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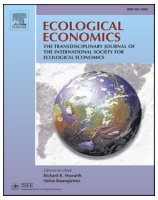

Farmers'perceived financial and non-financial costs of their biodiversity measures – Exploring viewpoints with Q-methodology

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ABSTRACT

Farmers' willingness to continue participation in their agri-environmental program and maintain biodiversity measures in the long term is shaped by the nature of costs they perceive during implementation. Research emphasizes the need to account for both financial and non-financial costs, but holistic assessments which both put these costs into relation and account for farmers' varied perceptions remain lacking. To capture the plurality of perceived costs, as well as the plurality of viewpoints farmers have of these costs, we applied Q-methodology across four European study areas. Building upon scientific literature and expert interviews, we defined a Q-set comprising 41 cost aspects from four dimensions, i.e. financial, management-related, emotional and social costs. 34 farmers with different socio-demographic and farming background Q-sorted these cost aspects. Elicited viewpoints showed that participating farmers are either most impacted by perceived governance-related uncertainty, unproductiveness, lack of support, administrative burden, underpayment, or social non-conformity. Findings give indications of highly diverse needs when implementing a biodiversity measure, within and across study areas. The systematic insights into farmers' cost perceptions and the structure established for this Q-study can guide research and policymakers who aim to comprehensively explore and evaluate well-targeted ways to improve farmers' experiences of biodiversity measures within agri-environmental programs.

1. Introduction

While numerous agri-environmental programs incentivize farmers' implementation of conservation measures across Europe, their contribution in reducing nature degradation is being questioned (e.g.: Pe'er et al., 2022). Given that several environmental benefits accrue over longer time scales, a key way to improve ecological effectiveness is seen in ensuring farmers' decision to continue participation in agri-environmental programs and maintain their conservation measures (Defrancesco et al., 2018). An extensive body of researchers provided insights into the multi-dimensional determinants, i.e. drivers and barriers for making such agri-environmental decisions (e.g. Knowler and Bradshaw, 2007; Dessart et al., 2019; Prokopy et al., 2019; Klebl et al., 2024; Schaub et al., 2023; Sander et al., 2024; Schulze et al., 2024a). Among those, negative experiences with agri-environmental programs and conservation measures were observed as standing against farmers' willingness for continuing participation and maintenance (e.g.: Selinske et al., 2015; Fienitz, 2018; Ranjan et al., 2019; Šumrada et al., 2021). Yet, to better understand such negative experiences and allow policy and program designers to make adaptations supporting continuation, a detailed understanding of which disbenefits, i.e. "costs" farmers perceive regarding the governance, implementation and management of their conservation measures, is needed.

Most commonly, costs of agri-environmental programs and measure implementation are associated with the financial dimension, i.e. loss of economic welfare due to management costs, opportunity costs, and

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certain transaction costs (e.g.: Ranjan et al., 2019; Tyllianakis and Martin-Ortega, 2021): Farmers need to cover expenditures for setting up and maintaining conservation measures, discard potentially more lucrative business opportunities on committed land, or spend money and time on contracting, learning or monitoring (e.g.: Knowler and Bradshaw, 2007; Mettepenningen et al., 2009; Coggan et al., 2022; Schaub et al., 2023). To outweigh the loss of economic welfare, agri-environmental programs commonly provide financial compensation, as, for example, the European Union's (EU) Common Agricultural Policy and its agri-environment-climate payments (Article 28 of Regulation (EU) No 1305/2013). Yet, research increasingly draws attention to potential drawbacks which farmers perceive beyond this neoclassic economic rationale of welfare losses (e.g.: Burton, 2004; Burton et al., 2008; Mettepenningen et al., 2009; Caldas et al., 2016; Selinske et al., 2016; Dessart et al., 2019; Tyllianakis and Martin-Ortega, 2021).

Applications of established concepts from other disciplines have contributed to a deeper understanding of such "non-financial costs". Currently prominent in political discussion (Matthews, 2024), this includes, inter alia, the so-called *administrative burden*. While specifying the transaction costs associated with policy administration (El Benni et al., 2021), which for the example of cross-compliance direct payments in Switzerland are estimated to amount to 5% of the entire budget, this concept goes beyond the spending of time and money. Defined as "*an individual's experience of policy implementation as onerous*" (Burden et al., 2012: 741), the administrative burden accounts not only for learning and compliance efforts, but also psychological costs resulting from policy interactions (Moynihan et al., 2015). Building thereupon, Ritzel et al. (2020: 12), for example, assessed how perceived loss of autonomy and increased levels of stress due to administrative obligations impact Swiss farmers' experiences with agri-environmental programs, and found them as relevant as "*rational factors*", such as documentary duties *per se*.

Additional non-financial costs arising from conservation measure implementation can be derived from Bourdieu's capital theory. To properly reflect the real-world system, Bourdieu (1986: 15) advocated for considering "*capital in all its forms and not solely in the one form recognized by economic theory*". In this sense, loss of cultural capital and social capital among the agricultural community, through loss of prestige or loss of trust, might arise whenever conservation measures do not form part of "*conventional 'good farming' practices*" (Burton and Paragahawewa, 2011: 95). Empirically applying Bourdieu's capital theory, Burton et al. (2008), for example, investigated how management restrictions and extensification requirements hinder farmers to generate productivist symbols, like "*tidy*" fields signaling "*good farming*" in the production-oriented cultures of their German and UK study areas. While Mettepenningen et al. (2009) argue that compensation payments shall compensate for both the monetary and such non-monetary costs, Burton et al. (2008: 21) reason that even if agri-environmental payments are "*apparently generous*", such barriers to cultural capital generation can leave farmers with an overall net loss (also see Cusworth, 2020).

Additional insights into the financial and non-financial dimensions in which farmers perceive negative impacts from measure implementation are to be gleaned from empirical research going beyond conceptual lenses. Particularly re-enrollment research, providing informed assessments of farmers already implementing conservation measures, can inform at which (perceived) costs implementation might come and might have the potential of deterring from continuation. For example, in a study by Reimer and Prokopy (2014), investigating US farmers' participation in diverse conservation programs, decisions to not re-enroll were found to result both from expected opportunity costs, with productive use of the land becoming more beneficial, as well as from workload, bureaucratic program requirements and perceived restrictions in autonomy. Beyond scholarly publications dealing with re-enrollment, given they are scarce (Defrancesco et al., 2018), Barnes et al. (2019) and Vaske et al. (2021) provided extensive reports on US conservation programs and long-term participation, showing that drop-out decisions are associated with perceived disbenefits in several dimensions. Again, financial costs were observed as important reason for farmers not wishing to re-enroll. However, reasons also comprised perceived negative impacts onto the management dimension, comprising limitations in land use, locally unsuitable requirements, administrative burden from complex requirements and risk for pest or fire damage, as well as perceived negative impacts on individual's well-being, such as too much governmental influence on the property and reduced aesthetics or recreational opportunities. Besides re-enrollment research, insights into potentially relevant cost dimensions can be derived from general assessments of agri-environmental programs as, for example, Lim and Wachenheim (2022), reporting farmers' (dis-) satisfaction in several financial and non-financial dimensions, or Eichhorn et al. (2020), examining diverse European agri-environmental programs. Evaluating innovative contract solutions for biodiversity protection, their *ex-post* SWOT analyses not only revealed negative financial impacts associated with program participation, such as expenses for nature protection certification and increased competition among farmers with similar environmentally friendly business models. The report also draws attention to disbenefits in the legal sphere, with the measure's requirements potentially coming at cost of other contractual obligations on the farm (Eichhorn et al., 2020).

Summing up, both conceptual and empirical research indicate the need to account for perceived disbenefits, i.e. costs in not only financial, but also non-financial terms to avoid negative experiences with agri-environmental programs and sustainably anchor conservation measure implementation in farming. Yet, research systematically synthesizing the varied financial and non-financial costs which farmers perceive in the course of measure implementation and investigating them in their entirety is, to the authors' best knowledge, limited. While there is research increasing awareness for the diversity of financial or practical burdens, with for example Schaub et al. (2023: 617) extensively investigating into "*farmers' forgone utility when choosing to participate*" or Coggan et al. (2022) outlining farmers' varied transaction costs, existing studies do not account for the full variety of costs, leaving aside aspects such as psychological onerosities or loss of non-economic capital as outlined above. At the same time, empirical studies so far have missed to examine the *diverse perceptions* farmers have of these varied costs. This is surprising given the broad empirical evidence on the heterogenous farmers' types and viewpoints even *within* European regions, which might be worth to be reflected in more diverse policy mechanisms to increase their efficiency and effectiveness (Bartkowski et al., 2022). Therefore, this study is guided by the aim to both gain a more comprehensive understanding of the plurality of costs, through synthesizing multi-dimensional burdens, as well as exploring the plurality of perceptions thereof. Hereby, it focuses on agri-environmental measures specifically targeting biodiversity conservation, in the following denoted as "biodiversity measures". This responds to their limited success so far (European Union, 2020), mirrored in an unfavorable status or trends of species and habitats across the EU (European Environment Agency, 2020), and the sustained efforts needed for protecting them (e.g., Race and Curtis, 2009; Reimer et al., 2014; Drechsler et al., 2017), emphasizing the necessity for continued implementation. Accordingly, we seek to answer the following research question: *Which different viewpoints do farmers hold about the diverse financial and non-financial costs of their biodiversity measures, as part of agri-environmental programs?*

To this end, this study applies Q-methodology, an exploratory mixed-methods approach allowing to "*reliably, scientifically and experimentally*" assess people's subjectivity and, subsequently, elicit shared viewpoints (Watts and Stenner, 2005, 2012: 44). Building on an extensive set-up process to comprehensively capture the multidimensionality of costs, we conducted interviews with farmers across four substantially different European study areas to elicit potentially varied perceptions of these costs. This study makes three major contributions: First, it contributes to a more comprehensive understanding of potential negative experiences, i.e. perceived costs as equivalent, multi-dimensional counterpart to

perceived benefits, also going far beyond the financial dimension. It thus complements research on the various drivers and barriers of farmers' agri-environmental behavior through providing new, synthesized insights into *one* such determinant, i.e. negative experiences farmers make with current implementation. Second, it captures diverse viewpoints on these multi-dimensional costs, informing a more comprehensive definition of support tools and program adjustments targeted at farmers' varied needs to mitigate potentially negative experiences with biodiversity measures and thus ensure continued implementation. Third, while this study does not aim to directly draw conclusions on continuation, the synthesis of financial and non-financial costs feeding the Q-methodological approach as well as the identified viewpoints provide systematic foundations to fuel the scarce, yet important field of continuation research (Race and Curtis, 2009; Reimer et al., 2014; Defrancesco et al., 2018; Gatto et al., 2019; Ranjan et al., 2019) in both qualitative and quantitative terms.

The remainder of this paper is structured as follows: In Section 2, we detail the Q-methodological approach, including data collection and analysis. The elicited viewpoints, building on statistical results and narrative-style descriptions, are presented in Section 3. In Section 4, we discuss overall perception trends, the elicited viewpoints and their implications for policy-making, alongside the limitations of this study. Lastly, conclusions are drawn in Section 5.

2. Methods

In this study, Q-methodology explores shared viewpoints on financial and non-financial costs of measure implementation to better understand the multi-faceted burdens which different groups within the farming community experience and, in a next step, to allow for well-targeted policy responses. Q-methodology is a technique widely used in socio-environmental sciences (Sneegas et al., 2021). Recent applications of Q-methodology relating to agriculture and food production comprise the assessment of viewpoints on food labels (Schulze et al., 2024b), agri-environmental contract design (Schulze and Matzdorf, 2023), food system sustainability (Röös et al., 2023), and advisory systems (Chowdhury and Kabir, 2023). This application of Q-methodology was guided by Watts and Stenner (2005, 2012) and, as common, comprised two major steps (also see Dieteren et al., 2023) which are briefly outlined as follows:

In the first step (data collection), the Q-set, i.e. items to sort such as statements or pictures on the research topic, is defined. The Q-set needs to be "*broadly representative*" of the so-called *concourse* (Watts and Stenner, 2012: 67), which is the every-day communication about the research topic (Brown, 1993). The size of the Q-set should lie within the "*house standard*" of 40 to 80 items (Watts and Stenner, 2012: 67). Subsequently, participants, i.e. the P-set, are asked to sort these items relative to each other according to their perceived importance, agreement, preference or the like. For insightful Q-studies, the P-set needs to be relatively small, deemed sufficient with even less than 40 participants (Watts and Stenner, 2005) and rarely exceeding 50 (Brown, 1993). Given the rationale of Q-methodology and the subsequent analysis with *participants' Q-sorts* serving as the variables (see below), the P-set is sampled strategically according to the research question (Watts and Stenner, 2012).[1] Importantly, the P-set does not need to be representative of the population, but diverse to ensure that as many potential viewpoints as possible are captured (Watts and Stenner, 2005, 2012).

Through sorting, participants transfer numerous items into their individual *gestalt* configurations, the so-called Q-sorts (Watts and Stenner, 2012). To ensure comparability between Q-sorts, sorting usually follows a forced distribution. This means that items cannot be assigned freely, but participants are asked to all sort into the same-shaped grid.[2]

In the second step (data analysis), Q-sorts of all participants are subjected to a joint *by-person* factor analysis which extracts so-called "factors", grouping farmers with similar Q-sorts and thus indicating shared viewpoints (Watts and Stenner, 2005, 2012). The number of factors to keep from factor analysis is guided both by qualitative considerations, such as a factors' real-life significance, and quantitative criteria (Brown, 1980; Watts and Stenner, 2012). Subsequently, factor arrays, i.e. "*best-estimate Q-sorts*" representing the viewpoints, are generated for each factor (Watts and Stenner, 2005: 82). To facilitate the interpretation of these viewpoints, the quantitative Q-sorting is typically accompanied and/or followed by qualitative interviews, during which participants explain the reasoning behind their ranking (Watts and Stenner, 2005; Watts and Stenner, 2012).

2.1. Q-set

The Q-set in this study comprises the multi-faceted perceptions farmers might state about costs of their biodiversity measure. The Q-set sampling is described in Fig. 1. To capture the diversity of potentially perceived costs, this process was unstructured, i.e. not guided by predefined theories (Watts and Stenner, 2012). Concourse identification

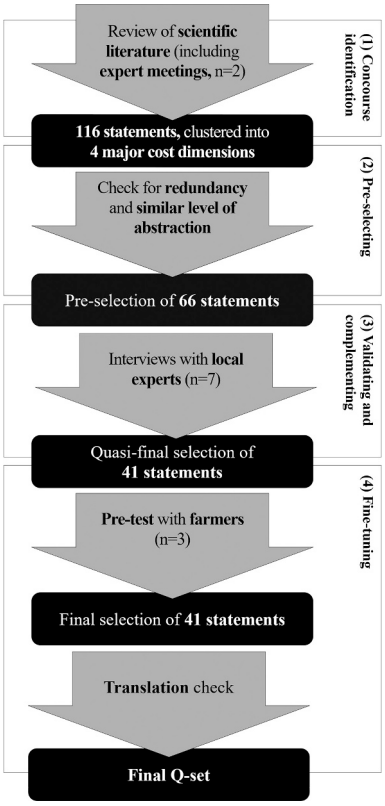

Fig. 1. Process of Q-set sampling.

[1] Q-methodology applies factor analysis, which is preferably run with less variables than observations. Given that factor analysis is run by-person (inverted) with *participants' Q-sorts* serving as variables and Q-items serving as observations, the P-set therefore is preferably smaller than the Q-set (Watts and Stenner, 2005; Webler et al., 2009; Watts and Stenner, 2012). Besides, small samples shall ensure focus on "*essential qualities*" and "*subtle nuances*" in the data (Watts and Stenner, 2005: 79; 2012).

[2] It is important to note that sorting is relative. Therefore, the middle of the grid does not necessarily separate items which are deemed, e.g., most important or most agreed with from those which are deemed most unimportant or most disagreed with (Watts and Stenner, 2012).

(1) was based on peer-reviewed publications, project and institutional documents, reporting about disadvantages which farmers encounter within their agri-environmental programs, or which they consider when deciding on further participation. To this end, literature search was focused on non-financial cost concepts as well as re-enrollment literature. Key words used to identify peer-reviewed literature comprised "*non-financial cost**", "*non-economic cost**", "*non-monetary cost**", "*re-enroll**", "*continu**", "*post program*", "*post contract*", "*contract end*" and "*end of contract*", combined with the term "*agri-environment**". Snowballing was applied until no new insights could be gained, i.e. saturation. Project and institutional, i.e. government-related documents comprised project evaluations resulting from the literature search outlined above, deliverables from preceding EU projects on the social impact of ecological farming approaches for farmers (LIFT[3]) and on impacts of innovative agri-environmental contract solutions (CONSOLE[4]), as well as an evaluation of agri-environmental payments by the European Union (2011). The literature search was conducted from February to June 2023. Expert meetings with an agricultural economist and a representative of a European farmers' association were conducted to cross-check for missing topics. Overall, 116 cost aspects, i.e. potential disbenefits encountered during the implementation of agri-environmental programs, were identified. Since publications mostly did not report them as direct citations from farmers, or reports were too specific on single agri-environmental practices, the conceptualizing authors generated short statements in easy-read and plain language from the identified cost aspects and abstracted them as much as needed to fit all investigated biodiversity measures and study areas (for practical checks see below). Inductive clustering of the identified cost aspects elicited four "*cost dimensions*": Financial costs relate to financial loss and uncertainty. Management-related costs deal with administrative and physical impediments. Emotional costs comprise impacts on values, preferences and well-being. Social costs regard adverse effects in farmers' social environment. While elicited cost aspects on Bourdieu's (1986) concept of social and cultural capital could be assigned to only one dimension ("social costs"), elicited cost aspects from the concepts of transaction costs and administrative burden were assigned to several dimensions, given they are multi-faceted in themselves and touch upon diverse aspects, e.g. information seeking coming with burden on time or money or fear of penalties leading to emotional stress.

In the pre-selection (2), statements were cleared from redundancies and adjusted for similar levels of abstraction. To validate and complement the remaining 66 statements in terms of practical and local relevance (3), we conducted individual online interviews with seven further experts (three advisors, three agro-economists, one farmers' representative) who are familiar with the agricultural context of the respective study areas and biodiversity measures (see Section 2.3). Building thereupon, the conceptualizing co-authors defined the quasi-final selection of 41 statements. For fine-tuning (4), the quasi-final Q-set was pre-tested by farmers ($n = 3$) with different production systems, resulting in minor changes in wording and the replacement of two statements due to perceived redundancies.[5] Subsequently, we discussed the wording among the entire team of co-authors to ensure unambiguous translatability. The final Q-set is shown in Table 4, while **Appendix A** details the main sources of each statement.

2.2. P-set

Given the scope of this study aiming to more comprehensively understand the plurality of costs perceived *in the course* of implementation, the P-set comprises exclusively farmers who are already implementing the investigated biodiversity measures as part of an agri-environmental program (see Section 2.3). Recruiting was conducted within the networks of local research partners from academic research institutions with agro-ecological focus and non-governmental agri-environmental organizations providing advisory services for farmers. To ensure that, in case viewpoints vary among the farming community, they are captured in their full plurality, we aimed for farmers with varied socio-economic and farm characteristics, especially gender, age, education, farm type, farm size, and farm management. The final P-set is presented in Section 3.1.

2.3. Study areas and their biodiversity measures

Study areas are located in Estonia, the Netherlands, Romania, and the United Kingdom (Fig. 2). Each area faces substantial threats to biodiversity which originate from land use change and are being addressed by public or private programs, incentivizing the implementation of corresponding biodiversity measures. Table 1 gives an overview. Details of the agricultural context and program administration are provided in **Appendix B**.

2.4. Q-sorting

The Q-sorting was carried out in individual face-to-face interviews. Interviews took place in autumn 2023 and lasted between 0.5 and 2 hours. Interviews were conducted by native-speaking research partners (for Estonian, Romanian, and Dutch)[6] or the first author (for English or German). The first author additionally assisted each interview to ensure uniform data collection. We used farmers' native language, except if explicitly preferred otherwise.[7] Prior to sorting, the Q-set was carefully translated and printed onto 41 cards.

Following Watts and Stenner (2012), farmers first familiarized themselves with the statements through assigning the cards to three piles (disagree, agree, neutral/undecided). Based on this rough classification, farmers sorted the statements relative to each other on a scale

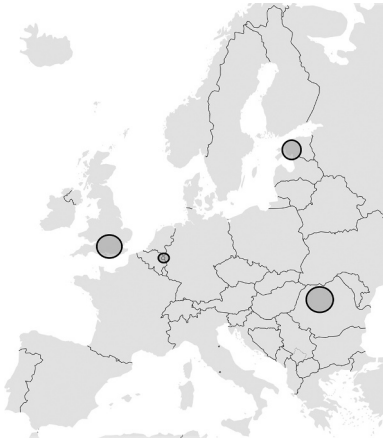

Fig. 2. Location of study areas across Europe.

[3] https://www.lift-h2020.eu/

[4] https://console-project.eu/

[5] These statements asked about emotional distress resulting from administrative tasks and farmers' perception of deviating from what their peers do, recommend or prioritize, which appeared too close to statements on the overall amount of paperwork and being seen as good farmer, respectively.

[6] Regularly, one local research partner was involved in the interviews per study area. Only in the Romanian study area, 3 research partners were involved who alternately took the lead role.

[7] In 2 cases, farmers opted for an interview in English respectively German because they were fluent in these languages and wanted to engage with the first author. Yet, throughout the interviews, native-speaking assistance was guaranteed through local research partners.

Table 1
Description of study areas by biodiversity threats and corresponding measures.

	Estonia (EE)	Netherlands (NL)	Romania (RO)	United Kingdom (UK)
Region	West Estonian coast-line without islands	South Limburg	Uplands of Romanian North-West & Center	Southern England
Agricultural context	Flat land, mainly crop and livestock farming, farms typically sized larger than 100 ha (Aamisepp et al., 2023)	Loess-covered, incised plateau with terraces and slopes (van de Westeringh, 1980); mainly arable crops and grassland, average farm size lower than 30 ha (Agrimatie, 2018)	Hilly/mountainous land, mainly mixed farming with extensive pastures and hay meadows, arable land and traditional orchards, high abundance of small-scale family farms (Page et al., 2012; Page and Popa, 2013.	Flat/hilly land, mainly arable crops and livestock grazing, more than 70% of the land is part of farms larger than 100 ha (DEFRA, 2023b, DEFRA, 2023c).
Threats to biodiversity	Abandonment of coastal meadows, i.e. biodiversity-rich, semi-natural habitats created through traditional agriculture (Melts et al., 2018; Lotman and Rannap, 2020)	Intensification of extensive permanent grassland, rich in biodiversity and determinant for scenic landscape (WallisDeVries et al., 2002)	Intensification or abandonment of high nature value permanent grassland, associated with small-scale family farms (Page et al., 2012; Page and Popa, 2013)	Intensification of farmland and loss of biodiversity in one of the most nature-depauperate countries worldwide (Boatman et al., 2007; Burns et al., 2023)
Investigated biodiversity measure and requirements	Conservation/restoration of coastal meadows, e.g. through land clearing, extensive grazing, delayed mowing	Conservation/restoration of extensive grassland, e.g. through delayed mowing, extensive grazing, and ceased fertilization	Conservation/restoration of high-nature value grasslands, e.g. through delayed mowing, reduced machinery use, fertilization andgrazing pressure	Winter cover cropping in arable systems to cover soil between summer harvest and spring cropping
Governance	Public (Estonian agri-environmental program)	Public (Dutch agri-environmental program with local collective)	Public (Romanian agri-environmental program)	Public (UK agri-environmental program); private by certain water companies

from −4 (most disagree) to +4 (most agree), guided by the question "*How do you perceive your biodiversity measure*?".[8] For an illustration of the grid for Q-sorting, i.e. the distribution format applied, see Fig. 3. Sorting was followed by qualitative questions, inter alia on motivations for sorting to the extreme ends, and surprising, confusing, or missing statements. The qualitative follow-ups were audio-recorded or, if the farmer preferred, protocolled by means of written notes.[9] Farm characteristics and socio-demographics were assessed through a short questionnaire.

2.5. Q pattern analysis

Q-sorts were analyzed jointly to identify different and shared patterns across participants from all study areas. For quantitative analysis, we used the open-source software KADE, version 1.2.1 (Banasick, 2019). First, by-person principal component analysis with subsequent Varimax rotation was run on the intercorrelated Q-sorts. In this study, Q-sorts are deemed as loading significantly on a factor if their loading exceeds $\pm 0.403 (P < 0.01$; calculated after Brown, 1980). Second, and based on extensive discussions among the conceptualizing co-authors on the one hand, as well as Humphrey's rule (product of factor's highest two loadings exceed once or, stricter, twice the standard error), the Kaiser-Guttman criterion (factor's eigenvalue ≥ 1), and the number of significantly loading Q-sorts per factor (≥ 2) on the other hand, we decided to retain 5 factors (also see Brown, 1980; Watts and Stenner, 2012). For generating the factor arrays, only Q-sorts which have a minimum loading of ±0.403 on the respective factor and do not exceed this level for another factor were used for factor array calculation and further analysis. Additionally, consensus and distinguishing statements ($P<0.01$) were calculated.[10] Factor 3 was found bipolar, meaning that Q-sorts load significantly in both negative and positive terms. Following Brown (1980), we split this factor into sub-factors (3a/b), coming with separate factor arrays and, consequently, separate interpretations. Fig. 3 graphically illustrates the array for an exemplary factor/viewpoint. Functioning as best-estimate of all Q sorts that have been flagged for the respective factor, it is a specific arrangement of the Q-set with its 41 cost statements from four dimensions.

For interpreting the factors and represented viewpoints, we largely adhered to "*crib sheets*" (Watts and Stenner, 2012): for each factor array, a crib sheet highlights which statements are ranked significantly differently (distinguishing statements), or simply more highly/lowly compared to all other arrays. Interpretation was supported by audio-recordings or protocols from the qualitative follow-ups. Audio-recordings were transcribed and translated by means of artificial intelligence, i.e. Whisper (Open AI, 2022) and DeepL Pro, with subsequent manual corrections.

3. Results

3.1. Factor characteristics

Across study areas, valid Q-sorts and qualitative data from interviews with 34 farmers were collected.[11] The characteristics of the five extracted factors, including bipolar Factors 3a/b, are presented in Table 2. Inter-factor correlation was limited overall, ranging from |0.002| to |0.417|, indicating high variation between the elicited factors. With an overall explained variance of 50%, we obtained a solution which in Q literature such as Watts and Stenner (2012) is viewed as statistically satisfactory and aligns with recent multi-national applications of Q methodology (also see Section 4.1). The extent to which each farmer's Q-sort loads onto the factors can be seen in Appendix C.

In Table 3, we describe the P-set and the farmers defining the respective factors. Fulfilling a pre-requisite for capturing potentially

[8] For example, a farmer might strongly agree to perceive her measure like described in statement Q11 ("There is too much paperwork coming with the biodiversity measure.") and thus assigned it to +4, while she agrees slightly less strongly to perceive the measure like described in statement Q1 ("The biodiversity measure is restricting the flexibility on my farm.") and therefore assigned it to +3.

[9] Out of 34 valid interviews (see Section 3.1), 32 farmers agreed to be audio-recorded and 2 farmers preferred protocolling by means of written notes.

[10] In case of a distinguishing statement, a factor's *z* score on an item differs significantly from those of other factors; in case of a consensus, it is similar across factors. The *z* score is based on the average of the ranks that the flagged Q-sorts of one factor assigned to an item, weighed by the sorts' factor loadings (see, e.g., Zabala et al., 2018).

[11] Despite comprehensive explanations, four Q-sorts had been excluded because statements were assigned only to the extreme ends (2), or Q-sorts and follow-ups showed substantial discrepancies (2).

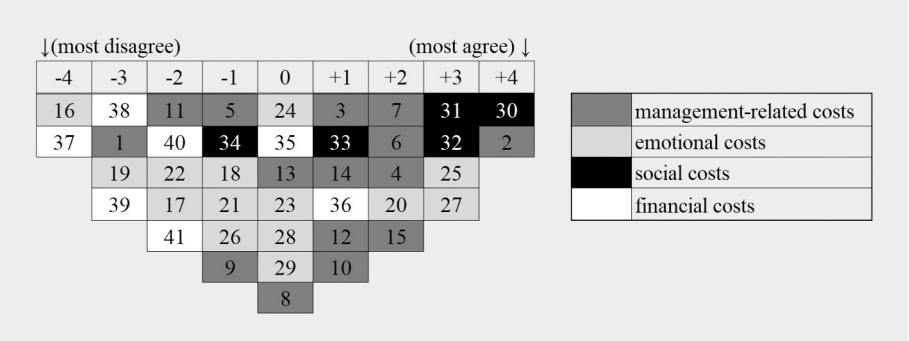

Fig. 3. Graphical illustration of an exemplary factor array.

Table 2
Summary of factor characteristics: explained variance, defining variables, and correlations of the five-factor-solution with split bipolar factors 3a/b.

	Factor					
	1	2	3a	3b	4	5
Explained variance (%)	13	9		8	14	6
Number of defining variables/flagged Q-sorts	7	6	3	2	8	3

	Correlations between factor arrays					
Factor	1	2	3a	3b	4	5
1	1	0.232	0.186	0.155	0.417	−0.002
2		1	−0.025	0.079	0.232	0.067
3a			1	−0.254	0.385	0.061
3b				1	0.116	−0.056
4					1	0.071
5						1

diverse viewpoints, the P-set is diverse for most of the outlined selection criteria, including farm size[12], farm types, farm management, years in the biodiversity measure, and age. These criteria are relatively well-balanced, meaning that viewpoints of the respective sub-groups are similarly likely to be reflected in the data. Particularly in terms of gender, however, the P-set is overall not balanced and comprises more male (31) than female (3) farmers or farmers indicating "other" (0), risking that their viewpoints are captured to a lesser extent, or not at all. As can be further seen in Table 3, factors show a high variety in composition. Only farmers associated with Factor 3b tend to be similar for most characteristics, i.e. all applying conventional management as well as having long experience with biodiversity measures and non-university education, while farmers associated with Factor 4 appear to have particularly few similarities. Noteworthy characteristics further relate to farmers associated with Factor 5, sharing a non-conventional farm management, and to Factor 4, coming with a comparatively high share of non-family farms.

Table 4 shows the calculated factor arrays. It further reveals in which cost aspects the represented viewpoints differ from all others, as indicated through distinguishing statements ($P<0.01$). While accounted for in the calculations, no consensus statement, indicating convergent ratings, was observed across factors.

Throughout reading, it is important to note that factor arrays are averaged best-estimates which are typical for the represented viewpoints, but can deviate from *individual* farmers' flagged Q-sorts. Moreover, the Q-methodological approach helps to gain a more holistic understanding of what burdens farmers in the course of measure implementation through putting various cost aspects into relation and identifying viewpoints of farmers who deem similar costs relatively most or least relevant. Yet, no conclusions can be drawn about the absolute level of perceived costs and farmers' (dis-)satisfaction with measure implementation. Similarly, the Q methodological approach is based on a strategically sampled, but not-representative P-set and, while capturing diverse viewpoints, does not inform about their relative abundance, i.e. distribution, among the European farming community (also see Sections 2 and 4.3). Lastly, given the scope of this study, the viewpoints capture the perception of costs, while neither farmers' motivations to (re-) implement their biodiversity measure, nor any effect on measure implementation can be deduced.

3.2. Presentation of factors

Factor 1: governance-related uncertainty

Farmers sharing the viewpoint represented by Factor 1 emphasize the problem of unstable or unclear regulations, or other forms of governance-related uncertainty coming with their biodiversity measure. More than any other group, they feel too much insecurity due to changing requirements (Q20:+4[13]). Like Farmer RO-5[14], arguing that

[12] With an average farm size of 86, 35, 4, and 82 ha in Estonia, the Netherlands, Romania, and the United Kingdom, respectively (European Commission, 2025, based on data from 2020; DEFRA, 2024, based on data from 2023), Table 3 shows that also farmers widely diverging from the national averages were included in the P-set to enable capturing of potentially diverse, rather than most common viewpoints.

[13] see Table 4; denoted as follows: (Q[statement ID]:[sorting value])

[14] see Table C.1 in Appendix C; the ID of Q-sorts/farmers is composed of an abbreviation of the study area (RO = Romania, NL = Netherlands, UK=United Kingdom, EE = Estonia) and a randomized number

Table 3
Description of total P-set ($n = 34$) and, by factor, farmers with flagged Q-sorts ($n = 29$). As detailed, this study differentiates between family farms and non-family farms based on who manages the farm, i.e. members of the owner's family or external persons, such as employed farm managers without family ties. Like in Calus and Van Huylenbroeck (2010), this characteristic does not relate to the share of rented/owned land.

			Flagged Q sorts (farmers) by factors					
			1	2	3a	3b	4	5
		Total	7	6	3	2	8	3
study area	Estonia	9	4	2	–	–	2	–
	Netherlands	10	–	4	–	1	2	2
	Romania	7	3	–	2	1	–	–
	United Kingdom	8	–	–	1	–	4	1
Farm characteristics								
	up to 50 ha	8	1	2	1	1	1	–
	51–100 ha	5	1	1	–	1	1	1
	101–200 ha	7	3	1	1	–	–	1
	201–500 ha	5	1	1	–	–	2	–
	501–1.000 ha	3	–	1	1	–	1	–
farm size	more than 1.000 ha	6	1	–	–	–	3	1
	mixed	16	4	3	2	1	4	1
	mainly animal husbandry	7	3	1	–	1	–	–
farm type (self-declared)	mainly arable	9	–	1	1	–	4	1
	mainly dairy	2	–	1	–	–	–	1
	conventional	19	3	4	2	2	5	–
	organic (certified)	9	3	1	–	–	1	2
farm management	transition/others/ both	6	1	1	1	–	2	1
years in biodiversity program	less than 5 years	6	2	–	–	–	2	–
	5–10 years	10	1	3	2	–	2	2
	more than 10 years	18	4	3	1	2	4	1
family farm	managed by owner's family	27	6	6	2	2	4	2
	managed by external person	7	1	–	1	–	4	1
Farmer characteristics								
	full or major time (> 50%) in farming	26	5	3	1	2	7	3
on-farm employment	half or minor time in farming	8	2	3	2	–	1	–
	female	3	–	1	1	–	1	–
	male	31	7	5	2	2	7	3
gender	other	–	–	–	–	–	–	–
	younger than 50 years	18	3	3	2	1	4	1
age	50 years and older	16	4	3	1	1	4	2
	no university degree	12	2	2	1	2	1	2
general education	university degree	21	5	4	2	–	7	1
	not disclosed	1	–	–	–	–	–	–

"*It's not really explained. […] We are in the fog every year*", Farmer RO-3 reasons that "*policies change from year to year, and we have to adapt on the fly, and we can't make an exact plan*". Farmer EE-6 relates uncertainty to potentially not receiving money when applying for grants, even in return for major investments: "*And then, how do you build your activities, like, on sand*?" In addition, worries are expressed that lease contracts might be cancelled despite ongoing obligations to maintain the biodiversity measure on the leased land (RO-3), funding might be stopped because of lacking state budget (EE-6), or payments are too dependent on unclear outcomes rather than controllable efforts (EE-5).

Relatedly, farmers tend to agree to the statement that the agents making the biodiversity measures lack practical understanding (Q27:+3), resulting in inadequate rules (RO-2) or even barriers to biodiversity protection: "*We do [biodiversity conservation] for pleasure. […] But agri-environmental measures don't let us*" (RO-3). Similarly, farming is deemed to have become more inflexible (Q1:+3). Compared to other groups, farmers sharing this viewpoint also agree more strongly that implementing their biodiversity measure comes at cost of time for family and friends (Q32:+2). This can be related to the process of funding application: "*So if you don't have anything at all right from the start, you're like forced to write these project proposals [to apply for grants for biodiversity measures], […] all that running around, all of that is free time and night-time hours when you're writing it, right*" (EE-6), but also to increased handwork, as stated by several farmers. In line, it is typically strongly agreed that compensation is insufficient (Q39:+4): "*There are many traditional practices, clearing the land is difficult, you can't use machinery, the land is uneven, lack of labor, lack of people. […] You don't find people. They're expensive*" (RO-5).

Whereas farmers perceive relatively high costs associated with governance and practical work, as laid out above, they perceive their biodiversity measure as fitting their local context relatively well. Looking at the on-farm fit on the one hand, farmers in this group typically disagree to the statements that their measure negatively impacts essential operations (Q4:−4) and threats from pests or diseases increased due to implementation (Q13:−3). Accordingly, EE-6 concludes: "*There's nothing else to do here after all!*" From an aesthetical point of view, farmers seem to even enjoy their biodiversity measure (Q29:−3): "*I find it ok to be 'manicured', chemical-free, traditional*" (RO-5). Looking at the social fit, on the other hand, farmers tend not to feel stigmatized because of their biodiversity measure, least from the farming community (Q30:−4). Farmers also disagree, more strongly than any other group, that society pushes them into the biodiversity measure without taking action itself (Q25:−3*[15]). Rather than social pressure, Farmer RO-2 experienced a certain indifference ("*People want to have a full stomach and then, then they might read what's written on [the product]*"), and other farmers such as RO-5 experienced only positively motivating behavior from society: "*They are even excited, [saying] 'luckily you do that'…'that's good!*'"

Factor 2: unproductiveness

Factor 2 highlights a perceived discrepancy between farmers' own, more production-oriented idea of farming and the need to reduce productiveness when implementing a biodiversity measure. This, on the one hand, results in emotional costs, including loss of identity: More than in any other group, farmers agree strongly that their farmland now looks less appealing to them (Q29:+3*). Farmer NL-10, while acknowledging his measure's results, argues: *"I prefer to see a straight field, like what is being mown every four weeks"* and continues: *"The school I went to, the agricultural school, they say you have to produce. Potatoes, milk, beet; and this has nothing to do with production*". Similarly, they agree relatively strongly that the work associated with their biodiversity measure is not part of a farmer's job (Q19:+2).

On the other hand, farmers feel that their biodiversity measures practically hinder production, coming with management-related costs for their farm. Importantly, farmers are most concerned that requirements sometimes do not fit the local conditions (Q10:+4*), as illustrated by NL-1"*The person who has to control everything, he is driving around [one day before it is allowed] to see if somebody has mown the grass"* but *"I have to work with the climate, with the weather, and I don't have to work with the calendar*" (NL-1). Additionally, farmers sharing this viewpoint tend to agree that the agents involved in the biodiversity measure have too little practical understanding (Q27:+3). Besides, threats to farming are deemed more relevant due to the measure (Q13:+4*): Farmer NL-2 assumes that "*there will be more insects and critters and so on that can be undesirable for the regular agriculture*", and Farmer NL-10 argues that "*the herb goes into the manure. Then I drive it back to the other fields. […] Well, on our farm it is very important that everything we grow is weed-free. […] And that's why we need much less pesticides*".

[15] Distinguishing statements (see Table 4) are indicated with asterisks throughout factor presentation.

Table 4
Factor arrays for five-factor solution including bipolar Factors 3a/b. Distinguishing statements ($P<0.01$) are indicated in bold.

Cost-dimension	ID	Cost aspect/Statement	1	2	3a	3b	4	5
management- related costs	1	The biodiversity measure is **restricting the flexibility** on my farm.	3	1	**−4**	2	−1	1
	2	There is too much **insecurity** with the biodiversity measure, e.g. because of changing policies, rules and requirements, funding or participation criteria.	2	3	1	0	2	1
	3	The biodiversity measure **conflicts with other rules and requirements** on my farm.	1	0	**−4**	1	0	0
	4	The biodiversity measure **negatively impacts essential operations** on my farm.	−4	−3	−3	0	−1	−1
	5	My farming has become **more complex** with implementing the biodiversity measure.	0	**−2**	2	1	3	2
	6	There is too much **conflicting information** around the biodiversity measure: I do not know which advice to follow.	2	1	2	**−2**	1	2
	7	I **hardly receive feedback**, e.g. on what is going well or how I could improve the biodiversity measure.	−1	2	1	−2	2	2
	8	There is **too little practical information** available on the biodiversity measure.	0	−1	**3**	−1	0	−3
	9	It is **difficult to access the materials required** for the biodiversity measure (e.g. equipment, seeds or breeds).	2	0	0	3	−4	−4
	10	The requirements of the biodiversity measure are sometimes **unsuitable for the local conditions** of my farm, such as soil or weather.	0	**4**	−3	−2	−1	1
emotional costs	11	There is **too much paperwork** coming with the biodiversity measure.	1	0	−2	3	2	3
	12	Due to the biodiversity measure, the **overall workload** on my farm has increased.	2	−1	0	0	3	0
	13	Due to the biodiversity measure, I increasingly have to deal with **pests, diseases or other threats**.	−3	**4**	−2	1	1	−2
	14	The biodiversity measure **hinders me from adapting my farm to climate change**.	−1	−1	−3	0	−4	−3
	15	With the biodiversity measure, farm work has become **physically more straining**.	1	−2	−1	−2	1	−1
	16	There is too much external interference coming with the biodiversity measure: I often **feel surveilled or lectured**.	1	2	−1	3	3	−2
	17	I feel that my own **knowledge is ignored by the agents involved** in the biodiversity measure.	0	−1	**3**	−1	0	0
	18	I sometimes feel **overwhelmed by all the requirements** of the biodiversity measure.	0	0	0	2	3	3
	19	Managing such a biodiversity measure does **not feel like being part of a farmer's job**.	−1	2	−2	3	−3	−1
	20	Since having opened my farm for the biodiversity measure, I feel **exposed to ever new requirements**.	4	1	−1	2	−1	0
	21	I am **stressed that I will be penalized harshly** if I accidentally make a mistake with the biodiversity measure.	1	2	1	4	2	1
	22	I sometimes feel that my efforts spent on the biodiversity measure **will not make any difference**.	−1	−1	0	−4	0	−3
	23	I sometimes feel like being **left alone** with everything related to the biodiversity measure.	0	−3	1	−4	−1	−2
	24	I sometimes feel **treated unfairly** with regard to the biodiversity measure.	0	0	0	**−3**	2	2
	25	I feel **frustrated** that societal pressure pushed me into the biodiversity measure, while society itself does not do enough to protect biodiversity.	**−3**	3	1	0	1	0
	26	I feel that my efforts spent on the biodiversity measure are **not acknowledged by society**.	−1	1	**4**	−2	0	1
	27	I feel the agents making such a biodiversity measure have **too little understanding of farming**.	3	3	2	1	0	**−2**
	28	I feel **overwhelmed with all the responsibility** for protecting biodiversity that is now resting on my shoulders.	1	−2	−2	**4**	1	−3
social costs	29	Due to the biodiversity measure, my **farm land looks less appealing** to me.	−3	**3**	−3	−1	−3	1
	30	Due to the biodiversity measure, **other farmers no longer see me as a good farmer**.	−4	−4	−2	2	−2	3
	31	Due to the biodiversity measure, some **neighbors are worried** about pests, diseases or other threats coming from my farm.	−2	1	−1	−3	−2	**4**
	32	The biodiversity measure comes at **cost of time for my family or friends**.	2	−3	1	−1	−2	−1
	33	**People would judge me harshly** if they feel that I make a mistake with regard to the biodiversity measure.	−2	−2	3	−3	−1	2
	34	Due to the biodiversity measure, **actors such as banks, fertilizer or crop protection suppliers view me more negatively**.	−3	−4	0	1	−3	3
financial costs	35	Generally, the biodiversity measure resulted in **higher prices for buying or renting new farm land**.	3	1	2	−1	−2	4
	36	Due to the biodiversity measure, my farm has a **disadvantage compared to my competitors**.	−2	−1	−1	−3	−3	−1
	37	My efforts spent on the biodiversity measure are **not reflected in higher prices** on the market.	3	2	4	0	**4**	−1
	38	**Financial uncertainty** has increased due to the biodiversity measure.	−2	−3	−1	2	0	−2
	39	The implementation and management of the biodiversity measure causes expenses which are **only partially covered** by the payments.	4	0	3	1	4	0
	40	Due to the biodiversity measure, my farm has to **forego more lucrative business opportunities**.	−2	−2	0	0	−2	0
	41	Due to the biodiversity measure, it is more difficult for my farm to **respond to changed economic conditions**.	−1	0	2	−1	1	−4

Despite perceived conflicts between biodiversity measure and production, farmers sharing this viewpoint have comparatively less concern in terms of workload and complexity (e.g.: Q5:−2*; Q32:−3), as well as financial insecurity (Q38:−3) or insufficient payment (Q39:0). On the one hand, this can be because the business model is already based on extensive farming. For example, Farmers NL-1 reasons that "*it's not work-intensive because it's […] in the strategy of the company*", while "*the intensive ones are not going to fit because you have to change really a lot*". On the other hand, this can be because only disadvantaged plots are enrolled for which the measure still brings some income while not compromising production or, as argued by Farmer NL-10, the long-term value of the soil. Farmer NL-8 explains: "*On that field, yes, there is no other function that brings more reward*" but "*if it was really an interesting arable plot, I wouldn't do this*". Farmer NL-8 also links this to short contracts which do not allow for major changes, but which would be needed to "*organize your whole business around that*". Relatedly, insecurity with the regulatory framework is ranked relatively high (Q2:+3).

In line with a more production-oriented idea of farming, farmers sharing this viewpoint agree more strongly than other groups that societal pressure pushes them into their biodiversity measure, while society itself is not doing enough to protect biodiversity (Q25:+3). Farmer NL-8 reasons that, generally in agriculture, people tell farmers how to farm, although "*I don't think they themselves have ever touched a cow or anything";* and even if they manage a small garden, they *"just do it on the side. If you're a farmer and have to live […] of it, then it's a different story"*. Yet, in return for implementing their biodiversity measure, potentially even beyond personal preferences, farmers sharing this perspective typically ranked social cost aspects particularly low. Importantly, farmers most strongly disagree that they are no longer seen as good farmers among their peers (Q30:−4) and that agri-business actors view them more negatively (Q34:−4). According to NL-10, the biodiversity measure could rather serve as "*license to produce*", legitimizing the more

intensive production on their remaining farmland in front of business partners, who seek to improve their image. Similarly, Farmer EE-7 who is implementing biodiversity measures against land abandonment (shrub encroachment) argues that those owning her rented land live in cities, but "*they come here once a year for a holiday [and they] are indeed happy that… well, that the surrounding fields are clean […]*".

Factor 3a: lack of support

More than any other group, farmers sharing this perspective feel insufficient support. This, on the one hand, refers to the public: Farmers are most concerned that their efforts are not acknowledged by society (Q26:+4*), which would rather judge any seeming mistakes harshly (Q33:+3), nor by the market (Q37:+4). Farmer RO-1 illustrates "*that's two of us from like, I do not know, 2.000 people*" who appreciate the biodiversity measure in the region, while "*your clients, where you are selling the milk and so on, they don't look […] if you give only hay to the cows*".

On the other hand, farmers tend to wish for more support from the administrative bodies. Compared to other groups, farmers ranked more highly that agents involved in the respective biodiversity measure ignore farmers' knowledge (Q17:+3). Additionally, seeking unambiguous and practical information is perceived as, while not impossible, at least challenging (Q8:+3* // 6:+2). Farmer UK-2 illustrates: "*I think there is more information becoming available, it's just knowing where to find it […] and how to interpret it and how to put it to use on your own farm. […] I'm confident we're doing the right thing, yeah, it's not impacting our business so actually let's keep doing it. But it will be nice to get some information back to say, this is what's happening*" (UK-2).

Even though farmers in this group thus feel more left alone with everything related to their biodiversity measures than all other groups, as shown in comparatively most agreement with statement Q23 (+1), there is little doubt about the measure's general fit to their management, intrinsic values and administration. Farmers disagree relatively strongly that flexibility is restricted (Q1:−4*), essential operations are impacted (Q4:−3), and that the measure conflicts with other rules and requirements (Q3:−4*), unsuitable local conditions (Q10:−3), or aesthetical preferences (Q29:−3). Farmer RO-1 illustrates: "*You don't have to feel constrained just by some rules that you […] have to apply in order to maintain something you think that it's valuable for you and for the community*". Similarly, farmers perceive the bureaucratic side of their biodiversity measure as hardly onerous. Compared to other groups, there is no outstanding overload with administrative topics, particularly in terms of excessive paperwork (Q11:−2).

Factor 3b: administrative burden

Given its bipolarity, farmers sharing the viewpoint represented in Factor 3b are least concerned about lacking appreciation and support related to their biodiversity measure, as farmers associated with Factor 3a are. This particularly manifests in strong disagreement to feeling left alone with everything related to the measure (Q23:−4). They are also most sure about being treated fairly (Q24:−3) and having unambiguous advice (Q6:−2*). Likewise, farmers tend to relatively disagree that they feel judged or unacknowledged by society (Q33:−3; Q26:−2), which expands to neighbors who do not appear worried about negative impacts from the biodiversity measure (Q31:−3). Farmer NL-3 illustrates: "*Nature management is […] being valued by the social environment, there are people who compliment you*".

It is, in contrast, the measure's administration which is perceived most burdensome among the farmers sharing this viewpoint. Farmers are most concerned of harsh penalties in case of accidental mistakes (Q21:+4), excessive paperwork (Q11:+3), difficulties to access the required materials (Q9:+3), too much responsibility resting on their shoulders (Q28:+4*), and high levels of surveilling or lecturing interference (Q16:+3): "*Every year, a week would go just on inspection*", Farmer RO-4 illustrates. In line, farmers sharing this perspective agree more strongly than all other groups that financial insecurity has increased (Q38:+2). This, not least, can be related to such administrative issues: "*If [the inspector] caught you not complying, there was the problem that he could take money from you 5 years in advance. If someone else ploughed your land by mistake, you couldn't prove it, it was still your fault*" (RO-4).

Compared to other groups, farmers in this group also strongly agree that their biodiversity measure does not feel like part of a farmer's job (Q19:+3): "*On the one hand, you're a farmer and on the other hand a nature manager. That conflicts from early morning to late evening*" (NL-3). This supposedly also leads to a perceived loss of reputation among the farming community (Q30:+2). Farmer NL-3 argues that for an intensive arable farmer, "*it looks like a mess",* but *"you have natural management, you also produce something different*". As a result, farmers sharing this viewpoint strongly disagree that the biodiversity measure would not make a difference (Q22:−4) and still do not feel like having put themselves into a disadvantageous economic position compared to their competitors (Q36:−3).

Factor 4: underpayment

Farmers sharing the viewpoint represented in Factor 4 are most concerned that their physical and cognitive efforts are not sufficiently acknowledged in financial terms. Firstly, this relates to the market price that does not rise in response to the measures (Q37:+4*). Farmer UK-6 reasons: "*There are added benefits that we're bringing that we're not being rewarded for, […] whether that be the marketplace that rewards that or another stakeholder in our environment should be rewarding for that"*. Secondly, it relates to the level of compensation payments from the program (Q39:+4). Farmers argue that the measure comes with too restrictive regulations, allowing only partial funding of the area under the measure (UK-7), as well as monetary drawbacks which are not covered, such as inflation (NL-4, NL-7), machinery wearing out on rocky, extensive land (EE-1), grazing livestock killed by wild animals (EE-1), or additional work to handle slug pressure on cover crops (UK-3). Relating to this, farmers agree relatively strongly that they encounter unfair treatment (Q24:+2). This is, for example, put down to unreasonable controls (e.g. UK-3, NL-4), suppliers benefitting at their costs (UK-1), or unequal payments compared to non-agricultural nature managers: "*When natural areas are being mowed for municipalities, then the horticulturists get […] very high rates per hour to mow it with very special machines. We do it all by hand and we do the same, but for trifle*" (NL-4).

In line with perceived underpayment, farmers in this group view their measures as exacting substantial efforts management-wise. This is indicated through high rankings of increased complexity in farming (Q5:+3) or overall workload (Q12:+3). Cover-cropping Farmer UK-3 illustrates: "*I think making another job at the busiest month of the year is not good news and, and definitely it's more complex*". Also, it relates to economics: "*If I am going to mow around bird nests and I am going to mow in rows and I am going to mow in phases in two times on the plot, then I have much higher costs*" (NL-4). Similarly, farmers sharing this perspective feel that their biodiversity comes with substantial administrative work (Q18:+3; Q16:+3).

Interestingly, even though farmers sharing this viewpoint feel that their efforts are underpaid, i.e. not sufficiently acknowledged, they are relatively confident that they still made the right decision with implementing their biodiversity measure. They tend not to see more lucrative business opportunities (Q40:−2) and cannot see why they should be looked at more negatively by agri-business actors (Q34:−3) or be less competitive (Q36:−3). Farmer UK-6 argues: "*There's a cost included, but I don't feel that that cost disadvantages me*". Such observation might relate to the fact that, beyond feeling entitled to more financial rewards for their work, the farmers' values as well as their social environment and business concept harmonize particularly well with the respective measure, similar to, e.g., Factor 1. Those sharing cost-viewpoint 4 not only experience the implementation and management of such biodiversity measures as part of their job (Q19:−3) and enjoy them aesthetically (Q29:−3). They also ranked several costs related to their social environment and deficient local embeddedness of the biodiversity measure

low. Farmer UK-3 illustrates that "*in the region, there's 60, 70%, over half growing cover crops, so I think people generally believe it's the right thing to do"* which has, however, "*changed massively*". Additionally, farmers disagree that their measure is an obstacle for adapting to climate change (Q14:−4), which might rather be deemed "*part of the cure*" (UK-1), and that required materials are hard to source (Q9:−4).

Factor 5: social non-conformity

More strongly than other factors, Factor 5 is dominated by social costs. For farmers sharing this viewpoint, their biodiversity measure tends not to conform with local farming conventions. They are most concerned that it gives neighbors cause to worry (Q31:+4*) and that they are no longer reputed as good farmers (Q30:+3). As reasoned by Farmer NL-6 who manages a biodiversity-rich grassland, traditional producers do not accept "*unwanted herbs*" but "*rather see this as a failure*". Additionally, farmers typically agree relatively strongly that their biodiversity measure raises negative views from actors in the agribusiness (Q34:+3).

Moreover, land is perceived as having become more expensive with the introduction of biodiversity measures (Q35:+4). Two farmers related this to their landlords: "*When they know about the higher rewards [because of funding], they also want more rent*" (NL-6) and "*get a piece of the pie on that, too*" (NL-9). Beyond this aspect, farmers do not have outstanding financial concerns. Similar to Factor 2, they do not at all perceive their biodiversity measure as an obstacle for responding to changed economic conditions (Q41:−4) and tend to be comparatively less concerned about negative income effects. This seems to relate to intrinsic values: According to Farmer NL-9, it shouldn't be the case "*that you actually aim for revenue to grow […] from the management agreement. Because then you're actually doing the wrong thing*", while Farmer NL-6 argues: "*It just fits with my own vision and my own nature goals and the financial part*". Accordingly, farmers sharing this viewpoint tend to disagree that their efforts would not make a difference (Q22:−3) and responsibility for protecting biodiversity is overwhelming (Q28:−3): *"It's not a burden. […] I'm proud of it with what I do"* (NL-9). In terms of support, the accessibility of required materials (Q9:−4) is deemed as unproblematic as the availability of practical information (Q8:−3). In line, and different from any other group, they least perceive those setting up the biodiversity measures as lacking practical understanding (Q27:−2*), or external input as being surveillant and lecturing (Q16:−2). Rather, farmers seem to seek for closer guidance, clear information (Q6:+2) and constructive feedback (Q7:+2), as illustrated by Farmer NL-9: *"[…] it would be nice if, for example, one would walk through the plot right now and say […] you did that right or you didn't do that right*".

Still, like in Factors 3b and 4, there is relatively high concern about the technocracy of their measure (Q18:+3; Q11:+3). This either refers to perceived restrictiveness, as illustrated by Farmer UK-5, stating that "*there is a lot of paperwork and there is a lot of red tape with everything that we sort of seem to*", or a different understanding of farming: "*We as agrarians […] like to have something in our hands, but not a pen or a computer*" (NL-9).

4. Discussion

This exploratory study aimed to gain a more holistic understanding of perceived costs: on the one hand, it synthesizes the plurality of financial and non-financial costs resulting from biodiversity measures. On the other hand, it accounts for the plurality of viewpoints towards these costs which exist among farmers who are implementing biodiversity measures. These aspects are so far underrepresented in agri-environmental research, yet essential to strengthen positive experiences in the course of measure implementation and thus ensure long-term continuation to maximize environmental benefits.

4.1. Key findings

Already in defining the Q-set, this study demonstrates the wide plurality of perceived drawbacks of implementing biodiversity measures, comprising both financial and non-financial costs. Through the sampling and inductive clustering of cost aspects, plurality was reduced to four recurrent dimensions: financial, management-related, emotional, and social costs. These "*cost dimensions*" might neither be overly surprising nor free from overlaps, e.g., reduced family time coming at emotional but also social costs, or perceived stigmatization from business partners potentially coming at financial costs, but also potentially leading to social isolation. Still, the four-dimensional structure proved useful for navigating through established concepts, empirical research, and Q sorts. Factor arrays, moreover, highlight that participating farmers did not prioritize costs of only one single dimension, such as the financial one. This once more emphasizes the necessity to account for costs in their wider meaning and, consequently, explore them in a multi-dimensional way.

The elicited viewpoints further illustrate that perceptions of above-mentioned costs diverge sharply among participating farmers, as implied by relatively low correlations between factors and the absence of consensus statements, i.e. statements rated consistently across factors. Our observations support findings from recent studies in the context of agri-environmental action, highlighting the existence of differentiated perspectives, attitudes, and behaviors among farmers which, instead of assuming uniform, economically-driven mindsets, need to be accounted for when shaping policy interventions (e.g., Walder and Kantelhardt, 2018; Braito et al., 2020). Divergence of viewpoints is most apparent when comparing Factors 2 and 5. Farmers who are relatively most concerned about *unproductiveness* (Factor 2) tend to feel that their biodiversity measure negatively impacts personal values, while they appreciate biodiversity measures as means to signal pro-environmental efforts to their social environment. Diametrically opposing, farmers most concerned by *social non-conformity* (Factor 5) emphasize a loss of reputation due to implementing biodiversity measures, while valuing them as integral part of their environmentally-oriented farming concept. Similarly contrasting concerns were expressed by farmers most concerned by a *lack of support* (Factor 3a) and the *administrative burden* (Factor 3b). While some farmers (Factor 3a) might benefit from closer guidance, this might cause particular frustration for the others (Factor 3b), highlighting the necessity of nuanced policy action. Among groups apparently sharing more similar viewpoints, perceptions show subtler, but nonetheless relevant differences. This especially applies to the most highly correlated Factors 1 and 4. At first glance, both imply a lack of funding. Yet, a pure increase of funding will neither be able to account for underlying concerns such as *uncertainty* with measures, rules and funds (Factor 1), nor *underpayment* (Factor 4), which not only relates to insufficient compensation, but also perceptions of unfair distribution of produced (public) benefits and encountered (private) costs.

Findings furthermore suggest that viewpoints of costs are highly individual across participating farmers, as indicated through the comparatively large number of viewpoints (Dieteren et al., 2023) which still explain a relatively low share of variance (50%) compared to recent Q studies.[16] This might not be uncommon in geographically widespread Q applications.[17] Also in existing literature on opportunity costs, for example, their relevance for farmers was found to vary strongly between individuals, both due to different local contexts and characteristics on farm-level (Schaub et al., 2023). However, interpretation of Table 3 showed that the plurality of viewpoints in this study does not necessarily originate from varied local contexts, given that no factor is defined by farmers from one study area only. Accordingly, even though farmers'

[16] E.g.: Walder and Kantelhardt (2018, 60% explained variance), Braito et al. (2020, 67%), Röös et al. (2023, 58.7%).

[17] E.g.: Berry et al. (2018, 43/47%), Schulze et al. (2024b, 49.61%).

context might be different, and for example Romanian farmers associated with Factor 1 (governance-related uncertainty) were more under the impression of unclear guidance and Estonian farmers were more under the impression of constraints in the state budget, their perceptions resulted in similar viewpoints about their biodiversity measure. Rather, viewpoints on costs seem to vary more strongly with factors specific to the farms and farmers, such as farm management or personal experiences with the program (also see Mack et al., 2019), and appear, at least to a certain extent, independent of specific programs and their requirements. The viewpoints of the Dutch sub-sample best illustrate this observation: While dealing with the same biodiversity measures, *conventional* farmers are most concerned of resulting *unproductiveness* (Factor 2), but highlight the measures' social benefit for responding to increased pressure (also see: Schaller et al., 2022; Scherfranz et al., 2024). The two *organic* farmers, however, are most concerned of *social non-conformity* (Factor 5) in front of intensively farming neighbors or agri-food actors, who they might suspect to anyway lobby against their alternative way of management (Verburg et al., 2022). Similarly, farmers who are most concerned about the *administrative burden* (Factor 3b) shared socio-demographic characteristics such as lower educational levels, which might be significant determinants for perceived loads of paperwork or fear of harsh penalties, as also tested and found significant by Ritzel et al. (2020). Concerns about *underpayment* (Factor 4), lastly, need to be reflected against the high number of non-family farms loading significantly onto this factor. Employed farm managers might be more dependent on financial advantages to justify measure implementation in front of owners, whereas such financial considerations are argued to be comparatively less relevant for family farms (Calus and Van Huylenbroeck, 2010). While further research will be needed to specifically adjust policy strategies to divergent, individual needs of farmers as recommended above, we derive general policy implications from these observations in Section 4.2.

Beyond plurality of viewpoints, we detected that certain costs are ranked similarly across participating farmers. Firstly, this concerns the cost aspect of market prices not reflecting the efforts (Q37). Beyond being a critical component of Factor 4, it is the cost aspect most frequently agreed with across the sample, with 19 out of 34 farmers ranking it at +4 or + 3. Only slightly less distinct, this also applies to perceived insufficient payments (Q39). These observations imply that farmers across Europe might not be (entirely) satisfied with the financial recognition received for their efforts and contributions, as illustrated by Farmer UK-4: "*I'd like more money for doing a good thing.*" Such economic considerations were, not surprisingly, found highly relevant also in other studies: Barnes et al. (2019), e.g., identified expected income loss as significant reason for drop-out from the US Conservation Reserve Program. For an Italian agri-environmental scheme, Gatto et al. (2019) found re-enrollment decisions to depend on varying factors throughout policy periods, while only economic opportunities play a continuously positive role. However, the above-mentioned frequency count in reverse also signals that 15 out of 34 farmers are most concerned about other than income aspects (also see, e.g., Vaske et al., 2021).

Secondly, we observed recurring issues regarding cost aspects related to the administrative burden, such as fear in terms of harsh penalties (Q20) and overload with the requirements (Q18), but also perceived governance insecurity (Q2). Across factor arrays, these statements are ranked relatively high (≥0). Such observations, surprising among a sample of farmers who are generally experienced with biodiversity measures (Table 3), need to be reflected against their temporal context. Given that the interviews were conducted during the transformation from the Common Agricultural Policy (CAP) to the new UK Environmental Land Management (ELM; DEFRA, 2023a), respectively at the beginning of the EU's new CAP period 2023–2027 (European Commission, 2022), farmers might have been under the impression of changing rules. Put in a nutshell by Farmer EE-8 stating that "*the last CAP period was better, because it was simpler*", these observations might, however, also mirror farmers' general frustration with burdensome environmental regulations from the CAP reform, as expressed by means of recent farm protests (Matthews, 2024). While policy-makers are currently trying to gain a better understanding of these acute administrative concerns, notably through an EU-launched survey (Matthews, 2024), longer-term research accompanying policy throughout entire periods will additionally be needed to understand how perceived costs and needs change over time (also see Selinske et al., 2015). This is particularly relevant given that the aspects mentioned, including efforts to internalize new rules or documentary duties, are expected to substantially decrease in the course of implementation (Coggan et al., 2022), whereas new concerns such as uncertainty about eligibility for re-enrollment might gain importance.

The importance to account for time dynamics in future studies on perceived costs bridges to the third pattern observed across the sample, concerning social cost aspects. While loss of prestige and trust among the farming community as a result of implementing conservation measures was still deemed substantial in the scientific discourse some years ago (e.g., Burton et al., 2008; Burton and Paragahawewa, 2011), the majority of farmers in this study ranked them low: Only two farmers, notably those loading onto Factor 5 (*social non-conformity*), agreed most strongly (+4/+3) to experience reputational damage in front of the farming community (Q30) or agri-food actors (Q34). In contrast, 13 and 12 farmers, respectively expressed their strongest disagreement towards these social cost aspects through assigning them to the negative extremes (−4/−3). Accordingly, the agricultural community currently seems to favor the (re-)integration of more sustainable farming practices (also see Cusworth, 2020), which reduces the relevance of social costs as a result. For an English case study, Cusworth (2020) argued that this "social normalization" process supposedly results from the broad implementation of conservation measures thanks to lenient agri-environmental programs, which, at least in terms of successfully changing social norms, advocates for commonly criticized light green measures with relatively modest demands (European Commission, 2020). Arguing that social cost aspects would have been ranked substantially higher only a few years ago, this societal change was also explicitly addressed by several farmers (e.g., NL-1, UK-3, UK-4, UK-6). Referring to biodiversity measure implementation, Farmer UK-3 illustrates that "*it's becoming accepted as a norm. It's been like Groundswell [a regenerative agriculture conference], where it used to be a hippie show and now it's mainstream*".

4.2. Policy implications

Beyond recurring cost perceptions which might benefit from general program adaptations, special attention will need to be paid to the demonstrated plurality of viewpoints to not overlook, or even reinforce concerns of single farmer groups, as mentioned above. This leads back to, and further supports the argumentation of Bartkowski et al. (2022), reasoning that effectiveness and efficiency of EU agri-environmental programs might rise through diversified, individualized contracts, accounting for both regional differences and farmers' heterogeneous types. Such argumentation is found also specifically in continuation research, with Selinske et al. (2016) suggesting that varied policy mechanisms are needed to ensure that the heterogenous farming community maintains conservation efforts (also see Race and Curtis, 2009).

Against the background of increased political emphasis on governance innovations in the context of biodiversity conservation, e.g., through the EU's Biodiversity Strategy (European Commission, 2020), and a growing body of scientific guidance (e.g., D'Alberto et al., 2024), the elicited cost viewpoints will, to this end, need to be set into relation with approaches such as result-based payments, collective administration or implementation, land lease or value-chain contracts. To illustrate: both the group of farmers most concerned by *unproductiveness* (Factor 2) and the group of those most concerned by *social non-conformity* (Factor 5), could, for example, benefit from payment by results. As argued by previous research, these might be powerful in creating

productivist symbols and thus a "*productivist agri-environmentalism*" (Burton, 2004; Burton et al., 2008; Burton and Paragahawewa, 2011: 101) for those who prefer to "produce". For those who experience major social costs, the value assigned to achieving biodiversity outcomes could help to foster prestige, thus increasing cultural capital, and to become the first port of call in conservation matters, thus increasing social capital (Burton and Paragahawewa, 2011). In contrast, for farmers concerned by a *lack of support* (Factor 3b), collective approaches as set up in the Netherlands and promising for fostered peer-to-peer learning and collaboration with diverse stakeholders within a network of accessible experts (e.g. Bazzan et al., 2023) might be a way forward. Given that collectives aim to reduce bureaucracy for its members and improve information provision, argued to reduce perceived administrative burden (Mack et al., 2019), they might also give relief to farmers burdened by the cost aspects prioritized in Factor 3a. Sorts from the Dutch study area seem to support this consideration. As expected, substantially more farmers rather disagreed (<0) than agreed (>0) that they feel left alone with everything related to the biodiversity measure, whereas ratings are more equally distributed among farmers in other study areas. Even in the Dutch study area, however, one farmer is strongly associated with Factor 3a (*Administrative Burden*), indicating once more that farm and farmer characteristics might have stronger influence on viewpoints than the context of the study area, its program and requirements.

Despite the potential of policy mixes, setting up varied programs for different groups of farmers can come with certain challenges, as discussed by Bartkowski et al. (2022). On the one hand, potential efficiency gains will need to be weighed against efficiency losses due to increased complexity coming with group-specific instruments. Digitalization, however, as summed up by the authors, might alleviate potential trade-offs. On the other hand, linking contract design to specific groups of farmers can raise issues on how to legitimate different treatment across groups (Bartkowski et al., 2022), which also relates to fairness. Yet, through leaving farmers full freedom to choose from a variety of contract types, each designed to tackle specific cost viewpoints, fairness might even be increased, providing *every individual* farmer with the opportunity to implement the biodiversity measures which reduces their individual burden. While CAP payments overall need to follow a standardized approach, their agri-environmental-climate schemes show a tendency towards such individualized contracts already, increasingly enabling farmers to join alternative result-oriented programs or benefit from collective bonuses. Additionally, local-scale initiatives, such as operational groups of the European Innovation Partnership, provide flexibility in designing biodiversity measures according to the needs of a relatively small group of participants (Article 127 of Regulation (EU) 2021/2115). Yet, the set-up of not only new approaches all over Europe, but even a variety thereof, probably poses major challenges to program-designers and, at least initially, increases transaction costs for both the administrative party and the farmers. As discussed in Section 4.1, such changes might cause protest from both sides and will require further examination to identify efficient coping strategies.

4.3. Limitations and outlook

While this study contributes to a more comprehensive understanding of the perceived financial and non-financial costs of biodiversity measures, it touches upon several limitations, signaling the need for further research. First, given the exploratory, relative character of the Q-methodological approach, the elicited viewpoints will need to be subject to representative surveys to allow for generalized conclusions on their completeness and relative abundance, i.e. distribution among the entire farming population (Watts and Stenner, 2012; also see Walder and Kantelhardt, 2018; Braito et al., 2020) as well as absolute assessments on levels of perceived costs and (dis-)satisfaction with measure implementation. Additionally, the effect of elicited viewpoints, cost dimensions or cost aspects on continuation will need to be examined through econometric analyses to identify for which costs, respectively for whom, support tools or program adjustments are most urgently needed. This will require introducing perceived non-financial and financial costs as explanatory variables to existing models in this field of research (e.g., Caldas et al., 2016; Defrancesco et al., 2018; Gatto et al., 2019).

Generally, while we carefully introduced the farmers to the scope of this research, continuously reminded them of it, and included the term "*biodiversity measure*" in the statements to frame data collection aptly, we cannot rule out that perceptions of the general agri-political context have influenced the Q-sorting. Yet, such confoundedness also indicates that farmers probably hold similar viewpoints of these spheres, thus still delivering relevant data. Additionally, given that the research was carried out in a multi-linguistic setting, the risk of translation errors, slightly different nuances in wording and thus impeded comparability need to be considered. To reduce this risk, a careful, two-step translation process was conducted, as described in Section 2. Lastly, the Q-set was designed to best reflect the plurality of non-financial and financial costs, inevitably coming with a high number of statements to be sorted. Even though the Q-set complied with methodological recommendations, and no participant commented on redundancies, the set size was on the upper end of practicability. Putting every single statement into relation with one another put substantial cognitive burden on the participants and supposedly contributed to four drop-out cases (see Section 3). When using the elaborated Q-set in other regions, we strongly advocate for reducing its size to approximately 30 statements.

5. Conclusions

This study applied Q-methodology across four European study areas to investigate into perceived cost of implementing biodiversity measures. To this end, it synthesized the plurality of financial and non-financial costs resulting from biodiversity measure implementation and explored viewpoints that exist towards these costs among the heterogenous farming community implementing these measures. First, the study underlines that perceived costs are highly diverse, going far beyond financial losses. This emphasizes the need for multi-faceted approaches when exploring farmers' experience with measure implementation, for which the identified cost dimensions serve as simple-to-use, evidence-based guidance. The identified cost dimensions additionally serve as a starting point for further research on the plurality of costs, both in conceptual and empirical terms. Second, we observed that prioritization of these costs is highly individual and reflected in substantially divergent viewpoints among participants. Viewpoints appear widely independent of the investigated biodiversity measures or study areas, which backs up previous research, arguing that even within one region, multiple policy tools instead of "one-fits-all" solutions might be needed to ensure positive experiences with agri-environmental action. Third, and beyond formal factor analysis, recurring observations across the sorts indicate that viewpoints might be subject to political and societal dynamics, such as changing funding regimes or social norms. Counteracting negative experiences therefore not only requires a profound understanding of who perceives which costs but also at which point in time, highlighting the value of time-dynamic assessments. Overall, while this exploratory Q-methodological study, building on a diverse, yet not representative P-set, was able to identify differences in existing viewpoints, the elicited cost viewpoints and costs aspects will need to be subject to representative and econometric examinations to assess their abundance and absolute level, also accounting for the diversity of innovative agri-environmental schemes, and identify their effect on (dis-)continuation to prioritize policy action. After slight adaptations, they can also serve as starting point for comprehensively examining perceived costs in other regions and domains, such as water protection or organic farming.

As a closing remark, it needs to be made clear once more that the focus of this study was on capturing the relative relevance of *costs*

perceived during biodiversity measure implementation. Despite potentially encountered costs, however, all farmers named several *benefits* during the qualitative follow-ups, e.g., its value for traditional farming, local nature, or personal joy. This study hopes to inform research and policy-led endeavors to further increase, or in less positive cases, create satisfaction. Such endeavors not only have the potential to ensure long-term implementation of biodiversity measures, but also fuel their deeper integration on the farm or spill-over to peers, thus benefitting ecological effectiveness in multiple ways. Yet, they will need to account for the multi-dimensionality of hitherto economically dominated "costs" and farmers' divergent, highly individual viewpoints of these costs, as demonstrated by this study.

CRediT authorship contribution statement

Verena Scherfranz: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Henning Schaak:** Writing – review & editing, Methodology, Conceptualization. **Jochen Kantelhardt:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Karl Reimand:** Writing – review & editing, Data curation. **Michael Braito:** Writing – review & editing, Methodology, Formal analysis. **Flaviu V. Bodea:** Investigation, Data curation. **Cristina Costache:** Investigation, Data curation. **Razvan Popa:** Project administration, Investigation, Funding acquisition. **Reinier de Vries:** Writing – review & editing, Investigation, Data curation. **David Kleijn:** Project administration, Funding acquisition. **Aki Kadulin:** Writing – review & editing, Investigation, Data curation. **Indrek Melts:** Writing – review & editing, Project administration, Funding acquisition. **Amelia S.C. Hood:** Writing – review & editing, Investigation, Data curation. **Simon Potts:** Project administration, Funding acquisition. **Lena Schaller:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization.

Ethics statement

This study has been granted ethical approval by the Ethics Committee of the University of Natural Resources and Life Sciences, Vienna (*Reference Nr.: BOKU-2023/025*). It adheres to the principles of good research practice, including confidentiality, written informed consent queries, and anonymity of participants.

Declaration of competing interest

The authors Verena Scherfranz, Henning Schaak, Jochen Kantelhardt, Karl Reimand, Flaviu V. Bodea, Cristina Costache, Răzvan Popa, Reinier de Vries, David Kleijn, Aki Kadulin, Indrek Melts, Amelia S.C. Hood, Simon G Potts, and Lena Schaller report financial support was provided by the European Union's Horizon 2020 Research and Innovation Programme, as stated in the Acknowledgements. Besides, all authors declare that there are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Sources of Final Q-set

Topics of Q-set picked up from the following sources, shown in alphabetic order

Barnes et al. (2019, 2020); Bigelow et al. (2020); Burton and Paragahawewa (2011); Burton et al. (2008); Caldas et al. (2016); Chaplin et al. (2019); Coggan et al. (2022); Cusworth (2020); Dayer et al. (2018); de Snoo et al. (2013); Eichhorn et al. (2020); El Benni et al. (2021); European Union (2011); expert interviews; Gatto et al. (2019); Greiner et al. (2007); Grosjean and Kontoleon (2009); Ingram et al. (2013); Janssen et al. (2008); Jordbruksverket (2022); Kuhfuss et al. (2016); Lim and Wachenheim (2022); Lutter et al. (2019); Mack et al. (2019, 2020); Murphy et al. (2014); Pratt and Wallander (2022); pre-test; Race and Curtis (2009); Reimer and Prokopy (2014); Riley (2016); Ritzel et al. (2020); Scherfranz et al. (2024); Selinske et al. (2015, 2016); Stuart and Gillon (2013); Suske Consult, n.d.; Swann and Richards (2016); Vaske et al. (2021).

Appendix B. Description of Study Areas and Biodiversity Measures

i. Estonia (EE)

The Estonian study area is located in the Western and South-Western part of the country's mainland without islands, along the coastline of the Baltic Sea. The study area encompasses two landscape regions: the West-Estonian Lowland on limestone bedrock, and the Gulf of Livonia Coastal Lowland mainly lying on Devonian sandstones (Arold, 2005). Farming in this area is mainly characterized by crop and livestock farming, typically sized 143 ha (Aamisepp et al., 2023). In immediate proximity to the sea, traditional agricultural activity, i.e. low-intensity mowing or grazing, has created extensive coastal meadows, a form of semi-natural grasslands with high importance for preserving rare plant and animal species (Rannap et al., 2004; Lotman and Rannap, 2020). Yet, the abundance of semi-natural grasslands has decreased considerably all over Estonia in the last century, as a result of land use changes (e.g., Sammul et al., 2008). The investigated biodiversity measure in this study area targets the maintenance of these coastal meadows, as part of the Estonian agri-environmental program and processed and controlled by the Agricultural Registers and Information Board and the Environmental Board. As a pre-requisite for receiving land management support, farmers have to follow different requirements such as late mowing, extensive grazing, no seeding, no additional fertilizing, and attending special training course (Maaeluminister, 2022).

ii. Netherlands (NL)

The Dutch study area is located in South Limburg, the southern part of the Limburg province. It is characterized by a loess-covered, incised plateau landscape coming with plain terraces, steep and gentle slopes (van de Westeringh, 1980). Farmland is mainly used for arable crops and grassland, with an average farm size of 29 ha (Agrimatie, 2018). Natural context and traditional farm management resulted in a rich grassland biodiversity and scenic landscape, which are threatened by land use intensification (WallisDeVries et al., 2002). Similar to the Romanian study area, the investigated biodiversity measure targets the maintenance or restoration of extensive grassland, and is funded by the public agri-environmental program *Agricultural nature and landscape maintenance (ANLb)*. However, the program and its measure are locally administered by the farmers' collective *Naturrijk*

Limburg which is responsible for the provision of advice, monitoring and issuing of payments (Natuurrijk Limburg, 2022). To receive funding, farmers need to comply with requirements such as ban of chemical weed control, low grazing pressure and additional rest periods during which harvesting is strictly forbidden (Natuurrijk Limburg, 2024).

iii. Romania (RO)

The Romanian study area is located around the two cities of Cluj-Napoca and Sighişoara, in the South-Carpathian uplands of Northern and Central Romania. It is characterized by livestock farming and permanent grassland, managed by mixed farms with extensive grazing systems, low-intensity hay meadows, pastures, arable land and traditional orchards (Page et al., 2012). High nature value permanent grassland, associated with small-scale family farms, is particularly abundant in this region (Page and Popa, 2013; Page et al., 2012). Both intensification and abandonment are threatening these habitats (Page et al., 2012). The investigated biodiversity measure, as funded and administered by the public *Payments and Intervention Agency For Agriculture,* shall maintain and restore species-rich grassland. As requirements of this biodiversity measure, farmers need to delay mowing dates, limit the grazing pressure, and/or reduce the use of heavy machinery (MADR, 2022).

iv. United Kingdom (UK)

The UK study area is located in Southern England. The most common farm types are arable and livestock grazing (DEFRA, 2023b, 2023c). The average farm size is 76 ha, but more than 70% of the land is part of farms larger than 100 ha (DEFRA, 2023b, 2023c). Generally, the UK has become one of the most nature-depauperate countries globally, with farmland birds and small mammals decreasing by 58% and 29% since 1970 respectively (Burns et al., 2023). Farmland biodiversity is threatened mainly by intensification (Boatman et al., 2007). Providing both environmental and production benefits (Daryanto et al., 2018), the investigated biodiversity measure in this study area is winter cover cropping, as funded and administered by the governmental program *Countryside stewardship* and certain water companies. Farmers who oblige themselves to comply with specific management requirements are provided compensation payments. Requirements typically comprise a minimally disturbing planting of fast-growing species, and a good ground cover established as early as possible after the harvest and lasting as long as possible before the next crop (Rural Payments Agency and Natural England, 2022; Thames Water, 2023).

Appendix C. Factor loadings and flagged Q-sorts

Table C.1
Factor loadings and flagged Q-sorts (bold) of the five-factor-solution with split bipolar factors 3a/b. The ID of Q-sorts/farmers is composed of an abbreviation of the study area (RO = Romania, NL = Netherlands, UK = United Kingdom, EE = Estonia) and a randomized number.

	Factor loadings with flagged Q sorts					
	Factor					
Q-sort (Farmer)	1	2	3a	3b	4	5
RO-1	0.265	−0.164	***0.487***	−0.487	0.266	−0.165
RO-2	***0.644***	0.138	0.189	−0.189	0.058	0.020
RO-3	***0.602***	0.042	−0.247	0.247	0.186	−0.123
RO-4	0.070	−0.031	−0.693	***0.693***	0.194	−0.160
RO-5	***0.792***	0.035	−0.126	0.126	0.347	0.045
RO-6	0.073	−0.202	***0.572***	−0.572	0.233	0.010
RO-7	0.397	0.222	−0.167	0.167	0.301	−0.186
NL-1	0.045	***0.468***	−0.251	0.251	0.368	0.253
NL-2	0.018	***0.432***	0.114	−0.114	0.057	−0.097
NL-3	0.227	−0.091	−0.447	***0.447***	0.257	0.120
NL-4	0.197	0.268	−0.096	0.096	***0.566***	0.252
NL-5	0.091	0.450	0.585	−0.585	0.252	0.152
NL-6	−0.216	−0.076	0.124	−0.124	−0.069	***0.524***
NL-7	−0.230	0.059	0.030	−0.030	***0.612***	−0.004
NL-8	0.125	***0.696***	−0.093	0.093	0.031	0.073
NL-9	−0.097	0.060	−0.071	0.071	0.074	***0.524***
NL-10	0.040	***0.688***	−0.205	0.205	−0.079	0.247
UK-1	0.029	0.269	−0.018	0.018	***0.649***	0.376
UK-2	−0.111	0.307	***0.429***	−0.429	0.328	−0.122
UK-3	0.125	0.238	0.110	−0.110	***0.715***	−0.125
UK-4	0.141	0.509	0.289	−0.289	0.425	−0.205
UK-5	0.215	−0.066	−0.011	0.011	0.031	***0.497***
UK-6	0.290	−0.029	−0.135	0.135	***0.713***	0.035
UK-7	0.271	−0.030	0.213	−0.213	***0.689***	0.045
UK-8	0.290	0.129	0.231	−0.231	0.321	0.209
EE-1	0.371	−0.003	0.344	−0.344	***0.423***	0.345
EE-2	0.442	0.202	0.067	−0.067	0.359	0.513
EE-3	***0.466***	0.153	0.206	−0.206	0.253	0.197
EE-4	0.242	***0.468***	0.266	−0.266	−0.030	0.271
EE-5	***0.600***	0.319	0.283	−0.283	0.322	0.074
EE-6	***0.586***	−0.399	−0.058	0.058	−0.100	0.082
EE-7	0.076	***0.565***	0.033	−0.033	0.154	−0.281
EE-8	0.395	−0.174	0.164	−0.164	***0.611***	−0.111
EE-9	***0.806***	0.167	−0.028	0.028	−0.093	−0.102

Data availability

Data will be made available on request.

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