf
14	Eelerwoude (2022). *Hydrologisch onderzoek de Heigraaf. KAMM-landgoederen*.	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/09/220906_202096_LS_Hydrologisch-onderzoek-de-

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15	Flux landscape architecture (2021). Utrechtse Heuvelland. *Een ruimtelijk toekomstperspectief voor nieuw bos rondom de Utrechtse Heuvelrug.*	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/04/Nieuw-HLB-Utrechts-Heuvelland-eindrapport-Flux-131021-gecomprimeerd.pdf
16	H+N+S Landschapsarchitecten (2022). *Ambitiedocument Blauwe Agenda Utrechtse Heuvelrug.*	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/07/2-Ambitiedocument-Blauwe-Agenda-Utrechtse-Heuvelrug-toegankelijk.pdf
17	HydroLogic BV (2021). Bouwstenen Visie Blauwe Agenda Utrechtse Heuvelrug - *Eindrapport.*	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/03/P1256-Bouwstenen-Blauwe-Agenda-Utrechtse-Heuvelrug-D01-20211119.pdf
18	Koolen, B., Veeman, J., Debets, W., Thiescheffer, J., & Vanstraelen, K. (2021). Perceptions on nature: *how the corona crisis affected our view on nature.* (Utrecht University student research)	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/04/Research-report_2C-Perceptions-on-Nature_attempt_2021-06-18-11-55-17_2C_report.pdf
19	Landschap Erfgoed Utrecht & Universiteit Leiden (2021). Erfgoed Gezocht - Utrechtse Heuvelrug. *Speur mee naar archeologisch erfgoed!*	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/03/eindrapportage_erfgoed_gezocht.pdf
20	NBTC-NIPO research (2019). *Bezoekersonderzoek Recreatiegebieden Utrecht 2019.*	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/03/2019_Bezoekersonderzoek-rapportage-Utrecht-DEF2.pdf
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23	Sanders, M. (Wageningen University & Research, WUR), Bredenoord, H., Kok, M., & van Oorschot, M. (allen PBL). *Nederlands natuurbeleid in internationale context. Voortgang realisatie natuur- en biodiversiteitsbeleid.*	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/03/pbl-2020-nederlands-natuurbeleid-in-internationale-context-3889t.pdf
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26	van Bekhoven, J., van den Berg, S., Ouwehand, M., van Pelt, M., & Starreveld, M., (2021). *Exploring the similarities between residents' and national park's ambitions for the Utrechtse Heuvelrug.* (Utrecht University student research)	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/04/Research-report_1E-Forest-perceptions-residents_attempt_2021-06-21-16-09-33_1E_report.pdf
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28	van der Meijde, J., Brèche, J., Voorneveld, B., Hermsen, C., & Moerma, M. (2021). *De Utrechtse Heuvelrug and The Right to Water.* (Utrecht University student research)	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/04/Research-report_3G-Perceptions-and-legitimacy-of-water-governance_attempt_2021-06-21-15-06-14_3G_report.pdf
29	Veelenturf, B., Erich,C., Talen, L., Zijderveld, R., & van den Heuvel, T. (2022). *Ecosysteemdiensten Nationaal*	https://www.np-utrechtseheuvelrug.nl/wp-

	Park Utrechtse Heuvelrug.	content/uploads/2022/03/slidesrapport-natuurlijk-bos.pdf
30	Vesters, B., de Mello, D, Hijstek, J., Marsmann, M. & Asbreuk, T. (2022). Luchtfiltratie Nationaal Park Utrechtse Heuvelrug. *Productiebossen*. (Van hall larenstein, university of applied sciences student research)	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/03/Utrechtse-Heuvelrug-productiebos.pdf
31	Weevers, B., Beuten, E., de Boer, F., Poldermann, & Hage, M. (2021). Interactions between Recreationists at the Utrechtse Heuvelrug. *An assessment of the influence of recreationists' dynamics on the level of enjoyment.* (Utrecht University student research)	https://www.np-utrechtseheuvelrug.nl/wp-content/uploads/2022/03/Research-report_2B-Density-of-recreationists-doing-sports-_attempt_2021-06-21-14-39-05_2B_Report.pdf

Table 8. Sources used for the ES literature review of the SNPUH kennisbank.

Appendix B

INFORMED CONSENT FORM (INTERVIEW)

In this study we want to learn about water problems landowners of Utrechtse Heuvelrug face and how Utrechtse Heuvelrug can support them to overcome these problems. Participation in this interview is voluntary and you can quit the interview at any time without giving a reason and without penalty. Your answers to the questions will be shared with the research team. We will process your personal data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act). Please respond to the questions honestly and feel free to say or write anything you like.

I confirm that:

- I am satisfied with the received information about the research;
- I have no further questions about the research at this moment;
- 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 data to be collected will be obtained and stored for scientific purposes;
- the collected, completely anonymous, research data can be shared and re-used by scientists to answer other research questions;

I understand that:

- I have the right to see the research report afterwards.

Do you agree to participate? o Yes o No

INFORMATION SHEET (INTERVIEW)

INTRODUCTION

You are invited to partake in a study on "Water problems landowners face and how to support them". The purpose of the study is to learn about water problems landowners of Utrechtse Heuvelrug face and how Utrechtse Heuvelrug can support them to overcome these problems. The study is conducted by Celine Klooster, Hanae ben Allal, Katharina Mono, Pia Winckler, Sean-Timothy Eldermand, Maxim Boven who are students in the Msc programme Sustainable Development at the Department of Sustainable Development, Utrecht University. The study is supervised by Dr. Joost Vervoort.

PARTICIPATION

Your participation in this interview is completely voluntary. You can quit at any time without providing any reason and without any consequences. Your contribution to the study is very valuable to us and we greatly appreciate your time taken to complete this interview. We estimate that it will take approximately 30 minutes to complete the interview. Some of the questions require little time to answer, while other questions might need more careful consideration. Please feel free to skip questions you do not feel comfortable answering. You can also ask the interviewer to clarify or explain questions you find unclear before providing an answer. Your answers will be noted by the interviewer in an answer template. The data you provide will be used for writing a Master thesis report and may be used for other scientific purposes such as a publication in a scientific journal or presentation at academic conferences. Only patterns in the data will be reported through these outlets. Your individual responses will not be presented or published.

DATA PROTECTION

If you consent, the interview will be recorded for transcription purposes. The audio recordings will be available to the Master student and academic supervisors. We will process your data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act). Audio recordings will only be stored on a secured and encrypted server of Utrecht University.

Appendix C

Interview guide for private landowners

Thank you for participating in our study today. My name is [NAME] and I am a master's student in Sustainable Development from Utrecht University. We are conducting a study about how the Nationaal Park Utrechtse Heuvelrug (NPUH) can support landowners with their water problems. The interview will take around thirty minutes and will be audio recorded. You can halt or stop the interview at any point. Everything you tell me is used only for research purposes. Your name will not be used, so no one can identify you or your answers. We have already received your consent with the consent form. Before we begin, do you have any questions so far?

Introduction question

1. Can you tell me a little bit about yourself?
    a. What is your name?
    b. How old are you?
    c. How long have you been a landowner in the Utrechtse Heuvelrug?
    d. What is your occupation?
2. Do you face water problems on your land (e.g., too much/too little water), and if so, which ones?
3. What do you think is the cause for these problems?
4. How do you feel represented by the NPUH and UPG?
5. Are finances a hurdle for you to either manage your land, adapt to climate change or react to water issues?

Adaptation practices (SQ2)

1. How do you adapt to the water problems you face?
2. Are you aware of adaptation practices by other stakeholders?
3. What help or support do you need to adapt to the water problems you face?

Inclusiveness (SQ3)

4. Do you perceive that these water issues are being solved, and if so, how?
5. Who is involved in water problem solving?
6. Do you feel like you are a part of solving these water issues, and if so, why?
7. Do you feel like everyone who should be included in solving these water issues is being included?

- If not, who is missing?
- What would be possible ways for all landowners to be included in the process?

8. Do you perceive that there are some landowners who could have a greater impact than others when it comes to solving the present water problems? If so, why?
    - Do you think that this is related to the landowners' financial capabilities?

Societal benefits (SQ4)

9. Who do you think benefits from the management of your land?
10. In what form would you think a financial contribution for these benefits would be realistic?
    - From whom should this contribution come?

Financing ecosystem services (SQ5)

11. Are you currently short of funding to address water issues in your area? If so, could you tell us what you would like to do if you did not have a deficit and how much it might cost?
12. Do you currently have ways to make money from your land? If yes, which ones? If not, what is preventing you from implementing anything?
13. If you were to get external help to remove these obstacles, what ways to make money from your land would you like to implement?

NPUH role (SQ6)

14. What role can the foundation NPUH take in supporting you with these water-related problems?

Appendix D

Interview guide for municipalities and land management organisations

Thank you for participating in our study today. My name is [NAME] and I am a master's student in Sustainable Development from Utrecht University. We are conducting a study about how the Nationaal Park Utrechtse Heuvelrug (NPUH) can support landowners with their water problems. The interview will take around thirty minutes and will be audio recorded. You can halt or stop the interview at any point. Everything you tell me is used only for research purposes. Your name will not be used, so no one can identify you or your answers. We have already received your consent with the consent form. Before we begin, do you have any questions so far?

Introduction question

1. What is your position in/at (...)?
2. What water problems does (...), as a landowner, face on their/its land?
3. As a municipality and landowner, are you aware of water problems private landowners face?
4. What do you think is the cause for these problems?

Adaptation practices (SQ2)

5. How does (...) adapt to the water problems?
    - How do private landowners adapt to the water problems?
6. Does (...) receive any support to adapt to water problems?
7. Do you support private landowners to adapt to water problems?
    - What support do you give these landowners to adapt to water problems?
    - What are the limits to your aid?
8. Do you have a (legal) responsibility towards the landowners to support them with adaptation practices?

Inclusiveness/Cooperation (SQ3)

9. How would you say landowners (including you) are included in the problem solving (national park wide)?
10. Do you perceive that there are some landowners who could have a greater impact than others when it comes to solving the present problems (including yourself)?

11. What could be possible ways for all landowners (and yourself) to be included in the process/adaptation practices (if that is not already the case)?

Social benefits (SQ4)

12. What benefits do people gain from the ecosystem *'Utrechtse Heuvelrug'* to sustain local human well-being in the broadest sense?
    - Who are those people?
13. Do all civil groups that make use of the ecosystem services make a (fair) financial contribution?
14. Would it be realistic to adopt a *'payment for ecosystem services system'* for the Utrechtse Heuvelrug (for those who are not contributing yet, but might be willing to do so)?
    - In what form?

Financing ecosystem services (SQ5)

15. Is there currently a lack of funding to solve water problems in the area under your care? If so, is there a plan of what you would do if resources were available and is there an estimate of how much it would cost?
16. Are there currently ways you are making money from the land under your care? If yes, which ones? If not, what prevents you from implementing such a thing?
17. If you were to get external help to remove these obstacles, what ways to make money from the land would you want to implement?
18. Is there a way at your organisation to help private landowners if they need help to solve their water problems?

NPUH's role (SQ6)

19. What role can the foundation NPUH take in supporting you with these water-related problems?

Appendix E

Interview guide for NPUH

Thank you for participating in our study today. My name is [NAME] and I am a master's student in Sustainable Development from Utrecht University. We are conducting a study about how the Foundation Nationaal Park Utrechtse Heuvelrug (NPUH) can support landowners with their water problems. The interview will take around thirty minutes and will be audio recorded. You can halt or stop the interview at any point. Everything you tell me is used only for research purposes. Your name will not be used, so no one can identify you or your answers. We have already received your consent with the consent form. Before we begin, do you have any questions so far?

Introduction

1. Can you tell me something about yourself?
2. What water problems do landowners face?
3. What do you think is the cause for these problems?

NPUH's role

4. Why is maintaining the quality of both nature and cultural heritage important?
5. Why is it important that the private landowners have confidence in the NPUH and are actively involved in what is happening?
6. What support do you give landowners to adapt to water problems?
7. What obstacles do you (or have) encounter(ed) when helping the private landowners?
8. Could you say that what the NPUH does is a government responsibility?
9. Do you have a (legal) responsibility towards the landowners to support them with adaptation practices?
10. What are the limits to your aid for supporting the landowners?
11. How would you say landowners are included in the problem solving? (What do you think can be done to include landowners more in problem solving?)
12. How do you experience the collaboration with the municipalities and the land management organisations?
13. What do you see as points for improvement for yourself to help the landowners better?
14. How do you think you can better support the different types of landowners in overcoming the problems they face, and what or who do you need to realise this?