

From Carbon Credits to an Expanded Payment for Ecosystem Services Scheme: A Case Study of the Valuta voor Veen Project in the Netherlands

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Master Thesis in Environmental Sciences

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When I was working in Friesland, I saw people talking a lot about the peat problems and what we had to do. But they didn't do anything because this money issue has to be solved...We want other ways of agricultural farming.

(FMF, personal communication, 20 November 2024)

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Environmental System Analysis

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Abstract

Peatland degradation, primarily due to agricultural drainage, poses a significant threat to the provision of multiple ecosystem services. Providing incentives for farmers and landowners to rewet peatlands through Payment for Ecosystem Services (PES) schemes, such as voluntary carbon standards, is therefore crucial. While Europe leads in peatland restoration, with several voluntary carbon credit standards being developed, the potential to expand the PES framework beyond existing carbon credit standards remains unexplored. This study examines the Netherlands as a case study, exploring the potential of an expanded PES framework from the perspectives of ecosystem services, implementation, and stakeholders. An expanded PES scheme is proposed, integrating elements from three existing initiatives: the voluntary carbon standard Valuta voor Veen (VvV) and MoorFutures, as well as the Agricultural Nature and Landscape Management subsidy (ANLb). Several regulating services are identified as suitable for incorporation into the VvV carbon credit standard in the Netherlands, including regulation of water flows, waste treatment, maintenance of life cycles, and maintenance of genetic diversity. The proposed expanded VvV scheme incorporates grassland management practices from ANLb packages and the concept of ecosystem service bundles from Moorfutures. The study addresses additionality and payment mechanisms pertinent to the implementation of this expanded scheme. Key stakeholders—including farmers and landowners, Nature and Environment Federations, and agricultural collectives—are identified as pivotal in the development of the scheme. This study demonstrates the potential of an expanded PES scheme, which could serve as one of the many approaches to facilitate peatland restoration.

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List of Abbreviation

Abbreviation	Name
ANLb	Agricultural Nature and Landscape Management (Agrarisch Natuur- en Landschapsbeheer)
ESVD	Ecosystem Services Valuation Database
EU	European Union
FMF	Frisian Nature and Environment Federation (Friese Milieu Federatie)
NRL	Nature Restoration Law
PES	Payment for Ecosystem Services
SNK	National Carbon Market Foundation (Stichting Nationale Koolstofmarkt)
VvV	Valuta voor Veen

1. Introduction

1.1. Multifunctional Roles of Peatlands in Ecosystem Services

Peatlands provide a variety of ecosystem services. Peat soils consist of at least 30% organic matter by dry mass. These soils form under waterlogged conditions, where the slow decomposition of organic matter allows it to be preserved (Tanneberger et al., 2021). Although peatlands cover only about 3% of the global land area, they store at least 600 gigatons of carbon, which accounts for 21% of global soil carbon (Leifeld & Menichetti, 2018; Yu, 2011; Yu et al., 2011). Peatlands can remove pollutants from streams, absorbing toxic metals and reducing suspended sediments, particulate organic matter, and dissolved organic carbon in the water (Martin-Ortega et al., 2014; UNEP, 2008). Additionally, peatlands provide habitats for highly adapted, rare, and threatened species, generally supporting a higher proportion of characteristic species than dryland ecosystems within the same biogeographic zone (Executive Agency for Small and Medium sized Enterprises., 2020; UNEP, 2008). According to the Common International Classification for Ecosystem Services (CICES), ecosystem services are divided into three categories: provisioning, regulating, and cultural services (Bonn, 2016). Provisioning and cultural services provided by peatlands often have well-established markets and generate considerable income for service providers, such as those involved in food or fodder production or various recreational activities. However, the most distinctive features of peatlands lie in their ability to deliver regulating services, which, despite their importance, are not yet fully integrated into established markets. These services include acting as the most space-efficient terrestrial carbon reservoirs, purifying and regulating water supply, and playing a crucial role in preserving biodiversity (Bonn, 2016; Bonn et al., 2014; Minayeva et al., 2017).

1.2. The Impacts of Agricultural Use on Peatland

Global peatlands are degrading, with 15% drained worldwide primarily for agriculture, leading to a decline in ecosystem service provision (Joosten, 2015; Rawlins & Morris, 2010). Draining peat soils with ditches is a common agricultural practice to improve crop yields. Peat soils contains about 95% of water by volume (UNEP, 2008); therefore, draining them directly leads to land subsidence (1-2 cm yearly), which can continue for more than a century and further

increase the flood risks and decrease the land productivity (Tanneberger et al., 2021). Furthermore, draining peatlands accelerates nutrient mobilization, such as nitrate, negatively impacting groundwater and surface water quality (Tanneberger et al., 2021). Drainage and intensive agriculture also threatens biodiversity by disrupting hydrological and geochemical balances, fragmenting habitats, and reducing the chances for species to exchange genes and recolonize areas (UNEP, 2008). Lastly, drainage can turn peatlands from a carbon sink into a carbon source (Dawson et al., 2004; Fritz et al., 2014; Loisel et al., 2021; Tanneberger et al., 2021; Wu, 2012). It exposes peat soils to air, leading to soil respiration and decomposition, which results in the release of carbon dioxide. Globally, degraded peatlands account for 5% of global carbon dioxide emissions, or 25% of carbon dioxide emissions from the land use sector, with Indonesia and the European Union (EU) being the two largest emitters (Executive Agency for Small and Medium sized Enterprises., 2020; Joosten, 2009, 2015).

1.3. Peatland Restoration in Europe

The negative impacts of drainage on ecosystem services can be reduced by rewetting peatlands (Tanneberger et al., 2021). The EU currently acts as a pioneer in efforts to protect peatlands and prevent their degradation. Within the EU Member States (EU27), peatlands cover an area of 268,000 km². More than half of Europe's natural peatlands have been lost or degraded (Executive Agency for Small and Medium sized Enterprises., 2020). Based on the 1979 Birds Directive and the 1992 Habitats Directive, around 33,000 km² of peatlands in Europe are now protected under the Natura 2000 Network (Executive Agency for Small and Medium sized Enterprises., 2020). The latest Nature Restoration Law (NRL)(European Union, 2024), which came into force on August 18, 2024, aims to restore degraded ecosystems, including peatlands. The NRL sets the goal of restoring 30% of drained peatlands by 2030 and 50% by 2050. The NRL also highlights the importance of incentivizing farmers and private landowners to rewet peatlands and ensuring a socially fair transition.

1.4. Payment for Ecosystem Services and Voluntary Carbon Credits

Payment for Ecosystem Services (PES) can provide incentives for farmers and private landowners to restore peatlands and address the decline of ecosystem services (FAO, 2007). PES is defined as “a voluntary transaction where a well-defined ecosystem service is ‘bought’

by an ecosystem service buyer from an ecosystem service provider if the service provider secures ecosystem service provision (Fripp, n.d.).” Common forms of PES include subsidies and tradable permits (Jack et al., 2008). In the context of peatland restoration in Europe, examples include the subsidy for Agricultural Nature and Landscape Management (Agrarisch Natuur- en Landschapsbeheer, ANLb) in the Netherlands aimed at improving the environment in agricultural ecosystems, and voluntary carbon credits.

Voluntary carbon credit represents a common form of PES. It is a market-based instrument that allows corporations to compensate for their unavoidable emissions while providing financial incentives for carbon sequestration or reduced emissions (Miltenberger et al., 2021). Leading examples in Europe of voluntary carbon standards for peatland restoration include Valuta voor Veen (VvV) in the Netherlands and Moorfutures in Germany. Given that peatlands under agricultural use are highly productive and profitable, developing a revenue model for landowners and farmers through PES is crucial for successful peatland restoration.

As more sectors recognizing ecosystem being an integrity providing multiple services, restoring peatlands as a nature-based solution for the provision of multiple ecosystem services has been proposed, and revenue models with carbon credits that incorporate co-benefits are expected to gain more attention (Amrei & Cassin, 2018; Muenzel & Martino, 2018; Pertiwi et al., 2022; Salzman et al., 2018; Thorslund et al., 2017). However, the feasibility of developing an expanded PES scheme that accounts for multiple ecosystem services within an existing voluntary carbon standard remains unexplored. This raises an important question: What are the potentials of expanding the Payment for Ecosystem Services framework beyond the existing carbon credit standard for peatland restoration?

2. Purpose of the study

To facilitate peatland restoration, this study explores the potential of expanding the PES framework beyond the existing carbon credit standard for peatland restoration. This study is expected to initiate discussions on developing PES schemes that account for multiple, rather than just one, ecosystem services, as an alternative way to incentivize and support peatland restoration. Additionally, it aims to provide insights for other countries developing PES schemes for peatland restoration.

2.1. General Research Question

What are the potentials of expanding the Payment for Ecosystem Services framework beyond the existing carbon credit standard for peatland restoration?

2.2. Specific Research Questions

1. What are the potentials of expanding the PES scheme beyond the carbon credit standard from an ecosystem services perspective?
2. What are the PES schemes for peatland restoration in Europe, and how might these examples inform the carbon credit standard?
3. What are the potentials of expanding the PES scheme beyond the carbon credit standard from an implementation perspective?
4. What are the potentials of expanding the PES scheme beyond the carbon credit standard from a stakeholder perspective?

3. Methods

This study focuses on the Netherlands as a case study. Details regarding the case study, data collection, and analysis are provided in Sections 3.1 and 3.2.

To address the four specific research questions (SRQs), this study follows a four-step process as depicted in the conceptual framework (Figure 1). First, the potential ecosystem services to be incorporated into the existing carbon credit scheme are identified in the case study (Section 3.3). Next, an expanded PES scheme is developed, using VvV—the only voluntary carbon standard for peatland restoration in the Netherlands—as the primary framework. This development is informed by other European PES schemes, including the ANLb subsidy from the Netherlands and Moorfutures from Germany (Section 3.4). The feasibility of implementing this expanded VvV scheme is then discussed (Section 3.5). Finally, the stakeholders relevant to the introduction of this expanded VvV scheme are analyzed (Section 3.6).

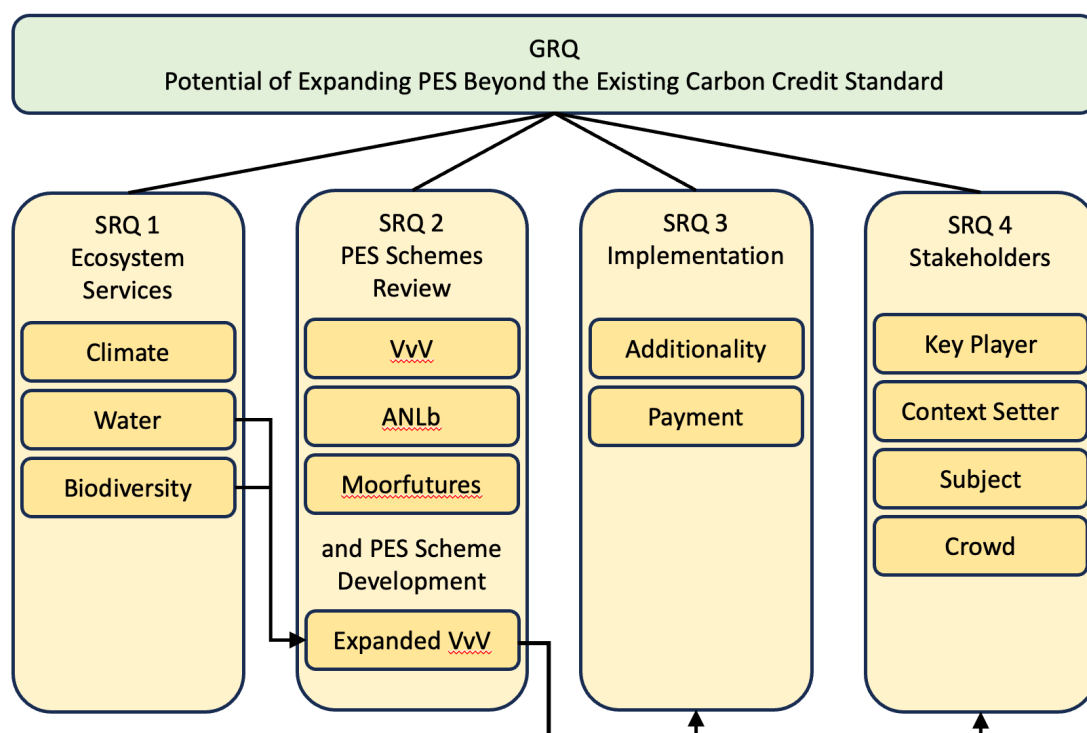


Figure 1. Conceptual framework of this study. SRQ1 identifies the ecosystem services suitable for incorporation into the expanded PES scheme, which are further addressed in SRQ2. The implementation and stakeholders in the expanded scheme are discussed in SRQ3 and SRQ4.

3.1. Case Study

The Netherlands has a long history of intensive drainage of peat soils. The majority of peat soils in the Netherlands are drained up to 1 meter below the surface level, primarily for use as pastures for dairy farming (C4 Landbouw En Landgebruik, 2019; Rienks & Gerritsen, 2005). While peat soils cover about 7% of the Dutch agricultural area, greenhouse gas emissions from these soils are responsible for more than 50% of emissions from agricultural soils and about 2.5% of the annual national GHG emissions (Akker et al., 2008; Fritz et al., 2014; Tanneberger et al., 2017). By 2030, the Dutch government aims to reduce emissions from peatlands by 1 Mt carbon dioxide equivalent (C4 Landbouw En Landgebruik, 2019).

On the other hand, the agricultural sector is facing significant economic challenges, including land subsidence and stricter regulations on nitrogen and carbon emissions. Farmers are advocating for a fair transition to more sustainable practices. Therefore, developing a promising revenue model for the sustainable use of peatlands is of great importance for stakeholders.

3.2. Data Collection and Analysis

This study utilizes both secondary and primary data, including an existing database, literature reviews, and interviews. The existing database is used to provide information on ecosystem services in Dutch peat meadows, answering SRQ1 (detailed in Section 3.3). Literature, predominantly published papers and reports from relevant governmental and non-governmental organizations, is reviewed in preparation for the interviews. Semi-structured individual interviews with relevant stakeholders are conducted. Table 1 details the positions, involvement, and number of interviewees. The interview period spans from November 4th, 2024, to January 13th, 2025. All interviews are recorded and transcribed verbatim using Microsoft Word. Qualitative content analysis is then conducted in ATLAS.ti, a computer-assisted qualitative data analysis software (Paulus & Lester, 2016), to sort data with assigned codes. Descriptive coding is performed by reading the interview transcripts and assigning category labels (Stoffelen, 2019). Subsequently, a list of unstructured descriptive codes is reviewed, merged, deleted, and renamed (Stoffelen, 2019). The final list of codes is then used as the database for answering predominantly SRQs 2, 3, and 4 (see Sections 3.4–3.6), but also

provides insights for SRQ1. Access to the codes, quotations, and full transcripts of these interviews is provided in Appendix 12.1.

Table 1. Interviews conducted in this study. More details about the relevant stakeholders are provided in Chapter 8.

ID	Role/Position	Organization/ Institution	Date of Interview	Location
Agricultural Collective	Expert familiar with ANLb subsidy and VvV	Noardlike Fryske Wâlden	04/11/2024	Virtual
Bij12	Consultant familiar with ANLb subsidy	Bij12	12/12/2024	Utrecht
Farmer	Farmer participating in VvV	Akkrumer Goedland	13/01/2025	Friesland
FMF	Developer of VvV	Friese Milieu Federatie	20/11/2024	Virtual
Wijland	Expert working on peatland restoration in western peat meadow area	Wijland	03/12/2024	Virtual
WUR 1	Researcher familiar with ANLb subsidy and grassland management	Wageningen University and Research	04/12/2024	Wageningen
WUR 2			09/12/2024	Wageningen
Moorfutures 1	Researcher developing Moorfutures	Greifswald Mire Centre	04/12/2024	Virtual
<i>Moorfutures 2</i>			10/12/2024	Virtual

3.3. Ecosystem Services Analysis

To answer SRQ 1, the ecosystem services provided by Dutch peat meadow are identified from the Ecosystem Services Valuation Database (ESVD), which is the largest global open-access database with monetary values for all ecosystem services (Brander et al., 2024). Ecosystem services are filtered with biome/ ecozone setting “peatland” and country setting “Kingdom of the Netherlands”. Ecosystem services with the same TEEB code are integrated and listed as one. The identified ESs are described based on the original papers listed in the ESVD. Field observations on VvV lands are not conducted as the focus of the study on ecosystem services identification is to only provide an overview of potential ecosystem services being incorporated in PES. To test the sensitivity of the choice of country setting, ecosystem services

filtered with 'peatland' and 'Federal Republic of Germany' are also retrieved and compared with the data used in this study, which is presented in the Appendix 12.2.

3.4. Review of PES Schemes in Europe

To answer SRQ2, three European PES schemes are reviewed. In addition to VvV, the ANLb in the Netherlands and another carbon credit standard in Germany, Moorfutures, are also reviewed and viewed as additional references for expanding the VvV scheme. The ANLb measures suitable for enhancing ecosystem services in peat meadows are identified with the assistance of expert *WUR 1* who is involved in grassland management within the ANLb (Table 1). Moorfutures was selected because it is the world's first voluntary carbon standard for peatlands, initially focusing solely on carbon credits before evolving to incorporate bundled ecosystem services. An expanded PES scheme which incorporates the multiple ecosystem services identified in SRQ1 is developed.

3.5. Implementation of Valuta voor Veen

To answer SRQ3, the key issues in implementing the expanded PES scheme are discussed using data from interviews and literature reviews. The scope of this study remains within maintaining the expanded PES scheme as a national carbon standard. The implementation of the expanded PES scheme is divided into how additionality is addressed and how the payment can be conducted.

3.6. Stakeholder Analysis

To answer SRQ4, the stakeholders relevant to the expanded PES scheme are identified, including national and regional governmental agencies, National Carbon Market Foundation (Stichting Nationale Koolstofmarkt, SNK), Platform CO2 Neutraal, agricultural collectives, farmers, agricultural associations, environmental NGOs, potential buyers of carbon credits, researchers, dairy cooperatives, consultants, and public. Their involvement, influence, and interests in the expanded PES scheme are analyzed using interview and literature review data and visualized in an influence-interest matrix.

4. Ecosystem Services on Dutch Peat Meadow

The ecosystem services provided by peat meadows in the Netherlands are identified from the ESVD and presented in Table 2. The ecosystem services presented are potential ecosystem services derived from peatland ecosystems that range from highly degraded to well-functioning, including regulating, provisioning, and cultural services. The regulating services are grouped into Air, Water, and Biodiversity in the following sections to enhance readability and clarity. In this study, the targeted ecosystem services are those with potential for incorporation into a PES scheme, with a specific focus on regulating services, including water and biodiversity. Unlike provisioning services such as meat or fodder, or cultural services such as recreation and tourism, regulating services are not commercialized in existing markets (Jack et al., 2008). Except for the climate regulation service, the impact of regional context on the provision of ecosystem services has been highlighted by three interviewees (Agricultural Collective, personal communication, 4 November 2024; Moorfutures 1, personal communication, 4 December 2024; Moorfutures 2, personal communication, 10 December 2024).

Table 2. Identified ecosystem services on Dutch peat meadows from ESVD.

Ecosystem Services Category		Ecosystem Services (TEEB)	Reference
TEEB	This Study		
Regulating	Climate	Air quality regulation	(Robinson et al., 2022)
		Climate regulation	(Böhnke-Heinrichs & Groot, 2010; Bos et al., 2008; Paulin et al., 2022; Reinhard, 2014; Reinhard et al., 2014)
	Water	Regulation of water flows	(Paulin et al., 2022)
		Waste treatment	(Böhnke-Heinrichs & Groot, 2010; Paulin et al., 2022)
	Biodiversity	Maintenance of life cycles	(Böhnke-Heinrichs & Groot, 2010)
		Maintenance of genetic diversity	(Böhnke-Heinrichs & Groot, 2010)
Provisioning	-	Food	(de Jong et al., 2021)
		Raw Materials	(Böhnke-Heinrichs & Groot, 2010; de Jong et al., 2021)
Cultural		Aesthetic information	(Bos et al., 2008)
		Opportunities for recreation and tourism	(Böhnke-Heinrichs & Groot, 2010; Bos et al., 2008; Robinson et al., 2022; Tanneberger et al., 2024)
		Inspiration for culture, art and design	(Böhnke-Heinrichs & Groot, 2010)
		Existence, bequest values	(Bos et al., 2008; Brouwer & Slangen, 1998; Reinhard, 2014)

4.1. Climate

Two regulating services that are relevant to the interaction between the atmosphere, vegetation, and soils on peatland are *air quality regulation* and *climate regulation* (Table 2). Vegetation, including meadows, can improve air filtration and reduce levels of particulate pollutants, providing cleaner air for people (Robinson et al., 2022). The *climate regulation* service includes greenhouse gases carbon dioxide and nitrous oxide. In peat meadows, the carbon dioxide regulation service arises from three scenarios: 1) carbon sequestration from the air by active *Sphagnum* species-dominated bogs, 2) carbon sequestration from the air by

wet grasslands, reeds, and scrub vegetation, and 3) reduced carbon emissions by decreasing peatland degradation (Reinhard, 2014). To elaborate on the third scenario, draining peatlands facilitates emissions of not only carbon dioxide but also nitrous oxide. Therefore, reducing peatland degradation through rewetting can mitigate emissions of both greenhouse gases. While methane may offset the reduced emission effect associated with rising groundwater levels, the overall benefit of reduced greenhouse gas emissions remains positive (Bonn et al., 2014).

4.2. Water

Peat meadows also provide two water-related regulating services: *regulation of water flows* and *waste treatment* (Table 2). The structure of peat soils allows them to retain significant amounts of water and, therefore, act as natural mediators of water flows (Stachowicz et al., 2022). Drained peatlands not only release greenhouse gases such as carbon dioxide and nitrous oxide into the atmosphere but also nutrients, including nitrate, sulphate, and phosphate, into the water. The release of these nutrients affects water quality and threatens most species that are adapted to low nutrient levels, negatively impacting biodiversity (Paulin et al., 2022). Rewetting can reduce nutrient release from peat oxidation; however, nutrient release from manure may increase if not managed well (Paulin et al., 2022; Wijland, personal communication, 3 December 2024). The *waste treatment* services provided specifically by lands applying paludiculture are also highlighted in the interviews, where the mobilized phosphorus can be absorbed by plants such as cattails (Moorfutures 1, personal communication, 4 December 2024).

4.3. Biodiversity

Biodiversity, in the context of this paper, refers to the simplified summary of two ecosystem services provided by peat meadows: *maintenance of life cycles* and *maintenance of genetic diversity* (Table 2). Peat meadows are crucial habitats for breeding and foraging for meadow birds, which obtain their food primarily from wet soils. Rewetting delays grass growth and creates space for chicks to walk and forage in spring. Additionally, peat meadows are known for their diverse vegetation along banks and ditch sides (Brouwer & Slangen, 1998).

Furthermore, a higher water table can reduce the amount of fertilizer applied, leading to more open and herb-rich vegetation.

5. PES Schemes for Peatland Restoration in Europe

Three PES schemes for peat meadows in Europe, including VvV, ANLb, and Moorfutures, are reviewed in the following sections. Figure 2 summarizes the ecosystem services which each PES cover.

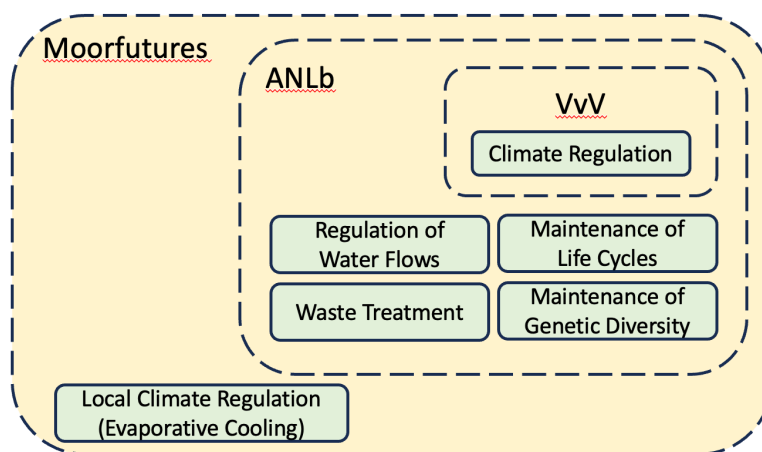


Figure 2. PES schemes and the ecosystem services they cover.

5.1. Valuta voor Veen

VvV is the first carbon credit standard for peatland rewetting in the Netherlands (Chen et al., 2023). This standard was developed to incentivize farmers and landowners to rewet peatland and focuses solely on reducing emissions. In 2017, the Frisian Nature and Environment Federation (Friese Milieu Federatie, FMF) initiated VvV in collaboration with the agricultural organization LTO Noord and farmer collectives Noardlike Fryske Wâlden and It Lege Midden (Chen et al., 2023). In the VvV project, peatland restoration is achieved through raising groundwater level and can occur on three types of land-use projects, as outlined by SNK: retention of agricultural meadow function, wet crop farming (also known as paludiculture), and nature development. Examples for each type of VvV project are listed in Appendix 12.3.

The emission reduction in VvV is calculated by increased groundwater level (CO₂-Emission Reduction through Increase in Groundwater Levels in Peatland Areas (Paying for Peat), 2020). Although peatland restoration in the Netherlands also generates other ecosystem services, VvV does not commodify them and focuses solely on *climate regulation* service (CO₂-Emission Reduction through Increase in Groundwater Levels in Peatland Areas (Paying for Peat), 2020;

Tanneberger et al., 2021). The price of VvV carbon credits was based on the opportunity cost (the loss of grass harvests) of raising the groundwater level (FMF, personal communication, 20 November 2024). Initially, the price was set at 75€ per credit. The current price is 100–115€, allowing farmers to earn a slightly higher revenue compared to conventional agricultural practices (FMF, personal communication, 20 November 2024).

Two limitations of VvV were mentioned by interview participants. Firstly, the potential trade-off between water quality and climate regulation is not addressed in the SNK regulation of VvV (Wijland, personal communication, 3 December 2024). While rewetting lands that are artificially fertilized, nutrients can leach from the soil if not managed properly. Secondly, the revenue model is not appealing enough for most farmers and landowners to join. For farmers in the western peat meadow area, VvV is not a promising revenue model, as the groundwater level in this region is higher, leaving little room for raising it to earn carbon credits without drastically changing agricultural practices (Wijland, personal communication, 3 December 2024). According to Agricultural Collective (personal communication, 4 November 2024) “there’s only a revenue model in areas where the water levels are low.” However, difficulties in the Frisian peatlands, where VvV was developed and where the water level has been drained up to one meter below the surface, have also been mentioned. One of the main reasons some VvV proposals have failed to be implemented is the difficulty of involving farmers located in the same water system to work together (Agricultural Collective, personal communication, 4 November 2024). In the Noardlike Fryske Wâlden working area, the only realized VvV project is Earnâwald (Appendix 12.3), which is owned by a single farmer (Agricultural Collective, personal communication, 4 November 2024). The revenue model currently doesn’t cover the cost of planning a VvV project. The costs for each project, including planning, adjusting, and maintaining the water system, primarily rely on government funding (Agricultural Collective, personal communication, 4 November 2024).

5.2. ANLb Subsidy

The ANLb subsidy is an EU Common Agricultural Policy funding mechanism that financially supports Dutch agricultural collectives in implementing sustainable agricultural practices. The ANLb packages suitable for peat meadows were identified by an expert from Wageningen University and Research (WUR 1) and are listed in Table 3. The relationships between the

ecosystem service categories (*Climate, Water, and Biodiversity*) and the ANLb measures are adapted from the ANLb coupling table (September 2024) provided by Bij12 (Bij12, 2024). There have been examples where farmers participating in VvV have combined ANLb measures (see Appendix 12.3); however, all approved VvV projects to date have only incorporated ANLb measures that are not relevant to raising groundwater levels to ensure additionality (Agricultural Collective, personal communication, 4 November 2024).

Two limitations have been identified in the ANLb scheme. Firstly, to qualify for ANLb subsidies, farmers must join agricultural collectives; however, budgetary constraints limit the number of farmers eligible for enrollment in these collectives, resulting in some farmers remaining on a waiting list (Bij12, personal communication, 12 December 2024). Additionally, certain land parcels are excluded from the eligible areas for subsidies. For example, the pilot project of VvV, Lytse Deelen (see Appendix 12.3), was unable to apply for ANLb subsidies until 2021 (Miedema & Miedema, 2020). Secondly, while ANLb can compensate for the opportunity costs associated with implementing ANLb packages (Agricultural Collective, personal communication, 4 November 2024; WUR 2, personal communication, 9 December 2024), it does not provide a better revenue model to incentivize farmers. The Agreement on Agriculture of the World Trade Organization limits payments from governments to farmers to avoid distorting international trade. The amount of subsidy is calculated based on the three-year average loss of grass harvest.

Table 3. ANLb practices suitable for peat meadows and their associated ecosystem services. 'X' denotes the ecosystem service category that can be enhanced by the corresponding grassland management activity.

Management Activity	Climate	Water	Biodiversity
No agricultural operations are carried out during the rest period from date x to date y	0	0	X
The grassland will not be mowed from 1 March and before the dormancy period.	0	0	X
At least f% to maximum g% of the unit or of the habitat under management has been cleaned or cleaned and mown annually	X	X	X
The crop is cut and removed at least once every 2 years.	X	X	X
Solid manure has been applied	X	X	X
maximum ha/X kg N animal excretion/ha/farm or Y LU/ha/farm	X	X	X
No use of chemical weed control on min x % of area.	X	X	X
Grazing is mandatory from date x to date y with minimum and maximum stocking density (LU/ha)	X	0	X
There is indemnity for damage by livestock from date x to date y	X	X	X
From date x to date y grazing allowed with maximum stocking density	X	X	X
Nests are demonstrably searched for. Found nests and/or chicks are protected and safeguarded from all agricultural operations	0	0	X
At least a different indicator species from list b for the purpose of specific target are present in transect in the period x to y	X	X	X
Watercourse has free access (via natural or man-made facility), after flooding is cleaned up	X	X	X
Annually, at least f% to maximum g% of the unit or habitat under management has been cleaned where the dredge has been sprayed from the water feature onto adjacent farmland	X	X	X
The gauge separation has been cleaned and/or maintained annually	X	X	X
Annual creation of a ditch with minimum width and depth for the purpose of infiltration is present from date x to date y	X	X	0

5.3. Moorfutures in Germany

MoorFutures is the first standard for carbon credits from peatland rewetting, which was introduced by the Ministry of Agriculture and Environment of Mecklenburg-Vorpommern in 2010 (Chen et al., 2023). The standard of Moorfutures is based on the principles of the Verified Carbon Standard and the Kyoto Protocol (Joosten et al., 2016). The emission reduction in this project is calculated by greenhouse gas emission site types (GEST) approach,

which enables assessment of greenhouse gas fluxes from annual groundwater level without comprehensive on-site measurements (Chen et al., 2023; Joosten et al., 2016). In 2013, MoorFutures was developed to integrate other ecosystem services, including *waste treatment* (referred to as *improved water quality* in the MoorFutures document), *regulation of water flows* (flood mitigation), *local climate regulation* (evaporative cooling), *maintenance of life cycles*, and *maintenance of genetic diversity* (mire-typical biodiversity) (Joosten et al., 2016; Tanneberger et al., 2024), into the carbon credits. These ecosystem services are semi-quantified, combined and sold as a single package, namely Bundled Ecosystem Services (Joosten et al., 2016).

The additional price for these bundled ecosystem services is not included in the carbon credits due to the issue of additionality, as ecosystem services such as *maintenance of genetic diversity* and *waste treatment* are provided while rewetting the area (Moorfutures 1, personal communication, 4 December 2024). The price of Moorfutures credits is calculated by dividing the cost of rewetting by the total number of credits (Moorfutures 1, personal communication, 4 December 2024). Although the revenue does not increase with the bundling of ecosystem services, the benefits of such bundling have been shown to raise environmental awareness among the public (Moorfutures 2, personal communication, 10 December 2024).

Current demand for purchasing Moorfutures credits exceeds supply, with buyers showing interest in the bundled ecosystem services, such as *waste treatment* (reduced nitrogen emissions) and *maintenance of life cycles* (Moorfutures 2, personal communication, 10 December 2024). Moorfutures operates on both state-owned and private peat meadows (Moorfutures 1, personal communication, 4 December 2024). Because it aims for complete rewetting of the lands and raising the groundwater to surface level (Moorfutures 2, personal communication, 10 December 2024), these lands lose their status as agricultural land after rewetting and are not eligible for agricultural subsidies. Recently, Moorfutures Flex has been developed as an initiative to obtain both carbon credits and agricultural subsidies from the EU on the same land through the application of paludiculture (Moorfutures 2, personal communication, 10 December 2024).

6. From Carbon Standard to Incorporation of PES Schemes

For a PES scheme to be effective, payments must be sufficient to ensure that the alternative—conventional agricultural practices on peat meadows—is less economically attractive (Fripp, n.d.). Virtually all drained peatlands in the Netherlands are privately owned, primarily by dairy farms, whereas in other European countries, such as Germany, peatlands are often state-owned (FMF, personal communication, 20 November 2024; Wijland, personal communication, 3 December 2024). Although the current credit price of VvV offers a slightly better revenue model, the success of some projects does not necessarily indicate that the existing PES scheme provides sufficient incentives for relevant stakeholders. The developer of VvV (FMF, personal communication, 20 November 2024) emphasizes the need to shift investment in planning VvV projects from governmental funding to landowners and project developers. To achieve this, the revenue model for peatland rewetting in the Netherlands must be highly attractive (FMF, personal communication, 20 November 2024).

The author of this thesis argues that expanding the PES framework beyond the existing carbon credit standard for peatland restoration in the Netherlands should be based on integrating the three PES schemes reviewed in this study (Figure 3). The ANLb grassland management packages suitable for peat meadows (Table 3) can be incorporated into VvV scheme to enhance the provision of ecosystem services, particularly in the categories of *Water* and *Biodiversity*. These ecosystem services can then be bundled with carbon credits, similar to the Moorfutures approach (Figure 3). The details are described as follows.

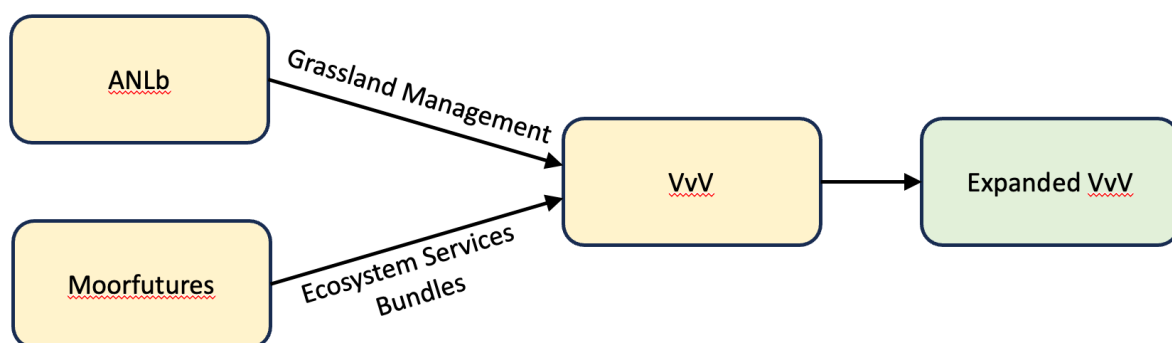


Figure 3. The expanded VvV scheme can be developed by incorporating ecosystem service bundles from Moorfutures and grassland management practices from the ANLb subsidy into the current VvV framework.

6.1. Introduction of Ecosystem Services Bundles

There are two ways to package ecosystem services for sale: bundling and layering. Bundling involves grouping multiple ecosystem services into a single package, which can be purchased by one or more buyers. Layering (also called stacking) refers to measuring and packaging ecosystem services separately into distinct credits (Amrei & Cassin, 2018; Reed et al., 2017).

Moorfutures was designed to bundle ecosystem services instead of stacking them, concerning potential issues of additionality and the absence of markets for other ecosystem services (Moorfutures 1, personal communication, 4 December 2024). While Moorfutures demonstrates the acceptance of credit buyers for ecosystem service bundles with carbon credits, the bundling system can be introduced into the VvV scheme, with additionality described in detail in Chapter 7. By introducing bundled ecosystem services in the categories of *Water* and *Biodiversity* in this study (Table 2), the VvV carbon credit can not only raise public awareness of the multiple ecosystem services generated from peatland restoration (Moorfutures 2, personal communication, 10 December 2024) but also be sold at a higher premium price.

6.2. Incorporation of Grassland Management Packages

Most VvV projects fall under the land-use category of retaining the agricultural function of peat meadows, and some operate without integrating the grassland management practices recommended in ANLb packages (see Appendix 12.3). However, as described by interviewees, raising the groundwater level alone without appropriate grassland management has limited positive effects on water and biodiversity (FMF, personal communication, 20 November 2024; WUR 1, personal communication, 4 December 2024).

Integrating ANLb measures into VvV schemes presents several potential advantages. First, it can create synergies between ecosystem services while mitigating trade-offs. Additionally, it opens opportunities for generating higher revenues rather than simply receiving financial compensation. Unlike ANLb subsidies, the implementation of grassland management measures under a carbon credit reward scheme is not subject to budget constraints. Verified adoption of grassland management measures that improve water and biodiversity could increase the value of carbon credits, further incentivizing farmer participation in peatland

restoration. Finally, this integration could also provide opportunities for lands that are ineligible for ANLb participation (Miedema & Miedema, 2020)(See Appendix 12.3).

7. Implementation of Expanded VvV Scheme

7.1. Additionality

For the expanded VvV schemes to be eligible for crediting, additionality is the most important factor to consider. Additionality refers to a project's ability to demonstrate that it would not exist without crediting funds (financial additionality) and that its practices are not required by law (regulatory additionality) (Mathias, 2022; van Baren et al., 2023). Unlike Moorfutures, which aims for complete rewetting of peatlands, VvV projects under the category of “retaining the agricultural function” would not promote as many ecosystem services without proper grassland management. Applying grassland management practices that benefit *Water* and *Biodiversity* is not required under current VvV rules, nor by national or EU regulations, and these practices would not be implemented without at least some compensation. Therefore, applying grassland management practices on lands enrolled in VvV but not in ANLb demonstrates both regulatory and financial additionality, making them eligible for bundling ecosystem services into carbon credits.

7.2. Payment

The rewarding scheme of PES can be categorized as either result-based, where payments are made based on the actual provision of ecosystem services, or prescription-based, where payments are made for implementing specific land or resource management practices (Fripp, n.d.; Kuhfuss et al., 2018; Mathias, 2022). Ideally, all PES schemes would be built on result-based rewarding; however, since most ecosystem services are difficult to measure, most PES schemes base their rewarding systems on proxy actions rather than the actual production of final ecosystem services (Fripp, n.d.; Jack et al., 2008). As the ANLb subsidy is based on rewarding land management practices (prescription-based payment), it would be logical for the expanded VvV scheme to recognize the enhancement of other ecosystem services based on grassland management practices.

8. Stakeholder Analysis

The stakeholders are categorized as key players, context setters, subjects, and crowds based on their potential interests and influence on the expanded VvV scheme and are described as follows (Figure 4).

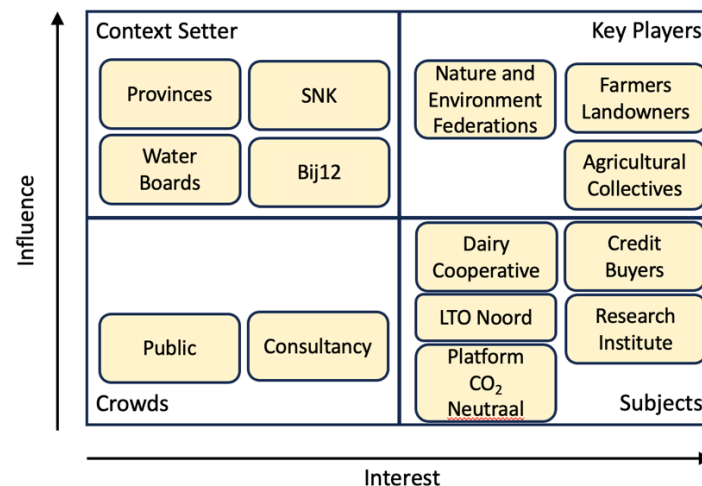


Figure 4. Stakeholder interest-influence matrix.

8.1. Collaborate with Key Players

Farmers and Landowners

Farmers and landowners can be the most important stakeholders, as they apply agricultural practices on peat meadows and have the potential to provide ecosystem services from their lands. Farmers currently participating in the VvV project are enthusiastic about the idea of incorporating other ecosystem services rather than focusing solely on *climate regulation* (Farmer, personal communication, 13 January 2025). However, most farmers who are not yet part of PES schemes are reluctant to change their production systems (Agricultural Collective, personal communication, 4 November 2024; Moorfutures 2, personal communication, 10 December 2024). Given the diverse interests and influence levels of farmers regarding the expansion of the VvV scheme, their common priorities are profitability and the simplicity of the PES scheme. Additionally, as ANLb subsidies can vary depending on policy changes, selling a product with continuous demand may be more attractive to farmers than relying on subsidies (Moorfutures 2, personal communication, 10 December 2024).

Nature and Environment Federation

The FMF was the initiator of VvV and has a strong interest and influence over the project. The expansion of VvV to incorporate additional ecosystem services and develop into a more comprehensive peatland restoration approach should align with FMF's interests. FMF, along with other Nature and Environment Federations, such as those in North and South Holland, should also be involved to ensure that the expansion appeals to farmers beyond Friesland.

Agricultural Collectives

Besides supporting members in grassland management and helping them obtain ANLb subsidies, agricultural collectives are also interested in exploring revenue models for farmers in the region (Agricultural Collective, personal communication, 4 November 2024). It Lege Midden and Noardlike Fryske Wâlden, the two agricultural collectives based in Friesland, participated in and influenced the design of VvV. A representative from an agricultural collective expressed disappointment with VvV, highlighting the difficulty of involving all farmers who share the same water system (Agricultural Collective, personal communication, 4 November 2024). Therefore, agricultural collectives should play a significant role in expanding the VvV scheme, integrating ANLb practices, and improving revenue models for farmers.

8.2. Involve Context Setter

National Carbon Market Foundation

SNK plays a significant role in setting the regulations for the VvV scheme, supervising project planning, and issuing certificates. As SNK's primary interest is to ensure a robust framework for carbon mitigation, incorporating other ecosystem services is not currently a priority. The expansion of the VvV scheme would require SNK to adapt its certification standards to recognize these co-benefits.

Provinces

Regional governments, such as the Province of Friesland, have an interest in improving the environment by enhancing the ecosystem services provided by peatlands. In addition to supporting VvV projects with funding (FMF, personal communication, 20 November 2024),

regional governments can align the expanded VvV scheme with provincial peatland restoration policies and climate goals.

Water Boards

Water boards have the authority to approve VvV projects regarding changes to the groundwater level, and therefore remain an important context setter for the expanded VvV scheme.

Bij12

Bij12 is responsible for the administration and implementation of the ANLb subsidy program. This organization shares common goals with the expanded VvV scheme and can therefore provide support to ensure the incorporation of ANLb practices into the scheme.

8.3. Consult Subjects

Buyers of credits

While the fundamental interest of VvV credit buyers lies in offsetting emissions, the interests of credit buyers are not confined to *climate regulation* but also extend to *Biodiversity* and *Water* (Moorfutures 2, personal communication, 10 December 2024). With markets for other ecosystem services still under development, projects that offer co-benefits could be of great interest to credit buyers, particularly for their communication and corporate social responsibility strategies (Mathias, 2022).

Platform CO₂ Neutraal

Platform CO₂ Neutraal is the intermediary that manages the transaction of VvV credits between credit providers and buyers. Though it is not involved in the design or implementation of the VvV project, it plays an important role in presenting the co-benefits bundled with carbon credits to interested credit buyers.

Dairy Cooperative

Dairy cooperatives operate across the entire dairy supply chain, from milk production to processing and global distribution. FrieslandCampina is one of the world's largest dairy cooperatives. In response to market demands, it has started focusing on reducing emissions

and improving soil health, water management, and biodiversity by implementing pilot regenerative agriculture projects since 2024. The adoption of an expanded VvV scheme could be facilitated by dairy cooperatives, provided there is sufficient market demand for sustainability.

LTO Noord

LTO Noord was involved in the design of the VvV scheme and support the farmers engagement in the VvV. Though not currently actively involved in the VvV projects, LTO Noord can be of consulting role to support the robustness of revenue models of the expanded VvV scheme.

Research Institutes

Research institutes such as Greifswald Mire Centre and Wageningen Research are important for facilitating the establishment of carbon credit standards for peatland restoration. They can further support the incorporation of ANLb practices into the expanded VvV scheme, for example, by suggesting the quantification and monitoring of ecosystem services or pricing the credits (FMF, personal communication, 20 November 2024; Wijland, personal communication, 3 December 2024).

8.4. Inform Crowds

Consultancy

There're currently no consulting companies involved in the VvV projects. However, companies such as Ekwadraat, which has already been involved in another method (Blijvend Grassland) of SNK (Agricultural Collective, personal communication, 4 November 2024), may find developing carbon credit projects with a premium price to be of interest. Consulting companies can participate in supporting the planning of VvV projects under the expanded scheme.

Public

By definition, the public is not directly involved in the transaction of credits or the design of the expanded VvV scheme. However, raising awareness of the co-benefits of peatland

restoration can help shape policies and stimulate both demand from credit buyers and supply from credit providers.

9. Discussion

The limitations of each research question, as well as how future studies can fill the gaps and enhance the robustness of this expanded VvV scheme, are discussed as follows.

To address SRQ1, the ESVD was used to identify potential ecosystem services for incorporation into the expanded VvV scheme. ESVD exclusively collects data on ecosystem services with monetized values, meaning that services difficult to quantify—yet still ecologically significant—may be overlooked. However, this approach offers an efficient overview, and the identified ecosystem services can be compared with those in other studies (Liu et al., 2023). Key ecosystem services related to biodiversity and water were identified as the most viable options for incorporation. It's noted that regional context plays a critical role, and the actual provision of these services on lands implementing grassland management practices should be assessed on a case-by-case basis (Agricultural Collective, personal communication, 4 November 2024; Moorfutures 1, personal communication, 4 December 2024; Moorfutures 2, personal communication, 10 December 2024). This highlights the need for further investigation into the regional variations of Dutch peat meadows and the acquisition of on-site information regarding ecosystem services.

To address SRQ2, three PES schemes in Europe are reviewed and an expanded VvV scheme incorporating grassland management practices and ecosystem service bundles is proposed. While this expanded scheme has the potential to create higher revenue models for credit providers, its success may be constrained by limited market demand (Kuhfuss et al., 2018). Additional incentive schemes, such as the Farmer KPI system, can be incorporated into the discussion as a response to the constraints, as it has the potential to drive market demand towards sustainability in the future (Wijland, personal communication, 3 December 2024). This system, currently under development, aims to promote circular agriculture and biodiversity restoration. The Farmer KPI system covers multiple environmental performance indicators that overlap with the ecosystem services categories identified in this study, including *Water* and *Biodiversity* (van Doorn et al., 2024). The potential integration of the

expanded VvV scheme with the Farmer KPI system was also suggested by WUR 1 (personal communication, 4 December 2024). Furthermore, the foundation of the expanded scheme remains the carbon credit generated from raising groundwater levels (CO₂-Emission Reduction through Increase in Groundwater Levels in Peatland Areas (Paying for Peat), 2020). If the water board mandates groundwater level increases during the project period, voluntary carbon credits would not be issued due to a lack of additionality (Agricultural Collective, personal communication, 4 November 2024; Wijland, personal communication, 3 December 2024). The question of how to enhance the resilience of credit providers within the expanded VvV scheme remains unexplored. Additionally, the expanded scheme is primarily designed for projects under the land use category of “retaining the agricultural function of peat meadows.” Further research is needed to determine how lands practicing paludiculture or designated as nature reserves could integrate ecosystem service bundling into their carbon credits.

To answer SRQ3, the issues of additionality and the payment mechanism are addressed. Implementing grassland management practices on lands enrolled in VvV but not in ANLb ensures both regulatory and financial additionality, qualifying them for bundling ecosystem services into carbon credits. However, the cost of implementing grassland management practices does not necessarily reflect their effects on ecosystem services, as these effects vary depending on the regional context. The extent to which ecosystem services are enhanced by each practice and how pricing can be incorporated on top of carbon credits still require further exploration.

To answer SRQ4, stakeholders relevant to the expanded VvV scheme are identified and analyzed using data from interviews and literature reviews. Although the author of this thesis reached out to as many stakeholders as possible within the data collection period, perspectives from certain key stakeholders, such as SNK or farmers who haven’t joined VvV, remain absent. Perspectives from more stakeholders should be comprehensively considered and addressed in future studies to ensure the feasibility and inclusivity of the expanded VvV scheme.

To sum up, this study illustrates how PES can be expanded by assessing the potential of ecosystem services, incorporating PES schemes, implementing them, and involving stakeholders. The expanded VvV scheme presented demonstrates the promising potential of

developing PES schemes from existing carbon credit standards and can serve as a reference framework for other countries developing similar schemes. A more comprehensive PES scheme, encompassing multiple ecosystem services, has high potential to facilitate peatland restoration and mitigate the decline of ecosystem services due to agricultural use.

10. Conclusion

This study identifies the potential ecosystem services to be incorporated into the expanded PES scheme for Dutch peat meadows. By reviewing three PES schemes in Europe—VvV and ANLb in the Netherlands and Moorfutures in Germany—an expanded VvV scheme is proposed. With the incorporation of grassland management from ANLb practices and the concept of ecosystem services bundles from Moorfutures, the expanded VvV scheme is expected to mitigate ecosystem services trade-offs in peatland rewetting, offer a higher revenue model for credit providers, provide opportunities for lands ineligible for ANLb participation, and raise public awareness of the co-benefits of peatland restoration. While this study addresses additionality and the payment mechanism, the integration of grassland management practices into the quantification and pricing of ecosystem services bundles still requires further exploration. Key stakeholders, including farmers and landowners, Nature and Environmental Federations, and agricultural collectives, are expected to play leading roles in the development of the expanded VvV scheme.

The expanded VvV scheme is developed by integrating elements from three PES schemes in Europe, and its potential is demonstrated from the perspectives of ecosystem services, implementation, and stakeholder engagement. This expanded scheme could serve as an effective approach for the Netherlands to facilitate peatland restoration and achieve its environmental goals. Furthermore, this study provides a framework for other countries currently developing PES schemes for peatland restoration. However, it is important to recognize that no single PES scheme can address all challenges. As the initiator of the VvV scheme stated, “It’s one of the ways to contribute to the peat problems we are dealing with, (but) it’s not the solution for everything (FMF, personal communication, 20 November 2024).”

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12. Appendix

12.1. Interview Data

The codes, quotations, and full transcripts of the interviews can be accessed through [this link](#).

12.2. Ecosystem Services on German Peat Meadow

Table A1. Identified ecosystem services on German peat meadows from ESVD.

Ecosystem Services Category	Ecosystem Services (TEEB)
Regulating Services	Climate regulation
	Waste treatment
	Moderation of extreme events
	Erosion prevention
	Maintenance of soil fertility
Provisioning Services	Food
Cultural Services	Aesthetic information
	Opportunities for recreation and tourism
	Existence, bequest values

12.3. Valuta voor Veen Projects

Lytse Deelen: Organic Dairy Farm in Friesland

The 32-hectare organic dairy farm *De Nije Mieden* is located in Haskerdijken, Friesland, nearby the nature reserve De Alde Deelen. Belonging to the VvV land-use category of ‘retaining the agricultural meadow function,’ the farm is managed extensively, without applying artificial fertilizer and with fewer than five mowing sessions each year. Sjoerd and Douwe Miedema operate this farm, selling dairy and meat products and carbon credits under VvV (€100,00 each) (Platform CO2 Neutraal, n.d.). The water level is raised 55 centimeters to 15 centimeters below ground level. The agricultural collective in this area is Gebiedscoöperatie It Lege Midden U.A. The operators of this farm didn’t receive ANLb subsidy until 2021 because the area was outside of National Ecological Network (NEN, Natuurnetwerk Nederland) and ANLb boundaries (Farmer, personal communication, 13 January 2025; Miedema & Miedema, 2020).

Langweer: Agricultural Nature Reserve Project in Friesland

This 65-hectare agricultural nature reserve is located in De Fryske Marren, Friesland. Belonging to the VvV land-use category of 'retaining the agricultural meadow function,' the current management is intensive, but the operator wants to transition to extensive management, possibly in combination with ANLb (Wijntjes b.v. & Protestantse Gemeente te Langweer, 2021). The landowner Mickey Wijntjes raises the water level from 100 centimeters to 40 centimeters below ground level to give space to wet crops and meadow birds. The agricultural collective in this area is Gebiedscoöperatie It Lege Midden U.A. No measures are currently taken to get ANLb subsidy (Wijntjes b.v. & Protestantse Gemeente te Langweer, 2021).

Krimpenerwaard: Paludiculture Project in South Holland

This 14-hectare organic cranberry farm is located in Krimpenerwaard, South Holland. The land owner Bart Crouwers farms cranberries without pesticides or grazing, and the carbon credits are currently sold out at price of €115,00 each. This farm reduces 150 tons of carbon dioxide emission every year (Platform CO2 Neutraal, n.d.). The agricultural collective in this area is Weidehof Krimpenerwaard.

Earnewâld: Project in preparation in Friesland

This 9-hectare plot is located in Tytsjerksteradiel, Friesland, near Alde Feanen National Park. The landowner, Ate Bijlsma, is planning to rewet the land, and meadow bird management will be included. The agricultural collective in this area is Vereniging Noardlike Fryske Wâlden. This project falls under the VvV land-use category of 'retaining the agricultural meadow function' and also receives ANLb subsidies.

Westzijderveld: Nature Reserve Project in North Holland

The 20-hectare nature reserve is located in Westzijderveld, North Holland. The water level will be raised and sequester 600 tons of carbon dioxide over the 10 years period. The price of carbon credits is €100,00 each. The initiators of this project are the Natuur en Milieufederatie Noord-Holland (Nature and Environment Federation North Holland) and landowner Staatsbosbeheer. The agricultural collective in this area is Water, Land & Dijken. This project falls under the VvV land-use category of 'retaining the agricultural meadow function' and also receives ANLb subsidies.