



NOVASOIL

INNOVATIVE BUSINESS MODELS FOR SOIL HEALTH

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Carbon credits (WU)



Project Consortium

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1 Background, focal question and needs

Global warming is causing challenges for the Netherlands and for Dutch agriculture, for instance, because droughts and floodings occur more frequently (Kennisportaal Klimaatadaptatie, 2024). On the one hand, these changes strongly negatively affect agricultural production. On the other hand, adjustments in agricultural production practices can help store CO₂ in soil or biomass, slow climate change, and reach the EU's goal to become climate-neutral by 2050 (European Commission, 2024).

In general, carbon storage can be achieved through so-called soil health activities (e.g., agroforestry, the cultivation of additional cover crops, changes in tillage or raising water levels on peatland) (European Commission, 2022, McDonald et al., 2021). These activities usually demand an extensification of agricultural practices. An extensification of agriculture brings along multiple other benefits besides improved soil health and CO₂ storage, for instance, the practices are also beneficial for biodiversity (Bartkowski et al., 2022). It is, therefore, important to motivate farmers to apply soil health measures, for instance, through financial remunerations. Measures can be financed, for example, by public payments from the common agricultural policy (CAP), private nature protection contracts (e.g., with dairy companies like Friesland Campina (Friesland Campina Nederland, 2024)) or carbon credit markets. Carbon credits are relatively new, and they can result from carbon farming activities when the activities comply with the requirements outlined in regulation 2018/841 (European Commission, 2022).

Carbon credit trade allows farmers to generate new streams of income. It is unsurprising that multiple initiatives in the Netherlands started to work on the topic. One of these initiatives is Rabo Carbon Bank (Rabobank, 2022). Another one is set up by the Dutch farmers' organisation ZLTO (ZLTO, 2024). Research on business models such as carbon credit trade that allow the remuneration of extensifying practices and creating public goods is important to allow such business models to become self-sustained. Research shows that current financial incentives might not be good enough to make farmers opt for carbon credit trade contracts (Demeyer et al., 2022), especially when they require long-term (>10 years) commitment (Tiusanen et al., 2022).

This report used expert opinions to learn more about the potential of carbon credit trade in the Netherlands. The experts came from a research institute, organisations with an early trial for carbon credit generation, a farmer collective and the entity that develops the certification framework for the Netherlands (Stichting Nationale Koolstofmarkt). The approach aims to contribute to a joint understanding of what a healthy soil is and how carbon credit trade might contribute to improvements in soil quality. In addition, we aimed to learn more about the current political setting (e.g., the relevant actors and awareness of the topic) and potential areas for future research. First, the results from the interviews are summarised. Next, it is outlined how policy innovations could support soil health in the Netherlands.



2 Policy mix

Table 1 Key elements of national **policy mix and institutional framework around soils**, based on and adapted from Rogge and Reichardt, 2016; Williamson, 2000.

Domains	Elements to consider	Description	Lickert (1-5)	
			P ¹	Q ²
0.Awareness and understanding	Definition of soil health	<p>Definition: Healthy soils might be characterised by their ability to provide multiple ecosystem services (e.g., carbon storage, soil biodiversity, arable products etc.).</p> <p>Healthy soils result from sustainable soil management. They are a key factor of agricultural production, determine crop productivity and farm resilience. In addition, they are an important determinant of the environmental quality of the production system (e.g., of soil biodiversity, and habitat quality), and can help to mitigate climate change. In doing so, they do not only help to meet environmental and economic aspects of sustainability, but also social demands by providing, for instance, a liveable countryside and food security.</p> <p>Assessment policy: Even though the value of soils is acknowledged, few policies directly address soil quality.</p> <p>Assessment BM: The case study strongly focuses on climate change mitigation, and the provision of additional income to farmers resulting from carbon credit trade. Soil health improvement and other ecosystem services than carbon storage might result indirectly from this.</p>	2	2

¹ P=priority. Please rank accordingly to 5 point-Likert scale based on how these elements are currently considered in your case study: 1 no priority; 2 low priority; 3 neutral; 4 moderate priority 5 high priority

² Q=quality. Please rank accordingly to 5 point-Likert scale based on the current quality of the political process in your case study: 1 very poor -2 poor; 3 acceptable; 4 good 5 very good



1. Policy concern	Soils as policy priority	<p>Compared to other topics soils do not seem to be a top priority in Dutch agricultural policy. During the last five years the mitigation of nitrogen surpluses was a top priority, as these surpluses are harmful to biodiversity and water quality.</p> <p>However, given that the Netherlands are a densely populated country concerns regarding soil quality and soil provision for agriculture might increase when urban areas continue to grow. Besides, this there is a growing interest in healthy soil, and healthy peatlands because of their ability to store carbon, and importance for food security.</p> <p>However, whether soil health is declining, and needs to be a matter of concern was evaluated differently by the stakeholders. Some pointed out that soil is well cared for when owned by the farmers because long-term fertility demands good soil quality.</p> <p>Assessment policy: Even though the value of soils is acknowledged, few policies directly address soil quality as other objectives (e.g., over-fertilisation) were prioritized.</p> <p>Assessment BM: The case study covers carbon credit trade and evaluates how farmers perceive a draft of the regulation that will come up for carbon credit certification. Hence soil quality does not play a major role but is a side effect.</p>	3	2
2. Policy agenda on soils	Political commitment towards soil health, non-binding targets	<p>The Netherlands stated to aim for sustainable soil management by 2030 but little action was taken, and sustainable soil management was never sufficiently defined.</p> <p>However, the Netherlands aim to become climate neutral, and hence soil protection will play a role. Carbon credit trade was identified as a potential building block for achieving the goal.</p> <p>Still, it is noteworthy that it remains to be seen whether these strategies change; A new parliament and government has been in place since summer 2024, it stated to</p>	3	3



		<p>focus less on climate and environmental protection.</p> <p>Assessment policy: The topic made it to the political agenda, however whether the new government follows the old political agenda remains to be seen.</p> <p>Assessment BM: The case study evaluates how farmers perceive the criteria in the regulation relevant to carbon credit certification. It is aiming to provide information to policy.</p>		
3.Institutional environment	Binding national regulations on soil	<p>There are few binding regulations that aim at soil health. Farmers must, for instance, take soil samples every four years (Dutch Fertilizer Ordinance). This information on nutrient contents might help to reduce over-fertilization.</p> <p>In addition, farmers must meet the enhanced conditionality requirements of the CAP (Common Agricultural Policy) . These could have indirect positive effects on soil health. They, for instance, foresee the usage of cover crops during autumn / winter. Furthermore, the demanded fallow areas close to water streams. These might also make an indirect contribution.</p> <p>Assessment policy: Might be effective to reduce over-fertilisation but does not aim at multiple ES.</p> <p>Assessment BM: not of interest to the business model</p>	4	4
4.Policy integration	Interactions between and within policy sectors	<p>The ministry (Ministerie van Landbouw, Natuur en Voedselkwaliteit) develops, proposes, and controls legislation. The ministry is also engaged in research programmes, committed to the Global Soil Partnership (FAO), which annually holds the day of the soils, and provides information material on the topics soil health and soil protection (Rijksoverheid, 2020).</p> <p>The waterboards control the height of the groundwater. This is relevant to prevent flooding and soil erosion (e.g. building and planning of dikes). They control water</p>	n.a.	n.a.



		<p>quality, which can contribute to prevent toxins entering the soils. They plan and control nature restoration projects that might be relevant to soil health, and they also provide information to farmers (Rijksoverheid, 2024).</p> <p>An example for their engagement in soil management is that the waterboard Limburg offers educational videos, and field excursions for farmers, where soil management and practices leading to better infiltration and less nutrient outflows are explained (Waterschap Limburg, 2024). Both ministries and waterboards are independent bodies.</p> <p>Overall, the participants described that interaction with local governmental bodies is challenging.</p> <p>They describe that farmers need more support and encouragement from these bodies when developing business models to lower the impact of agriculture. They felt that NGOs received more attention.</p> <p>Assessment BM/policy: How well the interactions between the policy sectors works could not be quantified. In theory, they are fully independent.</p>		
<p>5.Governance structures</p>	<p>Levels of governance involved, roles and functions</p>	<p>The European commission (EU level), the government and the agricultural ministries (e.g., Ministerie van Economische Zaken en Klimaat, Ministerie van Financiën, Ministerie van Landbouw, Natuur en Voedselkwaliteit) for the Netherlands, and the provinces are of importance.</p> <p>Besides them the waterboard is not to be underestimated in the Netherlands. It serves as an important regional governmental body; it controls water provision and ensures water regulation to prevent floods. The waterboards are independent of provinces or municipalities. They levy taxes, hold elections and function independently. They also enforce the measures necessary for water management and can punish offenders. The waterboards consist of stakeholders</p>	<p>n.a.</p>	<p>n.a.</p>



		<p>from multiple groups and farmers are usually well represented.</p> <p>Assessment policy: Structures are not evaluated.</p> <p>Assessment BM: the case study aims to inform policy makers.</p>		
6.Contracts	Property rights enforcement , land tenure agreements	<p>There is no obligation to ensure soil quality in any land tenure contracts. This can be considered problematic in short-term tenure agreements because farmers might not have an interest to ensure long-term soil health themselves. In long-term contracts there is a natural interest of the tenant to ensure soil health.</p> <p>This problem might increase in the future as there is a tendency to offer shorter contracts. For instance, the government also owns some farmland, which is rented out on an annual basis to the highest bidder.</p> <p>A potential voluntary solution might be to promote the usage of indices such as the open soil index. The underlying software seeks to determine current soil quality based on soil type and management and provides information on how soil health could be improved. Landowners could demand soil health measures and control for the status of their soils using such solutions (Ros and Fujita, 2019).</p>	3	2
7.Validation and coherence	Mechanisms in place to measure impacts and ensure compliance to targets and limits	<p>There are no soil health monitoring programs in place.</p> <p>Other regulations such as the enhanced conditionality of the CAP might make indirect contributions to soil health. Farmers not complying with the enhanced conditionality requirements, for instance, face cuts in direct payments.</p>	1	1
8.Non-governmental actors	Role of different actors and multi-stakeholder coordination	The following non-governmental actors might be of importance to promote soil health: dairy and arable farmers, financial institutions and landowners, crop breeders and input suppliers, technology suppliers, feed suppliers, intensive livestock farmers without farmland, advisors, soil sensing providers, contractors, crop insurance	3	2



		<p>providers, real estate, and land agents, agricultural purchasers, distributors and retailers, certification bodies, farmers organisations, agricultural communities, NGOs, water users and nature managers, non-agricultural actors and knowledge institutions</p> <p>Their roles and expectations towards soil health are described in detail by Kik et al. (2021). In sum they find that different actors have different interests in the ecosystem services soils provide, while farmers and value chain actors are more interested in economic outputs (income provision for farmers), reg. governments and waterboards showed a stronger interest in environmental outputs.</p> <p>Assessment Policy: Some discussions with supermarkets took place to make the marketing of more environmentally friendly products easier (no result). (Nieuwe Oogst, 2022)</p> <p>Assessment BM: The case study only analyses how farmers view the business model carbon credit trade. However, the results might be of interest to other stakeholders.</p>		
<p>9.Allocation of resources and sources of finance</p>	<p>Available budget for soil health and blended finance</p>	<p>Agri-environmental schemes (AES): Currently the AES provide the main funding source. However, their payments on offer were perceived as being too low by some participants.</p> <p>In addition, some private value chain contracts for nature protection are / were available, for instance, by Friesland Campina or Heineken. However, interview partners pointed out that farmers constantly face a risk that these payments might be discontinued. A practical example of this is that, according to the participants, Heineken ended their funding programs for the Netherlands.</p> <p>Potential payments from carbon markets were described as too low to set incentives. Especially interview partners from farmers groups were critical, while interview partners from the certification bodies</p>	<p>4</p>	<p>3</p>



		<p>disagreed on this and stated the payments are attractive enough.</p> <p>In addition, interview partners from knowledge institutions pointed out that there is scientific uncertainty regarding the effectiveness of carbon farming on arable land and whether such payments will be possible overall. They considered afforestation and peatland rewetting as better technologies to ensure long-term storage.</p> <p>Assessment Policy: There is awareness that participation rates in nature protection activities are low for the Netherlands. Switches in the organisation of AES were implemented to better motivate farmers (Alblas and van Zeven, 2023). There were discussions with supermarkets to improve marketing of more environmentally friendly products. (Nieuwe Oogst, 2022)</p> <p>Assessment BM: In the case study's experiment farmers are offered payments from carbon markets and payments from the CAP as additional incentives (blended finance)</p>		
<p>10. Policy consistency with soil health</p>	<p>Synergies and trade-offs between policy sectors and towards soil ES</p>	<p>Some measures that can influence soil health and carbon storage such as the reduction of mineral fertiliser and pesticides align with goals of the waterboard, and goals of ministries (e.g., Ministry of Economic Affairs and Climate Policy).</p> <p>However, when water tables are considered there could be conflicts between waterboard and the ministries that seek for climate or environmental protection. The waterboard usually requires lower tables to prevent flooding, while higher water tables are of importance on peatland to reduce CO₂ emissions.</p> <p>Besides this, there could be negative effects when value chain partners push for lower emissions per kg, this can lead to a more intensive production. For instance, there is already a switch from permanent grassland to clover to increase productivity of dairy herds and reduce emissions per kg.</p>	<p>2</p>	<p>2</p>



		That different actors are interested in different eco-system services is lined out in detail by Kik et al. (2021) Assessment policy: Measures to prevent negative effects do not seem to exist.		
11.Contextual factors	Enabling and disabling conditions	Enabling conditions: Guarantees to receive attractive payments in the long run (some private nature protection contracts were discontinued in the past), attractive payments (both AES and payments from carbon markets are currently perceived as being too low), provision of additional non-financial incentives (e.g., loser requirements or higher organic fertiliser amounts being allowed for farmers managing their soil sustainable, more flexibility in contracts) Disabling conditions: Farmers need to be included in discussions (often ministries cooperate more closely with NGOs), already high requirements make it difficult for farmers to implement additional nature protection measures (soil health) and comply with regulation 2018/841 Assessment BM: some new incentives are tested in the case study's experiment. Assessment Policy: Policy seems to be aware of farmers dislikes and explored for improvements, e.g., for AES.	3	4

3 Policy directionality

The next section assesses how existing instruments (regulatory and economic) are able to support business model carbon credit trade. In general, policy instruments constitute the concrete tools to achieve overarching objectives and are usually associated with specific goals, i.e. the intended effect of instruments on the medium-long term.

3.1 Instruments

Below the three policy instruments being the most relevant to the business model carbon credit trade in the Netherlands are summarised. *The participants were asked to evaluate three incentives for soil health improvements i. carbon credit trade, ii. investment support, and iii. payments over the CAP.*

1. Carbon Credit Trade & the draft of regulation 2018/841)



2. Investment support

3. Payments over the CAP (Agri-environmental schemes for more advanced environmental goals and Eco-schemes for less ambitious environmental goals).

Carbon Credit Trade for EU-certified carbon credits is still in its development. Regulation 2018/841 already provides information on what carbon credit certification might look like. Overall, certified carbon credits should meet the so-called Q.U.A.L.I.T.Y criteria. The Q.U.A.L.I.T.Y criteria summarise the requirements for the removals - Carbon removals should be **quantified** in an accurate and robust way, should generate a net carbon removal benefit that is **additional** (above existing legal requirements & common practices), should ensure **long-term storage of carbon**, and have at least a neutral impact or offer co-benefits for other **sustainability** objectives to allow certification (European Commission, 2022). However, it remains to be seen whether soil health measures on arable land will be able to fulfil the requirements for European carbon credits. There are doubts about soil's ability to achieve long-term storage (Paul et al. 2023).

Investment support is relevant for the business model carbon credit trade. Investment support for technique relevant for carbon sequestration might help to motivate farmers to engage in the business model. Such investment support programs currently include support, for example for smart farming technologies (precision agriculture), or agroforestry.

The **CAP's** enhanced conditionality requirements are relevant because carbon credits can only be granted for sequestration that is additional. Thus, farmers will not receive carbon credits for carbon that might be sequestered by fulfilling the enhanced conditionality. The enhanced conditionality, for instance, already requires a catch crop in certain periods. Furthermore, multiple eco-schemes and agri-environmental schemes (subsidies) on offer in the Netherlands promote soil health. For instance, some AES promote the usage of catch crops in additional periods that are already required by the CAP.

Besides this, other policy instruments might also be of interest:

When farmers operate in more environmentally friendly ways, they could also try to sell these products for higher prices. **Labelling schemes** can help to signal to consumers that products are more environmentally friendly.

Research and development programs that seek to overcome uncertainty by identifying the most suitable carbon farming measures and evaluating soil's ability to store carbon in the long-term, might also be effective to promote carbon credit trade. Multiple research projects already exist in the Netherlands and the EU, Springer (2023) presents an overview of these projects.

Looking at Table 2 it appears that the incentives described mostly falls into the categories supply push and demand pull.



Table 2 Policy instruments available, those described to be relevant for the business model are in bold script.

PRIMARY TYPE	PURPOSE TYPE		
	Supply	Demand pull	Systemic
Economic instruments	RD&D* grants and loans, tax incentives, state equity assistance (investment support)	Subsidies (Payments over the CAP) , feed-in tariffs, trading systems (EU certified carbon credits) , taxes, levies, deposit-refund-systems, public procurement, export credit guarantees	Tax and subsidy reforms, infrastructure provision, cooperative RD&D grants
Regulations	Patent law, property rights; land tenure;	Technology/performance labels and standards, prohibition of products/practices (enhanced conditionality) , application constraints; public procurement	Market design, grid access guarantee, priority feed-in, environmental liability law Information (regulation 2018/841)
Information	Professional training and qualification, entrepreneurship training, vocational training, advisory (Offered by companies with early trials for carbon credits such as ZLTO)	labelling programs (achieve premium prices) , public information campaigns; consumers organizations	Education system, thematic meetings, public debates, cooperative programs, clusters

The participants in the interviews were asked to evaluate the above three instruments, and whether they will be able to improve Dutch soil health, and stipulate the uptake of carbon credit trade as a business model. The results of this evaluation process are summarised in Table 3.



Table 3 Assessment of policy instruments with respect to Carbon Credit Trade (adapted from Rogge and Reichardt, 2016)

PRIMARY TYPE	PURPOSE TYPE		
	Supply	Demand pull	Systemic
Economic instruments	<p>State equity assistance (investment support)</p> <p>Assessment – poorly targeted</p>		<p>Cooperative research and development grants</p> <p>Assessment: can contribute to better data availability, to identify the best measures and resolve uncertainty</p>
Regulations		<p>Prohibition of Production Practices (Enhanced conditionality)</p> <p>Assessment – effective</p>	<p>Environmental liability law information (regulation 2018/841)</p> <p>Assessment: additionality requirement is evaluated to be difficult to fulfil by farmers</p>
Information & Education	<p>Professional training and qualification, vocational training, advisory</p>	<p>Labelling programs</p>	



Assessment: useful but not effective to promote costly adjustments alone

Assessment: potentially effective, demand for environmentally friendly products / carbon credits currently evaluated as low

Description

The framework for **carbon credit trade** is still being finalised. The certification process is still under discussion, and there seems to be a need for further research (whether soil health practices can lead to long-term carbon sequestration). In this case, carbon credit trade might be effective to promote more sustainable farm practices as it allows financial remuneration.

Payments over the CAP & the enhanced conditionality requirements were described as effective in implementing stricter measures. Almost all farmers receive CAP payments and, therefore, need to comply with the enhanced conditionality. However, when farmers seek to generate carbon credits, they will need to implement measures above those already demanded by the CAP. Farmers described this already to be difficult and pointed out that it would become even more difficult when the enhanced conditionality became more demanding.

State equity assistance (Investment support): Investment support might promote the adoption of carbon farming practices such as conservation tillage. How well these programs are picked up for technique that supports soil health was unknown, the programs offer support for various techniques and farmers might prefer other machines.

Besides reaching climate neutrality goals; retailers and farmers could try to achieve premium prices by labelling more environmentally friendly products. **Labelling programs** might help to generate additional payments for farmers on top of income from the sales of carbon credits.

Research and development grants can help to develop improved certification processes of carbon credits, identify the most suitable measures, and resolve the described uncertainty.

Training and qualification on how to promote soil health were described as an effective tool by farmers' organisations to promote soil health. However, the participants emphasized that viable



business models that allow farmers to generate new income streams are necessary and raised doubts that training and education alone will effectively promote soil health improvements. They also pointed out that Dutch farming is highly intensive and farmers can hardly afford to adjust management practices at their own costs.



Below some additional information relevant for the evaluation of the three policy instruments are summarised:

- *who is the target of this instrument,*

All instruments target farmers

- *does this instrument serve to implement an EU objective*

Carbon Credit Trade: The EU's Green Deal describes various actions that aim to ensure climate neutrality of the EU by 2050, and multiple other sustainability goals.

The CAP itself aims at affordable food and decent incomes for farmers. In addition, the CAP aims to promote a sustainable food system, climate action and the transition towards a sustainable food system. These goals are supported through CAP payments (AES and payments for eco-schemes), and by demanding certain action from farmers (enhanced conditionality).

Agri-environmental schemes (Pillar 2 payments) promote more ambitious environmental goals and are also important to reach the EU's biodiversity strategy.

Besides these, the creation of an environmentally friendly food system is also an objective of the Farm to Fork strategy.

- *is this instrument based on obligations of result or action-based?*

Most instruments (agri-environmental schemes and investment support programs) are action-based. However, the Dutch eco-schemes use a point system that is related to the expected outcomes and considered result-based. This is explained in detail by Jongeneel & Gonzalez-Martinez (2023).

Carbon Credit Trade is result-based, the carbon amount stored will be measured, certified, and sold as a carbon credit.

- *what are the sanctions in the event of non-compliance?*

Non-compliance with enhanced conditionality requirements results in financial penalties, including reductions in direct and rural development payments.

Inspections and monitoring ensure adherence to environmental and agricultural standards. Farmers have the opportunity to correct non-compliant practices but face administrative penalties for serious or repeated violations.



When not reaching the threshold necessary for result-based AES or when they do not comply with requirements in action-based AES, farmers will not be paid. In case farmer do not meet the requirements because of factors out of their control (weather) there will be negotiations about penalties.

Farmers will be liable when participating in EU Carbon Credit Trade. They need to ensure long-term storage. Possible responses to these liability risks might be insurances, or the provision of additional area that can be used as a backup.

- *does this instrument directly or indirectly target soil health?*

Payments over the CAP are bound to the enhanced conditionality requirements that often aims at biodiversity, water protection and other environmental objectives. There are nine standards:

- *Permanent grassland (ratio of grassland may not fall by more than 5% at national level)*
- *Protection of wetland and peatland (carbon rich soils)*
- *Ban on burning arable stubble*
- *Buffer strips along water courses*
- *Tillage management*
- *Minimum soil cover*
- *Crop rotation*
- *Non-productive area and features (4% at farm level)*
- *Ban on converting and ploughing permanent grasslands in Natura 2000 sites*

Soil health improvements can be a side effect and are often not the main objective. Exceptions to this might be tillage management and minimum soil cover, these might directly address soil health of arable lands.

Investment support is granted for multiple machines, and soil health improvements are not the only objective. Positive side effects for soil health might result from investments in machinery that lead to reduced fertiliser usage (precision farming / smart farming). In addition, some investment support payments directly aim at soil health: investment support for the usage of tires with higher pressure that reduce soil compaction, or investment support for machinery that is relevant for conservation tillage (and therefore carbon sequestration).

Carbon credit trade indirectly targets soil health.

3.2 Policy narrative

This section first provides information on the Dutch strategy to restore and maintain soil health (Soil health strategy), before providing some information relevant for the analysed business model (Carbon Credit Trade), even though no strategy is officially described for both subjects.



Building on Andrews (1987) and Porter (1980), a policy strategy can be described as a combination of policy objectives and the principal plans for achieving them.

“Soil strategy”

Objective: “The soil policy in the Netherlands focuses on using the soil in a conscious and sustainable manner. This involves protecting the health of people, plants and animals, whilst allowing the soil to be used for support of economic development” (Rijkswaterstaat, 2009).

Principal plans: Development of protection strategies on the level of municipalities and together with waterboards.

Even though the strategy was released a relatively long time ago, the participants felt that little attention is given to soil health and that little action followed. This might be because other adverse effects from intensive agricultural production seemed more important (nitrogen surpluses, loss of biodiversity).³

Carbon Credit Trade (Koolstoflandbouw)

There is no clear strategy described but carbon credit trade and carbon farming seem to be positively perceived. This is because carbon farming measures allow to reduce greenhouse gas emissions and reach climate neutrality goals of the Dutch government and the EU, while allowing to provide additional income to farmers.

Principal plans: Implementation of the EU’s regulation for carbon credit certification and trade. The regulation and the Q.U.A.L.I.T.Y also appear to be positively acknowledged as they will allow to generate reliable and transparent reductions (Tweede Kamer der Staten-Generaal, 2023).

Policy narratives are defined as the key words and concepts that express the political understanding of a problem, e.g., soil health. Below the policy narrative for carbon credit trade is described further using the bullet points:

a. Local policies and adopted incentives

According to the participants little action resulted directly from the soil strategy. For carbon credit trade the implementation of the EU regulation 2018/814 is on its way.

b. Management strategies and key soil functions

³ Looking at agricultural policy in general, the Netherlands have taken measures to address the other challenges of adverse effects of agriculture. These measures might have indirectly contributed to improving soil health, even if they did not result from the soil strategy. For example, there has been a change in the organisation of participation in contractual nature conservation (agri-environmental schemes); these activities are now organised by farmers' collectives to make them more attractive (Alblas and van Zeben, 2023). In addition, a program that has bought pig farmers out of production to avoid nitrogen surpluses may also have helped to improve soil health. Furthermore, as in other countries, the conversion to organic farming is being promoted, where soil health measures are more common.



Carbon credit trade – Management strategy: Implementation of the EUs regulation, development of a certification framework with Stichting nationaal koolstofmarkt

In addition, it is discussed to stipulate the demand for carbon offsets by discussing with supermarkets whether they would buy carbon credits to offset their own emissions, or to sell products from farms that apply carbon farming practices for higher prices (Nieuwe Oogst, 2022).

The soil function mainly addressed is carbon sequestration.

c. Addressed ecosystem services for soil health, namely:

The business model Carbon credit trade is strongly focused on the ES: Economic viability and climate control.

In addition, the EUs regulation foresees that carbon credit generation should not result in negative effects for food production. Hence the business model is also indirectly focused on retaining plant production.

Improvements for biodiversity and better water quality might also result as side effects from carbon farming activities.

Detailed evaluation of the ecosystem services generated by Carbon Credit Trade (based on expert interviews)⁴

- **provide food and biomass production, including in agriculture and forestry (plant production)**

Yes, carbon farming (coupled with Carbon Credit Trade) will still allow agricultural production.

- **absorb, store and filter water and transform nutrients and substances, thus protecting groundwater bodies (water quality)**

Yes, depending on the activities at the farm level positive effects can occur (e.g., when plating additional catch crops or reducing mineral fertilisers)

- **provide the basis for life and biodiversity, including habitats, species and genes (biodiversity)**

Yes, positive side effects could be possible from wider crop rotations and additional cover crops.

⁴ It is important to note that one of the experts evaluated carbon farming on arable land as unsuitable for carbon credit generation. This is because longterm sequestration of carbon might not be ensured when applying soil health practices on arable land (Paul et al. 2023). The expert thus stated that the analysed businessmodel cannot result in any of the above listed ecosystem services.



However, the positive side effects for biodiversity are considered to be the highest when rewetting peatland or planting trees (afforestation and agroforestry) not for soil health activities

- **act as a carbon reservoir (climate control)**

- Yes, the business model Carbon Credit Trade is mostly directed towards this ecosystem service.

- However, there is uncertainty whether and to what extent arable land will be able to act as a carbon reservoir

- **provide a physical platform and cultural services for humans and their activities (Economic viability)**

Yes, farming, and other activities remains possible when applying soil health measures on arable land. The landscape might become more attractive for tourism.

- **act as a source of raw materials (Plant production)**

Yes, farming remains possible when applying soil health measures on arable land

- **constitute an archive of geological, geomorphological and archaeological heritage.**

The surrounding might become more attractive when crop rotations become wider, more cover crops or additional trees or other woody elements are planted.

The most important aspects are summarised in tables 4a and 4b.



Table 4a Description of the policy narrative – Soil Strategy (based on Lehmann et al, 2020)

Policy narrative (and scale of action)	Policies and incentives in place	Management strategies in applied	Soil functions interested	Ecosystem services addressed
Soils should be managed in a sustainable manner. This includes the protection of soil health, habitats but also the productive use of land (economic development). Scale: strategies are developed on a regional scale (municipality level and together with waterboards)	Little action resulted from the soil health strategy itself However, improvements in the organisation of AES (collective implementation) or other political programs that aimed at the reduction of nitrogen surpluses likely improved soil health indirectly.	The Netherlands implement EU strategies and requirements for climate-, and environmentally friendly agriculture.	Habitat Provisioning Water cycling Nutrient cycling Primary productivity	Climate control Economic viability Plant production Biodiversity Water quality

Table 4b Description of the policy narrative for Carbon Credit Trade (based on Lehmann et al, 2020)

Policy narrative (and scale of action)	Policies and incentives in place	Management strategies in applied	Soil functions interested	Ecosystem services addressed
Carbon credit trade might help to reach the EU's and national climate neutrality goals: It allows to generate negative	Carbon Credit Trade for EU certified credits does not exist yet. Therefore, no incentives can be described	Implementation of the EU regulation for carbon credit certification and trade (Promotion of transparency	Carbon sequestration (Mostly)	Climate control Economic viability Biodiversity



<p>emissions in one sector to reach reduction goals in sectors with hard to offset emissions.</p> <p>As a positive side effect carbon credit trade is expected to generate new streams of income for farmers.</p> <p>Scale: national (certification framework is developed together with Stichting nationaal koolstofmarkt)</p> <p>(Tweede Kamer der Staten-Generaal, 2023)</p>	<p>In general, the business model offers market based payment for the credits.</p> <p>Possible additional incentive discussed: In the previous legislative period it was discussed to negotiate with supermarkets whether they would contribute via premium prices for products resulting from carbon farming (Nieuwe Oogst, 2022)</p>	<p>and accountability)</p> <p>Promoting the national demand for carbon credits</p> <p>(Engagement with citizens and businesses)</p>		<p>(Mostly)</p>
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4 Mapping exercise

4.1 Synthesis of the value mapping

This section contains information on the perception of the business model carbon credit trade. It seeks to map out the level of awareness, the contributions of the business model to soil health, and the value distribution between the business models stakeholders. The experts came from knowledge institutions (2), certification bodies (1), farmers' associations or farmers' collectives (2), or were engaged in farming (1).

What are the causes of degradation?

- Intensive agricultural usage - overfertilisation, uniform crop rotations...



- Urbanisation and the loss of areas for farming
- Climate change – floods and droughts

However, the experts did not uniformly agree that the status of Dutch arable soils is in poor condition. Especially the status of owned arable land was described to be good by some participants.

Nevertheless, for grassland it was more uniformly agreed that farmers further intensified their practices. They switched from permanent grassland that better ensures soil protection to clover that is renewed on an annual basis. Furthermore, the participants uniformly mentioned urbanisation as a treat.

What are the socio-technical solutions proposed (BM)?

The proposed business model (Carbon Credit Trade) stimulates farmers to implement less intensive soil health measures (e.g., additional cover crops, reduced tillage, organic fertiliser, agroforestry) by offering an additional source of income from carbon credit sales.

Why do soils matter in the BM?

Soils matter because they might be usable as carbon reservoirs.

What soil ES are targeted by the business model?

Main ES targeted: Climate control, economic viability

Positive side effects: Biodiversity, improvements of the landscape for tourism (economic viability)

Carbon farming activities that result in biodiversity improvements can display these on the carbon credit certificates. These certificates are assumed to have an additional value that could lead to higher prices for the certificates.

What soil ES are not provided / neglected?

ES other than climate control and economic viability can occur as a side effect, but they are not part of the business model. These ES include improvements in water quality or the esthetic value of the landscape (recreation).

The experts highlighted that the possibility to further produce agricultural products (ES – plant production) is of importance and that, in their opinion, other carbon farming practices that reduce the useability of the farmland (peatland rewetting) will be less accepted. Meaning farmers highly value the ES plant production.

Public/private - who can benefit from those values?

Private benefits: additional income to farms, premium prices in retail for more environmentally friendly products (additional income to farmers, additional turnover retail), additional sales of machinery, pesticides, or seeds necessary for carbon farming practices (additional turnover distributors)



Public benefits: climate control, biodiversity, water quality, recreation

What trade-offs emerge? Are the causes addressed?

Short term yield losses are possible when first applying carbon farming practices. For instance, it takes time for the bacteria in the soil to adjust and to be able to process more organic fertiliser. The requirement to use more or exclusively organic fertilisers is commonly included for carbon farming (adjusts over time).

Implementing some of the measures requires new machinery, which can strain farm financial resources (addressed through investment support). The revenue streams and the associated risks are currently not predictable.

What soil ES are targeted by the incentives?

Main ES targeted: Climate control, economic viability

Positive side-effects: Biodiversity

How is value distributed along the stakeholders?

Carbon farming is still in its development. In early trials, farmers implemented the activities, for instance, with banks such as the Dutch Rabobank (Rabo Carbon Bank).

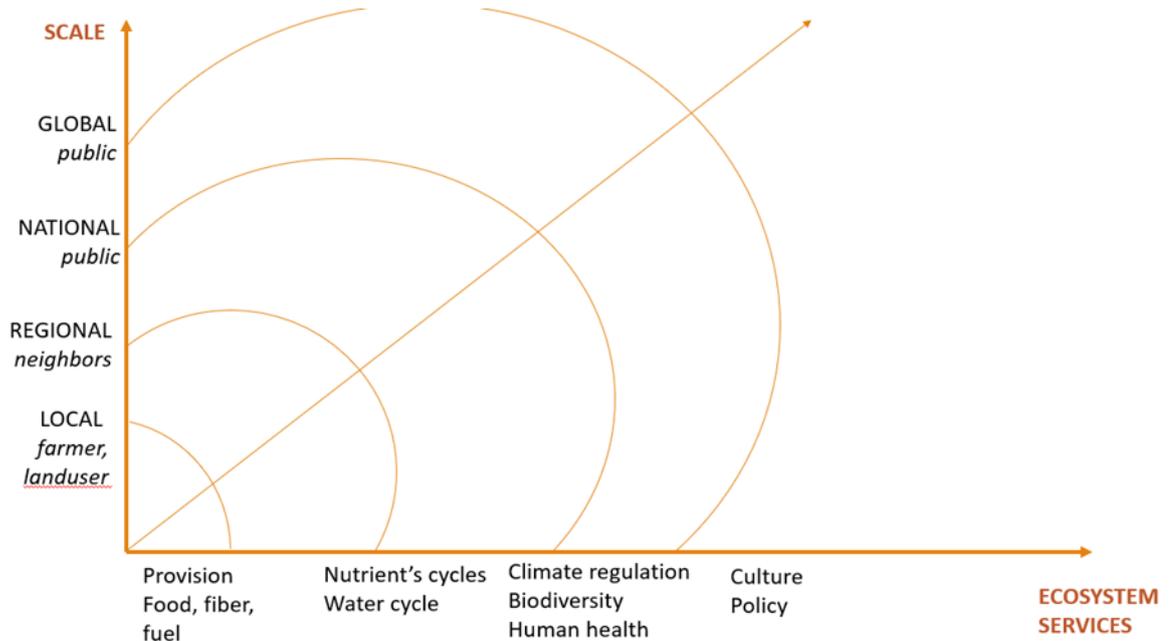
Rabobank provided advice on adjusting farm management practices and handled the certification and the sales process.

In return for their services, they have a share of the achieved sales price (20 %). Such agreements appear to be common in early carbon credit trade trials.

Where do the resources come from (public/private)?

Private sources – Carbon Credits are sold to private companies that aim to offset their emissions or claim climate neutrality.

Graphically display, how is soil health described and framed by the business model?



4.2 Solution mapping synthesis

Finally, participants were asked to discuss the needs changes for the development of soil health BM. The results are summarised below and placed into a pathway map to show when actions should be taken (Table 5).

a. What innovations and changes are we looking for?

Precision agriculture technologies can make the use of fertilisers and pesticides more efficient and allow for reductions (important for carbon farming, where fertiliser and pesticide reduction are often foreseen)

Upfront investments for carbon farming technologies could be supported. Investment support for machinery is available but poorly targeted. Farmers prefer machines making their farms more efficient but not necessarily machines making their farms more environmentally friendly.

Carbon farming at current prices is unattractive – better incentives are necessary. These could be financial or non-financial. Such incentives can be created by allowing for looser legislative requirements. For instance, to allow more organic fertilisers on grassland again, when the farm uses carbon farming practices and already improved water quality.

When working on solutions for over-fertilisation in certain areas (e.g., the development of compost for tulip production regions), farmers' associations criticised that they receive little support and encouragement from public entities. Better networks and improved trust would be necessary.



b. What regulatory and policy conditions would we need?

- viable business models are necessary for farmers to implement soil health technologies (viable mostly meant to be economically attractive in the discussion)
- current financial incentives by the sale of credits are often described as too low to be effective
- the participants stated that farmers might be more interested in alternative private market-based solutions (developing solutions within the value chain)
- These solutions could include to offset emissions for a business partner (e.g., a dairy company) and to receive higher prices for products produced under carbon farming practices
- Policy should promote the development of such business models. Currently, some participants feel that they have too little freedom to develop their farms further because the policy is strongly focused on environmental protection, which can limit farmers' freedom to develop business models.

c. What regulations (binding or not) and resources (new incentives) are needed?

- Legal stability: Legislation needs to become more reliable (currently, the requirements are adjusted too frequently, making it difficult for farmers to fulfil the additionality requirement in regulation 2018/841)
- Legislation should not be tightened according to farmers because the generation of carbon credits would become more and more difficult
- CAP payments: The CAP payments available for soil health measures are often considered too unattractive, and investment support could be better targeted
- Knowledge provision: Little is known on the best carbon farming practices and the expected amounts (best practices cases need to be described and presented)
- More research is needed on whether soil health measures fulfil the QU.A.L.ITY criteria.

d. Is there some contradictions between tools and/or policies?

The enhanced conditionality of the CAP and other regulations, e.g., for water protection contribute to a better soil protection, even though soils are sometimes not the main objective.

The enhanced conditionality already prescribes, for instance, a minimum soil cover in autumn / winter, or a certain amount of



nonproductive land. These are measures that might lead to some carbon sequestration already.

It is difficult for farmers to offer better environmental protection and to farm less intensively. Therefore, farmers already face difficulties to implement measures that are indeed additional (above measures already required by law, by the CAP, or in agri-environmental schemes). When regulations would become even stricter it becomes harder to fulfill the additionality requirement.

Considering other policies to promote soil health, agri-environmental schemes can also motivate some farmers to pick up carbon farming practices. Combinations of AES and carbon credit trade might be attractive.

When combinations of AES payments and payments over carbon markets will not be possible farmers will have to pick one or the other.

e. What could be the effect of the soil monitoring law?

The soil monitoring law could lead to a better collection of data necessary for the standardised baseline. The standardised baseline represents how much carbon is stored on farms using common farm practices for the area.

The carbon amount that farms with carbon farming practices have is compared to the carbon stored on a farm with standard practices. Based on this comparison, the amount of carbon stored in addition can be calculated, certified, and sold as carbon credits.

Larger-scale soil monitoring might also make the reductions stated more reliable. This could be beneficial for the attractiveness of carbon credits but also for the image of farmers, as farmers can more reliably state to contribute to the mitigation of global warming.

In addition, data collection might also help to identify the best carbon farming practices and resolve uncertainty about whether soils can store carbon effectively and long term.

f. What contractual solutions and terms and what kind of guarantees are needed for business model implementation? (e.g. certification)

Farmers stated to be more interested in market-based solutions with, for instance, value chain partners.

The contracts need to be long-term, reliable ('long term partnerships') and fair.

Fairness referred to having clear terms and conditions, a fair risk distribution (e.g., price, liability risks), purchase guarantees, third party monitoring, and some degrees of flexibility (allowing contract revisions, successors to discontinue the contract).

All of this might help motivate farmers to accept the necessary long-term contracts.

g. What resources could facilitate the change?



Research and Development: contract solutions, improved monitoring, and innovative business models to generate income from environmental protection activities.

Additional non-financial incentives: looser environmental protection requirements (when certain environmental goals are met by applying carbon farming methods)

Better trust and support from local authorities when developing new, innovative business models.

Improved Financial Support: investment support for machines, and expensive adjustments such as agroforestry exist but is often not well picked up, or targeted.

Table 4 Pathways mapping

	Short term (up to 3 years)	Medium (3 - 7 years)	Long term (after 7 years)
INNOVATIONS			
Regulations and binding policies	Less frequent changes (political / legislative stability)	Less frequent changes (political / legislative stability)	Less frequent changes (political / legislative stability)
Incentive instruments	Improvements of incentives (e.g., investment support)	Improvements of incentives (e.g., investment support)	Improvements of incentives (e.g., investment support)
Contractual solutions	Fair contract solutions need to be developed	Building partnerships	Maintaining partnerships
Infrastructure	Development of a vital carbon market (fair contract solutions, sufficient demand etc.)	Building a vital carbon market	Maintaining a vital carbon market
Product		Better awareness for environmentally friendly products (consumer)	



Services	Research on best soil health technologies	Improved training and education on these best soil health technologies	Best practice case studies and example farms
Technology	Research on best soil health technologies	Targeted investment support	Continuous, targeted investment support
Institutions	Trust and support (business model development)		
Actors' configuration	n.a	n.a	n.a
Coordination mechanisms and partnerships	Cf. contract solutions		
RESOURCES			
skills, knowledge, R&D	Cf. Technology, infrastructure		
DRIVERS: social habits, economic, environmental		Cf. product	

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