WETLAND RESTORATION PROJECTS AS A TOOL FOR CLIMATE MITIGATION

Impacts of social and natural factors on the *Sejersbæk Kog* project

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Abstract

Rewetting drained wetlands has gained attention within climate mitigation efforts over the last decades, and is increasingly seen as a crucial measure to drive down emissions in the agricultural sector. In 2021, the Danish government announced plans to rewet 100.000 hectares of drained wetlands - plans which might turn out to be an incommensurable task. While scholars generally agree on the climate benefits of rewetting drained wetlands, the rewetting is no simple feat, as a multiplicity of factors and their interconnections may impede or make possible rewetting. This report aims to explore such interconnections in the south of Denmark and subsequently asks: *How do natural and social factors enable or disable the rewetting of lowlands in Sejersbæk Kog?*

Answering the research question, the report applies an interdisciplinary and multi-method approach. It identifies soil project thresholds and landowners' participation as key variables for enabling or disabling the Sejersbæk Kog-project, and examines such through the conduct of soil sampling, a questionnaire and several semi-structured interviews. It finds that the soil properties are not disabling the project per se, but that these are influenced by management practices. It finds that landowner participation is influenced by governance perceptions and perceptions of future uses, which however interconnect in two distinct attitudes towards the project. These attitudes interdependently constitute a potentially enabling and disabling posture towards the project. Collectively, the key factors comprise a web of considerations forming part of a broader discourse, which influence the viability of rewetting Sejersbæk Kog.

Keywords: carbon storage, climate mitigation, governance, participation, phosphorus leaching, rewetting

Word count: 11.677

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Mitigation group

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List of abbreviations

Abbreviation	Item
CC	Carbon Credits
DOF	Dansk Ornitologisk Førening
EU	European Union
GHG	Greenhouse gas
NBS	Nature based solution
UNFCCC	United Nations Framework Convention on Climate Change
SK	Sejersbæk Kog

1. Introduction

Wetlands which have been drained for agricultural use are no longer acting as carbon and nutrient sinks. Thus, over the last decades, many measures have been taken globally to restore drained peatlands (Kreyling et al., 2021). In Denmark, drained wetlands in agricultural production comprise approx. 7 % of all agricultural land, but account for half of all CO2-emissions from croplands (Klimarådet, 2020a). Rewetting is thus increasingly seen as a central instrument in driving down emissions in the agricultural sector, emphasised by the more than 200 completed rewetting projects in Denmark.

In 2020, the Danish government implemented a new Climate Act, aiming to reduce greenhouse gas emissions by 70% in 2030, and reach full climate neutrality by 2050 (Klimarådet, 2020b). Conforming to this plan, in 2021 the Danish government announced its intention to rewet 100 000 hectares of wetlands currently in production. Yet, rewetting wetlands is by no means a simple task. For a rewetting project to be eligible for state funding it must meet minimum requirements for storing carbon while averting phosphorus leaching (Miljøstyrelsen, 2021). Additionally, the government's conversion schemes depend on the voluntary participation of the landowners. The successful restoration of wetlands, therefore, is conditioned on a variety of natural and social factors.

All of these overlapping factors are on display in *Sejersbæk Kog* [SK] where a rewetting project of 690 ha managed by Naturstyrelsen (the Danish Nature Agency) is currently undertaken. Based on existing maps of carbon content in the soil, it is projected that ≈8,000 tons of carbon could be retained by rewetting the lowlands in the project area (Naturstyrelsen, n.d.). Thus, SK is an ideal exhibition site for exploring the overlapping social and natural factors that inform the viability of rewetting projects.

1.1 Literature review

Interest in restoration of wetlands primarily pertains to their potentials for climate mitigation, as they can curb CO2-emissions from drained agricultural soils (Baumane et al., 2021). When wetlands are drained, the decomposition rates increase as the soil enters an aerobic state, which creates higher rates of CO2-emissions (Tanneberger et al. 2021). Thus, immediate reduction of carbon loss occurs following rewetting, and generates potential for further carbon sequestration (Kreyling et al., 2021). Although there is much support for rewetting projects as a promising emission reducing mechanism – many uncertainties remain in relation

to estimating said reduction. This ties to the concept of carbon credits [CC]. The carbon market was born in the early 1990s and was made official in the United Nations Framework Convention on Climate Change (Michaelowa et al., 2019). Its main goal is to incentivise businesses to reduce emissions through credits, which can be exchanged on a market. Carbon transactions can be divided in two categories: allowance based-transactions, which are permits to emit, and project-based transactions, in which a project that reduces GHG-emissions generates CCs. Project based transactions are the most risky ones, as they are based on calculations about future emission reductions (Singh, 2009). In addition to carbon content, in wetlands, bulk density and aerated nitrogen stocks might also influence the emission rate (Tiemeyer et al. 2020). When rewetting drained wetlands, iron-bound phosphorus in the soil gets mobilised, which can lead to eutrophication in nearby water bodies. Nutrient leaching is of particular concern in project areas where the land is and has been intensely cultivated, as the amount of phosphorus depends on the fertiliser use (Meissner et al., 2008). Thus, in addition to meeting the required reduction in CO2-emissions, Danish rewetting projects must avert P-leaching to be eligible for funding (Miljøstyrelsen, 2021). Assessments are conducted before implementation to estimate the risk, including analysis of the quantity and distribution of phosphorus (Hyvärinen et al., 2012).

Biodiversity enhancement is widely viewed as a co-benefit of rewetting projects, but it might not be as promising as suggested in terms of plant biodiversity (Soini et al., 2010; Baumane et al., 2021). Bird populations in European farmlands have rapidly declined over the last 40 years, as grasslands have been replaced by monocultural fields, shallow surface drains have been replaced by underground drains and degraded soil structure due to heavy machine use (Onrust et al., 2019). Rewetting projects have proven to be a promising way of providing breeding habitats for declining meadow birds. After raising the water table in parts of *Tøndermarsken*, a wetland area close to SK, meadow birds have recently returned to breed after years of absence (Fritidsmarkedet, 2020).

Kabisch et al. (2016) provide an overview of Nature-based Solutions [NbS]. This concept includes the maintenance, enhancement and restoration of ecosystems as a tool to address environmental concerns such as climate change and flood risk. A relevant aspect of NbS is that they include actions "which are inspired by, supported by, or copied from nature" (European Commission 2015). Therefore, we deemed it relevant for the SK-project. The authors identify knowledge gaps about NbS. These pertain to NBS' effectiveness in terms of trade-offs between ecosystem services and impacts on economic and social aspects, the relationship between NbS and society, the design of NbS and the implementation aspects.

(Kabisch et al., 2016). Therefore, Kabisch et al. (2016) clearly call for analyses of nature restoration projects which focus more on their social and economic implications.

For a more in-depth analysis of the relationship between NbS and society, we aim to dig into the participation of the landowners to the project, specifically into their perceptions of the project and what factors influence their decision to participate. In previous research, the dominating analysis tends to emphasise the centrality of the age of landowners and financial considerations as some of the most crucial aspects in their decision-making (Buschmann et al., 2020; Feng et al., 2020; Franzen et al., 2016; Graversgaard et al., 2021). A study conducted in Denmark on reconstructed wetlands shows how the four main barriers to landowners' participation are the application process, the amount of paperwork, economic factors, and whether the constructed wetlands would replace other farm agri-environmental requirements. Moreover, the authors concluded that most farmers are unsure about the benefits of restored wetlands (Gachango and Jacobsen, 2017).

Polman and Slangen (2008) highlight the importance of trust in governing institutions for the participation of farmers in agri-environmental contracts, and how a key variable for this trust to be built is consistency over time (Polman and Slangen, 2008). Kabisch et al. (2016) define governance of NbS as the amount of different stakeholders involved in the managing and monitoring of a project, and also identify it as a main indicator to assess its success. Moreover, a variety of scholars emphasise the importance of local contextual factors for the viability of rewetting projects. Rawlins and Morris (2010) e.g. point to conflicts around land use interests as obstructing rewetting. Schaller *et al.* (2011) equally point to stakeholder cooperation as a key variable. This 'local' emphasis thus suggests that there is a demand for exploring such contextual and perceptual factors, which is further stressed by Buschman *et al.* (2020: 12) stating that future research "...could provide a better understanding of the farmers' motives by researching variables such as socioeconomic attributes, history of use and norms…".

1.2 Research questions and analytical framework

Table 1. Research questions.

Research Question
How do natural and social factors enable or disable the rewetting of lowlands in Sejersbæk Kog?
Sub-questions
What factors inform landowners' participation in the SK-project?
How do these factors interconnect and form patterns shaping landowner participation?
Does the carbon content meet the threshold for carbon storage projects?
Are there indications that the SK-project will cause Phosphorus leaching into the aquatic environment?
How does the current and historical land use influence the carbon content and phosphorus leaching?

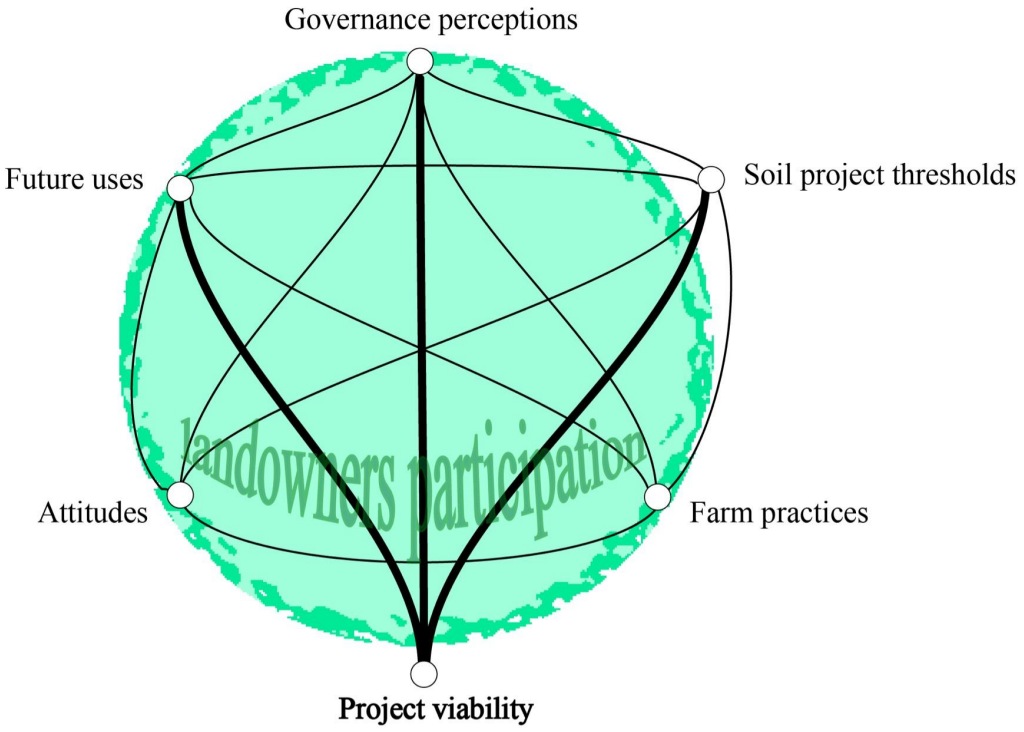

Figure 1. Analytical framework

To examine the viability of the project, we identify two factors as being crucial. First, we examine if soil project thresholds mentioned in the following section are met and how these properties are tied to historical land uses and in turn how historical uses are tied to perceptions shaping participation. Second, we investigate the landowners' participation, based on our literature analysis and the knowledge gap presented. We thus explore how governance perceptions and possible future uses of the area are influencing participation.

2. Background

2.1 The *Sejersbæk Kog* Project

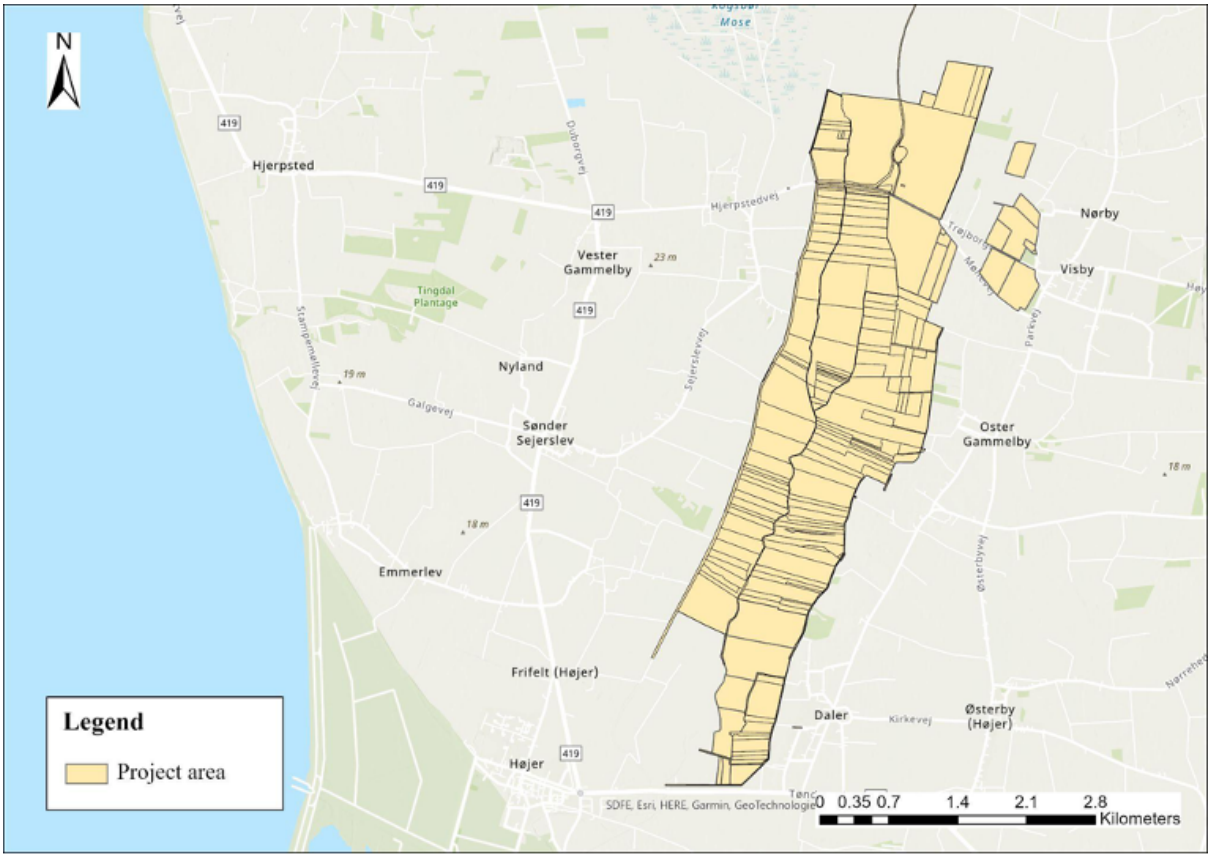

Figure 2. The SK-project area.

Located in Tønder, southern Denmark, *SK* is a river valley comprising drained wetlands with elevation going as low as -0.89 m below sea level (Fig. 3). The SK-project area has rivers passing through and artificial ditches, and forms part of the 10th biggest wetland area in Denmark (Naturstyrelsen, n.d.).

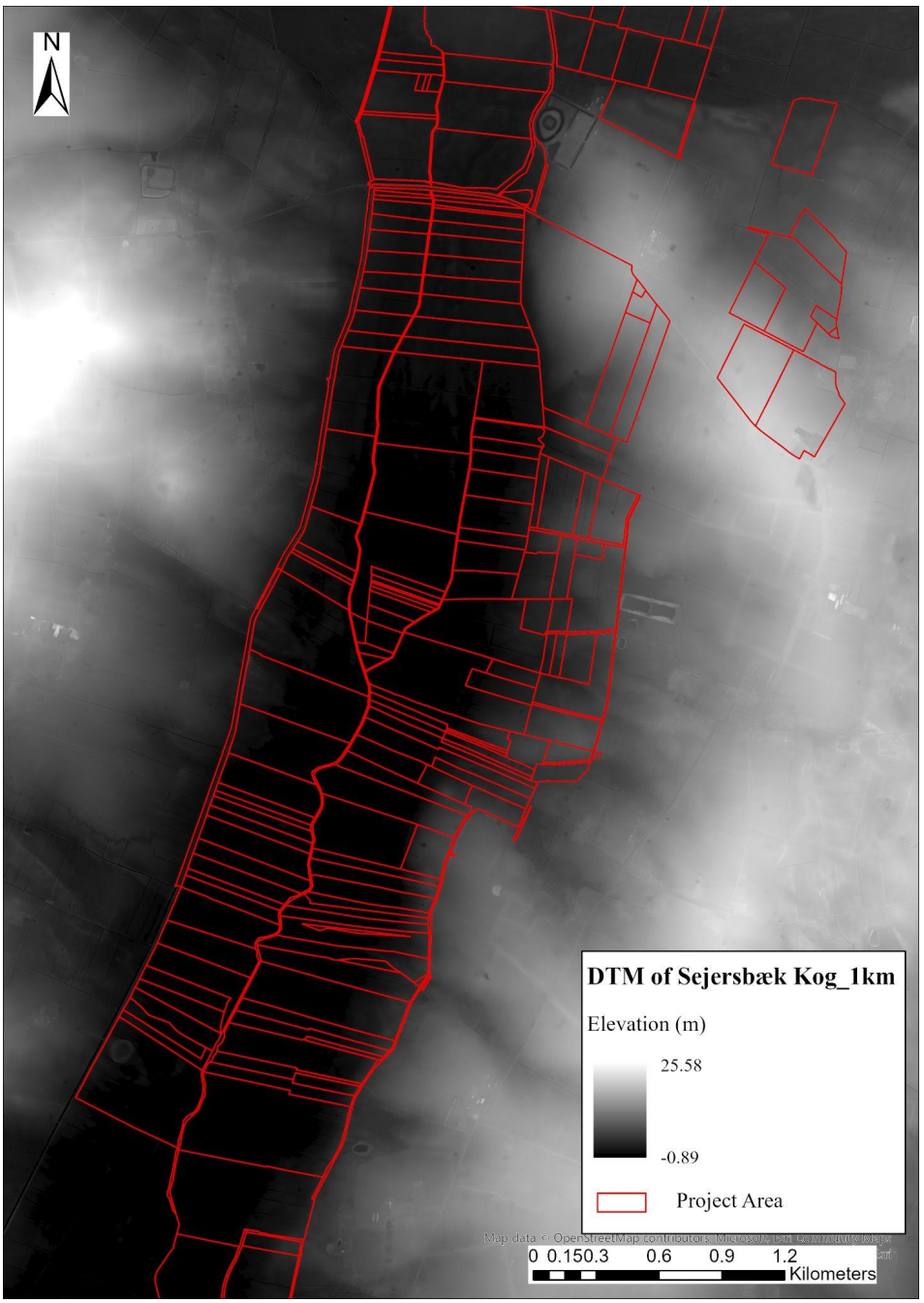

Figure 3. Digital Terrain Model displaying the elevation of SK.

Artificially drained peatlands lead to immense emissions of CO2, but these emissions can be curbed by rewetting the lands (Tanneberger et al., 2021). The *SK*-project aims to take ≈700 hectares out of production (see Fig. 2), and subsequently raise the water table by closing trenches. *SK* is in close proximity to two Natura 2000 areas, *Kogsbøl Mose* and the Wadden Sea. Thus, rewetting the area would create the co-benefit of reduced nitrogen discharge into sensitive environments. SK can also be used as climate protection for the city of Tønder, both by storing water during storms and being a source of clay to build protective dykes.

The project works on a voluntary basis and will not be implemented without the support of the affected landowners (Naturstyrelsen, n.d.). Currently, the vast majority of the area consists of conventional agriculture, with annual crops and conventional tillage practices. Such practices are not feasible in combination with higher water tables, and rewetted peatlands are therefore often used for non-producing purposes such as biodiversity measures (Tanneberger et al., 2021). In SK, there are two possible compensation mechanisms. Either, the landowner keeps the land and receives a one time monetary compensation, as the non-productive land will have less value - or participate in a land distribution scheme. Then, the land is sold to the government and the landowner acquires new land (Naturstyrelsen, n.d.). If this option is chosen, the landowners have the possibility of repurchasing their land in the project area once rewetting has been completed.

The project is run by two project managers, who primarily approached all landowners individually. Following, an open meeting was held with all affected landowners. On this occasion, a landowners committee was established, consisting of five landowners. The committee was tasked with pricing the land plots in SK. The evaluation is based on i.a. cultural conditions, surface form and elevation, presence of windmills, potential impacts of EU-subsidies and road conditions (Appendix 8.6). The valued fields, indexed between 0 and 100, can be found in appendix 8.6.

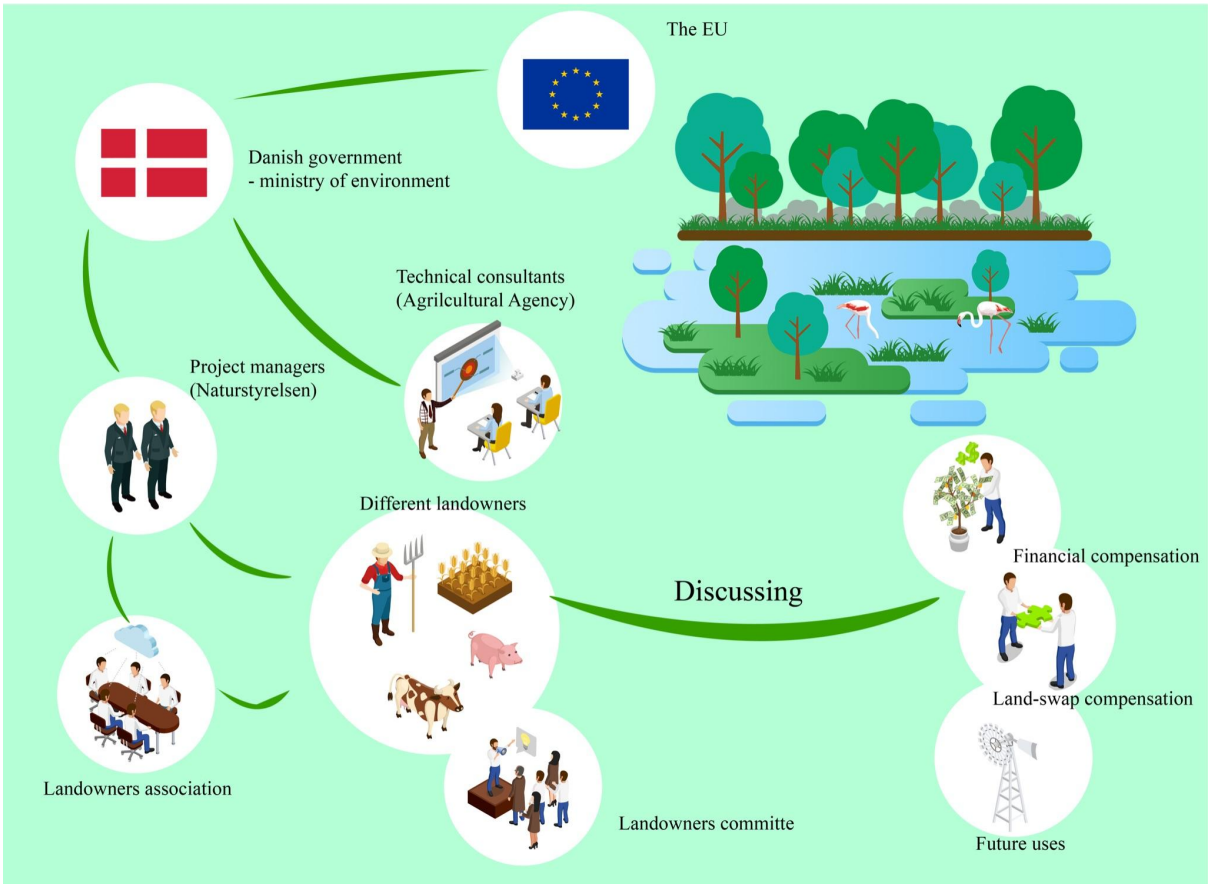

Figure 4. Visual representation of the process regarding the SK-project, and the involved organisations.

At the time of writing, the project managers conduct individual dialogues with each landowner to discuss their concerns, compensation and individual property issues (Naturstyrelsen, n.d.). For a rewetting project to be implemented in Denmark, more than 75% of the project area needs to have a carbon content over 6% (Miljøstyrelsen, 2021). Measurements have been made by *Naturstyrelsen* in *SK*, indicating that 83.5 % exceeds this threshold, with 56.3 % containing even more than 12 % organic carbon (Naturstyrelsen, 2021).

Currently, soil sampling to assess the risk of P-leaching is undertaken by *Naturstyrelsen*. In the next phase of the project, concrete compensation offers will be given to the landowners. *Natyrsturelsen* made it clear that the rewetting project will not pose a flood risk as the project would be able to control the water-table due to the drainage system of the area.

3. Methodology

3.1 Intro

In order to answer our research question, how do natural and social factors enable or disable the rewetting of lowlands in Sejersbæk Kog, we implemented an interdisciplinary research approach, with methods from both social and natural sciences. These methods were carried out in March 2022, when two weeks of field work were carried out in Tønder. In the following sections we describe our use of methods relating to questionnaire, soil sampling, semi-structured interviews and geospatial data visualisation.

3.2 Questionnaire

Using the SurveyXact software, we constructed an online survey. The questionnaire contained 14 questions in Danish, covering basic personal information, land use, recognition of the project and participation, as shown in appendix 8.3. Additionally, it ensured the respondents' anonymity.

The survey predominantly consisted of close-ended questions, with binary, nominal and ordinal variables, but also contained open-ended questions to allow for in-depth answers. For the question regarding income, which we deemed might be sensitive, we included the possibility of choosing not to respond. At the end of the questionnaire, the respondents were asked if they were willing to participate in interviews, thus the survey additionally acted as a means to reach interview respondents. We therefore used the questionnaire both to reach potential informants and to obtain background information on the landowners in the area.

3.2.1 Sampling strategy

Prior to distribution, a pretest was performed in order to detect any possible confusion regarding the questions. The pretest was sent to the members of the landowner committee, as these had been identified by the project manager.. After the pretest, we received sensible answers. Thus, we decided not to change its structure. Subsequently, the questionnaire was distributed twice by email to 70% of the landowners (56/80). In total we collected 21out of 56 responses, including the answers from the pretest.

3.2.2 Analysis

For the analysis, we first cleaned the data and removed outliers and very incomplete responses. Subsequently, the data set was discussed by various statistical methods. Pie charts and bar charts were used to visualise the responses. Additionally, the bar chart showed the fit of quantitative data to the normal distribution. Doing correlation analysis, we first used linear trend analysis to determine whether there was a significant linear relationship between the variables, followed by the establishment of multi-regression models to discuss exact levels of correlation and significance. It should be noted that for the 'recognition of climate change and the rewetting project', there were two grade systems in this study, which were "being more worried" from 1 to 10 and "being less knowledgeable" from 1 to 10. Unfortunately, we did not realise until very late that we had used inconsistent scales in these two questions - i.e. from less (1) to more (10) in climate change and from more (1) to less (10) in the rewetting benefits. This constitutes an obvious shortcoming of our results as the former scale is the most logical. We can therefore not be certain that our responses are self-evident.

3.3 Soil Sampling

Since low-land carbon projects aim to mitigate carbon losses, investigating the carbon content in the soil is important. One potential repercussion of rewetting projects is the potential phosphorus leakage into nearby water bodies once rewetted. As the *SK* area is, and has historically been, intensely cultivated, measuring, and quantifying said potential leakage is highly important. Thus, soil sampling was conducted to measure C and iron-bound P.

3.3.1 Sampling strategy

Access to the fields was gained via the informants. Each interviewed landowner was presented with a map of SK, and asked to identify their fields. Supplementary questions were asked regarding current and previous land use, including tillage practices, fertilisation, and crop cultivation, as one aim of the soil sampling was to investigate whether land use had any associations on the C and P content. To ensure validity of our sampling sites, we cross-referenced with the *Find Ejeren* [Find the owner] -app[1]. The sampling was made using a W-transect, with 20 steps (≈15 m) in between each sub-sample. The transect was made with a distance to the border of the field, to ensure the results would not be impacted by the

[1] The app combines data of 1) all land plots in Denmark with 2) the owner's registry and 3) publicly available contact information. Users can then, based on their geolocation, identify specific plots of land, its owner and contact information.

surrounding area on the one hand and represent the character of the field itself on the other. At the central point, coordinates were recorded using a Garmin eTrex® 10 GPS. The samples focused on the topsoil, which is the layer mainly affected by rewetting projects and which has been proven to correlate with project feasibility (Negassa et al., 2020). For each sampling site, a total of five subsamples were taken with a soil sampling spear, 25 centimetres deep. The subsamples were pooled, to average the value of the samples. For each site, this pooled sample is assumed to represent consistent soil conditions.

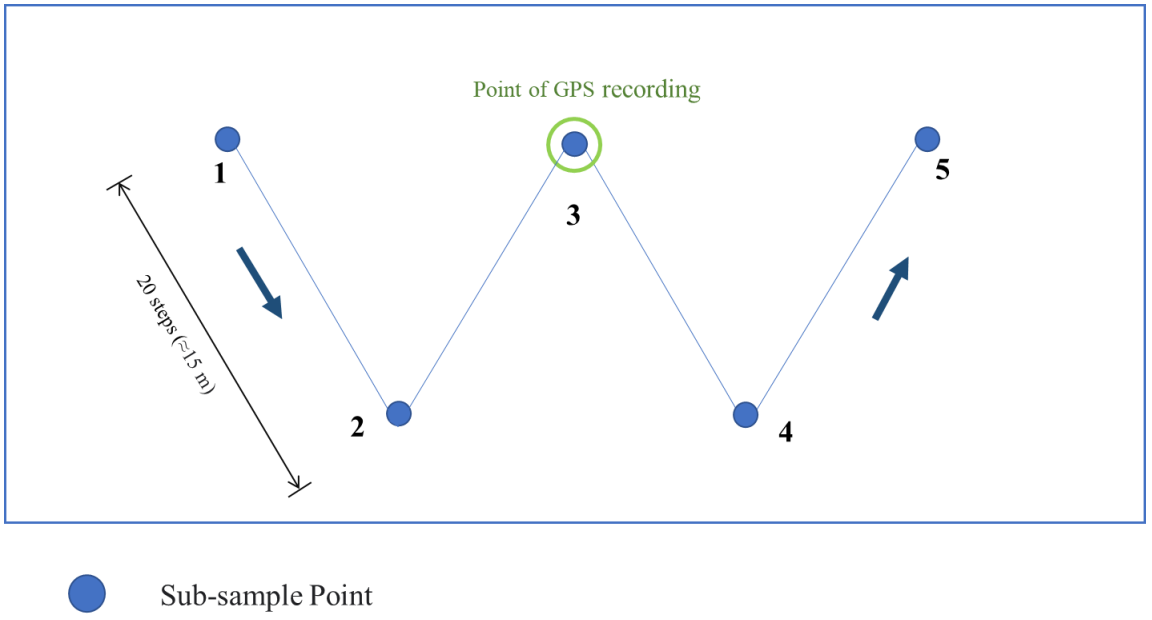

Figure 5. Schematic representation of sampling transect

Two to four fields were sampled on each of the seven landowners interviewed in this study. In total, 21 sampling sites, each consisting of five subsamples, were taken.

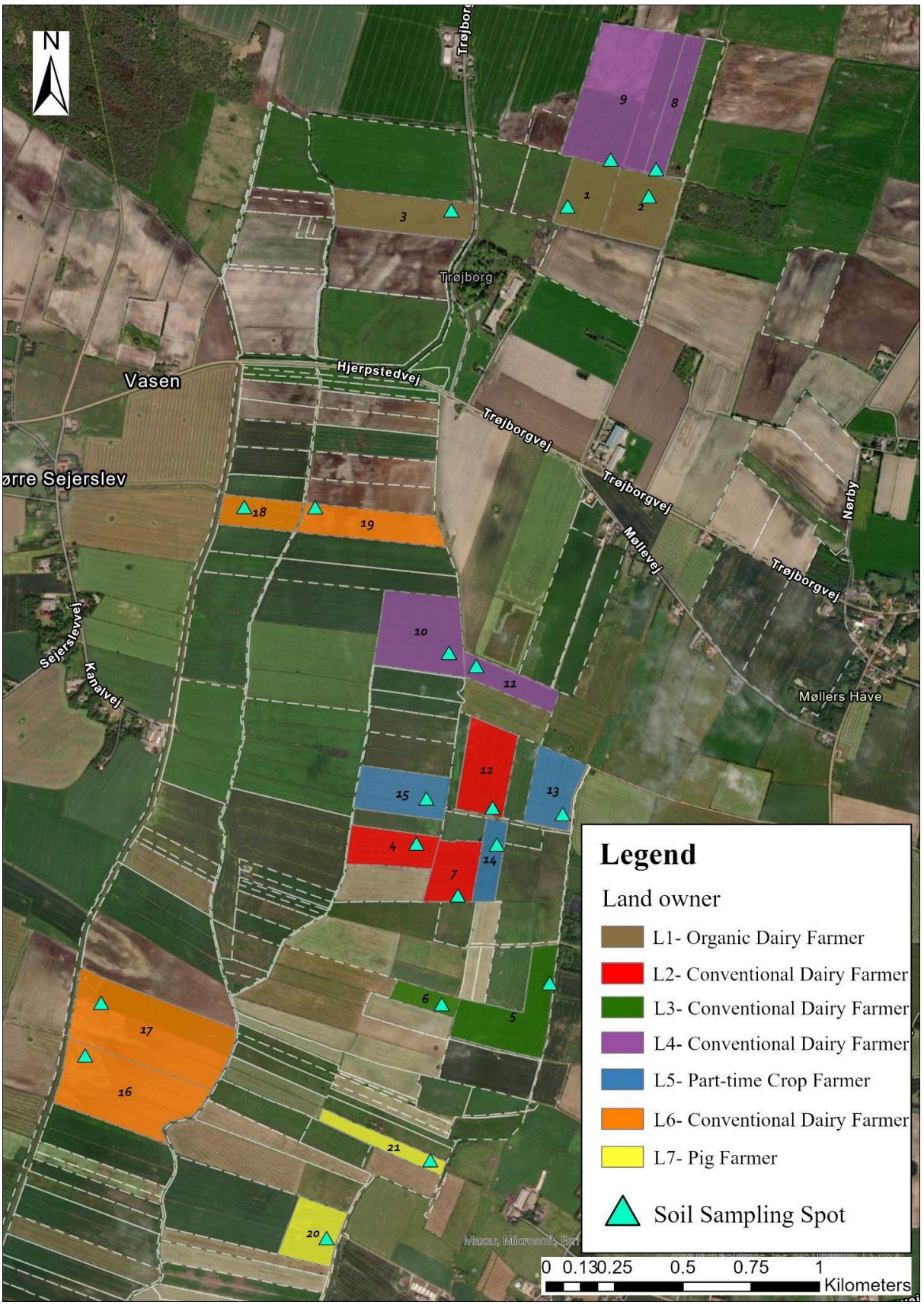

Figure 6. 21 soil sampling spots belonging to 7 landowners distributed in the project area

3.3.2 Analysis

A standardised dithionite-extraction procedure was performed, to analyse the amount of iron-bound phosphorus, in accordance with Hoffman *et al.* (2018). Total carbon and nitrogen were analysed on an Elemental Analyzer.

3.3.3 Data analysis

After finishing the laboratory analysis, we performed preliminary statistical analysis. To evaluate potential risk of phosphorus leakage within the project area, we used the method of Hoffman et al. (2018) with the following equation. The value of FeBD:PBD indicates the level of phosphorus leakage risk (Table 2).

$$Fe_{BD}(mmol/kg) = \frac{Fe_{BD}(mg/kg)}{55{,}847(mg/mmol))}$$

$$P_{BD}(mmol/kg) = \frac{P_{BD}(mg/kg))}{30{,}9738(mg/mmol)}$$

$$Fe_{BD} : P_{BD} - molforhold = \frac{Fe_{BD}(mmol/kg)}{P_{BD}(mmol/kg)}$$

Table 2. Phosphorus leakage risk level indicated by FeBD:PBD

The value of FeBD:PBD	Phosphorus leakage risk level
<10	High risk
10-20	Medium
>20	Low risk

Then a cluster analysis based on the characteristics of carbon content, nitrogen content, and the risk of P-leaching was conducted. The variables were standardised by using the inter-group class average method, and the square Euclidean distance was used to measure the distance.

All the collected and calculated data representing land quality will be analysed in combination with land use types and land prices, and compared to the spatial distribution characteristics shown in the maps visualised in ArcGIS. *Naturstyrelsen* already performed tests on carbon content and mapped the overview of the current drainage system indicating the soil water content in the project area, which was used for comparison and further analysis.

3.4 Interviews

As a key focus of our research lies in the motivations behind participation, we devoted special attention to collecting qualitative data. This aligns to the claim that there is a lack of qualitative approaches examining such rewetting projects, as identified in the literature (Buschmann et al., 2020). The method chosen was semi-structured interviews. We chose this over unstructured interviews because we had some key topics that we wanted to explore with informants, therefore, we would need to be somewhat in control of the interviews. Simultaneously, we deliberately sought to explore unforeseen topics. Thus, we developed an interview-guide consisting of keywords such as "governance perceptions" and "future uses" including suggestions for central questions about these issues.

We aspired to be three people carrying out the interviews: main interviewer, supplementary interviewer and note-taker. The interviewer would lead the interview on the basis of the interview-guide. The supplementary interviewer would contribute if a topic needed elaboration. The note-taker would be mandated to ask follow-up questions, in addition to taking notes. Before arriving at the farm, we would inform the landowners that we could conduct the interview in two ways: either as a go-along interview around the farm, or as a sit-down interview. When arriving, we would decide on the format to create an informal and comfortable setting for the informants. As we familiarised ourselves with the field, we made changes to the interview-guide as we realised that some topics were more and less important than anticipated. Additionally, we interviewed three informants that were not landowners in order to achieve a broader understanding of the project context. These were a) the *Naturstyrelsen* project manager, b) a technical official from Tønder municipality specialised in natural restoration projects, and c) a member of Dansk Ornitologisk Forening [DOF]. For these respondents we prepared tailor-made interview-guides, to better fit their roles and perspectives in the rewetting project.

3.4.1 Sampling strategy

We contacted our respondents in different ways. The non-landowner respondents were easy to reach as their contact information was provided online on the website of their associated organisations. Reaching landowners, we needed further efforts. In addition to the questionnaire, the project manager provided us with contact details for landowners on the committee, who we tried to schedule interviews with. By these two means, we attempted to get our first interviews. But it was via a coincidental encounter with a hunter during a field

trip in the area that we got the contact information for what turned out to be the first interview. From thereon, we proceeded in part via the above means but particularly via snowballing. At the end of each interview we would ask the respondent for the contacts of other landowners that they deemed to have an interest in talking to us. Thereby, we arranged the other interviews. Through this sampling strategy we managed a total of twelve interviews (Table 3).

3.4.2 Analysis

Table 3 contains overall characteristics of the informants. Due to the current unfolding of the project and that lots of questions still need to be resolved, we have chosen to anonymise our informants. We did so due to the fact that almost all informants shared some information or perspectives with us, which they deemed somewhat sensitive and rather personal. Thus, so as not to impede the unfolding of the project, we chose to anonymise to the extent possible. We proceeded through a retroductive approach. We started from our empirical data and looked to find the most crucial topics emerging from the interviews. We then developed a coding scheme retroductively, which was partly based on predefined categories and partly on categories developed as we familiarised ourselves with the data. We created two overarching categories, governance perceptions and future uses, which we identify as the topics that mostly showed to influence landowner participation. The categories covered under governance perceptions are governance, identity and compensation, and under future uses are windmills, CCs and the future potential for bird biodiversity. We then assembled the individual codings of each interview under the different categories, in order to understand the overall narratives around these topics. Importantly, we noticed how interconnected all these categories are, and found that separating them completely would undermine the complexity of their interconnections. Therefore, we created two dominating attitudes of landowners, which enable us to demonstrate how these six narratives interconnect and affect each other.

3.5 Geospatial Data Visualisation

GPS (Global Positioning System) uses satellites to locate positions in real time. The GPS device used in this study is the Garmin eTrex® 10. When working in outdoor spaces without physical obstructions, this device has high accuracy.

Each positioning information collected by the GPS device includes the user's instantaneous longitude, latitude and elevation. In this study, we mainly used the Mark Waypoint and Record Current Track functions of the GPS device to obtain the location of interviews conducted with interviewers and soil sampling sites, with the primary purpose of visualising them on maps. Further, we quantified certain indicators, and analysed and processed the sample data of the study area using statistical analysis and GIS spatial visualisation. Thereby, we explored the spatial distribution patterns of soil indicators and the spatial structure and differentiation rules of land quality and land price in the study area from multiple perspectives by combining topographic conditions and historical land use.

4. Results

In the following section we display the results obtained from our questionnaire, soil sampling and interviews.

4.1 Questionnaire

4.1.1 Data description

The results of the questionnaire were classified into two types, as shown in Fig.7 and 8. All 21 respondents with an average age of 60.43, and 76.2% were male. Most of the respondents had the following characteristics:

- living close to their land in SK (less than 5 km),
- having less than 50% of their income from agriculture,
- owning less than 20 hectares of land in SK,
- having some concerns about climate change (average index=5.21/10),
- having insufficient knowledge of the rewetting project (average index=6/10).

The fields are mainly used for conventional agriculture. More than 50% respondents clearly indicated that they want to participate in the project, and 66.7% prefer the land-swap compensation, but only 33.3% clearly indicated that they are satisfied with the compensation.

This indicates that there is a discrepancy between landowners and project implementers on compensation, which may negatively affect landowners' participation.

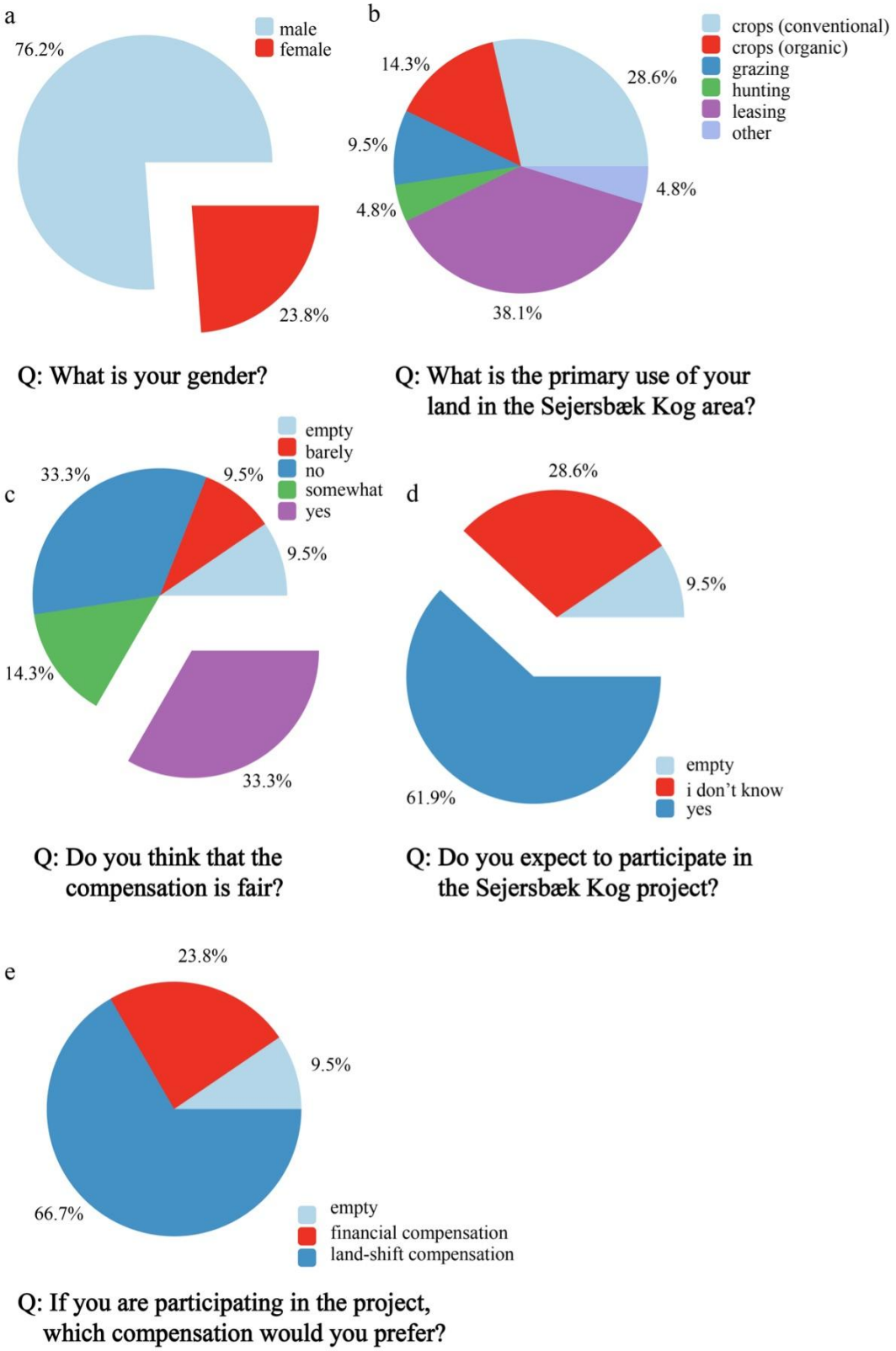

Figure 7. Visualisation of quantitative data in the questionnaire.

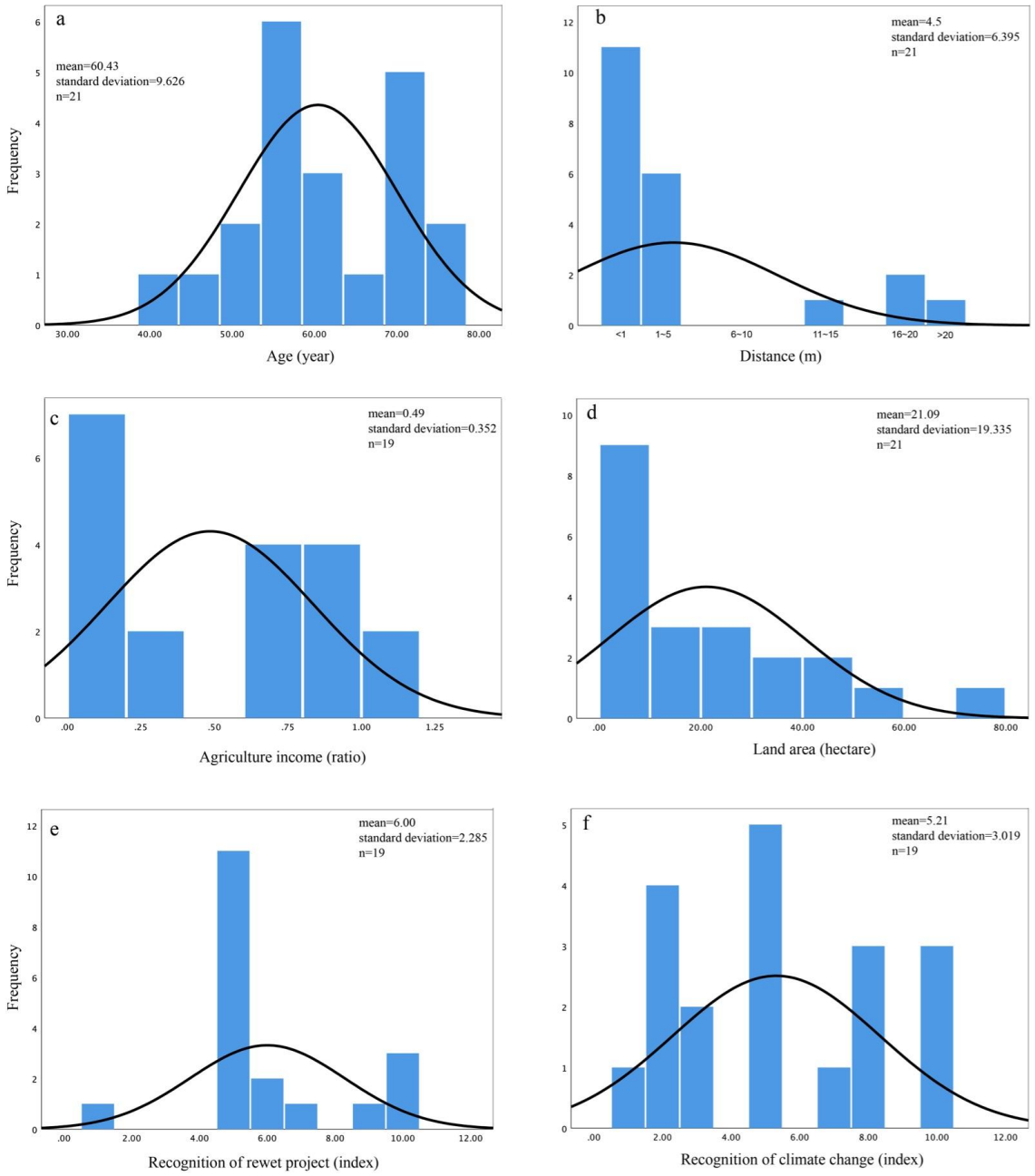

Figure 8. Visualisation of quantitative data in the questionnaire.

4.1.2 Linear trend analysis and regression model

Although the number of responses to the questionnaire was limited, we intend to show a variety of possible relationships between the data points. Fig. 9 shows that there is a potential linear relationship between some variables, which have been circled. One pattern that stands out is that the older the respondent the greater concern is about climate change. People with higher total income have a higher share of their income from agricultural activity and are also

more concerned about climate change. The agricultural income ratio was also positively correlated with land area in *SK*.

Then, the backward-type regression analysis for each of the nine variables as independent variables (recognition of rewet project, hectare, age, primary land use, income, recognition of climate change, distance, gender, agricultural income ratio) with the three dependent variables (participation, type of compensation, attitude of compensation) was established. The results are shown in the table below. For participation, the fit and significance of the models are not high, but it can be seen that among the nine variables, gender and agricultural income ratio had the most effect on participation, contributing 29.7% of the fit. The DW values indicated a small degree of autocorrelation for it was close to 2, so there was no correlation between gender and agricultural income ratio. There are seven variables that significantly co-affect the landowner's choice of compensation with a model fitness of 86.9%, and among the seven variables, the recognition of rewet project and gender dominated, which indicated that the more knowledgeable the person was with the project or female, the more likely they were to choose financial compensation. Moreover, there is a certain autocorrelation between these two variables. Attitudes of compensation were influenced by the combination of primary land use, age, gender, income, hectares, recognition of climate change, and agricultural income ratio. The effect was not significant.

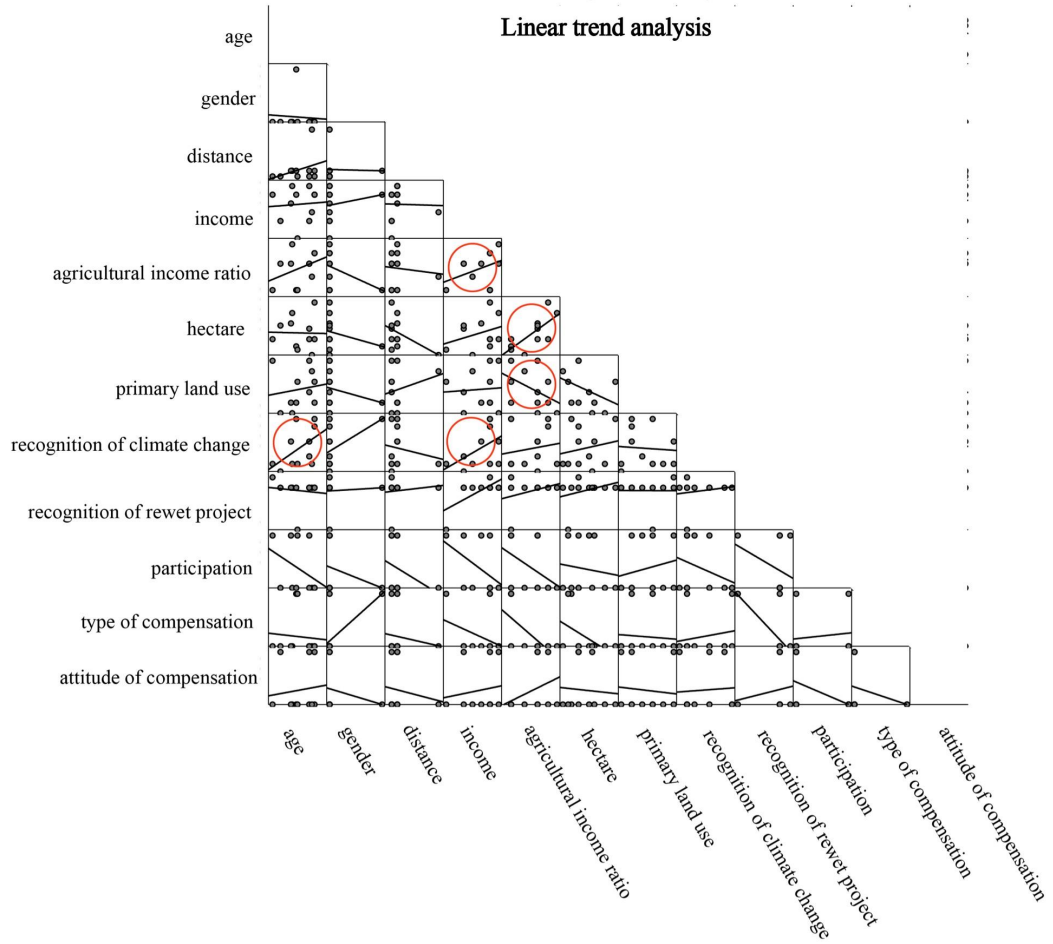

Figure 9. Linear trends of 12 variables in this study

Table 4. Multi-regression models of the questionnaire results

	Models	R^2	Sig	DW
Participation	1	-0.845	0.841[a]	
	2	-0.231	0.674[b]	
	3	0.067	0.487[c]	
	4	0.174	0.369[d]	
	5	0.24	0.269[e]	
	6	0.298	0.175[f]	
	7	0.324	0.112[g]	
	8	0.297	0.083[h]	1.965

	a variables: constant, recognition of rewet project, hectare, age, primary land use, income, recognition of climate change, distance, gender, agricultural income ratio b variables: constant, recognition of rewet project, hectare, age, primary land use, income, distance, gender, agricultural income ratio c variables: constant, recognition of rewet project, hectare, age, primary land use, distance, gender, agricultural income ratio d variables: constant, recognition of rewet project, age, primary land use, distance, gender, agricultural income ratio e variables: constant, recognition of rewet project, primary land use, distance, gender, agricultural income ratio f variables: constant, primary land use, distance, gender, agricultural income ratio g variables: constant, distance, gender, agricultural income ratio h variables: constant, **gender, agricultural income ratio**			
Type of compensation	1	0.797	0.155[a]	
	2	0.844	0.053[b]	
	3	0.869	0.016[c]	
	4	0.882	0.005[d]	
	5	0.864	0.002[e]	
	6	0.848	0.001[f]	
	7	0.839	0.000[g]	
	8	0.82	0.000[h]	1.171
	a variables: constant, recognition of rewet project, hectare, age, primary land use, income, recognition of climate change, distance, gender, agricultural income ratio b variables: constant, recognition of rewet project, age, primary land use, income, recognition of climate change, distance, gender, agricultural income ratio c variables: constant, recognition of rewet project, age, primary land use, income, recognition of climate change, distance, gender d variables: constant, recognition of rewet project, age, income, recognition of climate change, distance, gender e variables: constant, recognition of rewet project, age, recognition of climate change, distance, gender f variables: constant, recognition of rewet project, age, distance, gender g variables: constant, recognition of rewet project, distance, gender h variables: constant, **recognition of rewet project, gender**			
Attitude of compensation	1	0.144	0.617[a]	
	2	0.572	0.301[b]	
	3	0.703	0.126[c]	1.43
	a variables: constant, recognition of rewet project, primary land use, age, gender, distance, income, hectare, recognition of climate change, agricultural income ratio b variables: constant, recognition of rewet project, primary land use, age, gender, income, hectare, recognition of climate change, agricultural income ratio c variables: constant, **primary land use, age, gender, income, hectare, recognition of climate change, agricultural income ratio**			

4.2 Soil sampling

The results of the soil carbon content showed significant differences, with concentrations ranging from 1.72% to 38.79% (Table 5). The nitrogen concentration ranged from 0.17% to 2.62% (Table 5). Rewetting projects must not exceed a FeBD:PBD-threshold that indicates increased P discharge in nearby water bodies. At the time of writing, an extensive soil sampling is conducted by *Naturstyrelsen* to assess the risk in *SK*.

Based on our result, the risk of P-leaching does not seem to be a disabling factor for the *SK* project (Fig. 10). From the 21 samples, merely 1 indicates a high risk (FeBD:PBD <10), 10 indicates a medium risk (FeBD:PBD 10-20) and 10 indicates a low risk (FeBD:PBD >20). However, it is important to note that this does not fully ensure that the risk of P-leaching is non-existent, as we do not have information about how the water flow will be upon rewetting. The plot with the highest risk was used for rapeseed cultivation.

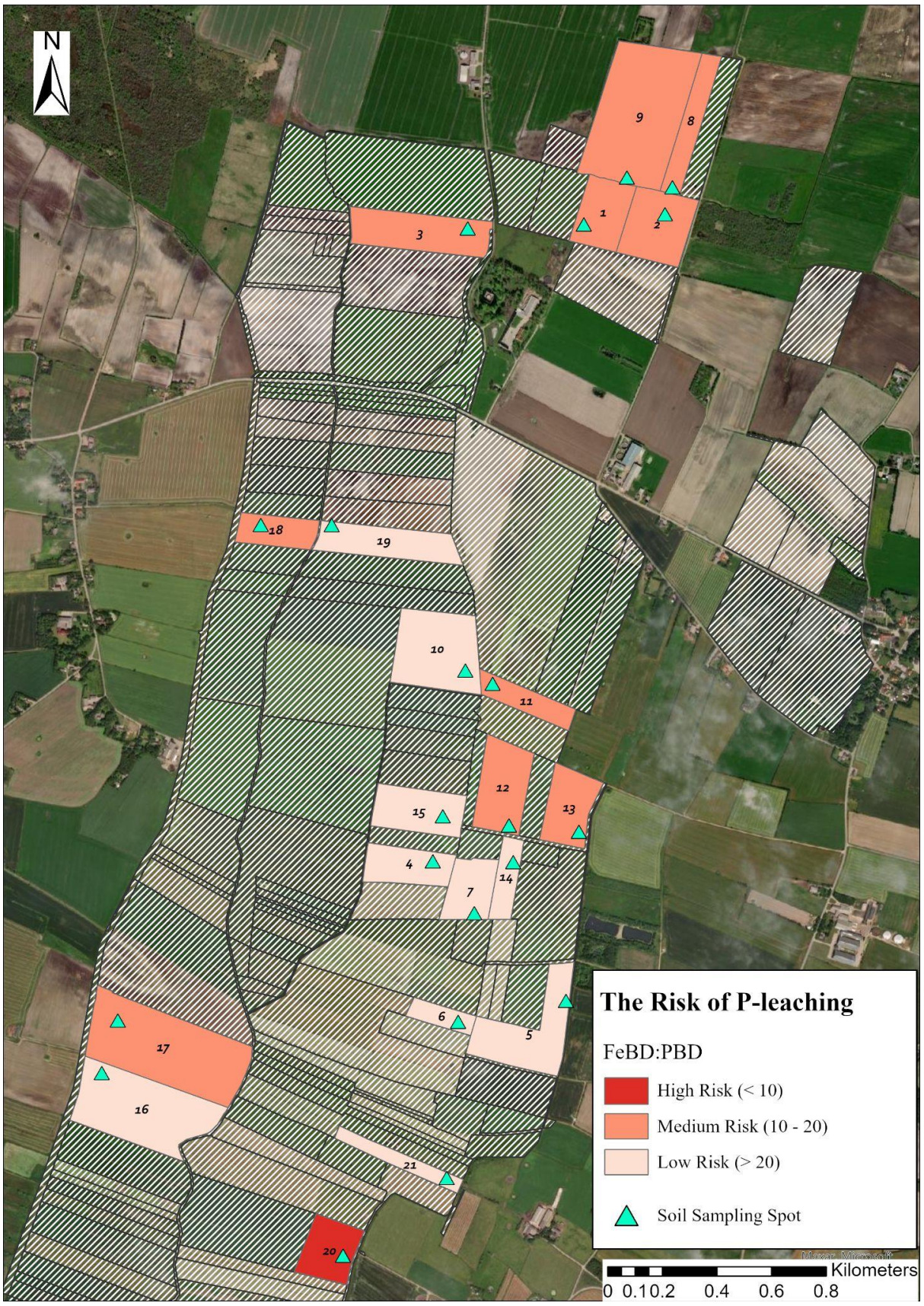

Figure 10. The risk of P-leakage in the project area represented by the sampling spots

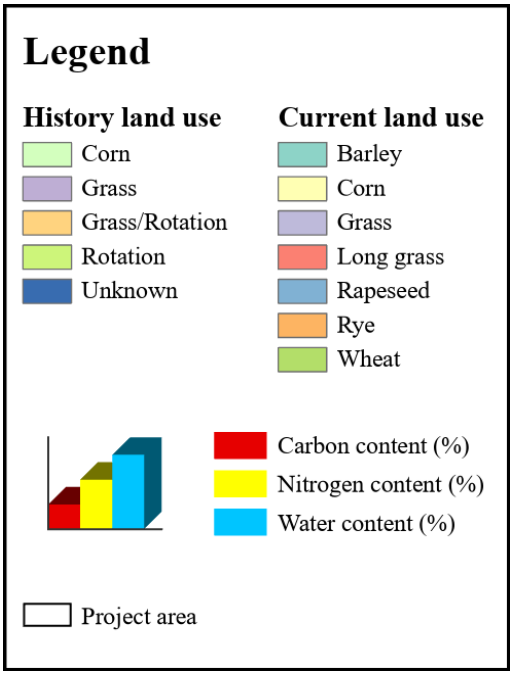

Figure 11.a

Figure 11.b

Figure 11. Historical land use types (11.a) and current land use types (11.b) in the project area, showing also the carbon content, nitrogen content and water content of the soil sampling sites ***(To make the bar graph clearer, the shown values of Nitrogen content and Water content are the original values multiplied by 10)***

Spatially, it can be seen From Fig. 11 that the distribution of carbon concentration was not homogeneous. The concentrations in the eastern sampling area were higher than those in the western. This was not consistent with the map of the 2014 soil survey (Appendix 8.5), which concluded that all these areas have a carbon content greater than 12%. It may be related to the agricultural activities on some lands in recent years. In our sampling area, generally the water content in our soil samples was higher in the southern part and lower in the northern part. This result might be due to the differences in elevation, based on comparison of the overview map of the current drainage system by *Naturstyrelsen* (Appendix 8.7).

In consideration of the current land use types, the plots of grass have a higher nitrogen content compared to other land uses. This goes in line with the results from *Naturstyrelsens* carbon assessment (Appendix 8.8) which displays a very high amount of kg N/ha in grasslands. Not surprisingly, as seen in Appendix 8.8, there is a correlation between amount of H/ha and amount of applied fertiliser. Our results also display higher water content and higher carbon content in the grassfields.

Although Carbon content or P-leaching risk is not directly connected to the pricing of the land, we aimed to see if connections could be found. Thus, cluster analysis was conducted. First of all, it can be seen from Fig. 12 that the samples were divided into two main groups. We checked the raw data and found that the lands in main group 2 had a high carbon content (over 20%), while the land in main group 1 had a relatively low carbon content. The land prices of the main group 2 were low, which were 35, 45 and 50, respectively. The low prices may be due to the high water content of the soil resulting in lower yields from agricultural practice. The main group 1 can be further divided into 2 groups, Sg (sub-group) 1 and Sg 2, while the Sg 2 had only one sample (number 14), which was due to it having the lowest risk of P-leaching (FeBD:PBD = 70). The Sg 1 was then divided into 2 SSg, where the SSg 2 had similar prices, but we found a wide range of land prices in SSg 1, ranging from 40 to 90, which indicated that the prices of some lands were more influenced by non-soil factors.

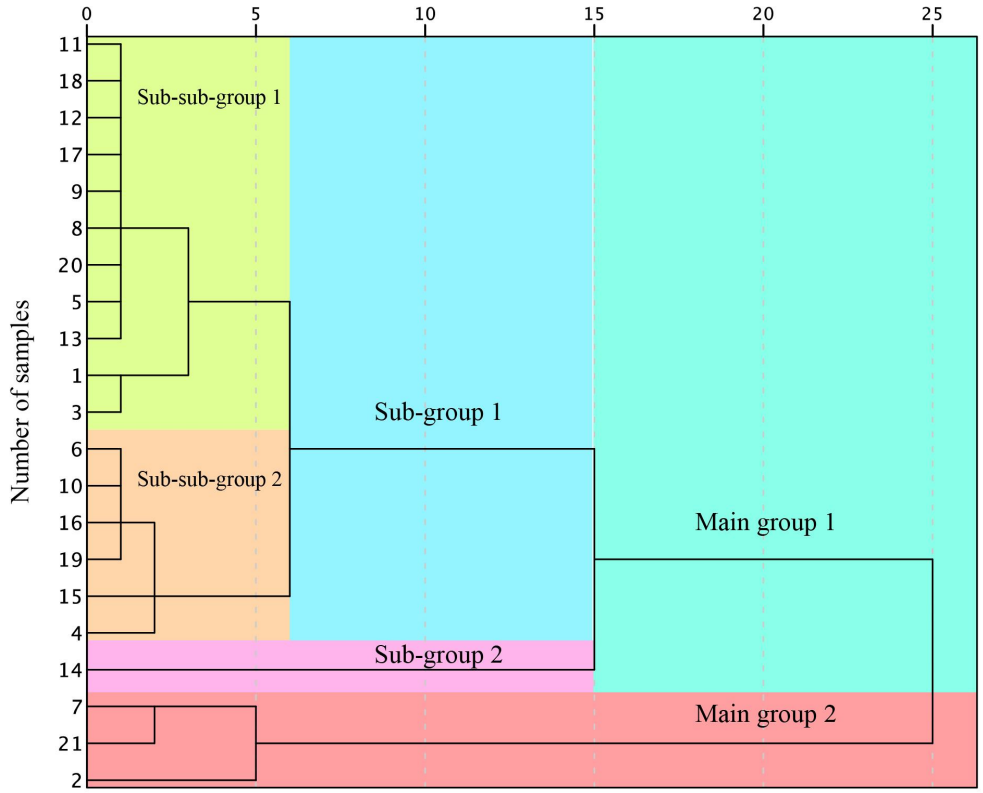

Figure 12. Classification of the lab-results based on cluster analysis

4.3 Interviews

The following section covers the results from our interviews, divided in two sections. First, we demonstrate the results from our interviews, which we have categorised in two overarching themes: Governance Perceptions - covering identity, compensation, governance - and Future Uses - covering windmills, CCs and biodiversity. We recognize that such categorisations are by default analytical and represent artificial boundaries. Thus, they are overlapping and interconnected. Secondly, we describe two distinct attitudes among the landowners - stability and speculation - in which the themes interconnect in different ways. In presenting those we are aware of the possibility of repetitions with the presentations of themes. However, we believe that the two attitudes illuminate the thematic interconnections and the formation of patterns within them. Concurrently, the themes help us to connect our results from interviews with the ones from the questionnaire and to state general traits that are shared by both attitudes. We stress that both attitudes are present with all informants. They should be understood as either ends of a continuum, which most landowners move between.

Some will subscribe more to one than the other, but even they will also have inclinations towards the other.

4.3.1 Themes

4.3.1.1 Governance perceptions

4.3.1.1.1 Identity

Here, we refer to all those considerations which have their origin in the interviewees' position in society as farmers. One topic which we label as part of identity is the organic vs. conventional divide. While only two of the farmers we talked to produced organically, some of the conventional farmers expressed their disapproval of organic agriculture, as to them it is less efficient, showing a clear profit-oriented mindset which is presented in the Speculation attitude. On the other hand, one theme which brings them all together is the feeling of being overlooked by institutions. Many share the opinion that agriculture is being used as the scapegoat of climate change and other environmental issues. As L4 said: "Climate change is not because of the land, the land has been here all along, so why are we taking it out of production?". This also shows some scepticism towards climate mitigation measures. They all agree that something should be done about the climate crisis, even though some are more sensitive to it than others. However, they all agree only to measures which benefit them as well, or at least those that do not harm them. Fig. 8f from questionnaire results shows a wide variety of answers on concerns on climate change, however, most of them position themselves in the centre of the scale.

4.3.1.1.2 Compensation

As the questionnaire showed (Fig.7e), most landowners prefer the land swap as compensation. Investigating this during our interviews, a large share of the landowners argue that they need better quality soil, as they wish to carry on producing and it provides a stable source of income. This consideration is crucial for the stability attitude as we will show later in section 4.3.2.1. However, some farmers are more conflicted about their preferred compensation. Here, some landowners brought up CCs as a reason for their ambiguity. These landowners are clearly willing to speculate in the CCs market and this is affecting their decision about compensation. Regarding those who choose the one-off payment, a relevant factor, according to the PM, is their age. Those who are about to retire, and whose children do not plan on inheriting the agricultural business, would rather choose the one-off payment.

When discussing whether or not the compensation is fair, a majority of landowners expressed cautious optimism, both during the interviews and through the questionnaire (Fig. 7d). However, the informants did also seem reluctant to fully buy into the promises - which is mirrored in the questionnaire results in Fig.7c. There is thus a discrepancy between our questionnaire results and the trends from our interviews, which might suggest that the matter of 'fairness' is actually connected to other issues - such as governance perceptions, carbon credits and identity. This point is further elaborated in section 4.3.2.

Furthermore, looking at the Fig. 8b we can see that 17 land owners have their fields less than 5 km away from their home. During the interviews the distance to the new land also showed to be relevant: "I have to get some areas from my neighbours, because we can not move the cows 1-1.5 kilometres to a field, and all the fields are just around this farm" (L1). Therefore, distance can be another factor influencing their perception of the fairness of the compensation.

4.3.1.1.3 Governance

Here we collected all the data which concerns the specific dynamics of this project's management, as well as the landowners' considerations about the broader governance of Denmark and the EU.

The PM highlighted how, throughout the project process, establishing a relationship of trust and respect with the landowners is crucial for the success of the project. It was his experience that government officials are usually perceived by landowners as distant and uninformed. This point is connected to the landowners' governance perceptions of local, national and supra-national institutions. Among the reasons stated for why the landowners tend to be suspicious of institutions is that they believe that agriculture is being scapegoated in climate change debates, as mentioned in the Identity section. Moreover, they see a danger in taking land out of production, considering how reliant Denmark is on imports. Furthermore, some are afraid that in a few years, the government will return to SK to implement a nature conservation project, which will disadvantage the surrounding farms. L7 shared his negative past experience in relation to environmental policies which he feels overlooked, if not actually harmed, the farmers. It is important to mention how most of our informants feel like they do not have the power to influence politics, and are left with a feeling of 'surrendering' to the project, as shown in the Stability section.

4.3.1.2 Future uses

4.3.1.2.1 Windmills

During our interviews, we came across considerations of setting up windmills in the area. The two main reasons in support for this project revolve around first, their belief that green energy projects are very profitable and second, hopes of attaining CCs - another stream of revenue - from a windmill project. Simultaneously, this topic brought up some of the farmers' concerns, regarding the feared government agenda of a natural area, as stated in the Governance section. Additionally, they are conscious of how windmills are a divisive issue in Tønder Municipality. In this regard L3 said: "It's so modern in Denmark to be against it [windmills]. It's always easy to be against, any changes can be bad". They fear that the wide-spread opposition to windmills will hinder construction. Contradicting the landowners' frustrations with the government, PM stressed that the government will not play any role in the future of the area once the rewetting is completed. This topic is presented more in-depth in the Speculation section.

4.3.1.2.2 Carbon Credits

A central issue in the SK-project concerns who will acquire the rights to sell CCs. Specifically, two landowners (L2; L3) feared that the Danish state would acquire the credits, as part of the national climate mitigation plan. The same landowners disagree with such a disposition, as they believe that they instead should get the right to sell the CCs after the project is done. Moreover, there is a shared impression that this market is highly confusing and unregulated - two of them even refer to it as the "wild west" (L2; L3). Some express a lot of scepticism towards it, and admit that they believe it is going to fail in the future, but they still want the option to make a business out of it now. This confusion adds to the frustration against the government, who should provide some clearance on the functioning of the carbon market in the eyes of these landowners. Moreover, the topic of CCs is connected to that of compensation, as some of them claimed that they would choose the one-off compensation and keep the land if they get the CC.

In other words, the CC issue emerges as a major impediment for the project - as identified by different informants. Nonetheless these general impressions and narratives around the issue are not homogeneous for all of them. Indeed, two of the landowners that we talked to are very determined to have this issue resolved, and will not participate in the project until it has been resolved. L2 even mentioned the possibility of implementing a

rewetting project independently from *Naturstyrelsen*. These two are more market driven in their decisions and for this reason identified as speculative landowners. On the other hand, the other interviewees stated that they will participate in the project because *Naturstyrelsen* is offering them a good deal - in terms of better quality land - now and they believe they do not have the power to influence politics. This landowner attitude is still interested in the CCs market, but ensuring stability by acquiring new and good land immediately to maintain production is more important.

4.3.1.2.3 Biodiversity

Wetland restoration projects in Denmark have not led to increased plant biodiversity (Baumane et al., 2021). When asked about this, the PM stated that rewetting projects regarding carbon storage should not be representative for biodiversity improvement. However, the SK-project aims at investigating the prospect of increased habitat for meadow birds in the area (Naturstyrelsen, n.d.). BV was positive that rewetting the area would create conducive conditions for birds. An overlying theme, however, is that biodiversity is not the main interest to any of the landowners. TM stated that the compensation is the most important, and that most landowners do not care about what happens then. However, there is a clear division in the thoughts surrounding biodiversity. Some landowners are negative to the potential increase in bird population, as they fear it will damage their crops - or in the long run convert *SK* into a protected area, thus encroaching on their farming practices. Equally, there was a widespread belief that agricultural land already hosts endangered birds: “In my world, agricultural land is real nature.” (L4), a statement which highlights a self-perception or identity among farmers as being landscape custodians. There are also some positive perspectives from the landowners, who hope for the bird population to increase. One important similarity between those sharing that view, however, is that farming is not their only source of income. The 9 of our questionnaire respondents, who earn less than 50 % of their income from agriculture (Fig. 8c), might share that sentiment.

4.3.2 Attitudes

4.3.2.1 Stability

Beginning with the discourse of stability, we see a pattern across the different landowner-informants, where concerns over ensuring a stable livelihood dominate their considerations for participating or not in the project. The stability landowners rally around the

argument that the soil in SK is generally not of high quality hence why the land swap compensation generally is preferred. They all point to the high water table as a key challenge. It is in this light that the land swap compensation is appealing as they believe that the new land will have certain preferable characteristics: higher elevation and less water. This appeal is encapsulated by one of our informants when elaborating about his preference for swapping land: "I can't stand the thought of not knowing if I will have enough forage for my animals. It needs to be safe, otherwise I do not sleep at night. I can't live with thinking 'maybe I have until february, then I will see if I can buy some'. I simply can't" (L4). The offered compensation and the perception of the project's broader governance context proves central for the preference for stability for L4. Nonetheless, it should be noted that the interview took place during the first weeks of the Russian invasion of Ukraine, the impact of which on global food supplies has been a source of concern, both publicly and among our informants.

Governance perceptions also inform motivations in the stability attitude. L4 shared concerns regarding increasing depopulation, which had led him to provoke the previous mayor of Tønder Municipality on Facebook during the municipal elections in 2021:

> "I said that if you take out 700 hectares of land, then you remove 700 cows and thereby about 70 jobs in the primary production. So I asked: "Is that what we want?" We are after all outside of the big cities [...] and now all of a sudden, they also have to close workplaces. And this is taking place while we talk about people leaving Tønder, and that we are short on jobs."

The quote implies that a concern exists thereby tying the project to local issues of keeping jobs in the municipality which in turn is tied to perceptions of broader societal group divides. In other words, it constitutes a central governance perception and identity issue. Against this backdrop, future opportunities offered by e.g. CCs or windmills may generate ambiguities for stability landowners as it complicates the decision of whether or not to participate in the project. On one hand, e.g. CCs offer a potential stream of revenue in an area in which such revenue is already in short supply. On the other, the inherent uncertainties of e.g. CCs might be outweighed by the project's compensation options. In other words, considerations on governance perceptions and future uses all operate as different factors within this context and thereby inform willingness to participate.

Another landowner indicates that identity perceptions in urban areas as 'sustainable consumers' are driving a market demand, which forces farmers into practices that he deems insensible: "In Copenhagen, if you want milk in your caffe latte, it has to be carbon neutral [referring to Arla's carbon neutral organic milk]. And when you buy your milk, all you care

about is that it says “carbon neutral” or “organic” [...] And we [farmers] have to deal with that also - that the consumers want this. But some time, there will be a big tv program about this big flop of nothing [carbon neutral]” (L3). This frustration with ‘Copenhagen’ demand points towards a politicisation of identity divides across geographies. Arguably, this landowner describes an experience of a kind of jeopardising of farmer’s identity more generally. This ‘jeopardising’ revolves around the fact that farmers are forced to give in to ‘foolish’ demands for carbon neutral milk, which runs counter to what is deemed ‘sensible’ - and thereby emanating from perceptions of shared identity - among farmers. This is further emphasised by L3 expressing both scepticism and optimism towards the CC phenomenon. Put differently, this example displays how perceptions of the broader societal context, in which issues of identity, CCs and governance perceptions operate, can inform the landowners’ willingness to participate.

Relatedly, other landowners explicitly articulate an ambiguity of needing to balance stability and risk speculation, particularly regarding the issue of CCs: “I have no money for waiting a long time. Maybe it will be 2, 3 or 4 years before I can sell a carbon credit. Maybe I can sell it, but there is not so much money in farming anyway. That is why I’ll participate [in the SK-project] now, because I will know what I have” (L6). CCs here have clearly made this particular landowner reconsider his options, yet the uncertainty around the prospects of agricultural CCs pushes this landowner towards participating in the project. The risks surrounding CCs thus play a crucial role in the considerations made in the stability attitude.

However, there is not unequivocal support for the project in the stability attitude, as a recurring theme concerns a cautious optimism with which landowners view the project. This partially comes down to past, personal experiences with public agencies and partially past projects in SK with different purposes. Some of the landowners do recognize the ‘professionalism’ of *Naturstyrelsen*, and e.g. particularly highlight the compensation dynamic that *Naturstyrelsen* manages all paperwork for land swaps as a crucial factor in their participation (L4; L6). The same landowners, however, seem equally unsurprised when stories circulated in the local community that *Naturstyrelsen* had failed to purchase farmland for the redistribution scheme and had been surpassed by other local landowners. Such experiences influence governance perceptions and downplay the optimism of the landowners towards the project, as it extends the time in which landowners are kept in uncertainty over whether the project will materialise. This governance perception is excellently displayed by one landowner, who generally appeared cautiously optimistic about the project: “If you want something, you have to pursue and achieve it. Otherwise they will never finish scraping

together 800 hectares. So they probably need to learn that in *Naturstyrelsen* - crossing the finishing line." (L4)

4.3.2.2 Speculation

Moving to the discourse of 'speculation', we identify a pattern among the landowner-informants as being willing to speculate in potential future gains from the changing land use of SK. The understanding of and ability to navigate the future uncertainties of the SK-project is clearly demonstrated by one of the landowners reflecting on the compensation options. "I don't see that the project cannot be pulled through, because there will be such a demand for selling land around" (L3). This indicates some recognition of the sufficiency of the size of the compensation while putting it in the context of the area being ideal for land swaps due to demographic developments. Together, they equally constitute a governance perception informing participation.

Relatedly, there seems also to be an element of identity driving the speculation attitude. This identity aspect is on display when landowners proudly describe how Danish agriculture is among the most efficient in the world. This achievement is spurred on by the introduction of chemicals and high-tech crops, which landowners in this attitude associate with progress and 'modernity'. This is exemplified by statements such as "I produce conventional milk - I am one of the good guys!" (L2). Another landowner equals organic farming to "the grandpa way" (L3). We can thus identify a conviction in the superiority of conventional cultivation and its epistemic association.

It appears that such convictions are driving a broader narrative within the speculation attitude, which does not fully subscribe to the benefits of taking out lowlands - such as those in the SK-project. This narrative is most prominently expressed when landowners explain their views on national climate mitigation policies, which ties into the themes of both governance perceptions and identity. All of our informants largely expressed similar scepticisms towards the political context of the SK-project, which seemed to interconnectedly inform a looming sense of the agricultural sector being unfairly treated in the climate debate. This point is exemplified by L2 whose central concern over taking land out of production relates to the risk of carbon leakage, i.e. the process by which emissions reductions in one location is replaced by similar or higher emissions elsewhere. He ascribes this to the ambition of Danish climate targets, while arguing that it is an unfair market constraint to put on Danish farmers. L6 described feeling unfairly treated when slurry used for biogas production benefits only the carbon accounting in the energy sector. L4 described a feeling of how farmers -

being a relatively small societal group - were easy targets for climate mitigation efforts, and that urban people should contribute as well. What is at play is thus a dual sentiment; on one hand, there is a feeling of societal malcognition of farmers' mitigation efforts, which on the other hand is tied back to the conviction in conventional farming. It thus becomes clear from the above examples that the triad of political context, project management and self-perception forms sentiments of being scapegoated, which in turn constitutes reservation and scepticism towards the project. The willingness to speculate in potential future gains is thus reinforced by this backdrop of governance and identity, as it offers other - and perhaps more self-influential - trajectories than that offered by the state in the SK-project.

Very relatedly, another key theme revolves around the themes of CCs and compensation more broadly. The landowners most willing to speculate care deeply about this issue, and see it as a potential goldmine. In fact, according to the project manager, emerging discussions around CCs had just recently become a key obstacle for the project - a statement to which some landowners aligned. Despite the interlocutors of CCs acknowledging the graft uncertainties of the future of such markets, interests in such credits prevailed. As outlined earlier, these landowners want this issue resolved. The potential outcomes of such resolutions would likely be that either the landowners would gain the right to the CC - potentially resulting in a higher buy-back price of the land - or not - potentially driving up the prices for the land so as to reflect the 'loss' of value on the side of the landowners. Thereby, the entire compensation scheme potentially appears deeply impacted by the outcome of CC discussions. In other words, CCs - representing a different trajectory than that offered by *Naturstyrelsen* - thus sits firmly within the attitude of speculation and as a key factor influencing participation.

Interestingly, L2 interpreted the state's interests in SK as primarily relating to the CC potential of the area. He argued that this all comes down to the fact that the Danish state - by reducing emissions through the SK-project - can sell such reductions to other countries in accordance with principles of the UNFCCC. The experience of *Naturstyrelsen* acting very fast seemed to underscore this interpretation as it fuels a governance perception of landowners being persuaded into participating before knowing what they would be missing out on: "The timing is wrong - *Naturstyrelsen* and all the others are pushing us to sell these papers. But CCs are so new on the agenda, it is speeding up now. It is in the media everywhere, it is a hot issue" (L2). This sentiment was equally shared by other landowners (L4; L7). Specifically, the same logic of the attitude of speculation wanting to increase profits from the land, it seems, is reversed and applied to the Danish state. The state's interests are

interpreted as equally profit-oriented, and their actions in the project are discussed in terms of 'robbery'.

Paradoxically, most landowners do acknowledge that their agricultural practices are both GHG-emitting and not environmentally friendly - many of our informants were dairy farmers. The latter awareness is specifically underscored by some landowners who speculate that the purpose of the project is actually concerned with decreasing nutrients leaching, rather than concerning carbon (L3). Their interests in CCs and windmills, however, seem to be spurred on by such recognitions, as these opportunities offer the landowners a potential solution to drive down their emissions (L1; L2; L3; L4; L6). As L2 put it: "We don't need to rely on subsidies [...] We can finance the reduction goals ourselves. But the politicians already promised reductions."

5. Discussion

5.1 Results discussion

In a rewetting project there is a broad spectrum of concerns which can hinder implementation. Regarding the soil sampling, our results do not indicate a high P-leaching risk. It is however important to note that due to the scattered distribution of our samples as well as the vast size of the project area, no general conclusions can be drawn. Regarding carbon content, our results are not as reassuring. From the 21 fields measured, merely 43 % exceed the threshold of carbon content over 6 %. This contradicts the assessment by *Naturstyrelsen* (Appendix 8.8) which showed over 80 % of the land having a sufficient carbon content. Evidently, the broad scope of their assessment makes their results more reliable than ours. Nevertheless, the broad variation of carbon content in the fields we measured (table 5.) suggests that the carbon is not evenly distributed throughout SK. *Naturstyrelsen*, and some landowners alike, declare that the technical prerequisites in this area are ensuring a safe rewetting in terms of flood risk. Ultimately, the natural factors measured do not indicate any disability for the SK-project. Rather, landowners' participation plays a much more decisive role in the viability of the SK project, as both PM and the TM claimed.

It is important to note, that although many concerns have been discovered both throughout *Naturstyrelsen*'s process and our own, most landowners show a willingness to participate. However, as the number of rewetting projects is expected to increase in Denmark

(Miljøstyrelsen, 2021; Klimarådet, 2020a), understanding how to design and implement such projects in an effective manner becomes increasingly important. Similar to the argument of Kabish et al. (2016), we find that one of the central barriers to the success of SK-like projects are the fear of the unknown, i.e. not understanding the benefits and consequences of such projects. The split between stability and speculation attitudes prominently demonstrates this. On the one hand, the stability farmers' ability to ensure a stable livelihood influences their participation. The future certainty of the compensation options offered by the project thereby acts as an enabling force for the project. On the other hand, the uncertainty of whether the project will materialise – based on governance perceptions emanating from prior experiences as well as the rumours about *Naturstyrelsen's* inability to buy land for redistribution – enables the sense of distrust prevalent in the speculation attitude. This uncertainty coupled with a stronger willingness to speculate in the unknown of the future – i.e. future uses, e.g. windmills and CCs – feeds the feeling of being "robbed". As the government is eliminating a potential stream of revenue (i.e. CCs), which in the landowners view should belong to themselves, the option of doing the project themselves emerges as a solution in this realm of thought.

In this way, 'the unknown future' plays a dialectic role in impeding the project as the expectations of the two attitudes are both enabling and disabling. In this regard, as shown in Fig. 8e, such discrepancy could be understood in light of the fact that the majority of questionnaire respondents have limited knowledge of the benefits of rewetting wetlands. In other words, lack of knowledge of the benefits of the project feeds into the uncertainty and unknown of the future. Across our informants, however, the feeling of being overlooked by the government plays a crucial role for participation, aligning to the argument of Polman and Slangen (2008) that trust in institutions is also crucial for participation. As our results indicate from both the perspective of the landowners as well as from the PM, taking out more land of production will only increase the feeling of being overlooked. This feeling, we find, in part emanates from broader governance perceptions such as the societal-group divide as described earlier. In this regard, this imbalance of perceptions is a factor that might not directly disable the project, but will definitely be slowing it down. Previous research (Rawlins & Morris, 2010; Schaller et al., 2011) also stresses the importance of local context in relation to rewetting projects. In Tønder, there have been previous attempts to increase bird biodiversity (Fritidsmarkedet, 2020), which has shown to impact the views of some landowners. Some viewed biodiversity projects to overlook farmers' interests. However, from our results, the potential biodiversity enhancement does not seem to act as either an enabling nor disabling

factor for the project. Rather, it is a further example of how different perspectives are occuring in SK. A crucial factor displayed in the stability attitude in relation to the land swapping compensation, is the quality of the soil. As stated before, they in part refer to the high water table. Our soil sampling results display a variety of water content, in one field going up as high as 68,6% (table 5), thus mirroring their concerns about the soil quality in SK.

With the soil sampling, we aimed to see how land use influences carbon- and iron-bound phosphorus content. Although our results displayed a wide variety in terms of the two indicators, no definite conclusion can be drawn in terms of crops grown since the majority of the fields were used in a similar rotation system (grass, crop, crop) and therefore the overall land use did not vary significantly. We could, however, find a difference in relation to variation in management practices. Out of the 21 fields sampled, only 5 had a carbon content higher than 10 %, ranging from 11.17 - 38.79 %. These were also the only 5 fields with organic production. The intensively, conventionally cultivated fields all had low carbon values. These results indicate that management practices do influence carbon content, which could be taken into consideration when predicting CO_2-emission aversions in future projects. Although carbon storage is the main goal of the project, carbon content is not included when pricing the land (Appendix 8.6). Seeing as our results might indicate that organic fields are of a higher value in terms of preserved carbon, this suggests that they could be valued higher than conventional fields during land pricing. Interestingly, the differences in farming practices influence not only the carbon content of the soil, but is also connected to their identities as farmers and their perception of climate mitigation measures. Specifically, as the conventional farmers take pride in their practices, a derivative consequence is the disapproval of nature restoration projects and environment protection at the expense of farming practices and efficiency

Relatedly, as CCs seems to be if not disabling then at least stagnating the SK-project, this can be interpreted as a shortage in the compensation mechanism. As the CC is accounted for in the national climate mitigation plan, it cannot be given to the landowners, as the credits cannot be counted twice. Instead, including the carbon content in the pricing of the land might alleviate the frustration from the landowners, whilst simultaneously making the goals of the project clearer for them. This however is accompanied by risks, as such land pricing principles could jeopardise the participation of conventional farmers, which constitute the majority of Danish and European farmers. Policymakers are thus facing a delicate balancing

act when designing the framework for rewetting project, factoring in a variety of different concerns.

5.2 Methodological discussion

As we sent out the questionnaire during the first days of our field work, we used the results throughout the field work to develop our understanding of the issues of most importance to the landowners. The questionnaire, thus, played a key role in advancing our research in the following ways: by 1) providing contact details of landowners, 2) providing data that we could ask informants to elaborate on, e.g. CCs, 3) providing data which formed an important piece of background knowledge for us to better understand the context of our field. Thus, we emphasise that the questionnaire was never intended the purpose of a data source for 'deep analysis', but rather as a methodological and conceptual starting point. Using quantitative methods for investigating the interconnections between motivations, perceptions and experiences, we saw as a misfit, hence our focus on qualitative methods for the social science. However, we did expect to receive more answers and faster, which led to initial concerns that we would not get sufficient interview appointments. This fortunately turned out positive.

A key reflection regarding our soil sampling concerns the fact that we did not consider the size of each sampled plot. We did the same process throughout, despite some fields being larger while others were narrow, thereby being potentially more impacted by the neighbouring plots. Others had different characteristics in terms of elevation and slope, which we did not take into consideration. In terms of P-leakage, the direction of the water flow as well as distance to water bodies could have been an important variable to consider. In hindsight, this could have been thoroughly considered when choosing the placement and direction of the transects. However, as our results do not indicate a high risk of phosphorus leaching, this turned out not to be an issue. Furthermore, it is important to highlight that *Naturstyrelsen* have already done carbon content assessments on a much larger scale, the results of which we have been given access to. They do not however, focus on a distinction between different land uses. But as our results indicate, land management seems to have a correlation to the carbon content thus suggesting the land use influence as an important point of consideration. We could e.g. have sampled bulk density to find other properties of the soil. However, with the scope of the study we believe the soil samples were sufficient. Finally, our

snowballing strategy influenced our soil sampling as we sampled plots in largely the northern half of the project area (Fig. 2).

A central reflection regarding our use of semi-structured interviews as a method for data collection concerns the sometimes very coincidental nature of making progress, particularly during field work. Our first interview with a landowner brilliantly demonstrates this, as the appointment was largely the result of an informal conversation with a close friend of the landowner. As the strategy we had planned for establishing contact with the landowners then turned out to be slow, we had to be versatile to make use of the opportunities offered. Regarding the interviews, it would have been beneficial to the project had we had more time to do further follow-up interviews. Our experience with doing three interviews with the *Naturstyrelsen* project manager displays how such follow-up interviews enabled us to explore certain topics in much greater detail. Additionally, we are aware of the homogeneity of our sample due to the snowballing, especially regarding age and farming practices.

Regarding asking questions, we all experienced that the responses of our informants varied greatly depending on the questions we asked, and particularly the way questions were posed. In many ways, we encountered the difficulty in phrasing a question in a way so that it balances between specificity around a certain theme, while maintaining space for informants to fill in with their perspectives. Perhaps we could have made use of other means, such as visual tools like pictures or timelines to circumvent the constraints of interview situations. By constraints we imply e.g. simultaneously being attentive to perspectives shared, managing the interview, having new questions ready, while being ready to pick up on emerging issues, etc. However, a certain interview also demonstrated that sometimes informants' personal agendas and lecture-like responses make asking questions redundant. On snowballing, we found that a clear shortcoming of our strategy pertains to us interviewing some landowners that are in fact neighbours and/or similar producers. This might have impacted the way that they discuss the dynamics of the project, as they likely share everyday life more with each other than with others in the area. We could therefore have done more to reach out to other landowner types, to circumvent the arguable homogeneity of our informants. We could equally have done more to interview women as the results from our questionnaire (Table 4) shows gender had a strong correlation to various variables.

Furthermore, one of our assumptions, given the literature (Feng et al., 2020), was that age would be a relevant variable for the participation in this kind of project. The regression analysis does however indicate gender, age and income as the factors that influence people's

perception of the project. The deviation here may be related to the small scale of our questionnaire which causes a lack of generalizability of the conclusions. However, given the results in fig. 8a, in particular the low value of the standard variation we do not think that our results justify linking this variable with their participation. Moreover, as our informants were a relatively homogenous group we therefore decided not to consider this variable strongly. It should be noted that this lack of variety is likely influenced by the outcomes of our snowballing. We had to abandon our plan to do focus group interviews as stated in our synopsis, as we sensed that most landowners had no interest in participating. It should be noted, however, that we did not pursue it strongly. As a consequence, we did not use the Traditional Ecological Knowledge approach to investigate the farmers' perception of the properties of their own soil, as we had planned to during focus groups.

On conducting the interviews, we decided on assigning different roles based on our experience with the first interview. Then, all of us were present as well as a professor, which turned out to be too crowded. On top of that, we had no delegated responsibilities which made the setting somewhat messy. The delegation of clear responsibilities provided us not only with clearer direction when conducting the interviews, it also helped facilitate fruitful conversations, as we were more attuned towards the conversation, and were able to follow up on the perspectives shared. By the end of the field trip, some interviews were even conducted without the interview-guides given the familiarity of the topics and the setting. Regarding the go-along and sit-down strategy, it had mixed results. The advantage of go-alongs was clearly displayed as the landowners were clearly in comfortable settings. A disadvantage, however, was to ensure that all interviewees could catch up with the landowner. In some cases, the advantages and disadvantages were fully reversed during the sit-down interviews.

On coding strategy, we decided to create themes to be able to condense our empirical material. However, we do acknowledge that it might oversimplify the complexity of our study site. However, the codings that we developed broadly reflect the themes that we identified prior to our field work, with a few exceptions. We thus identify an inclination both in relation to our data collection and its processing. There might indeed be other equally relevant issues, but since we did not explore these, we have no ability nor material to consider such. Accordingly, we tried to address this inclination through our choice of methods, semi-structured interviews, in combination with choice of format, go-along vs. sit-down, which would open up space for informants to fill in their perspectives. Therefore we can also somewhat conclude that as there are exceptions to this trend - e.g. CCs and windmills -, our

strategy to manage such bias has at least been partially successful. We do however acknowledge that it has not eliminated it completely.

Concludingly, a delicate reflection regards working with a project that is unfolding and concerns a somewhat sensitive topic. During some interviews, certain informants made clear that a certain statement was confidential, which puts us in an ambiguous ethical position as researchers. Do we include it - in a disguised way - due to its potential relevance for the project and our research, or do we abide by the promise of confidentiality? We decided to go with the latter, however, it remains to be seen if/how our engagement generates anything in or around the project. Finally, talking to only certain landowners provides us only with particular data, from which we can infer only particular results and particular conclusions. Thus, our study is not purposed to draw general conclusions about designing rewetting projects. Rather, we aim to excavate and understand some of the inherent - and inevitably qualitative - dynamics at play in such projects. Such results, despite their particular character, can in turn support the attunement of those developing more generalised knowledge on rewetting projects.

6. Conclusion

To answer our overall research question, *How do natural and social factors enable or disable the rewetting of lowlands in the SK?,* none of the factors that we analysed seems to directly disable the SK rewetting project. Our soil sampling actually showed that carbon content of many fields in the project area does not exceed the legal thresholds, specifically those which have a history of intensive cultivation. However, according to the more extensive soil analysis by Naturstyrelsen, the thresholds are met. On the other hand our results about iron-bound phosphorus does not indicate a high risk of leaching, therefore, this is neither a disabling factor for the project. However, as we stated in section 5.2 we are fully aware of the limitation of our risk assessment. Therefore, we are not fully able to draw a definitive conclusion. As far as the social factors are concerned, even though there seems to be no true barriers to the success of the project, we did encounter some impediments.

The split in terms of promises of certainty between the stability and speculation attitudes as discussed in section 5.1 is the most prominent demonstration of such impediments. The split encapsulates three important aspects; first, how our two overarching themes are interpreted differently by the landowners. Second, that they interconnect and are mobilised differently and, third, represent two attitudes, which interdependently constitute

both a potentially enabling and disabling posture towards the SK-project. The landowners' governance perceptions - e.g. being unfairly scapegoated in the climate change debate - and perceptions of uncertainty of future uses - e.g. regarding CCs and windmills - should be understood against this backdrop of interconnections and enability/disability.

In conclusion, neither the social nor the natural factors elaborated on in this report might fully disable the project. Rather, they constitute a web of concerns that are part of a broader discourse which needs to be addressed to ensure the viability of future rewetting projects.

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8. Appendix

8.1 The overview of applied methods

- Questionnaire

5 sent on 28th February for pretest, 51 sent on 1st March, 21 responses received.

- Soil sampling

21 soil samplings collected and analysed from 21 fields.
3 on 2nd March, 1 on 4th March, 8 on 8th March, 7 on 9th March, 2 on 10th March.

The details of soil samples

Sample	Sample Collection Time	Longitude	Latitude	Elevation (m)
1	3/2/22 12:37	8°45'34.05" N	55° 1'26.00" E	0.087875
2	3/2/22 12:49	8°45'50.78" N	55° 1'27.24" E	-0.105053
3	3/2/22 13:21	8°45'10.10" N	55° 1'25.48" E	-0.137939
4	3/4/22 15:36	8°45'3.37" N	55° 0'10.43" E	-0.924622
5	3/8/22 10:18	8°45'30.92" N	54°59'53.95" E	3.330444
6	3/8/22 10:36	8°45'8.70" N	54°59'51.42" E	-2.965286
7	3/8/22 11:15	8°45'11.95" N	55° 0'4.31" E	-2.432178
8	3/8/22 14:08	8°45'44.06" N	55° 0'58.37" E	-2.449832
9	3/8/22 14:20	8°45'42.90" N	55° 1'31.57" E	-2.454456
10	3/8/22 14:39	8°45'9.93" N	55° 0'33.07" E	0.725281
11	3/8/22 14:46	8°45'15.57" N	55° 0'31.51" E	0.167336
12	3/8/22 15:08	8°45'19.03" N	55° 0'14.72" E	2.528053
13	3/9/22 10:32	8°45'33.46" N	55° 0'14.00" E	2.096115
14	3/9/22 10:47	8°45'19.94" N	55° 0'10.37" E	0.269695
15	3/9/22 11:00	8°45'5.39" N	55° 0'15.78" E	1.109814
16	3/9/22 14:26	8°43'55.28" N	54°59'45.19" E	-3.230415
17	3/9/22 14:39	8°43'58.54" N	54°59'51.43" E	-0.11306
18	3/9/22 15:04	8°44'27.63" N	55° 0'50.24" E	-2.070793
19	3/9/22 15:17	8°44'42.26" N	55° 0'50.25" E	-3.254116
20	3/10/22 14:08	8°44'45.14" N	54°59'23.65" E	1.817383
21	3/10/22 14:30	8°45'6.46" N	54°59'32.91" E	2.085068

- Interview

12 interviews with 7 landowners and 3 other actors
Including 3 walk-along interviews, 6 sit down interviews, 2 field interviews, 1 zoom interview.

- Preparation

16 group meetings throughout the field work.

8.2 Interview guidelines

Bold questions are the most relevant ones that cannot be missed during the interviews.

8.2.1 Landowners interview guide

The interview guide slightly changed during time, in particular new questions have been added. We put the final one since it is the most comprehensive one.

Key words

1) GREETING // Introducing ourselves and the context of our research project

2) OVERALL SEJERSBÆK

3) TIMELINE MAP - GOVERNANCE

4) LANDOWNERS GROUP DYNAMICS

5) FUTURE USES

6) CARBON CREDITS

7) SOIL

8) BIODIVERSITY

(1) Governance structure

- **Do you have prior experience with participating in projects similar to SK?**
    - If yes, what kind of project was that? Who ran it? What was your experience?
    - If not, do you know of any other projects either through colleagues, friends, associations? What have you heard?
    - Would you say there is a shared impression among landowners for participating in such projects? Elaborate:
        - If yes, could you describe it? Is it tied to specific actors? Who are they?
        - If not, why do you think that is?
- **What is your experience with participating in the Sejersbæk Kog-project?**
    - How have you been approached by the project managers? What is your general impression?

- Could you take us through the process and highlight events/episodes that have stood out to you?
- Why do you think these events particularly stood out to you?
- **What is your overall impression of the project? Is it shared by other landowners? Do you talk about it?**
    - Are there any specific aspects of the project that you are particularly interested in/concerned by? Why do you think that is?
    - Do other landowners share that view? Why do you think that is?
    - Are there some group(s) of landowners that have a different view than you? What is that? And why do you think that is?
- How was/is your experience with the redistribution committee?
- Is there anything that you wish had been handled/managed differently?
    - If you were in charge of the Sejersbæk Kog-project, how would you have managed it?

- **Do you know about the Kogsbøl mose project? Has it influenced your decisions?**

(2) Project discourses

- **What is the talk about carbon credits (klima-krediter) among you and your neighbours?**
- Do you know of other interests in the Sejersbæk Kog-area outside of the project? Your opinion → overlapping or conflicting interests? Has it influenced your decision?
- Are you a member of a farmer's association? Why? What are its core interests? Do they conflict with some of the aforementioned interests in the area?

(3) Future uses

- What would you have used your land for had this project not been initiated?
    - Other landowners in the area?
- **What do you think of the future of your land in the project area? Do you have any hopes or concerns?**
    - What in your view is causing/generating such hopes/concerns?
    - Do you think your hope/concern is shared by other landowners in the area?
- **Are there any potential future land uses of the project area that you are strictly opposed to? Why/how?**
    - Anyone sharing your opposition?
    - Who differs from your position? Why do you think that is?
- **Any land uses that you are particularly supportive of? Why/how?**
    - Anyone sharing your support?
    - Who differs from your position? Why do you think that is?
    - If you plan to keep the land, will you cultivate the area once it is rewetted? Why/why not?

(4) Biodiversity

- **One of the potential benefits of the project concerns creating habitats for meadow birds. What are your thoughts on that? Would you be willing to allocate your land to bird habitats?**
- Are you aware of the endangered status of meadow birds? What do you make of it?
- Have you noticed the decrease in meadow birds?
- Does the issue of loss of biodiversity, in this case but also in general, worry you? Do you think it will impact you directly?

(5) Soil properties perceptions

- **Please point out on the map which fields are yours**
- **What is the current and previous land use?**
- **Do you know the carbon content of your agricultural soil? Do you consider it an important indicator?**
- **What kind of agriculture practices have you used on the land?**
- Do you think the new field will have better properties? Is this why you want the new field? (If the person wants another field as compensation)

8.2.2 Tonder Municipality interview guide

(1) Personal Information / background questions

How did you get your knowledge? (experience, education)

Are you a local?

What do you think, as a citizen, about this project?

Can you tell us a little bit about your **experience** in rewetting projects?

(2) Governance structure

What is the **institutional** perspective on these projects?

Tell us a little bit about the **governance structure** of the Sejersbæk Kog project?

- Do you think the government and the municipality overlap? Do you think there are any differences in the way things are managed?
- We heard that people usually avoid EU projects because they take very long and involve a lot of paperwork. What do you think?

We know of the Kogsbol Mose project which was recently finished. How involved were you in that?

- Can you tell us the differences in the administration?

(3) Participation

What is your experience with landowners' participation?

- What are their main concerns usually? And in this case?
- How hard is it to involve them?
- What about the compensation? How do you usually decide?
- We've learnt that a lot of people get a good deal out of this by selling the land and then buying it again. Can you confirm? What do you think?

What kind of **difficulties** do you usually face in terms of participation? Are there any typical counter narratives that you usually find?

(4) Future uses

What kind of future uses do you usually see in these kinds of projects? biodiversity? windmills? Solar panels? Grazing?

What kind of environment is the best for establishing bird **biodiversity**? What level of water?

- Do you think locals care about bird biodiversity? Could this be a factor in their decision?

What are the expectations of the environment after the project (soil, biodiversity), all achieved?

Have you quantified the benefits of the project, such as the amount of CO2 emissions reduced?

(Regarding the future land potential, we need to consider the flooding risk due to rewetting)

- How would it operate?
- If you believe it wont work, what measures are usually needed to prevent or reduce the damage caused by flooding?

Do you know how other rewetting projects predicted the possible flooding risk? Are the predictions/monitoring results accurate? Is there any practical help? Could you please give us some examples?

As the manager mentioned, the southern part will be used to store water, is the water storage controllable? What will be the impact on the neighbouring area?

8.2.3 DOF interview guide

(1) Introduction questions

Are you a local? If not, when did you move here?

What is your position at DOF?

How did you get involved?

What is your main interest related to birds in Tønder?

(2) Birds in general

What are the most common species now in Sejersbæk Kog?
- What are the key species we need to know?

In your opinion, what should be done by Naturstyrelsen in Tønder to benefit the birds?
- What should be done specifically in SK?

Do you know how the bird population has changed in Kogsbøl Mose?
- Do you think that there can be anything from that area that can be applied to Sejersbæk kog?

Could you tell us about any other projects or measures for bird protection in Tønder?

Do you have any recognition of the farmers' opinions and perception of the birds?

(3) The project

What do you think the area will look like?

Naturstyrelsen mentions meadow birds - what species are these?
- What would you say their situation is now?
- Are there any species in particular whose situation is particularly dire?
- How would you guess the future aspect of the area will change the bird population in the project area?

The project area now: is it an ideal habitat for birds? What birds?
The project area after: how will things change?
Would that, in your opinion, be a good trade-off?

Would rewetting/stopping production be enough?

- Are there any measures that could be done in addition to those things?

What do you/your association think about this project and rewetting projects in general?

8.2.4 Project Manager 1 interview guide

Introductory

- Name? Position? For how long? Responsibilities? Do you live in the area?
- Prior experience with rewetting projects/related projects?

Rewetting

- How are you designing the rewetting?
- How are you dealing with methane emissions? (*Are you removing nitrogen?)* Phosphorous?
- Are you considering alternative (agricultural) practices?
- We've read that the land plots in the project area are heavily exploited. What does 'highly exploited' imply in this context?
- You are currently developing technical assessments of the project area. What is included in the technical assessments?
    - What's your assessment of the carbon content of the soils in the project area?

Volunteering

- How has the initial reaction from the local community been? Positive? Drawbacks?
    - Are you drawing on experiences/evidence from related projects? Kogsbøl Mose, e.g.?
        - Soil-issues or social issues?
- How are you planning to approach the local landowners? You work there, do you know them in advance?
- How are you making land owners volunteer? Are you doing promotion-campaigns in the local community? Sending technical material? How do you deal with the voluntary aspect of this project
- How are land prices determined? How does compensation/redistribution work? Are you using any kinds of models/standards that you apply? If so, which?
    - How is the redistribution board/body set up? Are there legal principles to abide to?
    - What is the budget for compensations, and how is it divided? (What's the price of one Ha?)

Flood risk

- We read that the result of preliminary analysis shows that there is no substantial risk. Can you elaborate on this?

- How is the study area delimited in relation to flooding? Is it possible to get the boundary/map files?
- Do you have a map/model/something for flooding that we can use?

``````

**Other**

- How are you coordinating with other public bodies? Municipality, ministries, local NGOs?
- Knowing the area and the project: Do you have any advice for our future work? Disadvice?
- Do you have a list of names of landowners, tied to the individual land plot (matrikelnr.)?
- How can we play into their work?

### 8.2.5 Project Manager 2 interview guide

**Keywords**

**ASPECT OF THE AREA**

**PRE PURCHASE**

**CROPS/PIGS FARMERS**

**GOVERNANCE STRUCTURE**

**DIFFICULTIES**

**HUNTING / FUTURE USES**

**CARBON CONTENT**

**ARLA / CARBON CREDITS**

**BIODIVERSITY**

What is the area going to look like? (e.g. water level)

How does the selling process work? How does the **pre purchase** option work? Do you know if a lot of them are doing this?

Could you elaborate about how carbon credits are relevant for this project?
``````

How did you assess that the area is good to establish **biodiversity**?

How are farmers with crops/pigs dealing with the project? (Dairy farmers can use parts of the area for grazing)

Perspectives for **hunting**

What makes a **government** project different then a municipality one?

What are the **difficulties** you encounter?

Project area? Peat/carbon content? Your results showed ~100 hectares below 6 % threshold (we show him the map)

8.2.6 Project Manager 3 interview guide

Start by stating what we have done during the two weeks, talk a bit about our results and from there go into the things we need clarification on.

Is this about carbon or **nitrogen**?

Ask about the **future use.** Are you really going to leave after the project is done? We have reasons to think they are already thinking about doing something afterwards.
→ We came across some **concerns about biodiversity:** geese eating the crops of the surrounding crops.
→ **Future flooding area**
→ Volunteer from DOF said the best thing would be a **lake.** Have you thought about that?

How is the process of buying land for the **compensations**?

Have you already finished any contracts? Have you already acquired land?

Buybacks: how is that carried out? Because they are informal agreements → Prices going up: how does that affect the buybacks?

Have you come across concerns tied to **previous bad experiences** with similar projects? Is that a barrier for you?

What's your mandate on **carbon credits**? What's the plan?

One landowner said that he would have done the project in multiple smaller steps → why are you doing the entire area all at once?

Some landowners believe that the **water level will go up and down** → thoughts? Is this true?

Do you have a map of all the plots and their pricing? We want it

Timeline→ How did you contact them?

We already have carbon content and know that phosphorus is on the way. Have you done any other **assessment reports**?

8.3 Questionnaire - Questions

Timeframe

1st of March 2022 to 12th of March 2022 (pretest sent on 28th of February).

Survey Structure

1. Introduction:

Kære lodsejere i projektområdet Sejersbæk Kog. Vi er seks kandidatstuderende fra Københavns Universitet, som besøger Tønderområdet fra d. 28. februar indtil d. 11. marts for at udføre et uafhængigt forskningsprojekt om lavbundsprojektet, Sejersbæk Kog som del af et metodekursus i feltarbejde. Vi er særligt interesserede i at undersøge på den ene side hvilke overvejelser I som lodsejere i projektområdet har i forbindelse med at deltage i projektet, og på den anden side jeres overvejelser om projektets mål om kulstoflagring, fuglehabitater, mm. Derfor er jeres holdninger meget vigtige for os.

Dette er et meget kort og hurtigt besvaret spørgeskema, som vi ønsker at bruge som et startskud for vores undersøgelse. Det vil være af stor hjælp, hvis I har tid og lyst til at bruge fem minutter på at besvare den. Vi garanterer at alle besvarelser håndteres fuldstændig anonymt. Vi håber, at flere af jer kunne have lyst til at mødes med os og diskutere projektet yderligere. Vi er meget interesserede i at høre jeres holdninger, bekymringer og idéer.

Dear landowners of Sejersbæk Kog, we are a group of six master students from the University of Copenhagen. We are visiting Tønder from February 28th to March 11th to do independent research on the Sejersbæk Kog rewetting project, as part of a field work and methods course. We are very interested in investigating what considerations you as landowners have in connection to participating in the project, as well as your considerations

about the project's goals for carbon storage, bird habitats etc. Therefore, your opinions are very important to us.

This is a very brief survey that we would like to use as a starting point for our research, and it would mean a lot to us if you could take 5 minutes to answer it. We assure the complete anonymity of the respondents. We hope we will meet you in person soon to discuss this project further, and to listen to your opinions, concerns, and ideas.

2. Questions:

Q1:
I hvilket år er du født?

_____

What year were you born?

_____

Q2:
Hvad er dit køn?

▢ Mand

▢ Kvinde

▢ Andet

What is your gender?

▢ *Man*

▢ *Woman*

▢ *Other*

Q3:
Hvor langt fra Sejersbæk Kog bor du?

▢ <1 km derfra

▢ 1-5 km derfra

▢ 6-10 km derfra

▢ 11-15 km derfra

▢ 16-20 km derfra

▢ >20 km derfra

How far away from Sejersbæk Kog do you live?

▢ *<1 km away*

▢ *1-5 km away*

▢ *6-10 km away*

▢ *11-15 km away*

▢ *16-20 km away*

▢ *>20 km away*

Q4:
Hvad er din årlige indkomst (før skat)?

▢ <200 000 kr

▢ mellen 200 000 kr. og 299 999 kr.

▢ mellen 200 000 kr. og 299 999 kr.

▢ mellen 300 000 kr. og 399 999 kr.

▢ mellen 400 000 kr. og 499 999 kr.

▢ mellen 500 000 kr. og 599 999 kr.

▢ mellen 600 000 kr. og 700 000 kr.

▢ >700,000 kr.

▢ Ønsker ikke at oplyse

What is your yearly income (before taxes)?

▢ *<200 000 kr*

▢ *between 200 000 kr. and 299 999 kr.*

▢ *between 200 000 kr. and 299 999 kr.*

▢ *between 300 000 kr. and 399 999 kr.*

▢ *between 400 000 kr. and 499 999 kr.*

▢ *between 500 000 kr. and 599 999 kr.*

▢ *between 600 000 kr. and 700 000 kr.*

▢ *>700,000 kr.*

▢ *Prefer not to say*

Q5:
Hvor stor en procentdel af din indkomst kommer fra landbrugssektoren (cirka)?

▢ 0 %

▢ 1-25 %

▢ 26-50 %

▢ 51-75 %

▢ 76-99 %

▢ 100 %

Please estimate how many percent of your income comes from the agricultural sector?

▢ *0 %*

▢ *1-25 %*

▢ *26-50 %*

▢ *51-75 %*

▢ *76-99 %*

▢ *100 %*

Q6:
Hvor mange hektar land har du i Sejersbæk Kog-projektet?

_____

How many hectares do you own in the Sejersbæk Kog project area?

_____

Q7:
Hvad er den primære brug af din jord i Sejersbæk Kog?

▢ Afgrøder (konventionelle)

▢ Afgrøder (økologiske)

▢ Jagt

▢ Græsning

▢ Jeg forpagter min jord ud

▢ Rekreativ brug

▢ Ander, uddyb venligst…

_____

What is the primary use of your land in Sejerbæk Kog?

▢ *Crops (conventional)*

▢ *Crops (organic)*

▢ *Hunting*

▢ *Grazing*

▢ *I lease my land to others*

▢ *Recreation*

▢ *Other, please specify…*

_____

Q8:
Hvor bekymret er du for klimaforandringerne på en skala fra 1-10?

Ikke bekymret Nogenlunda bekymret Meget bekymret

How worried are you about climate change on a scale from 1-10?

Not worried *Somewhat worried* *Very worried*

Q9:
Hvor meget ved du om genetablerede vådområders evne til at mindske drivhusgasudledninger fra landbruget?

Jeg kender meget til det Jeg er nogenlunde bekendt med det Jeg kender ikke til det

How much do you know about the potential of rewetting wetlands for reducing greenhouse gas emissions from agriculture?

I am very aware I am somewhat aware I am not aware

Q10:
Regner du med at deltage i Sejersbæk Kog-projektet?

▢ Ja

▢ Nej

▢ Ved ikke

Are you planning to participate in the Sejersbæk Kog-project?

▢ *Yes*

▢ *No*

▢ *I don't know*

Q11:
Hvis du regner med at deltage, hvilken af de følgende faktorer påvirker din deltagelse? (Du kan vælge mere end en faktor)

▢ Min jord er ikke særlig produktiv

▢ Jeg går snart på pension

▢ Jeg brugte slet ikke min jord

▢ Jeg synes projekter der reducerer drivhusgasudledninger er vigtige

▢ Jeg tror at kompensationen (enten jordlod eller penge) er mere værd end min nuværende jord.

▢ Anden (uddyb venligst) …

_____

If you are participating in the project, which of these factors are influencing your participation? (You can choose more than one option)

▢ *My land is not particularly productive*

▢ *I will retire soon*

▢ *I do not use my land*

▢ *I believe that projects that reduce GHG-emissions are important*

▢ *I believe that the compensation (either land redistribution or money) is worth more than my current soil.*

▢ *Other, please specify….*

_____

Q12:
Hvis du deltager i projektet, hvilken kompensation foretrækker du?

▢ Jeg foretrækker at bytte min jord for et andet jordlod.

▢ Jeg foretrækker at modtage finansiel kompensation.

If you are participating in the project, which compensation would you prefer?

▢ *I would prefer to receive another plot of land.*

▢ *I would prefer to receive a financial compensation.*

Q13:

I forlængelse af det foregående spørgsmål, kan du uddybe hvorfor du foretrækker den valgte kompensation?

_____

Referring to the previous question, could you elaborate on why you chose that compensation mechanism?

_____

Q14:

Mener du, at den tilbudte kompensation er rimelig?

▢ Ja

▢ Til dels

▢ Næsten ikke

▢ Nej

Do you think that the offered compensation is fair?

▢ *Yes*

▢ *Somewhat*

▢ *Barely*

▢ *No*

3. Concluding statement:

Mange tak for din tid og din besvarelse. Hvis du kunne tænke dig at hjælpe os med at indsamle yderligere data, og vil give samtykke til at vi må kontakte dig, så del meget gerne dine kontaktoplysninger med os her, så vil vi kontakte dig. Selv hvis du deler dine

kontaktoplysninger med os, vil din besvarelse i dette spørgeskema forblive fortrolig og anonym.

Kontaktoplysninger:

_____

Thank you so much for your time and input! If you are willing to help us to collect data, please leave your phone number and/or your e-mail address here and we will get in touch with you. Even if you leave your contact information below, the answers which you provided in this survey will remain confidential and anonymous.

Contact information:

_____

8.4 Questionnaire answers

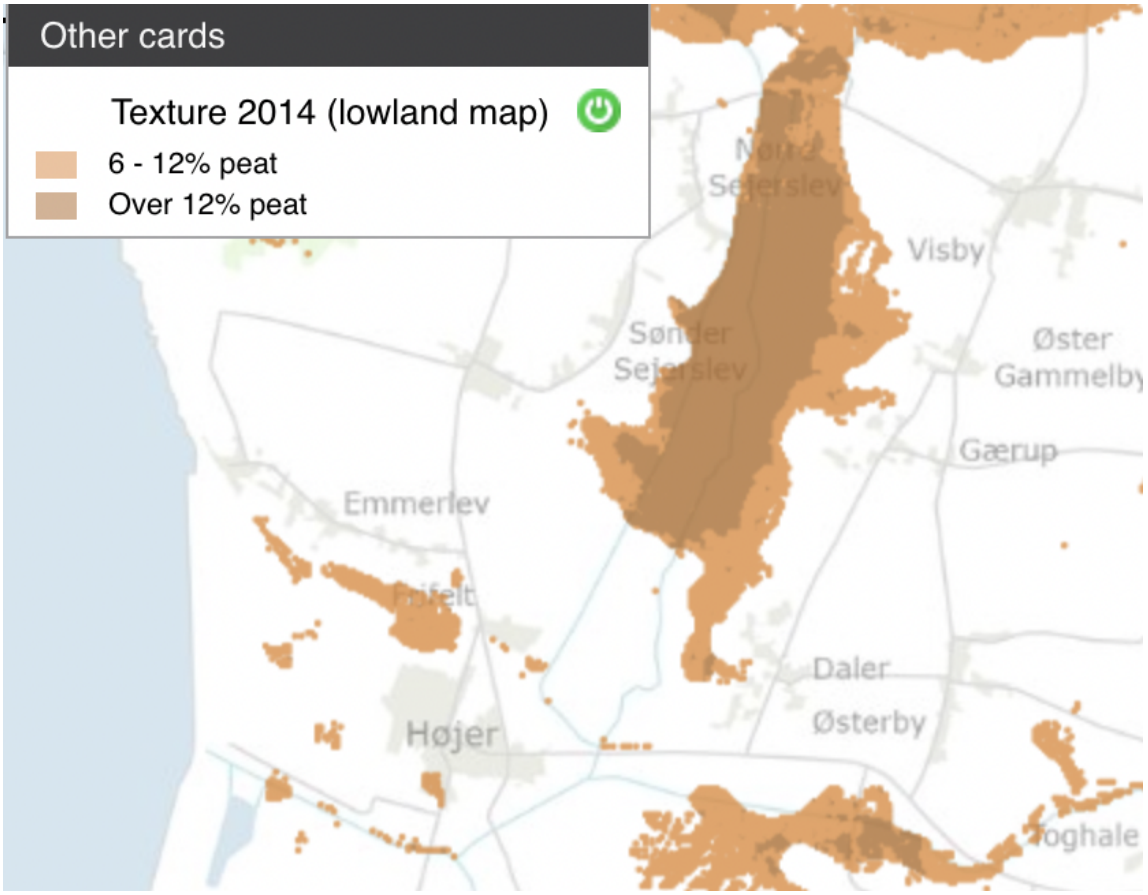
Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q7B
a	1966	Man	1-5 km away	>700,000 kr.	100%	40	Crops (conventional)	
b	1970	Man	1-5 km away	>700,000 kr.	76-99%	46	Crops (conventional)	
c	1965	Man	<1 km away	I prefer not to say	76-99%	74	Crops (conventional)	
d	-	Man	<1 km away	<200 000 kr.	0%	0	Crops (conventional)	
e	1973	Man	<1 km away	I prefer not to say	0%	4	Crops (conventional)	
f	1963	Woman	1-5 km away	between 600,000 kr. and 700,000 kr.	1-25%	8,2	I lease my land to others	
g	1967	Man	1-5 km away	between 500,000 kr. ans 599,999 kr	51-75%	30	I lease my land to others	
h	1948	Woman	16-20 km away	I prefer not to say	1-25%	6,56	I lease my land to others	
i	1963	Man	<1 km away	I prefer not to say	76-99%	ca 35 ha	Crops (conventional)	
j	1968	Woman	<1 km away	between 300,000 kr. and 399,999 kr	26-50%	8	I lease my land to others	
k	1965	Woman	16-20 km away	between 400,000 kr. and 499,999 kr	1-25%	1,5	I lease my land to others	
l	1953	Man	<1 km away	between 300,000 kr. and 399,999 kr	51-75%	25	Hunting	
m	49	Man	<1 km away	between 600,000 kr. and 700,000 kr.	76-99%	50	Grazing	
n	1951	Man	11-15 km away	between 400,000 kr. and 499,999 kr	26-50%	0	Other, please elaborate...	I am the chairperson of the dike-association, which is responsible for draining the area
o	111	Man	6-10 km away	between 400,000 kr. and 499,999 kr	51-75%	123	Crops (conventional)	
p	1948	Woman	>20 km away			7,56	I lease my land to others	
q	1966	Man	<1 km away	I prefer not to say	0%	4	I lease my land to others	
r	1962	Man	<1 km away	<200 000 kr.	1-25%	5 ha	Grazing	
s	1953	Man	1-5 km away	>700,000 kr.	51-75%	15	Crops (organic)	
t	1981	Man	<1 km away	between 600,000 kr. and 700,000 kr.	1-25%	ca 15	Crops (organic)	
u	1949	Man	1-5 km away	between 600,000 kr. and 700,000 kr.	76-99%	15	I lease my land to others	

v	1958	Man	<1 km away	I prefer not to say	100%	25	Crops (organic)	
w	1975	Man	<1 km away	between 300,000 kr. and 399,999 kr	51-75%	28	Crops (conventional)	
Respondent	**Q8**	**Q9**	**Q10**	**Q11**	**Q11B**	**Q12**	**Q13**	**Q14**
a	2	I am somewhat familiar with it	Yes	I believe that the compensation (either land redistribution or money) is worth more than my current soil / Other (please elaborate)	It gives the opportunity of land redistribution.	I would prefer to receive another plot of land		Yes
b	Somewhat worried	5	Yes	My land is not very productive		I would prefer to receive a financial compensation		Yes
c	3	10	Yes	I believe that projects that reduce GHG-emissions are important / Other (please elaborate)	Because of Arla. We need to reduce CO2 emissions	I would prefer to receive another plot of land	I need my land in my production. When you cultivate the land, it sequesters more carbon than it emits. This is often neglected in the entire debate.	Yes
d								
e	Very worried	I know nothing	Yes	Other (please elaborate)	Possibility of new land	I would prefer to receive another plot of land	Because we can not manage without 1/3 of our land	No
f	8	I am somewhat familiar with it	Yes	My land is not particularly productive / I do not use my land / I believe that the compensation (either		I would prefer to receive a financial		Yes

				land redistribution or money) is worth more than my current soil.		compensation		
g	Somewhat worried	I am somewhat familiar with it	I don't know	I will retire soon		I would prefer to receive another plot of land	The guy who has the land will be missing 30 hectares	Yes
h	Somewhat worried	7	Yes	Other (please elaborate)	selling my land	I would prefer to receive a financial compensation		Yes
i	Somewhat worried	10	I don't know	Other (please elaborate)	Price and CO2 reduction in relation to existing production	I would prefer to receive another plot of land		No
j								
k	Very worried	9	Yes	Other (please elaborate)	It is a good idea	I would prefer to receive a financial compensation	I do not know the size of the compensation	Somewhat
l	3	I am somewhat familiar with it	I don't know	My land is not particularly productive / I believe that projects that reduce GHG-emissions are important.		I would prefer to receive another plot of land		Somewhat
m	8	I am somewhat familiar with it	Yes	I believe that the compensation (either land redistribution or money) is worth more than my current soil		I would prefer to receive another plot of land	I am an organic farmer	Yes
n	2	I am somewhat familiar with it	Yes	Other (please elaborate)	Drainage conditions of the area	I would prefer to receive another plot of land	When you sell your land, the state takes up to half your revenue in taxes	Barely
o								

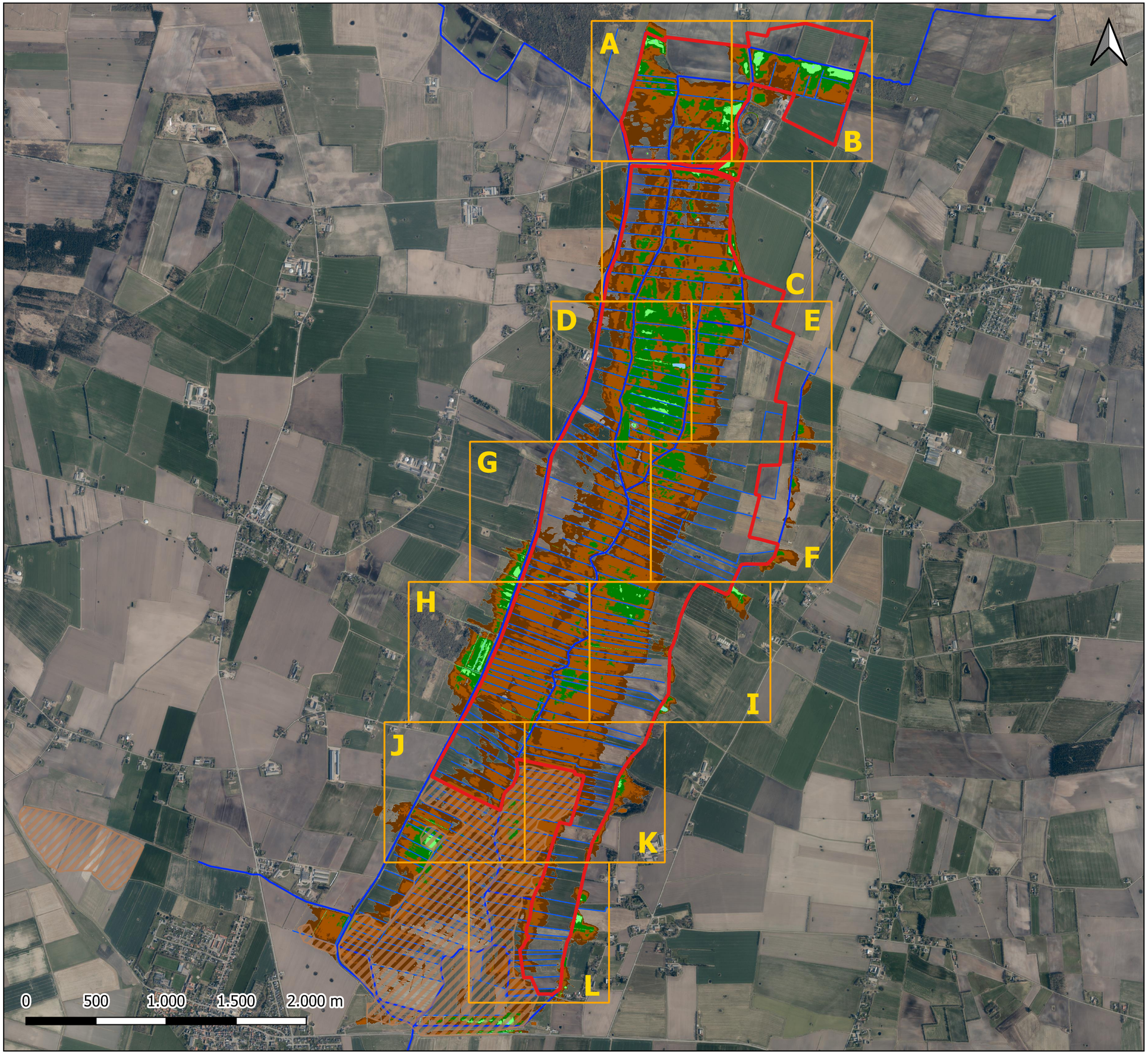
p								
q	8	6	Yes	I believe that projects that reduce GHG-emissions are important.		I would prefer to receive another plot of land		No
r	2	I am very familiar	I don't know	Other (please elaborate...)	I want a grazing agreement for my sheep	I would prefer to receive a financial compensation		Somewhat
s	Somewhat worried	I am somewhat familiar with it	Yes	I believe that the compensation (either land redistribution or money) is worth more than my current soil		I would prefer to receive another plot of land		No
t	2	6	I don't know	Other (please elaborate...)	better arrondation and bonintet	I would prefer to receive another plot of land	I prefer developing instead of closing	Barely
u	7	I am somewhat familiar with it	Yes	Other (please elaborate...)	swap land with higher-lying lands	I would prefer to receive another plot of land	It will fit the machines that I own. But if the compensation is good, I have time to wait for the right land.	No
v	Very worried	I am somewhat familiar with it	I don't know	I believe that the compensation (either land redistribution or money) is worth more than my current soil		I would prefer to receive another plot of land		No
w	Not woried	I am somewhat familiar with it	Yes	I believe that projects that reduce GHG-emissions are important / I believe that the compensation (either land redistribution or money) is worth more than my current soil		I would prefer to receive another plot of land		No

8.5 The map of the 2014 soil survey



8.6 The map of land price

8.7 The map of current drainage system



Miljøministeriet
Naturstyrelsen

Lavbundsprojekt Sejersbæk Kog

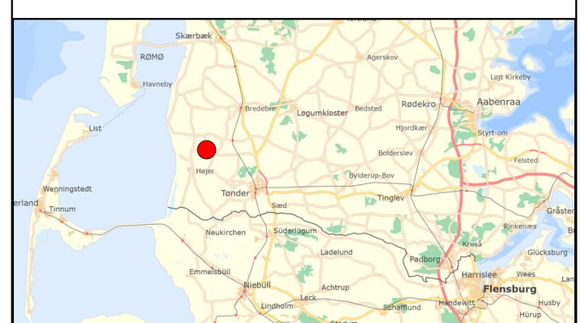
Bilag 2A
Oversigt, nuværende afvanding

Signaturforklaring

- Offentlige vandløb
- Private grøfter
- Klæg område
- Projektområde

Nuværende sommermiddel

- (< 0.00 m) Frit vandspejl
- (0.00 - 0.25 m) Sump
- (0.25 - 0.50 m) Våd eng
- (0.50 - 0.75 m) Fugtig eng
- (0.75 - 1.00 m) Tør eng
- (1.00 - 1.25 m) Mark



Udarbejdet:	MTLJ
Kvalitetssikret:	MACO
Projektnr.:	1322100059
Dato:	19/01/2022
Målforhold:	1:25.000

8.8 The results from Naturstyrelsens C-assessment

Aktiv udtagning - CO2 beregning - drivhusgaseffekten ved udtagning af organiske lavbundsjorde, Version 3.1.1

Projektansøgnings ID:		**Dato for oprettelse:**	**fredag, november 01, 2019**
Total projektareal, ha	**723,88**	**Dato for sidste lagring:**	**tisdag, februari 16, 2021**

Del 1: Før omlægning

Arealer med GLR koder i projektområdet, ha

Løbenummer	Evt. Markblok-nummer	GLR Afgrødekode	Afgrødetekst	Afgrødetype	Areal i alt	N, kg N/ha	N i handelsgødning, kg/år
		260	Græs med kløver/lucerne, und	Omdrift	211,57444	287	60722
		3	Vårhavre	Omdrift	109,38107	116	12688
		1	Vårbyg	Omdrift	65,29245	133	8684
		252	Permanent græs, normalt udb	Permanent Græs	42,2866	157	6639
		263	Græs uden kløvergræs (omdrif	Omdrift	37,24355	395	14711
		216	Silomajs	Omdrift	33,73564	174	5870
		14	Vinterrug	Omdrift	32,30786	144	4652
		15	Vinterhybridrug	Omdrift	22,00255	159	3498
		308	MFO-brak, sommerslåning	Brak	20,69364	0	0
		4	Blanding af vårsåede arter	Omdrift	20,63561	116	2394
		11	Vinterhvede	Omdrift	18,23104	181	3300
		22	Vinterraps	Omdrift	17,74636	208	3691
		2	Vårhvede	Omdrift	15,29201	130	1988
		701	Grønkorn af vårbyg	Omdrift	8,44547	125	1056
		210	Vårbyg, helsæd	Omdrift	6,94666	116	806
		257	Permanent græs, uden kløver	Permanent Græs	6,6335	395	2620
		255	Permanent græs, under 50% k	Permanent Græs	5,21378	287	1496
		152	Kartofler, spise-	Omdrift	2,18245	171	373
		271	Rekreative formål	Permanent Græs	1,71993	0	0
		256	Permanent kløvergræs, over 5	Permanent Græs	1,61749	75	121
		31	Hestebønner	Omdrift	1,42969	0	0
Arealer med GLR koder, ha					680,61179		135310

N fjernelse fra det direkte opland - for Vådområde- og Lavbundsprojekter	**N tilført vådområdet, kg N/år:**		**N fjernet I vådområdet, kg N/år**	
Oversvømmelse med vand fra vandløbsoplandet, jf. gældende N-regneark:				
Vand fra Det **Direkte opland**, jf. gældende N-regneark:				

Førtilstand, drændybde for hele projektarealet	**Hektar i alt, ha**	**Areal, =>12 %OC, ha**	**Areal, 6-12 %OC, ha**	**Areal, Mineraljord, 0-6 % OC, ha**	**CO2-ækv. i alt, tons/år (eksl. N2O)**

Tekniske arealer	Veje og andre befæstede arealer		3,0523			3,05		0,0
GLR-arealer	0 – 25 cm drænet		1,1915	0,1591	0,9046	0,13	OK	4,9
	25 – 50 cm drænet		14,7757	3,0203	10,3234	1,43	OK	284,2
	50 – 75 cm drænet		80,3543	61,64	14,8612	3,85	OK	2550,0
	75 > cm drænet		584,29	319,3224	164,7579	100,21	OK	14865,9
GLR arealer inden omlægning, ton CO2-ækv. i alt /år			680,61	384,14	190,85	105,62		17705,0
Grøfter med vand, GLR, ha	Standardværdi 5 % af landbrugsarealet		34,03	19,21	9,54	5,28	OK	691,4
Naturarealer	Sø / rørskov, **inkl**. grøfter med vand	5123	0,3371	0,0631	0,1997	0,07	OK	1,2
	Sump, 0-25 cm drænet	4112	3,0317	2,0445	0,6359	0,35	OK	22,1
	Våd eng, 25-50 cm drænet	4110	6,1312	4,5585	1,0762	0,50	OK	177,0
	Fugtig eng, 50-75 cm drænet	4110	8,1622	6,1078	1,4562	0,60	OK	252,4
	Tør eng, > 75 cm drænet	4110	19,75	9,6949	8,4609	4,64	OK	515,3
Naturarealer, i alt			37,41	22,47	11,83	6,17		968,1

	Hektar i alt	Areal, =>12 %OC	Areal, 6-12 %OC	Areal, Mineraljord, 0-6 % OC	Tons CO2-ækv. /år, inden omlægning
Arealer i alt, ha	**721,1**	**406,61**	**202,68**	**111,79**	**23019,6**
N2O effekt af reduceret gødningsforbrug, ton CO2-ækv./år		409,5	204,1	112,6	726,3
CO2 fra nedbrydning af organisk Stof i landbrugsarealer, ton CO2-ækv./år		14165,2	3496,5	0	17661,7
N2O fra nedbrydning af organisk Stof i landbrugsarealer, ton CO2-ækv./år		1889,9	468,4	0	2358,3
CO2 fra nedbrydning af organisk Stof i naturarealer, ton CO2-ækv./år		752,5	203,5	0	956,0
N2O fra nedbrydning af organisk stof i naturarealer, ton CO2-ækv./år		16,8	8,7	0	25,5
C udvasket til vandløb fra marker, ton CO2-ækv./år		436,6	108,5	0	545,1
CH4 fra markarealer, ton CO2-ækv./år		34,0	9,3	0	43,3
CH4 fra naturarealer, ton CO2-ækv./år		9,7	2,4	0	12,1
CH4 fra grøfter i landbrugsarealet, ton CO2-ækv./år		556,9	134,5	0	691,4
N2O fra ændret N tilførsel fra Oversvømmelse med vand fra vandløbsoplandet, ton CO2-ækv./år					0,0
N2O fra ændret N tilførsel fra oplandet, ton CO2-ækv./år					0,0

	Tons CO2-ækv./år, inden omlægning
I alt fra landbrugsarealer indenfor projektområdet inden omlægning	22026,0
I alt fra naturarealer for projektområdet inden omlægning	993,6
I alt fra projektområdet inden omlægning	23019,6
Gennemsnit per ha landbrug inden for projektområdet ved nudrift	32,4
Gennemsnit per ha naturareal inden for projektområdet ved nudrift	26,6
Gennemsnit per ha inden for projektområdet ved nudrift	31,8

Del 2: CO2 udledning efter omlægning, tons CO2-ækv./projektområde

	Hektar i alt, ha	Areal,	Areal,	Areal,	Tons CO2-ækv.

Hele projektarealet (inkl. veje og andre anlæg), ha	Nyt fuldt vanddækket	29,4553	24,5833	2,9966	1,88		191,2
	0-25 cm til mættet zone	218,2612	186,783	23,0317	8,45		1726,2
	25-50 cm til mættet zone	169,5159	112,9821	45,3874	11,15		4814,4
	50-75 cm til mættet zone	81,9781	39,0552	32,1712	10,75		2247,5
	> 75 cm til mættet zone, residual	224,67	43,2	99,1	79,6	OK	3788,6
Emissioner I alt			9172,1	3595,9	0,0		12768,1

Areal tjek, Ha i alt	Ha, Veje og befæstede arealer	3,05					
	Ha, landbrugs- og skovarealer	680,61179	384,14	190,85	105,62		
	Ha naturarealer (eksl. sø), i alt	37,41	22,47	11,83	3,11		
	Ha vanddækket, i alt	29,46	24,58	3,00	1,88		
	Ha grøfter, i alt	34,03	19,21	9,54	5,28		
	Ha, projektareal i alt	721,07	406,61	202,68	111,79		

Del 3: Effekt af omlægning, tons CO2-ækv./projektområde

	=> 12 % OC	6-12 % OC	< 6% OC	
I alt for projektområdet før omlægning inkl. N fjernelse fra opland, tons CO2-ækv./år	18271,1	4635,9	112,6	23019,6
I alt for projektområdet efter omlægning, tons CO2-ækv./år	9172,1	3595,9	0,0	12768,1
% fordeling af projektarealet	56%	28%	16%	100%

Samlet CO2 reduktion efter omlægning for projektområdet, tons CO2-ækv./år	10252
Samlet CO2 reduktion efter omlægning, tons CO2-ækv./år/ha projektareal	14

Effektberegning

Procent af projektområdet beliggende på kulstofrige lavbundsjorder med større end 6 % organisk kulstofindhold	84 %
Ændring i udledning indenfor projektområdet, ton CO2-ækvivalenter pr. ha pr. år	14

WETLAND RESTORATION PROJECTS AS A TOOL FOR CLIMATE MITIGATION

Impacts of social and natural factors on the viability of Sejersbæk Kog project

(From: https://peatlands.org/peatlands/what-are-peatlands/)

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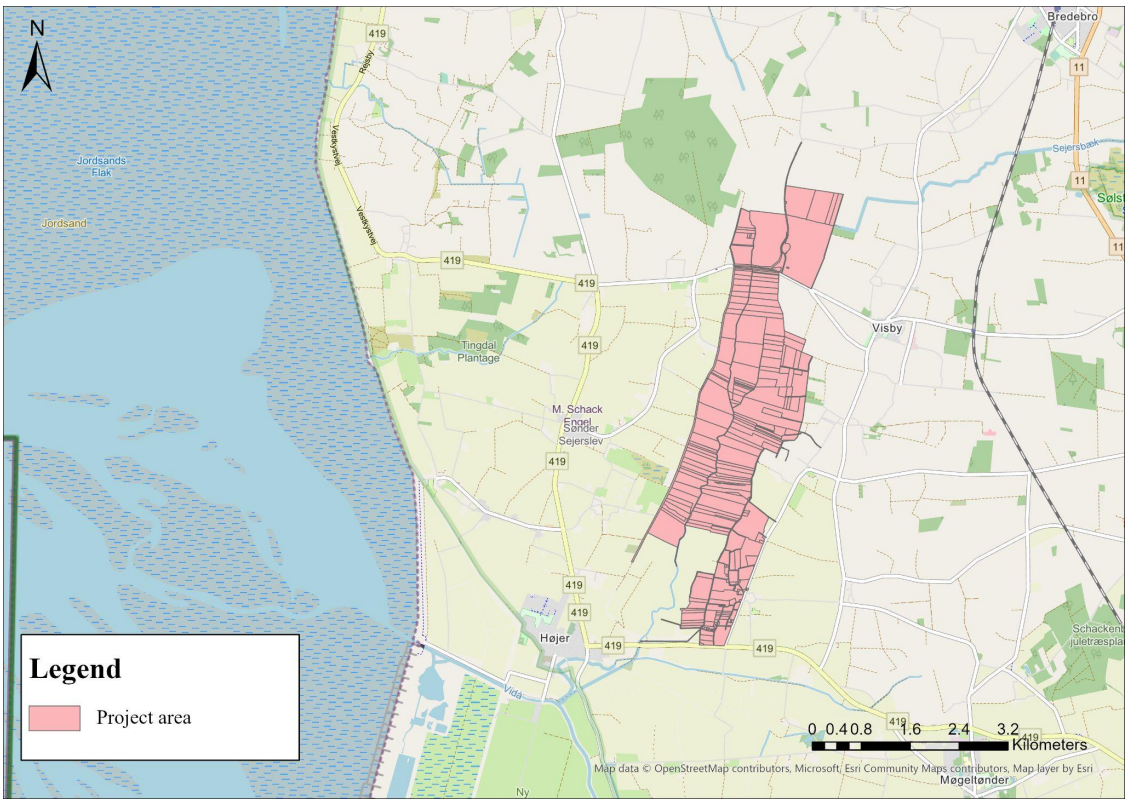
1.Introduction

Intact wetlands are providers of numerous ecosystem services: carbon storage, water quality regulation and harbouring very specific ecosystems [11]. Wetlands which have been drained for agricultural use are no longer able to act as carbon and nutrient sinks. Thus, over the last decades, many measures have been taken globally to restore drained peatlands [11]. In Denmark, drained wetlands in agricultural production comprise approx. 7 percent of all agricultural land, but account for half of all CO2-emissions from croplands [10]. Rewetting wetlands is thus increasingly seen as a central instrument in driving down emissions in the agricultural sector. This is emphasised by the more than 200 completed rewetting projects in Denmark. Although the dominating focus of rewetting projects relates to nutrient transport and carbon storage, Danish authorities also view rewetting projects as a way to restore declining biodiversity in the country [1].

In June 2020, the Danish government implemented a new Climate Act which aims at reducing greenhouse gas emissions by 70% in 2030, and reaching full climate neutrality by 2050 [16]. Conforming to this plan, in October 2021 the Danish government announced its intention to rewet 100 000 hectares of wetlands currently in production. Yet, rewetting wetlands is by no means a simple task. For a rewetting project to be eligible for state funding it must meet minimum **requirements** for storing carbon while averting nutrient leaching [15]. Additionally, the government's conversion schemes depend on the voluntary **participation** of the landowners. The successful restoration of wetlands, therefore, is conditioned on a variety of natural and social factors.

All of these overlapping factors are on display in *Sejersbæk Kog* [SK] where a rewetting project of 690 ha managed by the Danish Nature Agency (Naturstyrelsen) is currently undertaken. Located in Tønder, Denmark, *SK* is a river valley comprising drained wetlands, and forms part of the 10th biggest wetland area in Denmark [19]. Vast areas are drained wetlands currently under agricultural use. Based on existing maps of peat content in the soil, it is projected that approximately 8,000 tons of carbon could be retained by rewetting the 690 hectares of climatic lowlands in the project area [17]. Thus, SK is an ideal exhibition site for exploring the overlapping social and natural factors that inform the viability of the project.



The SK-project area.

2. Research Question

In light of the above, we present our framework (Fig. 1) and aim to answer the following research question : *"How do natural and social factors enable or disable the rewetting of lowlands in Sejersbæk Kog?"*

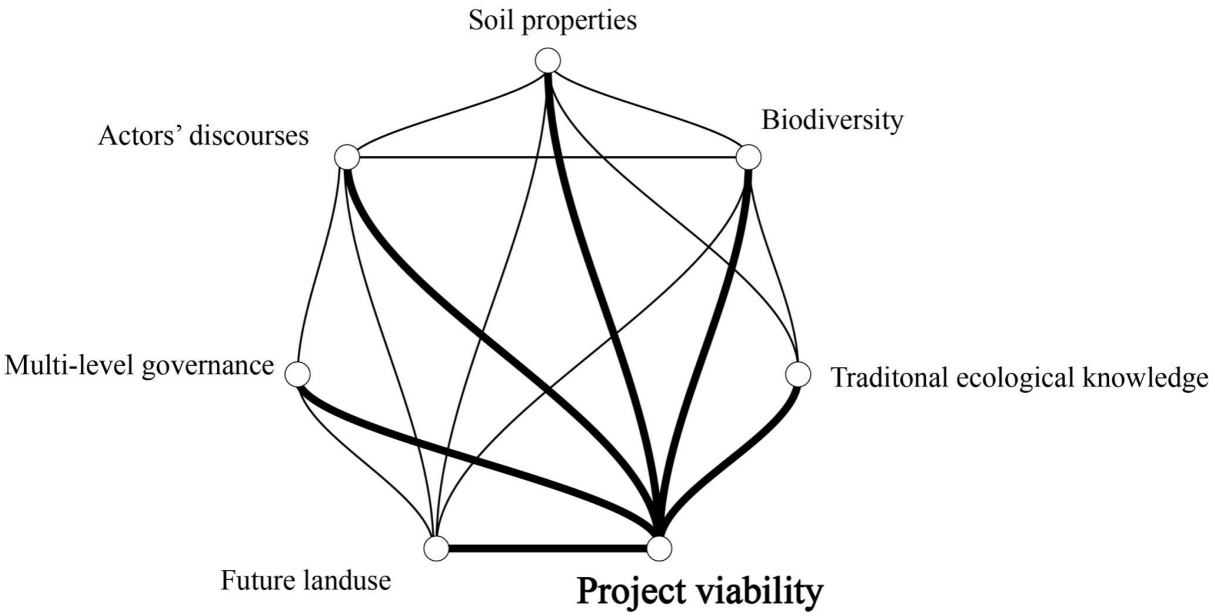


Fig.1 The framework of this study

Table of sub-questions	
2.1 Social science questions	
i.	What demographic, economic and political factors influence the viability of the SK-project?
ii.	How do potential future land usages inform the willingness of landowners to participate?
iii.	How are different governance structures shaping the willingness of the landowners to participate?
iv.	How are different discourses of the project influencing participation?
2.2 Natural science questions	
v.	How do Phosphorus and carbon content disable/enable the success of the rewetting of SK? -Does the carbon content meet the threshold for carbon storage projects? -Are there indications that the SK-project will cause Phosphorus leaching into the aquatic environment?
vi.	What is the potential for establishing bird habitats after rewetting?
2.3 Questions for analysis	
vii.	How do farmers' perception of soil properties deviate from our soil assessment, and how does this influence their participation?
viii.	How do farmers' perceptions of meadow birds deviate from our biodiversity assessment, and how does this influence their participation?

2.4 Anchoring our research approach

To examine the viability of the project, we identify two factors as being particularly important. First, **landowners participation** is crucial as the absence of it will disable the project. Second, we examine soil properties to understand if **project thresholds** are met, how these properties are tied to historical land uses and in turn how historical uses are tied to perceptions shaping participation.

On the one hand, since the project depends on the voluntary participation of the landowners, we identify **participation** as a key factor. But what constitutes willingness to participate relates to a variety of social factors**.** The dominating analysis in this regard tends to emphasise the centrality of the **age** of landowners and **financial** considerations as some of

the most crucial aspects in the farmers' decision-making, [4, 8, 6]. Therefore, we intend to investigate these factors by asking sub-question *(i)*.

Franzen *et al.* [6] and Graversgaard *et al.* [8], nonetheless, outline how other factors such as social interests and programmatic factors are decisive for the viability of rewetting projects. They identify aspects like vision of the **future**, **bureaucratic barriers** and **trust in institutions** as being influential for landowners to participate. Similarly, a variety of scholars emphasise the importance of local contextual factors for the viability of rewetting projects. Rawlins and Morris [20] e.g. point to conflicts around land use **interests** - e.g. recreational versus productive - as obstructing rewetting. Schaller *et al.* [21] equally point to stakeholder cooperation as a key variable. This 'local' emphasis thus suggests that there is a demand for exploring such contextual and perceptual factors, which is further stressed by Buschman *et al.* [4] stating that future research "...could provide a better understanding of the farmers' motives by researching variables such as socioeconomic attributes, history of use and norms…".

In this study we investigate the potential for **future uses** of the land looking to assess the potential for enhancing biodiversity in the project area (sub-question *vi*). This in turn is tied to soil properties (sub-question *v*) - as degraded soil influences biodiversity - and landowners perceptions - as visions of the future shapes present decisions to participate (sub-questions *vii-viii*). These perceptions may constitute central issues for future projects and land uses, and thereby also drive contemporary decision making and agendas. Thus, we ask question *(ii)*.

Equally, we identify understanding perceptions of the **governance structure** of the SK-project and how these relate to experiences with other projects as another key variable. In this connection, our agenda is driven by how past experiences inform participation in the SK-project. Therefore, we ask sub-question *(iii)*.

Finally, we identify understanding different **discourses** and potential **counter-narratives** relating to institutional trust as our final key variable. Thus, we ask sub-question *(iv)* .

Concerning the natural science perspective, we identify **soil properties** and **biodiversity** as key factors for understanding what enables and disables the rewetting of SK. Interest in restoration of wetlands primarily pertains to their potentials for climate mitigation, as they can curb CO2-emissions from drained agricultural soils [1]. Immediate reduction of carbon loss occurs following rewetting, and generates potential for further carbon sequestration [11]. However, calculating emissions is associated with uncertainty. For a rewetting project to be implemented in Denmark, more than 75% of the project area needs to have a carbon content over 6% [15] and must also not exceed a certain threshold of phosphorus leaching (Kristensen, 2022). Hence, we will implement a soil sampling strategy to answer sub-question *(v)*. The sampling strategy will be developed on the basis of historical land-use as well as contemporary land-use, to see if any potential variance can be ascribed to the usage of land. Moreover, we intend to compare our measurements of soil properties with responses from the landowners to see if there are deviations and discuss whether such deviations affect participation, therefore we ask sub-question *(vii)*.

Providing suitable breeding habitats for meadow birds has proved to be a very promising way of potential land use after the rewetting project, with some birds returning to the Tøndermarsken area for reproduction in 2020 after years of absence [7]. Studies have shown that European farmland bird populations have declined over the last 40 years as herb-rich grasslands have been replaced by monocultures, foot drains (shallow surface drains) have been replaced by underground drains, and increased grazing pressure and heavy use of machinery have led to degradation of soil structure and natural soil renewal processes [19]. Especially soil properties and the availability of earthworms have a significant impact on meadow birds as it affects their food supply. Moreover, according to De Felici *et al.,* [5], also plant species are relevant in order to conducive bird movement and may also promote earthworm availability. For this reason we research question *(vi)*. Moreover, we intend to compare our biodiversity assessment with responses from the landowners' perception of it. In this sense this assessment is relevant also to try to answer sub-question *(viii)*.

3. Methods

3.1 Social science methods

To be able to address sub-questions *(i-iv) and (vii-viii)* we will collect quantitative data concerning demographic and socio-economic factors, soil properties and biodiversity perception, and qualitative data concerning future usages, governance structure and project discourses.

3.1.1 Quantitative methods

3.1.1.1 Questionnaire

We will design a questionnaire which will explore demographic, socio-economic and political factors and reflections on participation in the project in order to answer sub-question *(i)*. The questionnaire is targeted to the affected landowners, and the data will in part serve as a backdrop for other methods for data collection. The questionnaire will also act as a driver for identifying further informants. We might develop further questionnaires later on if our fieldwork does not go as planned, since questionnaires are convenient for collecting data. The questionnaire, which can be found in appendix 5.1, will be sent to the landowner committee for pretesting.

3.1.2 Qualitative methods

Spurred on by Buschmann *et al. 's* [4] argument calling for qualitative approaches to provide in-depth understandings of farmers' motivations for participation in rewetting projects, we intend to use qualitative, ethnographic methods as well. Here we deploy a combination of methods to answer sub-questions *(ii-iv)*. Moreover, we aim to gather data regarding landowners' perceptions of their soil's properties *(vii)* and biodiversity *(viii)*.

3.2.2.1 Semi structured interviews

We aim to use semi-structured interviews to collect data enabling us to answer sub-questions *(iii-iv)* and *(vii-viii)*. In particular, we reckon that by applying this method we will gain a better understanding of the individual opinions of the key actors. The actors we plan to interview are public officials from Tønder municipality, the coordinator of the neighbouring and similar *Kogsbøl Mose [KM]*-project, the manager of the SK-project and selected landowners.

Regarding question *(iii)* we aim to collect data about how they perceive other actors involved in past and current rewetting projects, understand how project decision-making is experienced, and what strategies individual actors deploy to pursue their interests when engaged in such projects.

Addressing question *(iv),* we will research the different narratives and discourses that are expressed and experienced by the various actors engaged in the project. Special attention is devoted to whether/how counter-narratives are present, e.g. carbon credits and EU subsidies, and how this discursive landscape influences participation of the landowners.

Addressing questions *(vii-viii),* we aim to explore perceptions among the various actors engaged on both the soil properties and biodiversity, as well as how their views correspond with our findings. An accompanying purpose of using semi-structured interviews apart from obtaining primary data is also to use the occasion to ask for the possibility of conducting go-along interviews, which is described in the following section. Thus, we also perceive the semi-structured interviews as a strategic step towards collecting more data.

3.2.2.3 Go-along interview

As mentioned, we wish to conduct go-along interviews in addition to our semi-structured interviews [13]. Go-alongs are an interview technique where interviewers accompany interviewees in their 'natural outings', which allow interviewees to informally respond to questions and share reflections and experiences in familiar surroundings. This method also provides insights into spatial practices and environmental perceptions We intend to conduct go-alongs primarily with landowners. Ideally, we would also conduct some with the project managers of SK. Accordingly, the go-alongs will seek to collect data addressing all of sub-questions *(ii-iv)* and *(vii-viii)*. The methodological interests and strategies addressed in section 3.2.2.1 reoccur here.

3.2.2.2. Focus Group

Using this method we aim to collect information in order to answer subquestions *(ii-iv)* and *(vii-viii)*. Here, we plan to organise focus groups mainly with the landowners, ideally those that respond to our questionnaire. The main objective of using focus groups is to develop a sense of how certain local actors - principally landowners but perhaps also project managers, public officials, business people, etc - individually and collectively perceive the different factors influencing the viability of the SK-project [3]. as exhibited in sub-questions *(ii-iv)*. The methodological interests and strategies relating to sub-questions *(ii-iv)* and *(vii-viii)* addressed

in section 3.2.2.1 reoccur here, and additionally we will explore sub-question *(ii)* to understand how perceptions of future land uses inform decision-making today. We consider utilising different visual tools for instigating discussions, which would enable us to access tacit knowledge and perceptions. Nonetheless, a risk of utilising focus groups is that of groupthink or not adequately making room for all respondents to share their opinions.

3.2 Natural science methods

We will focus on two methods in relation to the natural sciences. By tracking our travelling routes, GPS will play an essential role of data visualisation for our sampling sites and interviews locations, giving a spatial view of our study area.

3.2.1 Soil sampling

By using this method we aim to answer questions *(v)* and *(vii)*. We will collect 20 soil samples throughout SK, which will be assessed for Carbon and Phosphorus content. We will focus on the topsoil, which is the layer mainly affected by the rewetting project and has been proven to correlate with project feasibility [18]. The sampling strategy will be based on historical land use, derived from historical imagery and information from the landowners. We will divide the 690 Ha area into two classifications; intensely used and less intensely used. Thus, collecting in total 10 samples from intensely used land and 10 samples from less intensely used land. Our hypotheses are as follows: a) C-content will be lower in intensely managed plots, and b) P-content will be higher in intensely managed plots due to fertilisation.

The indicators will be compared with thresholds for rewetting projects as well as relevant literature. Finally, we will discuss the results compared to the TEK which we will collect from focus groups.

3.2.2 Biodiversity assessment

By using this method we aim to answer questions *(vi)* and *(viii)*. The SK-project aims to investigate whether the area could provide suitable breeding habitats for meadow birds upon rewetting [17]. Thus, we will perform a biodiversity assessment using meadow birds as indicators in both *KM* and *SK*. At both sites, we will use distance sampling to assess bird population. The inclusion of *KM* is motivated by the relatively recent implementation of that project, thus providing a view of how the bird population at *SK* could potentially develop. Results from both study sites will then be compared to a baseline of literature and other studies. The protection of meadow birds and restoration of their habitats will be discussed in the focus groups with the landowners.

3.3.3 Traditional ecological knowledge (TEK)

The local farmers have invaluable insight into historical changes in land cover and soil management that may have indirectly affected project participation. TEK is defined as the accumulation of knowledge, practice and belief about the relationship between biology and environment, which evolves through the adaptive process and is passed down from

generation to generation [2]. TEK's spread mainly occurs among individuals of different generations, but also among relatives-based groups [14]. In our study, we find inspiration in the concept of TEK and wish to explore if/what knowledge on the natural surroundings has accumulated over generations and understand how such might shape landowners' willingness to participate. Moreover, we could compare these findings with the results from our soil sampling (sub-question *(vii)*) and our own biodiversity assessment (sub-question *(viii)*). This might highlight discrepancies between perceptual and material conditions as to soil properties and biodiversity, and ultimately help us understand the motivations driving participation.

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5. Appendix

5.1 Appendix 1

Questionnaire in English: https://www.survey-xact.dk/LinkCollector?key=CLG78SGWJP3N
Questionnaire in Danish: https://www.survey-xact.dk/LinkCollector?key=9UT2XSEXJ635

5.2 Appendix 2, Data matrix

Overall Research Question: How do natural and social factors enable or disable the rewetting of lowlands in Sejerbæk Kog?			
Research questions	**Data required**	**Methods**	**Material**
Social factors			
(i) What demographic, economic and political factors influence the viability of the Sejersbæk Kog-project?	Data related to economy (income, land ownership structure) and demography (age, gender, level of education) and some of their political views	Questionnaire aimed at the landowners	SurveyXact
(ii) How do potential future land usages inform the willingness of landowners to participate?	Perceptions of potential future land uses Information from landowners about birds	Focus groups with landowners Semi-structured interviews with landowners	Voice Recorder Pen and Paper
(iii) How are different governance structures shaping the willingness of the landowners to participate?	Local actors' attitude towards the experience of former government project	Focus groups with landowners Semi-structured interviews with the landowners, project managers and and staff from the municipality	Voice Recorder Pen and Paper
(iv) How are different discourses of the project influencing participation?	Perceptions of rewetting project	Focus groups with landowners Semi-structured interviews with landowners, project managers and staff from the municipality	Voice Recorder Pen and Paper
Natural factors			
(v) How do Phosphorus and carbon content disable/enable the success of the rewetting project in Sejerbæk Kog?	Phosphorus content Carbon content	Soil sampling Recording coordinates and plotting the	Soil sampling kit Historical land use

- Does the carbon content meet the threshold for carbon storage projects? - Are there indications that the Sejersbæk kog project will cause Phosphorus leaching into the aquatic environment?	Geographical location of soil sampling sites	shape/boundaries of sampling spots with GPS GIS analysis with ArcGIS software	imagery for determination of sampling site GPS DEM (Digital Elevation Model) and possible leak locations
(vi) What is the potential for establishing bird habitats after rewetting?	Bird species diversity data Geographical location of bird species sampling sites	Distance sampling at Sejerbæk Kog and Kogsbøl Mose Focus Group with landowners Interviews with *Naturstyrelsen* and *Dansk Ornitologisk Forening* Recording coordinates and plotting the shape/boundaries of sampling spots with GPS	Distance laser Bird species expert/book GPS
Bridging the Sciences			
(vii) How do farmers' perceptions of soil properties and our soil assessment deviate from each other and how does this influence the participation ?	Soil properties data and landowners' traditional knowledge about soil properties Geographical location of all the landowners	TEK method Soil sampling and the traditional knowledge collected from questionnaire or interviews Recording coordinates of all the landowners with GPS	GPS Voice Recorder

(viii) How do farmers' perceptions of meadow birds and the biodiversity assessment deviate from each other and how does this influence the participation ?	Plant diversity data landowners' traditional knowledge about meadow birds and plant species Geographical location of all the landowners	TEK method Shannon species diversity index and the traditional knowledge collected from questionnaire or interviews Recording coordinates of all the landowners with GPS	GPS Voice Recorder Images of birds
Data visualisation			
Aims: Displaying the distribution location of sampling sites and informants Analysing and visualising the impact of various natural/social factors	GPS coordinates of soil sampling sites GPS coordinates from walk-along interviews GPS coordinates from distance sampling sites Information from informants	Importing the locations of sampling and interview sites GIS analysis with ArcGIS software	GPS GIS software Shapefile for the study area(Land plots) Data compiled from samples, questionnaires and interviews Satellite images

5.3 Appendix 3, Schedule

Working Tasks	Start Time	Duration	Task Completion (%)	Week 8				Week 9							Week 10				
				Feb 24th	Feb 25th	Feb 26th	Feb 27th	Feb 28th	Mar 1st	Mar 2nd	Mar 3rd	Mar 4th	Mar 5th	Mar 6th	Mar 7th	Mar 8th	Mar 9th	Mar 10th	Mar 11th
				Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri
Contact the Kogsbøl project's manager																			
Biodiversity sampling																			
Soil Sampling																			
Send out questionnaire						Pre test		Final											
Focus groups																			
Semi-structured interviews								Asger	DOF *										
Contact Denmark Bird Association																			
Go-along interviews																			

*Dansk Ornitologisk Forening

5.4 Appendix 4, Interview guide

For semi-structured interviews, go-alongs and focus groups. Will be tailor-made for each individual interviewee and interviewer.

Overarching themes - keywords

(1) Future uses of land in the project area
(2) Governance structure of the SK-project and others
(3) Project discourses and counter-narratives
(4) Perceptions of soil properties
(5) Biodiversity and sentiments towards enhancing such in the project area

(1) Future uses

- How are you participating in the project? Compensation or land redistribution?
- What is your understanding of the Sejersbæk Kog-project?
- What would you have used your land for had this project not been initiated?
    - Do you know other landowners in the area that would have done like you?
- What do you think of the future of your land in the project area? Do you have any hopes or concerns?
    - What in your view is causing/generating such hopes/concerns?
    - Do you think your hope/concern is shared by other landowners in the area?
- Are there any potential future land uses of the project area that you are strictly opposed to? Why/how?
    - Anyone sharing your opposition?
    - Who differs from your position? Why do you think that is?
- Any land uses that you are particularly supportive of? Why/how?
    - Anyone sharing your support?
    - Who differs from your position? Why do you think that is?
- If you plan to keep the land, will you cultivate the area once it is rewetted? Why/why not?

(2) Governance structure

- Do you have prior experience with participating in projects similar to SK?
    - If yes, what kind of project was that? Who ran it? What was your experience?
    - If not, do you know of any other projects either through colleagues, friends, associations? What have you heard?
    - Would you say there is a shared impression among landowners for participating in such projects? Elaborate:
        - If yes, could you describe it? Is it tied to specific actors? Who are they?
        - If not, why do you think that is?

- What is your experience with participating in the Sejersbæk Kog-project?
    - How have you been approached by the project managers? What is your general impression?
    - Could you take us through the process and highlight events/episodes that have stood out to you?
        - Why do you think these events particularly stood out to you?
    - What is your overall impression of the project? Is it shared by other landowners? Do you talk about it?
        - Are there any specific aspects of the project that you are particularly interested in/concerned by? Why do you think that is?
            - Do other landowners share that view? Why do you think that is?
        - Are there some group(s) of landowners that have a different view than you? What is that? And why do you think that is?
    - How was/is your experience with the redistribution committee? Supportive/opposing? Feedback?
    - Is there anything that you wish had been handled/managed differently?
        - If you were in charge of the Sejersbæk Kog-project, how would you have managed it?
- Do you know about the Kogsbøl mose project? Has it influenced your decisions?

(3) Project discourses

Also covered by questions above

- What do you know about carbon credits (klima-kreditter)?
    - Others?
- Do you know of other interests in the Sejersbæk Kog-area outside of the project? Your opinion → overlapping or conflicting interests? Has it influenced your decision?
    - Others?
- Are you a member of a farmer's association? Why? What are its core interests? Do they conflict with some of the aforementioned interests in the area?

(4) Soil properties perceptions

- What have you mainly used your soil for in the time you have owned it?
    - Have you used any specific fertiliser? With what purpose?
- Do you believe there is a risk of phosphorus leaching once the area is rewetted? Why/Why not?
- Do you know the carbon content of your agricultural soil? Do you consider it an important indicator?
- Do you think the new field will have better properties? Is this why you want the new field? (If the person wants another field as compensation)

(5) Biodiversity

- One of the potential benefits of the project concerns creating habitats for meadow birds. What are your thoughts on that? Would you be willing to allocate your land to bird habitats?
- Are you aware of the endangered status of meadow birds (find specific species)? What do you make of it?
- Have you noticed the decrease in meadow birds?
- Does the issue of loss of biodiversity, in this case but also in general, worry you? Do you think it will impact you directly?

5.5 Appendix , TEK questions

Ecological Knowledge

1. Do you have land plots both within the project area and outside of it?

2. What have you cultivated before ?

3. How long have you been in the cultivation?

4. How much do you think you can evaluate the general quality of the soil (from 1-10)?

5. (Multiple) What do you use to evaluate ?

   A. colour
   B. smell
   C. tactility
   D. biology
   E. others (please mention)

6. What do you think are the differences between land that needs to be re-wetted and other land ?

7. (Multiple) What agricultural practices have been used on this land in the past ?

   A. ploughing
   B. plough less tillage
   C. drainage
   D. fertilisation
   E. pesticides
   F. herding

8. (Multiple) Where did you get this knowledge from?

   A. school
   B. pre-generation
   C. personal experience
   D. farmer consultant

9. (Multiple) Which of the following soil properties do you know?

A. pH
B. water content
C. bulk density
D. soil aggregate
E. soil carbon content
F. soil biology
G. soil total nitrogen
H. soil phosphorus

10. Which environmental consequences of the project are you most concerned about ?

A. regional climate change
B. flood
C. transfer of contaminants
D. soil degradation

11. Can you identify the following birds (names) ?

Using images of meadow bird species

12. How many kinds of birds have you seen in Tønder? Please indicate the approximate location.

Using images of meadow bird species

13. How much do you know about the habitat of these birds (food, environment, etc.)?

14. Do you agree that rewetting projects will increase meadow bird diversity?

A. agree
B. maybe
C. I don't know
D. disagree

15. I support the transformation of the re-wetted land into a bird paradise.

A. agree
B. maybe
C. I don't know
D. disagree

16. The increase of birds will bring a lot of problems such as sanitation and diseases.

A. agree
B. maybe
C. I don't know
D. disagree

17. The increase of birds will promote the development of the town e.g. through tourism.

A. agree
B. maybe
C. I don't know
D. disagree

Environmental attitudes

A=STRONGLY AGREE, B = MILDLY AGREE, C = UNSURE, D = MILDLY DISAGREE, E= STRONGLY AGREE, F = NO OPINION.

1. We are approaching the limit of the number of people the earth can support.

2. Humans have the right to modify the natural environment to suit their needs.

3. When humans interfere with nature it often produces disastrous consequences.

4. Human ingenuity will ensure that we do NOT make the earth unlivable.

5. Humans are severely abusing the environment.

6. The earth has plenty of natural resources if we just learn how to develop them.

7. Plants and animals have as much right as humans to exist.

8. The balance of nature is strong enough to cope with the impact of modern industrial nations.

9. Despite our special abilities humans are still subject to the laws of nature.

10. The so-called ‘ecological crisis’ facing humankind has been greatly exaggerated.

11. The earth is like a spaceship with very limited room and resources.

12. Humans were meant to rule over the rest of nature.

13. The balance of nature is very delicate and easily upset.

14. Humans will eventually learn enough about how nature works to be able to control it.