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RESEARCH ARTICLE

Transformation towards the sustainable management of peatlands: A characterisation of farmers in the Teufelsmoor, Germany

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Abstract

1. Peatland restoration through rewetting is a pivotal solution to counteract the climate crisis.
2. Since many peatlands with the potential for rewetting are farmland, rewetting can only be achieved in collaboration with peatland farmers. However, the discord between the need to rewet peatlands and the implementation of rewetting measures calls for a transformation in how peatlands are managed.
3. To explore their willingness towards rewetting, interviews were conducted with 19 peatland farmers in the Teufelsmoor, Germany. Here, we categorised the perceptions, challenges and opportunities of rewetting as *operational impediments*, *knowledge and awareness of peatlands and rewetting*, *collaboration between stakeholders* and *peatland perceptions and sense of identity*.
4. Based on these results, we characterised peatland farmers as *Pioneers*, *Sceptics*, *Pragmatists* and *Hobby Farmers*.
5. This characterisation showcases peatland farmers as a group with differing perceptions towards rewetting and highlights the need for different approaches to foster a transformation to agriculture that works *with* peatlands and peatland farmers to ameliorate the climate crisis.

KEYWORDS
climate change mitigation, peatland, perceptions, rewetting, social-ecological systems, transformation

1 | INTRODUCTION

Despite covering only 3% of the Earth's terrestrial surface, peatlands store 30% of the global soil carbon stock, storing twice as much carbon as the world's standing forests (Loisel et al., 2021; Morton & Heinemeyer, 2019). To make way for agriculture, humans have extensively drained peatlands (Fluet-Chouinard et al., 2023; Harris et al., 2021). The detrimental consequences of these practices are numerous, damaging the regulatory functions of peatlands and the unique biodiversity and habitats they host (Silvestri et al., 2017; Trenbirth & Dutton, 2019). Greenhouse gas (GHG) emissions stemming from degraded peatlands are now receiving due recognition as a pressing global concern (Harris et al., 2021; Zhongming et al., 2021), with the atmospheric CO_2 resulting from drained peatlands 'account[ing]

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for 5%–10% (0.5-1GtC) of the global annual anthropogenic CO_2 emissions' (Loisel et al., 2021, p. 71). Although peatlands comprise only 7% of agricultural land in Germany, this small area is responsible for about 40% of the GHG emissions from agriculture and agriculturally used soils in Germany (Martin & Couwenberg, 2021). Rewetting of peatlands under agricultural use is a promising avenue to fulfil their climate change mitigation potential (Dellmann et al., 2019). In temperate Europe, rewetting grassland on drained peat soils saves up to *c*. 20t CO_2eq ha−1 y−1, and rewetting croplands even up to *c*. 30t CO_2eq ha−1 y−1 (Hiraishi et al., 2014; Wilson et al., 2016), roughly the emissions of a car driving 150.000km. Rewetting measures can be complemented by paludiculture, a form of agriculture on rewetted peatlands (Wichtmann et al., 2016). Suited to the ecology of peatlands, paludiculture may allow for new peat accumulation and for further emission prevention (Wichtmann & Joosten, 2007). Sphagnum paludiculture, for example, on former bog grassland in Hankhausen, Lower Saxony, comprises GHG sinks on the sphagnum moss production fields, while ditches and causeways still contribute overall GHG emissions of about 4–10t CO_2eq ha^{-1} a^{-1}(Daun et al., 2023). Paludiculture is considered to navigate the demands between production and climate protection by retaining the carbon storage capacity of peatlands whilst supporting economic interests with renewable resources such as fossil peat substrate substitutes and building materials (Becker et al., 2020; Wichtmann et al., 2016; Ziegler et al., 2021).

The required transition away from agricultural practices that degrade peatlands is, however, met with resistance within farming communities. Impediments range from the practical and technological challenges of rewetting to the financial onus and risks that come with a change of land use (Nordt et al., 2022; Schäfer & Yilmaz, 2019). These local challenges are set within a political framework that currently does not support a successful transition away from agriculture reliant on drainage (Grethe et al., 2021; Peters et al., 2021). This manifests as a lack of financial incentives for rewetting and policies that continue to support peatland drainage (Abel et al., 2019; Grethe et al., 2021; Harris et al., 2021). These examples were identified as contributing to the resistance towards the rewetting of peatlands and paludiculture (Chapman et al., 2019; Röhrig et al., n.d.; Zasada & Sagebiel, 2018) and indicate the need for a systemic transformation of peatland management (Harris et al., 2021). Such a transformation can be understood as a shift in the 'fundamental attributes of a system (including value systems; regulatory, legislative, or bureaucratic regimes; financial institutions; and technological or biological systems)' (Lavell et al., 2012, p. 564). The operative hurdles are embedded within narratives and perceptions of the individuals and communities living in peatlands; transformation must also address these psycho-social dimensions, such as an individual's relationship to the land (Burton et al., 2008; Chapman et al., 2019; Holden et al., 2016).

The effective rewetting of peatlands requires the collaboration and leadership of peatland farmers as the primary land-use decision-makers of peatlands that have the potential to be rewetted (Burton et al., 2008; Stüber et al., 2022). Understanding who the agents of change and resistance are, is fundamental, as 'the people and organisations responsible for implementing adaptation' (Colloff et al., 2017, p. 88) are often neglected when considering the changes that need to be made in a system (Ives et al., 2020; Riechers et al., 2022; Rust et al., 2021). There is a specific need to understand the perceptions of peatland farmers towards rewetting due to the high emissions produced from this sector (Hyland et al., 2016). An understanding of the identity and differences in decision-making of peatland farmers helps to identify challenges and opportunities for transformation (Hyland et al., 2016). However, worldwide, few formal statements have been gathered from peatland farmers to date (Häfner & Piorr, 2021; Norris et al., 2021).

A transformation in the Teufelsmoor region in Germany, as an exemplary peatland area of study, will require a shift in decision-making regarding peatlands. Beyond economic considerations, it is crucial to recognise the significance of 'emotional reasoning' (Hyland et al., 2016, p. 8). This reasoning is informed by the theory of individuals´ self-concepts, which posits that individuals´ beliefs, perceptions and evaluations about themselves influence their behaviour and decision-making (Lokhorst et al., 2013, Verplanken & Holland, 2002). This understanding can contribute to shaping new narratives that engage peatland farmers as active agents in the social and ecological transformation of peatlands. Our research was guided by the following questions:

- What are the perceived challenges and opportunities of rewetting from the perspective of individual peatland farmers in the Teufelsmoor?
- Can patterns in perceptions and decision-making be used to cluster farmers into groups of varying attitudes and behaviours towards peatland management practices?

2 | METHODOLOGY

Building upon prior research on political, economic and technical challenges and opportunities, in, or valid for the Teufelsmoor region (Nordt et al., 2020; Trenbirth & Dutton, 2019; Wichmann, 2018) and consequential contact to Teufelsmoor farmers by two of the authors, we conducted qualitative inductive research in the form of semi-structured interviews. The data collection did not strive for a representative account of peatland farmers' perspectives but focussed on the in-depth subjective experience of individual peatland farmers as the emotive dimension often falls short in planning and policymaking, despite playing a significant role in the decision-making of individuals (Ives et al., 2020). In the case of rewetting peatlands, individuals have the power to impede or excel a transformation of peatland management.

2.1 | Study area—Teufelsmoor

Comprising roughly 360km^2, the Teufelsmoor, Lower Saxony, represents the largest connected network of bogs and fens in Germany.

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It is further distinguished by the extensive amount of land with a protection status (Figure 1; LK OHZ, 2017). 15% of the emissions from Lower Saxony stem from degraded peatlands, of which roughly 5% come from the Teufelsmoor alone, amounting to over 600,000 t CO_2eq every year (Greifswald Moor Centrum, 2022b; Nordt et al., 2020). The Teufelsmoor was selected as the study area due to its significant contribution to climate change, an associated pressing need for regional transformation as well as farming experiences on rewetted peatlands due to implemented peatland protection measures. Subsequent to the large-scale nature conservation project 'Hammeniederung' with measures implemented on 2780 ha by the local authority between 1998 and 2009 (Landkreis Osterholz [LK OHZ], 2012), a feasibility study was issued 2019 by the regional Farmer's Association in search for utilisation alternatives for biomass harvested on wet meadows (Nordt et al., 2020). The many projects with a focus on rewetting offer a propitious setting to characterise peatland farmers and the barriers and opportunities for a transformation of peatland management.

2.2 | Data collection and analysis

Qualitative semi-structured interviews were conducted in February and March of 2022. We selected participants who farm on peatland in or around the Teufelsmoor. We contacted the regional Farmer's Association, who provided a signup sheet at a local meeting for farmers interested in participating. These 11 farmers were all members of the 'Arbeitskreis "Aufwuchsverwertung"' (AAV), a local working group of farmers, the local Farmer's Association, and public authorities, searching for utilisation options for biomass harvested on wet peatlands. We asked those initially signed-up farmers to indicate possible further interview participants beyond this social and professional network (snowball sample method, Bryman, 2016a), to capture diverse perspectives on rewetting. We sampled until data saturation was reached, which was when a redundancy was observed where further interviews did not add new viewpoints (Creswell & Creswell, 2017; Fusch & Ness, 2015). Overall, we interviewed 19 peatland farmers from the Teufelsmoor region. This research was approved by the Advisory board for ethical issues in research (Ethical Review Board) at the Leuphana University of Lüneburg and followed the guidelines for research involving humans as outlined by the Advisory Board. All interviewees signed a consent form at the beginning of the interview following an explanation of the research project and the interview process before the recording began, consenting to the anonymous use of their material and the option to opt in or out of future contact.

An interview guideline (Appendix A) was used to ensure the same topics were addressed in each interview whilst allowing the flexibility to encourage a conversational interview style in order for

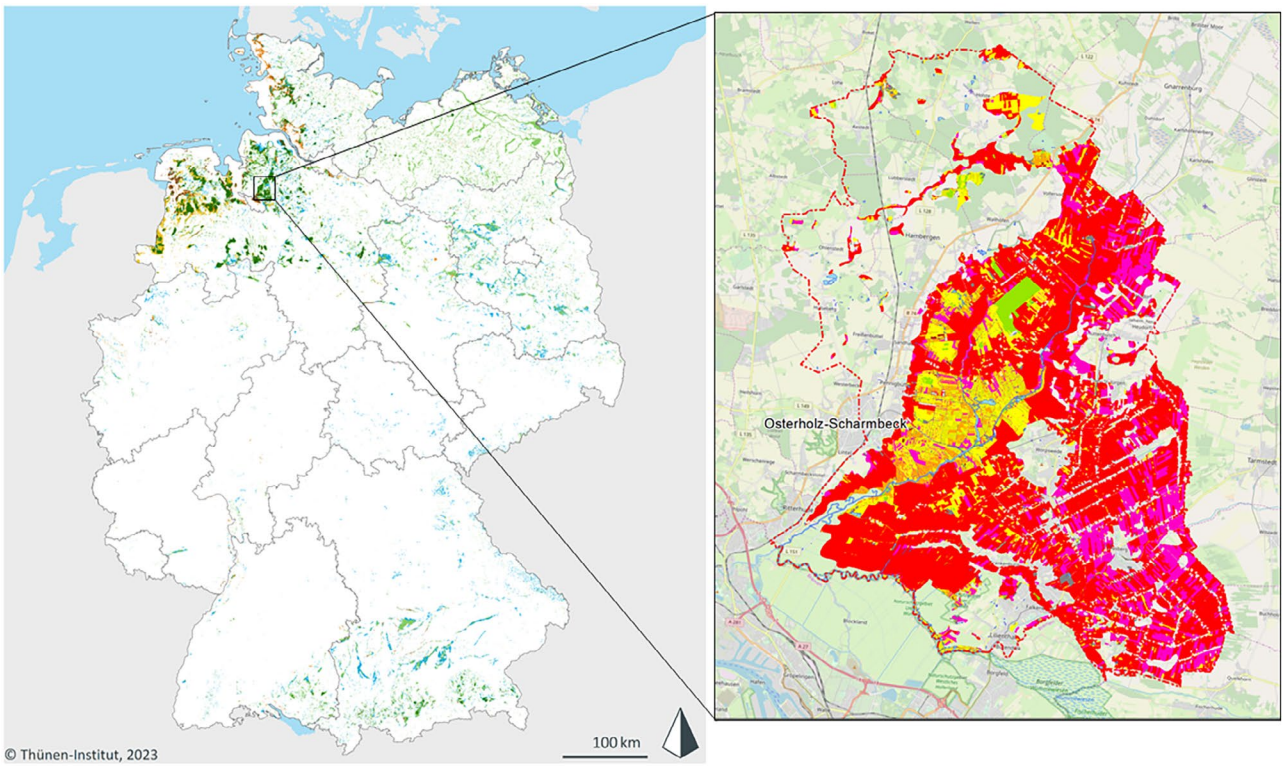

FIGURE 1 Map of organic soils in Germany (Thünen-Institute, 2023) and location of the study area, with estimated soil borne peatland emissions in the Teufelsmoor region, Lower Saxony, Germany. Colours indicate Global Warming Potential based on GHG emission site type (Couwenberg et al., 2011): Purple >30 t CO2e ha-1 a-1, dark red 25,1–30 t CO2e ha-1 a-1, red 20,1–25 t CO2e ha-1 a-1, orange 15,1–20 t CO2e ha-1 a-1, light yellow 10,1–15 t CO2e ha-1 a-1, dark yellow 5,1–10 t CO2e ha-1 a-1, light green 0,1–5 t CO2e ha-1 a-1, dark green 0 t CO2e ha-1 a-1, grey—no data (Reichelt & Schwenck, 2020 in Nordt et al., 2020).

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interviewees to share topics of importance to them. The guideline covered how interviewees view the *target* and *process* of rewetting peatlands, what they consider their *role* as farmers to be, and their *visions and thoughts for the future*. Questions, as much as was reflexively possible, were framed openly to encourage free responses (Mayring, 2016). All interviews were conducted by the same interviewer who met the interviewees for the first time. Participants additionally completed a short-written questionnaire regarding characteristics of their farm (Appendix B), the answers of which aided a contextualisation of the interviewee's statements.

The interview material was transcribed using the f4x software (Audiotranskription, n.d.), followed by manual verification using the protocol technique (Mayring, 2016). Data analysis comprised of an empirically driven qualitative content analysis (Bryman, 2016a), in which all interview material was coded using the MaxQDA 2022 software. Each interview transcript was read to collect first impressions and gain familiarisation with the data corpus. In a second close reading, first tentative emergent codes were generated, followed by iterative cycles of coding. Codes were given single words or short phrases such as *autonomy* or *practicalities* and recorded in a codebook (Appendix C) with a description to ensure reliability and validity of the coding process (Bryman, 2016a). Data analysis was conducted by a single coder, which may introduce limitations such as subjectivity and bias due to the sole perspective. Efforts were made to minimise bias by reflecting on assumptions and comparing findings with existing literature on peatland rewetting and paludiculture implementation. The data were summarised and clustered into themes representing the salient results, generating a clustered abstraction of the interviewees statements. Normativity and researcher bias should be noted as a limitation in the interpretation. The results were clustered as *operational impediments*, *peatland knowledge and awareness*, *collaboration between stakeholders* and *peatland perceptions and sense of identity*.

We applied a grounded theory approach (Charmaz, 2014) to the results of the content analysis. The results were iteratively clustered and visualised as mind maps until the data had been distilled into four discrete categories, which reflected the different perception and attitudes amongst the interviewees towards rewetting. The categories were described and labelled, serving as caricatures of plausible self-concepts.

3 | RESULTS

All interviewees farmed on drained or rewetted peatlands, which were designated with some form of protective status. The area of land in private ownership ranged from 9 to 152 ha, with most interviewees additionally leasing land (16–300 ha) either privately or from public land. Forms of agriculture included beef and milk cattle, with most having switched to sucklers due to the increasingly poor nutritional value of fodder from peatlands, as well as some arable farming and gas and pellet production from biomass. Of the 11 AAV members, eight had peatland soils only, all other interviewees farmed on mixed soils.

3.1 | Operational impediments

Although few interviewees were categorically against rewetting, there was much uncertainty regarding the implementation, which was predominantly viewed with scepticism: 'The goal is wonderful, the implementation is difficult to catastrophic and is also not possible in many areas' (Farmer (henceforth: F) 9). The prime doubt expressed by interviewees was a perceived lack of political will to implement effective policy and support mechanisms, leading to a high-risk perception of the financial and long-term security of livelihoods. The fact that farmers 'are obligated to drain' (F3) highlights antagonistic policies, which lead to conflicts, impacting the form of involvement received from sectors such as the Water Board: 'Nature conservation has always regretted that they can't make it wetter, for water law reasons' (F18). Although there was a general interest in options such as paludiculture, the willingness to change was conditional to an assurance of financial security and continued ownership of land: 'I am prepared to change something on my land, even on privately owned land, it just has to be profitable' (F3). Respondents saw rewetting combined with solar farms as a plausible option due to the guaranteed income. Some interviewees were closing their business or planned to end the legacy of their farm following retirement due to financial pressures, risks and restrictions of farming on peatland and land with a protective status. All interviewees addressed the wish to make a direct profit from agriculture rather than depend on subsidies, financial aid and secondary sources of income. Repeatedly articulated was the demand for clear temporal outlines of income per rewetted hectare and carbon certificate schemes.

Nature and impending climate protection policies were perceived as major restrictions, with fears of expropriation and loss of economic viability. Those that also had mineral soils perceived rewetting schemes as low risk for their existence, expressing pity for their colleagues with peat soils only. There were contentions in the scale of rewetting, with some expressing an 'all or nothing' approach, with reservations about what this would mean for agriculture and the communities in the region, which would become 'economically dried out, but geologically rewetted' (F11). Interviewees suggested a patchwork approach with differing levels of rewetting and varying forms of land use and income opportunities: 'My hope is that there are areas where intensive farming can continue and areas where farmers are content to have their land flooded or bought out' (F15). Further practical concerns included accessibility to wet land, lacking infrastructure to process paludiculture products, missing market chains, challenging topographies and water availability.

3.2 | Peatland knowledge and awareness

Farming on peatlands was described as challenging, both under saturated and drained conditions, with recognition from interviewees of issues such as subsidence and poor yields. Despite this overarching awareness, interviewees displayed varying degrees of knowledge regarding the science of peatland ecology, rewetting

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and paludiculture. There was an overall acceptance of the climatic problems conventional agriculture on peatlands poses, and that the current trajectory cannot be sustained. With whom the responsibility for change lies, was however, a contentious issue: 'We must always remember that we are 7% and not the other 93%' (F1). Scepticism was present towards the science behind rewetting and the effectiveness in mitigating emissions. The value of rewetting the Teufelsmoor and risking livelihoods was questioned when business as usual continues elsewhere and other known effective solutions are not deployed. This frustration and sense of injustice were reiterated, with emissions from pumping water in the Teufelsmoor and further externalities viewed as a paradox: 'They want to abandon the peatland here so that the rainforest burns for us somewhere else' (F7). The farmers feared the irreversibility of rewetting and were sceptical as to whether rewetting was a long-term solution. A latent hope was expressed that a better climate mitigation solution would be discovered that does not jeopardise the current way of farming. Solutions offered by interviewees included the reallocation of existing funds to prioritise farmers, land swapping opportunities and deep ploughing or the covering of peat layers with sand to avoid exposure to the atmosphere.

Interviewees shared the frustrations at the lack of respect and acknowledgement of the experience and local knowledge of farmers: 'someone comes (…) and tells me what you did was all rubbish, and that's the foundation you build on' (F4). A lack of confidence was expressed in the competencies of policymakers regarding peatlands. The Farmer's Association, social interactions, the internet and social media were named as the most common sources of information on farming practices and rewetting. Individuals felt overwhelmed by the swathes of information received in workshops that questioned their way of life.

Interviewees struggled to imagine what the role of a landscape manager would entail, being further hampered by lacking rewetting 'know-how' and knowledge of peatland ecology: 'These rushes and whatever these things are all called, I don't really know these grasses' (F13). The presence of deer was regarded as an indicator of a healthy landscape with the conviction that rewetted areas hosted no wildlife. A shared perception was that the rewetting of the Pennigbütteler Moor, an area within the Teufelsmoor region was a failed attempt: 'In the Pennigbütteler-Wiesen it's really backfiring at the moment' (F14)—probably referring to the rewetted retention area I (LK OHZ, 2012) now becoming wasteland in the view of the farmer. Further concerns highlighted Germany's food sovereignty, an increase in mosquitoes, bush encroachment and methane production, and the perception that their land is already 'wet': 'Rewetting - that is the only thing that is being talked about. (…) we are wet, and that is always ignored, and that annoys me enormously' (F6).

3.3 | Collaboration between stakeholders

Interviewees addressed frustrations in the communication between farmers and other sectors and felt that long-term participation and exchange was lacking following initial engagement with farmers over regional changes in land use. The fear of mandatory rewetting measures was described as a driving factor in the wish for individual agency on how to run their farm and real collaboration in implementing changes: 'I am annoyed that we are forced into roles and cannot shape these roles ourselves' (F1). The interviewees desired a form of collaboration, which would better foster joint decision-making between stakeholders as well as the exchange of knowledge and experience. Repeatedly described were disrespect towards and misrecognition of farmers, where accusation and confrontational dialogues were perceived as customary from other stakeholders such as conservationists.

There was a perceived lack of transparency from the district and poor representation by the Farmer's Association. Feelings of betrayal and broken trust were described following the operationalisation of the collective ordinance (Sammelverordnung), the extension and large-scale incorporation of nature and landscape conservation areas, with diverse management restrictions, that is amount of fertilisation or harvest dates (LK OHZ, 2017). These still-held emotions resulted in a tenuous relationship and resistance towards collaboration by some: 'We got to know an arrogance from the district of Osterholz in the course of the introduction of the collective ordinance, that was quite hefty' (F14). Perceptions reign that farmers were manipulated by the district in the past and are therefore hesitant to make more changes and not receive compensation, as they feel promises were made and abused. Some interviewees felt victimised, while others suggested it was down to the individual farmers, as others had managed to continue to run successful businesses. The lack of transparency referred to the long-term visions for the region, where conflicting agendas and objectives between stakeholders were named: 'The district no longer wants anyone to live here at all' (F3). Some interviewees were on the brink of leaving the Farmer's Association as they did not feel represented as peatland farmers, a sentiment that has been ameliorated with the appointment of a new chairman. Some positive relationships were also described, such as the guidance and advice received from the Biological Station (BioS) (n.d.), the Greifswald Mire Centre (GMC) and other actors in conservation and local politics.

3.4 | Peatland perceptions and sense of identity

Interviewees valued the Teufelsmoor for its wide, open landscape, wildlife, hay harvest and a place of home, but described undrained peatlands as unproductive, dead wastelands with a low aesthetic value compared to drained farmed land. Repeatedly, words such as 'fallow', 'dead' and 'bleak' were used: 'In these dead things, there's not much going on' (F17). Parallel to these negative connotations, a strong sense of place and pride were described in what has been achieved, despite the setbacks of farming on peat soils. Nature was framed not to be left to its own dynamics, describing the need to 'care', 'tidy' and 'order' the landscape. Few interviewees embraced the idea of becoming landscape managers, as this would

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not correspond to their reasons for becoming farmers. The identity and purpose of farming was expressed to pertain to the relationship with cow-herds, now for many an 'expensive hobby', and the production of goods. The history of draining the region was frequently mentioned, with rewetting and paludiculture not fitting into the narrative of 'good' farming. Decreasing numbers of farmers, a reduced sense of community, the pressures of 'urban settlers' and growing concerns about the future of farming in the region and prospects for young farmers, all contributed to an overall shared mood of 'more frustration than joy' (F2).

3.5 | Characterisation of farmers

We defined four main characteristics of farmers, whereby individuals can belong to more than one group. Sceptics and Pragmatists outnumbered the Pioneers and Hobby Farmers within the sample.

The Pioneers are driven largely through need as opposed to personal conviction and see the rewetting of peatlands and paludiculture as an opportunity to secure their livelihood and tap into a market they could excel in. Pioneers are initiators willing to take on a certain amount of risk in face of the consequences through inaction. Pioneers tend to exhibit pro-environmental behaviour and perceive a social and environmental responsibility in their role as a farmer. Pioneers see value and an opportunity in changing the social service they could provide, that is carbon storage and renewable resources, and are willing to take on a role as landscape manager. The Pioneers were aware of the relationship between peatlands, climate change and possible solutions. The self-motivated proactive engagement with the rewetting of peatlands and the development of paludiculture practices by Pioneers is held back by the lack of political, financial and practical support mechanisms; though value is seen in leading the way, they fear being left in the lurch. Examples of statements from Pioneers are 'It is an opportunity for everyone if we show a way forward and are a small beacon and show that we have approached and addressed the climate issue - and it works' (F3) and 'We can rethink in the other direction and maybe get something going where we can do something with it, that this area is used to our advantage. (…) We would get a different name, we would basically not be agricultural farmers, but climate farmers' (F16).

The Sceptics are traditionalists, resistant to and hesitant about changes which may jeopardise their income security and what they know and are familiar with. Rewetting peatlands and adopting paludiculture is not deemed as purposeful, with reservations about the science behind rewetting, specifically the effectiveness regarding the mitigation of carbon emissions. Most Sceptics have mixed soils and therefore feel less affected by the dialogue on rewetting, feeling they have other more immediate concerns. The Sceptics question why their livelihoods should be put at risk when the rest of society continues business as usual, feeling victimised, dejected and resigned in their role as a farmer in the Teufelsmoor region. They see themselves as a producer of traditional goods such as food, rather than as a landscape manager. Sceptics are more likely to express a 'not in my back yard' attitude (Dear, 1992) towards rewetting and perceive themselves as less accountable for the contribution to carbon emissions and that their practices are damaging to the environment. Statements representing the Sceptics are for example: 'I don't think anything of the goal of rewetting. For us farmers here, in the Teufelsmoor in particular, it is a threat to our existence' (F13) and 'We will have a few guided tours here where rangers with nice hats walk through the peatland and tells tourists that people used to live here, and we saved the climate with it, or didn't make it' (F14).

The Pragmatists are characterised by a willingness to change and actively follow the dialogue on the rewetting of peatlands, are aware of the problems and solutions, but are hesitant to becoming actively involved until more evidence and concrete structures are in place. The Pragmatists want planning security, wish for more public support and the assurance that there is a stable market and demand for paludiculture products and long-term income. Although theoretically onboard with the concept of rewetting peatlands, pragmatists are doubtful about the implementation process and fear the complexity has not been accounted for by politicians and peatland scientists alike. The willingness to change is conditional on continued traditional agriculture with cows, alongside paludiculture and rewetting is considered a problem for the future. Pragmatists are cautious, waiting to see how the narrative develops before taking any risks and making changes on their farms, while however, actively encouraging and observing the Pioneers and applauding their proactive engagement. Quotes from Pragmatists include: 'Pay me for it, then I can do it. Why am I doing this? Because I support it? Because I think it's one hundred percent, right? No, of course not. Do I have any other choice? No, I don't?' (F8) and 'I am not the man who says that we must have everything guaranteed by the state. (…) But if we are deprived of our livelihoods and told that you must do something else, then it must be clear that the state is also prepared to say, ok, we are there to get things going' (F4).

The **Hobby Farmers** have an alternative source of income and therefore do not financially rely on the farm, making the adoption of new practices a moot point when it comes to ensuring their livelihood. Nor is the legacy of the farm a pressing concern. Farming is a personal pursuit, usually driven by a desire to balance out a desk-based job and to work outside and with cows. Landscape management and the dialogue on the rewetting of peatlands is observed passively, as Hobby Farmers do not deem engagement necessary with a debate that transcends the boundaries of their land and their choice of pastime. Hobby Farmers do not see themselves as producers, perceiving no sense of social responsibility in their role of 'farmer'. If faced with changes in peatland farming, some would rather abandon farming altogether while others would adopt changes so long as they continued to gain personal satisfaction and could keep some cows. Hobby farmers farm as they see fit and as brings them joy, with varying levels of concern for climate change issues. Statements from Hobby Farmers include: 'My inclinations are simply towards my milk-cow herd, I'm a cow person, I'm up for it, I can do it. (…) I am not against landscape management; I'm just not interested' (F18) and 'It does not correspond

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to the philosophy of why we do agriculture. (…) We are creating something for ourselves, these are things we do for ourselves and not for other people' (F14).

4 | DISCUSSION

With its structure of deeply drained intensive crop- and grassland utilisation, as well as extensified wet meadow and pasture use with nature conservation-targeted management regulations, the Teufelsmoor is exemplary for agriculturally used peatlands in northwestern Germany. Besides differing farm parameters in South and Northeast Germany's peatland regions, for example in farm size and gross margin (Latacz-Lohmann et al., 2019; Röder et al., 2015), perception of peatlands as production base and reservation towards peatland rewetting are similar across German peatland regions (Schaller et al., 2011).

Our study provides insights on the plurality of perspectives from within a region confronted with the need to rewet peatlands. We portray this plurality by characterising farmers as Pioneers, Sceptics, Pragmatists and Hobby Farmers. Interviewees describe barriers such as a lack of resources and infrastructure from politics, ineffective and antagonistic collaboration, and communication between stakeholders, all of which lead to an overall sense of frustration and insecurity, manifesting as resistance or a conditional willingness to rewet their land. The results cluster into four salient dimensions that summarise the perceptions, challenges and opportunities of rewetting in the Teufelsmoor; *operational impediments*, peatland *knowledge and awareness*, *collaboration between stakeholders*, and *peatland perception and sense of identity*. A similar spectrum of variables has been identified elsewhere, where conflicts with peatland conservation arise (Colloff et al., 2017; Harrison et al., 2020; Tanneberger et al., 2021). A landscape, its history and future are closely entwined with the individuals, both agents of change and resistance, who live and work there; the driving forces for transformation must therefore come from within the region itself, and this study explores these motivations (Gorddard et al., 2016; Zasada & Sagebiel, 2018).

4.1 | Challenges and opportunities of rewetting peatlands

Opportunity costs can differ widely and have a large impact on individual farm ability to raise water levels (Wichmann & Nordt, 2024). Interviewed dairy farmers with high opportunity costs were therefore more sceptic towards rewetting. Rewetting and paludiculture can be understood as an opportunity to leave the vicious cycle of peatland drainage and subsidence and navigate emission targets as well as the farmer's desire to work their land (Norris et al., 2021; Röhrig et al., n.d.). Such change in land use requires fundamental changes in diverse aspects of the farm (Burton et al., 2008), and the operational impediments confronted, largely lean on a transformation of externally driven shifts in policy, infrastructure and finance, where interviewees felt their hands were tied. The turnover of individuals in political roles presents a further impediment, resulting in shifts in agendas and working relationships, and short political terms are at odds with the long-term planning required for peatland restoration (Wichmann, 2018; Zasada & Sagebiel, 2018). Importantly, market forces require restructuring through political support (Chapin et al., 2022) to foster demand for and value of healthy peatlands and paludiculture products. There is little a region can do to change such variables other than generate a strengthened lobby articulating the specific challenges and pressures experienced first-hand by peatland farmers. The open letter sent to German ministers in 2022 (Greifswald Moor Centrum, 2022a) and the voice of the Farmer's Association in local politics are examples of such efforts.

We note a paradox in the interviewees desire for increased planning security and clear policy guidelines, while also wishing for increased flexibility and autonomy. The fear of expropriation and laws enforcing rewetting, mostly understood as land abandonment, point to a sense of helplessness, victimisation, and passivity, which a positive narrative of rewetting, adapted farming techniques, and transparent discussions could help reframe. Currently, all rewetting schemes are voluntary; however, studies show that additional measures are required for a change in mindset and transformation (Allen et al., 2018; Burton et al., 2008; Hirschelmann et al., 2023). The Sceptics and Hobby Farmers, for example, are more likely to wait for regulations enforcing rewetting or leave the profession entirely, than voluntarily rewet their land. Support mechanisms and safe spaces for experimentation may foster transition, increasing farm flexibility for an uncertain and rapidly changing future (Darnhofer et al., 2010) and ensuring that Pioneers in rewetting do not suffer from incurred risks. The motivation of Pioneers in the Teufelsmoor however, as expressed in the interviews, is in danger of being lost if appropriate support mechanisms are not implemented soon.

Ineffective financial support structures present a substantial barrier to adaptation, especially in the form of continued subsidies for farming on drained peatlands (Colloff et al., 2017; Röhrig et al., n.d.; Schäfer et al., 2022). Monetary compensation can ease feelings of sacrifice and loss, transform intent and allow experimentation and risk-taking without threatening one's existence (Abson et al., 2017). A steady income provides security and a sense of being seen and valued—perceived to be lacking at present by interviewees. Rewetting measures would therefore benefit from financial, and thereby social and political, endorsement. Money alone, however, will not lead to a transformation in which farmers work with and connect with, rewetted peatlands (Zasada & Sagebiel, 2018). The existence of other forms of capital in farming calls for a transformation at noninstrumental levels (Burton et al., 2008), as money alone cannot satisfy the desire to work with the land, tend cows and harvest hay. Such factors were highly valued by interviewees, and assumed to change in nature, or indeed no longer be permissible, in a rewetted peatland landscape. Yet, the motivation and resistance of farmers to rewetting

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measures are still too prevalently reduced to economic and technical reasoning alone by research and practitioners alike (Gosling & Williams, 2010; O'Brien & Sygna, 2013; Vanclay, 2004). Although financial concerns play their part, prioritisation hinders a transformation by not addressing the complexity that motivates farmers' resistance towards rewetting. The results highlight the plethora of factors which contribute to perceptions towards rewetting which call for a just transformational process addressing all these dimensions, from finances to emotions (Chapin et al., 2022; O'Brien & Sygna, 2013).

4.2 | The value of knowledge and experience

The lack of knowledge regarding peatlands within all sectors poses an obstacle to transformation. Knowledge is a powerful tool which can shift social values and resulting behaviour (Colloff et al., 2017; Hyland et al., 2016). An effective transformation therefore entails different forms of knowledge (Colloff et al., 2018) present within a region, extending to 'experiential and meanings-based knowledge' (Gorddard et al., 2016, p. 62). With few personal experiences in the community, interviewees struggled to envision a rewetted landscape or feel confident about implementing rewetting. Though experts in their field (Rust et al., 2021), the expertise of peatland farmers is at times discordant to the local ecology and its ecosystem services. Effective peatland restoration requires comprehension of ecohydrological processes, calling for further education for all stakeholders on the processes and science of raising water levels to combat existing doubts, as expressed by the Sceptics. Regional knowledge, however, is an asset that should not be overlooked; those who have the practical skills of draining peatlands are possibly best equipped to reverse the process (Holden et al., 2016; Röhrig et al., n.d.).

Narratives based on historical knowledge can impede change and are no longer context-appropriate for the current climate crisis (Colloff et al., 2017). The knowledge largely applied in peatland farming reflects a time when climate change was not a pressing concern and food security was a national priority (Hirschelmann et al., 2023; Rust et al., 2021), the latter a concern which resurfaced amongst interviewees with the start of the war in the Ukraine in 2022. Though a valid concern, peatlands do not proffer long-term and sustainable options for ensuring food sovereignty and must therefore be managed for climate mitigation while mineral soils are appropriately used for food production (Greifswald Moor Centrum [GMC], 2016). Farmers are generally aware of the problems that intensive agriculture brings (Riechers et al., 2022), with many interviewees stating that the growth in farms is dictated by market forces rather than a desire to manage large industries, pressures which individuals feel unable to escape. Interviewees additionally described conflicts in decision-making in their capacity as both a citizen and a farmer, giving rise to differing perceptions and behaviours regarding rewetting, especially concerning financial considerations (Gosling & Williams, 2010).

As seen in the interviews, farmers tend to draw on 'peer networks' (Rust et al., 2021, p. 1). This propensity can be viewed as a resource to facilitate peer learning, capitalising on the relationships and sources of information that farmers already trust and deploy (Dellmann et al., 2019; Hyland et al., 2016). Learning that transcends roles and disciplines through participation has shown to foster dialogues in which perspectives are exchanged, biases overcome and new concepts, such as paludiculture, explored (Abson et al., 2017; Hyland et al., 2016; Lankester, 2013). Public outreach forms an important element in this process (Norris et al., 2021; Stüber et al., 2022). The impact of effective outreach has been demonstrated by the change in narrative and attitudes towards peatlands in the Flow Country, Scotland (The Flow Country, 2023), where community engagement fostered identification and a connection with the peatlands, impacting the wider community and region by integrating the cultural ecosystem services of peatlands (Flint & Jennings, 2022; Flood et al., 2021)—antipathy has been replaced by pride. Initiatives such as 'Peatland Day' (Landvolk Osterholz e.V., 2020) and the 'Landscape Walk' (Stüber et al., 2022) highlight regional work already being done to foster new traditions and community engagement with peatlands. Such initiatives offer a platform to strengthen knowledge on peatland ecology and tangibly showcase paludiculture products to strengthen a new peatland farming narrative (Röhrig et al., n.d.). This knowledge would also enrich the agricultural curriculum, which is currently doing peatland farmers and society a disservice by not providing adequate and relevant education on peatland farming in the context of the climate crisis (Abel et al., 2019).

Addressing information deficits and misunderstandings, and developing a common ground in terminology, for example, has the potential to reduce reservations and biases held towards individuals and sectors such as between agriculture and conservation. Differences in the pursuit of knowledge, such as described by Rust et al. (2021), where research tends to pursue results that are transferable and generalisable, whereas farmers desire results that are locally applicable in an immediate timeframe, impact the application of knowledge. This in turn reflects differences in intent, values and assumptions, such as the future of the Teufelsmoor, leading to divergences in communication and collaboration. Sceptics hope that alternative solutions would come along, a hope that needs diffusing as conventional drainage-based farming is not a sustainable option. Differences in awareness became evident amongst interviewees regarding the Pennigbütteler–Moor, which is mentally shelved by many as a failed implementation of rewetting. It appears that rather than the ecological aspects, the process, differences in vision of land-use and aesthetics, caused grievance. Efforts were made at the time to identify those most affected, and yet the process was not well-received by farmers (LK OHZ, 2012). Most of the project area was not in agricultural use when the project began (LK OHZ, 2012), and yet the loss of 'productive' land was mourned. The Pennigbütteler–Moor perhaps embodies the fears of losing land to a process farmer have no connection or identification with.

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4.3 | Effective collaboration and support systems

The rewetting of peatlands demands collaborative efforts across fragmented landscapes and diverse stakeholders (Häfner & Piorr, 2021; Norris et al., 2021; Zasada & Sagebiel, 2018). Interviewees perceived past participation attempts as tokenistic and short-term. Collaboration rests on effective communication that ultimately leads to action, affording assessment of current communication pathways in the Teufelsmoor. Transparency and clarity in visions and targets were perceived to be lacking by interviewees, pointing to conflicting agendas in the vision for the region between a cultural landscape, tourism, agriculture or conservation. Effective collaboration is costly and time-consuming (Prager, 2015) but facilitates the articulation of shared objectives amidst differences in perceptions and working structures between sectors and individuals and strengthens the science, policy and practice interface (Abson et al., 2017; Holden et al., 2016; Pollermann, 2004).

Effective communication does not necessarily equate to *more* communication, but the quality of communication and an understanding of the perspectives of the 'other'. Poor communication can hinder transformation (Chan et al., 2018; Joosten & Clarke, 2002; Riechers et al., 2022). The wish for better communication from interviewees was stipulated by an aversion to another 'round table', where previous failed attempts were attributed to a lack of time, will and prejudices from other stakeholders. Conciliation is required to overcome the resentments expressed by interviewees that arose from the operationalisation of the collective ordinance (Deismann, 2016). The results show that trust and mutual respect are pivotal, but currently lacking. The occasionally paternalistic interactions described by interviewees shows that factors other than the information itself contribute to a resistance to rewetting. Competencies in interpersonal communication and negotiation skills are therefore relevant. Farmers tend to distrust individuals from outside the farming community, where a lack of empathy is perceived (Arbuckle Jr et al., 2015; Neef & Neubert, 2011; Rust et al., 2021), a perception shared by the interviewees who appealed for a better rapport with other stakeholders. The importance of Pioneers, and consequently the support they require, is highlighted here, as they form a trusted and tangible source of information for their peers, helping to reduce fears and uncertainties regarding rewetting whilst taking on the associated risks. The interviews also highlighted ambiguities in terms, such as nuances in "wet" and "rewetted", showing a lack of congruence. Acknowledging the plurality, showcased by this characterisation, is the first step to reaching a mutual understanding of the practicalities, definitions, and visions for rewetting the Teufelsmoor, where trust can be fostered through transparency (Joosten & Clarke, 2002; Rust et al., 2021).

Rewetting a region can benefit from coordination of the complex network of actors involved (Jedicke, 2009; Norris et al., 2021; Prager, 2015). A neutral and trusted mediating body to coordinate between differing perspectives in large-scale endeavours, such as rewetting, prove to be successful (Boulton et al., 2013; Meißner & Mäck, 2018; Rust et al., 2021). While a transformation of peatland management in the Teufelsmoor is already underway, the restraints on funding and personnel caution against new structures to avoid additional burden on an already strained system. Rather, the region's existing structures and resources would benefit from further development, adaptation and optimisation (Abson et al., 2017) and overall coordination. The Teufelsmoor has a propitious network of organisations that can be drawn upon, from the BioS, Farmer's Association, and 'Paludikultur Niedersachsen' (Paludikultur Niedersachsen, 2023), to name but a few. Although there are set policy targets on peatland related emission reduction in Germany (BLZV, 2021, BMUV (Federal Ministry for Environment), 2021), they face several barriers for implementation (Chen et al., 2023).

4.4 | The influence of perceptions and identity

Perceptions towards peatlands, the purpose of farming and surrounding culture all feed into the identity, and therefore agency, of individual peatland farmers:a transformation pathway would benefit from reflecting these factors (Haden et al., 2012; O'Brian, 2020). Relating to a landscape informs the identity of individuals (Gosling & Williams, 2010), and fostering positive relational connections (Chan et al., 2018) to peatlands is essential for a just transformation. Peatland farmers are being asked to value a landscape they have few positive relational values with, with most interviewees perceiving intact peatlands of no value, and conservation is equated with a loss of worth, wildlife and production. Although Pioneers are eager for change, negative connotations towards peatlands prevail. The implementation of rewetting therefore does not necessarily come with a wholehearted appreciation of peatlands, where other factors such as opportunistic approaches and survival often drive changes in land-use (Burton, 2004; Norris et al., 2021). The heritage of peatlands has been characterised by a battle against water, which ties into a reduced relatedness and by extension perhaps a reduced wellbeing in peatlands, shaping the mindsets of the present and future (Cooke et al., 2016; Flood et al., 2021). The name Teufelsmoor itself, stemming from the term *Duvelsmoor*, meaning 'numb', expresses and contributes to how the landscape is perceived (Kulp, 1995). Interviewees described attachment to a landscape largely no longer recognisable as peatland, an attachment to an ecosystem farmers have learnt to work against rather than with, posing a significant barrier to transformation (O'Brien & Sygna, 2013). Shifting the narrative of what 'good farming' in peatlands means and fostering a new relationship with water, must therefore address both cognitive and emotional reasoning (Burgess et al., 2000; Burton, 2004; Thomas et al., 2019).

Interviewees strongly identify with the role of 'farmer', which is largely linked to the production of 'useful' goods and a cared for and ordered landscape than to environmentalism. Such desires have been identified elsewhere in farming communities, generating tensions with conservation initiatives (Hyland et al., 2016; Thomas et al., 2019; Zasada & Sagebiel, 2018). Rewetting is perceived to threaten livelihoods and the forms of production peatland farmers

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have become accustomed to (Hyland et al., 2016). Fears were expressed that farming would be replaced by a cultural landscape, catering to tourism that made farmers redundant. Paludiculture and payments for ecological services have yet to become established as trusted forms of agriculture, with paludiculture only recently receiving formal recognition in the Common Agricultural Policy (EU Peatlands and CAP Network, 2021). Carbon storage is not seen as 'purposeful' (Thomas et al., 2019) and a challenge will be shifting away from animal products to building materials and climate change mitigation (Zasada & Sagebiel, 2018). The thought of changing land use through rewetting would be eased by the assurance of uses for the biomass harvested from rewetted peatlands (Nordt et al., 2022; Zasada & Sagebiel, 2018). Currently, peatland farmers are competing in a market where they are at a disadvantage, eroding not only the peat soils but the confidence and joy in production. A wide range of legal, economic and physiological constraints prevent paludiculture to be seen as an economic viable land-use alternative to dairy farming (Chen et al., 2023; Nordt et al., 2022; Wichmann et al., 2022). The peatland farming community would benefit from the endorsement of a narrative fostering a new legacy that engages the local community and a new vision of what to leave behind for future generations (Joosten & Clarke, 2002). The role model as 'peatland climate farmers' incorporates the self-image of producer and provider of public goods and services, such as GHG mitigation and water retention, (DVL, 2021), while receiving acceptance and appreciation. Peatland regions in transition need broader networks and supportive communities to collaborate for joint development of new landscape visions and livelihoods (Flood et al., 2022). The concept of a 'peatland community' (Greifswald Moor Centrum, 2022c) could nurture such a narrative and community involvement, by generating a shared identity. Perhaps paludiculture and the ecological services it brings can spark hope, positivity and even joy for farmers and allow rewetted peatlands to be viewed in a new light, as alive, beautiful and productive.

If the Teufelsmoor as a community engages in active climate protection and works towards resilient ecosystems, this will support and impact agriculture worldwide and contribute to what is a shared global problem (Beauchamp et al., 2019; Haden et al., 2012). Peatland farmers are managing a resource on which 'the equitable wellbeing of current and future generations of humanity and other species' rely (Chapin et al., 2022, p. 1909), which comes with a responsibility to protect those resources (Burton, 2004). This raises the question of social responsibility and individual rights, and many interviewees did not see why they need risk their livelihoods when the rest of society continues as per. Joosten and Clarke (2002, p. 11) express the utilitarian viewpoint that the 'interests of individuals are to be sacrificed for the sake of greater benefits to the greatest number' when it comes to rewetting, a sentiment echoed in the 2022 Lower Saxony Coalition agreement (SPD Landesverband Niedersachsen & BÜNDIS 90/DIE GRÜNEN Landesverband Niedersachsen, 2022), a statement likely to be critically viewed by peatland farmers. The plurality of values and visions means that what Pioneers may view as an opportunity is seen as a threat by Sceptics (O'Brien & Sygna, 2013). Empowering Pioneers may inspire the whole farming community. Such empowerment must address the operational and knowledge-based aspects of rewetting, whilst not neglecting the identity and internal transformation required within individuals. As draining peatlands was a public target (Wichmann et al., 2022), rewetting peatlands needs public support und financial incentives, as i.e. is planned within the national Climate Action Program (BMUV, 2023).

5 | CONCLUSION

This study explores the resistance and reservations of peatland farmers towards rewetting of peatlands in the Teufelsmoor. This characterisation shows that the Teufelsmoor farmers are not a homogenous group and serves as a heuristic to recognise and explore the differing perceptions towards rewetting that drive *Pioneers*, *Sceptics*, *Pragmatists* and *Hobby Farmers*. The interviews showed a reserved willingness to consider changing land-use, under stipulation of increased external support. Diverse measures for support are necessary to overcome the operational impediments that currently hold back those willing to make a change. Acknowledging the differences in knowledge, identity and perceptions within a region allows for the identification of communication, engagement, education and collaboration strategies as well as mixed approaches, with the most leverage in affecting a transformation of peatland management and valuation. Shifts in communication structures, identity and perceptions require deep systemic changes that need nurturing from within the networks of the Teufelsmoor region itself. This study can contribute to the understanding of the differences within a group of 'peatland farmers', allowing for more differentiated approaches to be developed that foster the rewetting of peatlands that encompass the multiple dimensions that impact the readiness of individuals to rewet their land.

AUTHOR CONTRIBUTIONS

Amelie Hünnebeck-Wells, Jacqueline Loos, Anke Nordt and Susanne Abel were involved in conceptualization; Amelie Hünnebeck-Wells was involved in data curation, formal analysis and writing—original draft; Amelie Hünnebeck-Wells and Jacqueline Loos were involved in methodology; Amelie Hünnebeck-Wells, Anke Nordt and Susanne Abel were involved in project administration; Jacqueline Loos and Anke Nordt were involved in supervision; Amelie Hünnebeck-Wells, Jacqueline Loos, Anke Nordt and Susanne Abel were involved in writing—review and editing.

CONFLICT OF INTEREST STATEMENT

There are no competing interests. This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors. Jacqueline Loos was funded through a Junior Professorship granted by the Robert-Bosch Foundation. Anke Nordt and Susanne Abel are members of the GMC, whose work was referred to in some interviews. Anke Nordt provided first contact to the farmer association organising the 'AAV' to Amelie Hünnebeck-Wells.

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Anke Nordt and Susanne Abel were not involved in interviews and data analysis and did not imply any statements regarding the work of the GMC. The work of the AAV was supported by the GMC and two affiliated authors in 2017–2022.

DATA AVAILABILITY STATEMENT

In order to maintain the anonymity of the interviewees participating in this research, the interview transcripts cannot be placed in a public repository.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Appendix A. Interview Guideline.

Appendix B. Questionnaire.

Appendix B. Code Book.

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