Journal of Rural Studies 108 (2024) 103282

Contents lists available at ScienceDirect

Journal of Rural Studies

journal homepage: www.elsevier.com/locate/jrurstud

Using a perception matrix to elicit farmers' perceptions towards stakeholders in the context of biodiversity-friendly farming

Verena Scherfranz[a,*], Katie Moon[b], Jochen Kantelhardt[a], Anneli Adler[c], Sílvia Barreiro[d], Flaviu Valentin Bodea[e], Vincent Bretagnolle[f,g], Viviane Brönnimann[h], Jan Peter Reinier de Vries[i], Alice Dos Santos[f], Maura Ganz[h], José M. Herrera[d,j], Amelia S.C. Hood[k], Friedrich Leisch[l], Alice L. Mauchline[k], Indrek Melts[m], Razvan Popa[e], Vanesa María Rivera Girón[d], Andy Ruck[c], Flóra Vajna[n], Elena Velado-Alonso[o], Lena Schaller[a]

[a] *University of Natural Resources and Life Sciences, Vienna, Department of Economics and Social Sciences, Institute of Agricultural and Forestry Economics, Feistmantelstraße 4, 1180 Wien, Austria*
[b] *School of Business, University of New South Wales, Canberra, ACT 2601, Australia*
[c] *Swedish University of Agricultural Sciences (SLU), Department of Crop Production Ecology, Ulls Väg 16, 75651 Uppsala, SWEDEN*
[d] *Instituto Mediterrâneo para a Agricultura, Ambiente e Desenvolvimento, Universidade de Évora, Pólo da Mitra Apartado 94, 7006-554 Évora, Portugal*
[e] *Universitatea Babeș Bolyai, Faculty of Biology and Geology, Str. Clinicilor 5-7, Cluj-Napoca 400006, Romania*
[f] *CEBC, CNRS & La Rochelle Université, 79360, Beauvoir sur Niort, France*
[g] *LTSER Zone Atelier „Plaine & Val de Sevre", Villiers en Bois, 79360, France*
[h] *Agroscope, Division of Agroecology and Environment, Reckenholzstrasse 191, 8046 Zürich, Switzerland*
[i] *Plant Ecology and Nature Conservation Group, Wageningen University, Droevendaalsesteeg 3a, 6708PB Wageningen, the Netherlands*
[j] *Departamento de Biología, Instituto de Investigación Vitivinícola y Agroalimentaria, Universidad de Cádiz, Puerto Real, Spain*
[k] *Centre for Agri-Environmental Research, School of Agriculture, Policy and Development, University of Reading, Earley Gate, PO Box 237, Reading, RG6 6AR, UK*
[l] *University of Natural Resources and Life Sciences, Vienna, Department of Landscape, Spatial and Infrastructure Sciences, Institute of Statistics, Peter-Jordan-Straße 82/I, 1190 Wien, Austria*
[m] *Estonian University of Life Sciences, Institute of Agricultural and Environmental Sciences, Fr.R. Kreutzwaldi 5, 51006 Tartu, Estonia*
[n] *Lendület Ecosystem Services Research Group, Institute of Ecology and Botany, HUN-REN Centre for Ecological Research, Alkotmány u. 2-4, H-2163 Vácrátót, Hungary*
[o] *Consejo Superior de Investigaciones Cientificas, Estación Biológica de Doñana, Av. Américo Vespucio 26, 41092 Sevilla, Spain*

ABSTRACT

Farmers' pro-environmental action is substantially influenced by various stakeholders from their business and social environment. Recent studies recommend actively involving influential stakeholders in agri-environmental initiatives, information or media campaigns. While it has been argued that farmers' perceptions towards these stakeholders can help inform effective involvement, comprehensive assessments of these perceptions remain scarce, particularly in the context of biodiversity-friendly farming. To understand and compare farmers' perceptions of these stakeholder quantitatively, we developed and applied a perception matrix. In an exploratory survey with 49 farmers across ten European countries, farmers rated twelve groups of stakeholders (e.g. government bodies, farm advisors and input suppliers) against eight perception constructs (e.g. trustworthiness, interest in protecting biodiversity). We found that perceptions differed significantly both between groups of stakeholders and between constructs. Whereas several stakeholders were, on average, perceived positively regarding their general characteristics, such as trustworthiness, reliability, understanding and support for farming, perceptions regarding their biodiversity-related behavior were significantly more negative. Our findings indicate potential to improve policy development and implementation of agri-environmental initiatives through the involvement of multiple, non-governmental, agricultural and non-agricultural stakeholders in biodiversity-friendly farming initiatives across the entire agri-food value chain. Such multi-stakeholder initiatives could help to not only reinforce biodiversity conservation action among the farming community, but across society as a whole as emphasized by the Convention on Biological Diversity. Further research is needed to confirm the observed trends on a larger, representative sample, for which the presented perception matrix is well suited.

* Corresponding author.
E-mail address: verena.scherfranz@boku.ac.at (V. Scherfranz).

https://doi.org/10.1016/j.jrurstud.2024.103282
Received 14 September 2023; Received in revised form 9 February 2024; Accepted 10 April 2024
Available online 6 May 2024
0743-0167/

1. Introduction

Farmers' pro-environmental farm management is key to achieving the European Unions' (EU) green transition as strategized in the European Green Deal and its Farm to Fork Strategy (European Commission, 2019). Farmers' engagement in pro-environmental farm management is substantially influenced by actors with whom they interact, such as up- and downstream industries, peers or extension agents (for a summary on these "stakeholders" see, e.g., David et al., 2022). Several studies suggest actively involving and partnering with influential stakeholders in agri-environmental programs or other public and private endeavors to more effectively target farmers and motivate their implementation of pro-environmental management practices (e.g.: Eanes et al., 2017; Stuart et al., 2018; Dessart et al., 2019; Marks and Boerngen, 2019). Yet, in identifying which stakeholders to involve, it is essential to not only reveal who might be considered the most influential stakeholders, but also how farmers perceive them.

Farmers' perceptions of stakeholders can provide insights into whom they like to collaborate with, prefer to take advice from, or trust (e.g.: Sutherland et al., 2013; Eanes et al., 2017; Stuart et al., 2018; Vrain and Lovett, 2020; Rust et al., 2022; Burbach et al., 2023). Looking, for example, only at existing interactions and relationships in a social network, in the absence of understanding perceptions, can therefore be misleading when involving stakeholders (Adams et al., 2018). To illustrate, stakeholders' high influence or centrality in conservation action might be explained by obligatory interactions with monopolistic buyers or government bodies rather than as a reflection of farmers' free choice or agency, preferences or expected benefits. This potentially limits the stakeholders' effectiveness in motivating pro-environmental action (Adams et al., 2018). Minor stakeholders who have low levels of influence but who are perceived positively might, in contrast, be overlooked (Adams et al., 2018). Additional to research on the interaction with, the use of information from, or trust in different stakeholders (e.g.: Mase et al., 2015; Eanes et al., 2017; Maas et al., 2021; Beethem et al., 2023), insights into farmers' perceptions are consequentially needed to understand why farmers value certain stakeholders over others, e.g. as business partners or information sources (e.g.: Stuart et al., 2018; Houser et al., 2019).

Insights into farmers' perceptions are particularly relevant in the context of biodiversity-friendly farming. Given the ongoing loss of biodiversity, stimulating conservation action at all societal levels is urgently needed (Convention on Biological Diversity, 2021, 2022). Recognizing that the same stakeholders might be perceived differently depending on whether farmers are thinking about pro-environmental or production actions (also see, e.g.: Eanes et al., 2017; Reimer et al., 2022; Rust et al., 2022), a more profound understanding of farmers' perceptions towards stakeholders regarding biodiversity-friendly farming has the potential to provide valuable insights for informing promoting action also in this context.

A few insights can be gleaned from studies that relate stakeholder perceptions to biodiversity-friendly farming, at least indirectly. Stuart et al. (2018), for example, assessed US midwestern farmers' views on sources informing their nitrogen management in crops. The authors found industry actors to be more relevant than public actors, such as government and academia, whom farmers perceived as generating and sharing less up-to-date information. Rust et al. (2022), looking at Hungarian and UK farmers, revealed a similar shift in preferences of sources informing sustainable soil management, with other farmers considered more important than public, institutionalized actors including researchers, given their empirical, practical, and local knowledge and easy understandability of advice. Generally, farmers in this study were found to place trust on sources whom they perceived as empathetic towards their needs (Rust et al., 2022). Vrain and Lovett (2020) assessed English farmers' perceptions towards sources delivering advice in the context of water pollution mitigation. They found that farmers are most positive about environmental farming initiatives and trusts who offer both information and financial support as well as independent advisors with specific expertise whom they perceive as knowledgeable, experience trust for and appreciate as providers of grants. In contrast, they held most negative perceptions towards an environmental NGO and market-related actors from water companies or salespeople providing information on nature conservation, water protection or their products, whom they distrusted and perceived as biased. Sutherland et al. (2013) investigated English farmers' trust in sources providing agri-environmental advice, finding that several farmers appreciated those whom they perceived as being neutral or on the farmers' side, which can be particularly challenging for environmental NGOs. Burbach et al. (2023) assessed farmers' perceptions towards agencies and actors involved in the management of two US watersheds, finding that perceived familiarity does not automatically result in, for example, higher trustworthiness.

To summarize, these studies uncovered a variety of positive and negative perceptions held by farmers regarding a vast range of conservation and agricultural stakeholders who can influence pro-environmental actions, also beyond "traditional experts" such as advisory services (Rust et al., 2022, p. 31). Yet, while the qualitative approaches amongst these studies, including open or semi-structured interviews (see, e.g.: Stuart et al., 2018; Rust et al., 2022; Sutherland et al., 2013), allow for in-depth insights into individuals' multi-faceted perspectives, they impede comparability between views on stakeholders as well as between views of individual respondents (Moon et al., 2017). Similarly, word clouds, as used by Vrain and Lovett (2020) to visualize qualitative data, do facilitate graphical, albeit not statistical comparisons. Quantitative approaches, including surveys applying ordinal or Likert scales (e.g.: Houser et al., 2019; Burbach et al., 2023) make data fully comparable and reduce cost and time requirements. Yet, quantitative approaches can be difficult to use in ways that allow respondents to consider perceptions in relation with each other (Moon et al., 2017). Additionally, research so far is limited in geographical, agronomic or institutional scope: studies mostly focus on only one or few agricultural regions, specific farm types or specific stakeholders, such as public agencies, extension, or research bodies. Furthermore, we have not been able to identify studies explicitly focusing on perceptions of stakeholders with respect to biodiversity-friendly farming, aiming to conserve species and habitats.

Based on setting up a *both* comprehensive and comparative assessment, our study aims to answer the following research question: which perceptions do farmers hold towards diverse stakeholders from their business or social environment in the context of biodiversity-friendly farming and how do perceptions differ between these stakeholders? We used an exploratory, multi-national survey with farmers across study areas in ten European countries. Accounting for the unfavorable conservation status or tendencies occurring for habitats and species across the entire EU (European Environment Agency, 2020), we aimed to gain insights into overall perception trends and patterns in farmer-stakeholder interactions to reveal shared opportunities and challenges for stakeholder involvement within diverse socio-geographical contexts.

The main contributions of this paper are twofold. First, the findings of our trans-European study can contribute to the strategic involvement of stakeholders within agri-environmental programs or other initiatives, such as the Common Agricultural Policy of the European Union. Second, we present Perception Matrices (in the following denoted as "PMs", Moon et al., 2017) as an innovative approach for assessing and improving our understanding of perceptions towards stakeholders from the perspective of farmers operating in different contexts, speaking different languages, and having different socio-demographic backgrounds. To the best of our knowledge, PMs have so far not been applied in agri-environmental research to elicit farmers' views on stakeholders. Yet, PMs are a promising tool in this field of research. By allowing quantitative ratings of numerous stakeholders against numerous perception statements at once, PMs not only enable the elicitation of multi-faceted views, but also allow for inter- and intra-individual comparison of perceptions ratings that can be related with each other (Moon et al., 2017).

The remainder of this paper is structured as follows. In Section 2, we present the methodological framework, briefly outlining the genesis of PMs, then describing their practical implementation and our data collection and analysis. The final PM as well as the associated results are presented in Section 3. In Section 4, we discuss both the findings and potential policy implications, as well as the methodological approach to facilitate further application of PMs in similar research settings. In Section 5, we draw final conclusions and point to opportunities for further research.

2. Methods

2.1. Methodological background

PMs are an adaptation from the Repertory Grid Test (RGT), a qualitative instrument with quantitative traits developed for clinical psychology by George Kelly (Moon et al., 2017; Kelly, 1955). Moon et al. (2017) formally re-defined RGTs as a quantitative tool and introduced it as "PMs" into the field of environmental research. In an exploratory study, the authors assessed and compared scientists' and policy makers' perceptions towards various groups of stakeholders in the context of fox eradication in Australia.

To complete a PM or an RGT, interviewees are asked to rate columns, comprising persons or objects ("elements" E_e), against rows, comprising bi-polar, contrasting pairs of perception statements ("constructs" C_c^- respectively C_c^+; see Fig. 1). These statements are worded as quantitative rating scales. To illustrate: elements $E_{A \ldots C}$ could be father, mother and best friend, which are rated against constructs such as open-minded (C_1^+) versus narrow-minded (C_1^-), discreet (C_2^+) versus indiscreet (C_2^-).

In RGTs, elements and constructs are originally defined by the interviewees themselves (Kelly, 1955; Jankowicz, 2004; Moon et al., 2017). RGTs therefore allow for a reflection of highly personal views, since each interviewee creates and rates their own matrix. In contrast, in PMs, both elements and constructs are supplied by the researchers

	E_A	E_B	…	E_e	
C_1^-	[1…5]	[1…5]	[1…5]	[1…5]	C_1^+
C_2^-	[1…5]	[1…5]	[1…5]	[1…5]	C_2^+
…	[1…5]	[1…5]	[1…5]	[1…5]	…
C_c^-	[1…5]	[1…5]	[1…5]	[1…5]	C_c^+

Fig. 1. Model of a Perception Matrix or RGT with E_e elements to be rated against bipolar constructs C_c^- and C_c^+, worded as 5-point scales [1 … 5] in this case.

(Moon et al., 2017). While RTGs are applied within constructivist framings, PMs are used within objectivist framings (Moon et al., 2017; Moon and Blackman, 2014). Applying a PM in practice, all interviewees complete the same standardized matrix, making it suited to provide comparable data between interviewees (Moon et al., 2017). Our study, addressing the need to better understand perceptions of farmers operating in different contexts, speaking different languages, and having different socio-demographic backgrounds, is therefore centered around the development, and based on the application of a PM. Since RGTs provide the methodological foundation of PMs in general, and were used to inform the PM design through a farmers' pre-survey in this specific study (see Section 2.2), we will, in the following, briefly present this method.

RGTs were originally introduced as a tool to assess individuals' construing of the world, i.e. the personal reality rather than the objective reality, which both are deemed to exist (Kelly, 1955). According to Kelly (1955)'s constructionist perspective, individuals apply constantly adjusted patterns or templates ("constructs") to perceive, interpret, predict and control events such as other people and their behavior ("elements" or "figures"). Within this constructionist framework, meaning of the reality is assumed to be constructed through an interplay of the individual and their external reality (Moon and Blackman, 2014). Both elements E and constructs C differ between individuals, since they anticipate different events or use different approaches to anticipate the same events (Kelly, 1955). Lastly, the structure individuals erect, i.e. their "own alternative approaches to reality" (Kelly, 1955, p. 12), is argued to determine their behavior (Kelly, 1955). RGTs have been adapted from the field of psychology and have been, since then, applied in various fields, ranging from business and marketing (Rogers and Ryals, 2007) to research in tourism (e.g. Mak et al., 2013) or energy policy (e.g. Sühlsen and Hisschemöller, 2014). In agricultural sciences, RGTs find application in assessing, for example, Kenyan farmers' perceptions of seed potato (Atieno et al., 2023), Ugandan farmers' perceptions towards sources of banana planting materials (Kilwinger et al., 2020) or Australian sheep farmers' perceptions towards new approaches in parasite control (Thompson, 2009). Durgun et al. (2020) adapted RGTs to assess how small-scale fishers rank the importance of various information sources in Turkey.

2.2. Practical implementation: pre-surveys including RGT and setting up of the PM

To set up the standardized PM and provide both elements and constructs, we applied a multi-disciplinary, multi-national approach (Fig. 2,

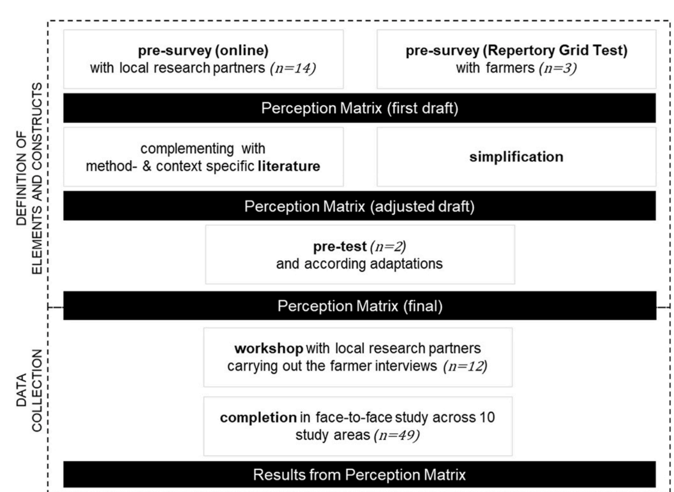

Fig. 2. Stepwise methodological approach to assess farmers' perceptions as applied in this study.

upper part). In a first step, two pre-surveys were conducted to gather a variety of elements and constructs relevant to farmers in the study areas, while not aiming to collect *perception ratings*: To ensure local relevance, a **pre-survey** with the 14 local research partners situated in the study areas was carried out online. They were asked to list stakeholders potentially influential in the biodiversity-related decision-making of farmers in their region and name perceptions these farmers are likely to have about them. To ensure practical relevance of the PM, a **parallel pre-survey with farmers** (n = 3) was conducted. In this pre-survey, RGTs were applied, through which farmers were guided to uncover both personally-relevant stakeholders and corresponding perceptions they hold about them in the context of their biodiversity-friendly farming. The RGTs followed the procedure recommended by Jankowicz (2004). Both online survey and RGTs took place in July and August 2021.

Stakeholders (elements) and perception statements (constructs) collected through the pre-surveys were merged into a first draft, abstracted and cleared for redundancies. To illustrate: farmers' elicited constructs "*I trust them vs. I do not trust them" and "they act in a way advantageous for my farm vs. they only want to impose their own interests"* were both expressed to describe stakeholders' general trustworthiness. Farmers' constructs "*they may and want [protect biodiversity] vs. they are politically restrained [to protect biodiversity]*" and "*they stir up opinion vs. they are neutral [about biodiversity]*" both relate to perceived objectiveness about biodiversity. The resulting constructs were re-worded to define scales with contrasting, bipolar negative (1-point) and positive (5-point) ends, such as "*not trustworthy vs. trustworthy*" and "*not objective about biodiversity vs. objective about biodiversity*" (also see Moon et al., 2017). In this design, a rating of 3 represents the neutral middle. Elements named only once or being highly specific to countries or study areas were omitted.

Based on several feedback loops between the core authors, the first draft was compared with scientific literature (Eanes et al., 2017; Stuart et al., 2018; Bakker et al., 2021; Maas et al., 2021; Rust et al., 2022) and simplified to ensure practicability in the subsequent farmer interviews. This process included reducing the number of elements and constructs, such as environmental NGOs left unmentioned during the farmers' pre-survey, as well as checking for unclear wording, imprecise bipolarity and double-barreled (Sullivan and Artino, 2017) constructs. Where possible, elements were worded in a way that addresses farmers' personal experience with stakeholders (e.g. "*My* fertilizer suppliers") to make the rating task more meaningful to the farmers. To reduce the risk of halo effects and judgements being anchored to more general impressions (Thorndike, 1920), we adapted the order of constructs: Those referring to stakeholders' general behavior (e.g. their trustworthiness) were positioned at the bottom of the matrix. Those specifically referring to stakeholders' biodiversity-related behavior (e.g. their objectiveness about biodiversity) were positioned on the top. Based on a pre-test with students of agricultural sciences ($n = 2$), minor revisions resulted in the final PM.

To guarantee uniform data collection by the multiple local research partners in the study areas, the PM was embedded in an extensive interview guideline. The interview guideline included, inter alia,[1] a detailed instruction comprising potential introduction phrases (see Supplementary Data 1) as well as socio-demographic and management-specific questions to describe the sample. As a final step, the interview guideline and the matrix were explained to the local research partners in an online workshop. The workshop was recorded, giving the local research partners the possibility to look up details at a later point in time. Additionally, a self-cast video of an exemplary interviewing process with the designed PM as well as an exemplarily filled-in model PM were provided. Before interviewing, the local research partners translated the PM into their local languages.

2.3. Data collection

The farmer interviews were conducted as part of the EU Horizon 2020 research project SHOWCASE. Interviews took place in autumn/winter 2021/2022 in study areas of 10 European countries (Fig. 2, lower part): Switzerland (CH), Estonia (EE), Spain (ES), France (FR), Hungary (HU), the Netherlands (NL), Portugal (PT), Romania (RO), Sweden (SE) and the United Kingdom (UK). Study areas had been designated within the research project because of facing substantial threats for farmland biodiversity through land use changes, i.e. abandonment, intensification or both. For an overview of the study areas, see Supplementary Data 2.

Given the high heterogeneity of farming operators across the study areas, "farmers" were defined as persons who take decisions about what management is implemented on the farms. To reduce the likelihood of unreliable data potentially provided by interviewees with little understanding of the overall concept of biodiversity and thus indistinct perceptions on the topic, the local research partners applied convenience sampling within their institutional networks (similar to Stuart et al., 2018). This approach accounted for low acquaintance with the term "biodiversity", with 59% of EU-28 citizens having never heard of it or not knowing what it means (European Union, 2018).

Considering individual ranges of convenience (Kelly, 1955), defined as the elements for which the application of a construct is perceived as relevant, interviewees could omit ratings of specific $c \times e$ intersects. If farmers perceived elements entirely irrelevant on the topic, for example producer organizations (E_E) in the event that the interviewee is not part of one, they could delete them from the matrix.

2.4. Data analysis

Data originating from the farmer interviews was analyzed in R version 4.1.2. Similar to Moon et al. (2017), we created an *Average Matrix* across the sample of all study areas. It displays arithmetic means $\bar{x}$ and, additionally, corresponding standard errors *se* of ratings per $c \times e$ intersect. Since certain elicited constructs referred to more general characteristics of stakeholders while others more specifically referred to their biodiversity-related behavior, constructs were additionally grouped: biodiversity-related constructs comprise $C_{1 \ldots 4}$, while general constructs comprise $C_{5 \ldots 8}$ (Fig. 3-I).

To detect if farmers' ratings significantly differed between stakeholders, we computed Friedman tests. Friedman tests compare dependent data between multiple groups (Field et al., 2012). Dependent, within-subject character of data originates from each farmer assigning ratings to several stakeholders. Stakeholders were compared by their

[1] Being part of a major interview from an EU Horizon 2020 research project, several other questions on biodiversity management were included (Schaller et al., 2022). However, since they are not related to farmers' perceptions of their business or social environment, they are not presented here.

Table 1
Sample description overall and by study area (as described in 2.3 and Supplymentary Data 2, named after the country they are located in) considering farm characteristics. For reasons of anonymization, farm characteristics described in one position (e.g. first for all categories) do not refer to one and the same farm (to illustrate: participant 1 in EE does not necessarily operate a small conventional livestock farm). Mean and sd of farm size are rounded to the nearest integer. *3 Participants indicated to farm both conventional and organic & transition land. Label for organic production as introduced by Commission Regulation (EU) 271/2010.

study area	n	farm size [categories]	farm size [ha; mean±sd]	farm management	farm type	age	agricultural education
over-all	49	17 sized <100 ha 24 sized 100-499 ha 8 sized ≥500 ha	440±1232	26 conventional 20 organic & transition 3 conventional and organic & transition*	14 arable 6 livestock 7 orchards M 22 mixed	< 9 aged younger than 40 years > 40 aged 40 years and older	14 university degree 35 other education
CH	5	<100, <100, <100, <100, <100	29±5	conventional, conventional, conventional, conventional, conventional	arable M M M M	< > > > >	university, other, other, other, other
EE	5	<100, 100-499, 100-499, ≥500, ≥500	327±222	conventional, organic, organic, organic, organic	livestock M M M M	< > > > >	university, university, university, other, other
ES	5	<100, <100, 100-499, 100-499, ≥500	311±405	conventional, conventional, conventional, organic, organic	orchard orchard orchard orchard M	> > > > >	university, university, university, other, other
FR	4	100-499, 100-499, 100-499, 100-499	176±51	conventional, conventional, organic, organic	arable arable arable arable	> > > >	other, other, other, other
HU	5	<100, 100-499, 100-499, 100-499, 100-499	164±123	conventional, conventional, conventional, organic, organic	livestock livestock M M M	> > > > >	university, other, other, other, other
NL	5	<100, <100, <100, <100, 100-499	81±59	conventional, conventional, conventional, conventional, organic	arable arable arable M M	< < < > >	university, other, other, other, other
PT	5	100-499, 100-499, 100-499, ≥500, ≥500	2275±3561	conventional, conventional, organic, organic, conventional and organic	orchard orchard orchard M M	< > > > >	university, university, other, other, other
RO	5	<100, <100, <100, 100-499, 100-499	83±59	conventional, conventional, organic, organic, organic	arable livestock livestock livestock M	< > > > >	university, other, other, other, other
SE	5	<100, 100-499, 100-499, 100-499, 100-499	195±85	conventional, organic, organic, organic, conventional and organic	arable M M M M	< > > > >	other, other, other, other, other
UK	5	<100, <100, ≥500, ≥500, ≥500	706±415	conventional, conventional, conventional, organic, conventional and organic	arable arable arable arable M	< > > > >	university, university, other, other, other

biodiversity-related ($C_{1 \ldots 4}$), respectively general ($C_{5 \ldots 8}$) ratings that were averaged.[2] The test statistic X^2 was corrected for ties, meaning average perception ratings occurring more than once. To detect if farmers assigned significantly different ratings on one stakeholders' biodiversity-related and general constructs, we conducted paired, i.e. dependent-means t-tests (Field et al., 2012). Interviewees' ratings were, as above, averaged for biodiversity-related ($C_{1 \ldots 4}$) and general statements ($C_{5 \ldots 8}$) and tests were run for each stakeholder separately. To adjust p-values originating from multiple comparisons, we applied the Holm (1979) method.

Across analyses, single farmer ratings deviant from the instruction were treated as follows: Farmer ratings representing a range (e.g. "2–5") rather than a single value were averaged (e.g. "3.5"). This approach is deemed to be suitable since ratings were intended to represent average perceptions which farmers have about the stakeholders in their environment. Farmer ratings representing a decimal number (e.g. "1.5") rather than an integer were included as such to not over- or underestimate their perceptions through rounding up or down.

3. Results

The PM was filled in by 49 farmers, in the following named "participants". The sample is described in Table 1, distinguishing by study areas and farm characteristics. Due to the convenience sampling of farmers acquainted with biodiversity-friendly farming, the sample is biased towards organic farm management[3] and large-scaled[4] farm operations, as well as young[5] farmers with high education[6].

The final PM, resulting from the multi-national, multi-disciplinary approach, includes twelve elements and eight constructs. Accordingly, a fully completed matrix could result in up to 96 (12 × 8) ratings per participant. Elements (Fig. 3-I: column names) comprise stakeholder groups E_e (with $e = A \ldots L$) including institutional, market and societal actors including other farmers, where applicable worded as personal contacts (e.g. "My fertilizer suppliers"). Constructs (Fig. 3-I: row names) comprise perception statements C_c (with $c = 1 \ldots 8$) relating to biodiversity-related ($C_{1\ldots4}$) and general ($C_{5\ldots8}$) characteristics of stakeholders and their behavior.

Participants' average ratings pointed to clear extremes (Fig. 3-III). While researchers (E_B) were overall perceived most positively (3.81 ±0.05[7]; Fig. 3-III), government bodies were perceived most negatively (2.54 ± 0.05; Fig. 3-III). It is noted, however, that interviews were conducted by researchers, which might introduce bias (see Section 4). Despite distinct overall perceptions, the PM did reveal nuance, indicating that stakeholders are viewed in a multi-faceted way with characteristics identified as both potentially limiting but also motivating with respect to collaboration, use of information, and trust. To illustrate,

[2] We did not include ratings in statistical testing in case a farmer rated a stakeholder against only *one* out the four biodiversity-related and/or general constructs or did not rate a stakeholder at all.

[3] Share of agricultural holdings in transition, fully or partially organic in EU in 2020: 3.6% (Eurostat, 2024).

[4] Mean size of an agricultural holding in EU-27, 2020: 17.4 ha (Eurostat, 2022a).

[5] Share of farmers aged less than 40 years in EU, 2020: 11.9% (Eurostat, 2022b).

[6] Share of farmers with full agricultural education in EU, 2020 (including, but not limited to university education): 10.2% (Eurostat, 2022b).

[7] arithmetic means ± standard error ($\bar{x} \pm se$).

participants acknowledged researchers' (E_B) reliability (C_8), trustworthiness (C_6) and their biodiversity-related behavior ($C_{1 \ldots 4}$). Yet, several participants felt that researchers have limited understanding of farmers' reality (C_5). This construct was rated positively (>3) by only 17 (35%) participants (for frequency counts and ratios of single element-construct intersections see Supplementary Data 3, Table I). Not all participants provided perception data on all construct-stakeholder combinations, given individual ranges of convenience. Ratios are therefore calculated referring to the sum of participants who provided data on the respective construct-stakeholder combination. In this case, all 49 participants rated EB against C5, out of which 17 ratings were >3, i.e. 35%. Additionally, numerous participants were relatively skeptical about researchers' support for future-proof farming (C_7), rated positively (>3) by only 26 (55%) participants. This data suggests that researchers, while scoring high on some constructs, were not perceived as being sufficiently aware of the practicalities of farming.

With respect to government bodies (E_A), participants on average displayed slightly negative perceptions across all constructs. Most distinctly, participants did not perceive that government bodies were objective (C_3) nor that they treat them like partners (C_4) in the context of biodiversity. In terms of government bodies' general behavior, participants particularly doubted their understanding of farmers' reality (C_5), rated negatively (<3) by 30 (63%) participants, as well as their medium- and long-term reliability (C_8). Still, government bodies were in the midfield regarding their perceived theoretical (C_1) and practical (C_2) endeavors for protecting biodiversity, suggesting that participants acknowledge their pro-environmental action compared to other stakeholders, while deeming it as insufficient.

While confirming that participants' perceptions across study areas were unique for certain stakeholders, statistical testing suggests that others shared a similar reputation amongst participants (Fig. 4). Researchers' (E_B) biodiversity-related behavior ($C_{1 \ldots 4}$), for example, significantly distinguished them from several other stakeholders, such as government bodies (E_A), farm advisors (E_C), peer farmers (E_D), farm input suppliers ($E_{F \ldots H}$) and people in general (E_K; see Fig. 4). As mentioned above, researchers stood out through a particularly high esteem towards their dealings with biodiversity. In contrast, it was mainly due to their general characteristics ($C_{5 \ldots 8}$; see Fig. 4) that participants rated government bodies (E_A) and people in general (E_K) significantly differently than most other stakeholders. Ratings relating to these stakeholders were among the lowest with regards to their understanding of farming, their trustworthiness, support for future-proof farming, and reliability ($E_A C_{5 \ldots 8}$: 2.45 ± 0.07, respectively $E_K C_{5 \ldots 8}$: 2.90 ± 0.08; see Fig. 3-III). Similarities were, for example, further observed for farm input suppliers ($E_{F \ldots H}$) on the one hand and production-related stakeholders ($E_{C \ldots E}$) as well as the social environment (E_L) on the other hand. Even if participants did rate them in slightly different ways with, for example, crop protection suppliers being rated more negatively regarding their trustworthiness ($E_G C_6$: 2.97 ± 0.22; see Fig. 3-I), differences were not significant, indicitating that participants viewed them in relatively homogenous ways. Accordingly, these stakeholder groups might come with similar effects when being involved in biodiversity-friendly farming initiatives.

Statistical analysis (Fig. 5) further demonstrated that across most stakeholders that were, on average, perceived positively regarding their general characteristics ($C_{5 \ldots 8}$), participants were significantly more skeptical about their biodiversity-related behavior ($C_{1 \ldots 4}$). Differences were most noteworthy for stakeholders closely related to agricultural production, including advisors, other farmers and producer organizations, as well as farm input suppliers ($E_{C \ldots H}$) with $P_{adjust} < 0.01$. Only government bodies (E_A) and researchers (E_B) were more positively perceived for their biodiversity-related behavior than for their general characteristics. Even if this observation is significant only for researchers, it indicates the relative strong point in their reputation in the context of biodiversity-friendly farming.

Looking at differences between these construct ratings in more detail (Fig. 3-I, II), participants' low average ratings on stakeholders' biodiversity-related behavior was particularly driven by a perceived lack of responsibility for biodiversity (C_2). These perceptions extended to peer farmers themselves, as a stakeholder group (2.86 ± 0.12, Fig. 3-I). To illustrate, only 133 out of 525[8] ratings (25%) were positive (>3) when asked if stakeholders take responsibility with regards to biodiversity (for frequency counts and ratios of ratings across stakeholders see Supplementary Data 3, Table II). This observation was most distinct for upstream stakeholders ($E_{F \ldots H}$). Only 6 participants (17%) assigned positive ratings (>3) to, for example, crop protection suppliers (E_G).

Interestingly, participants were more likely to acknowledge stakeholders' goal to protect biodiversity than their efforts to take on responsibility, indicating that they are perceived to seek biodiversity protection, but not necessarily act in a way that secures biodiversity outcomes (C_1: 3.04 ± 0.05 versus C_2: 2.78 ± 0.05; Fig. 3-II). For downstream stakeholders ($E_{I,J}$), we identified a particularly distinct gap between these constructs. To illustrate, direct buyers (E_J) received 21 positive ratings (58%) on having biodiversity as a goal (C_1) but only 8 positive ratings (22%) on taking on responsibility (C_2).

Despite participants' relatively negative perceptions regarding stakeholders' biodiversity-related behavior, they felt that most of their business and social environment helps them to keep on farming. A majority of positive (>3) ratings (262 out of 501, 52%) indicated that stakeholders are perceived as supporting them to farm in a future-proof way (C_7). Only 77 ratings (15%) were lower, i.e. closer to the pole of perceived hindrance. On average, participants indicated that only government bodies (E_A) rather hindered them to farm in a future-proof way; from 48 ratings, 20 (42%) ratings were negative (<3).

Participants were, however, more critical about the understanding stakeholders display for farming (C_5). Importantly, participants appeared to not feel understood by society, including direct buyers or people in general, as well as government bodies ($E_{A,J,K}$). In contrast, farm input suppliers ($E_{F \ldots H}$), while perceived in negative terms for their biodiversity-related behavior, were relatively highly appreciated for their practical understanding in comparison with several other stakeholders.

[8] Due to stakeholders/constructs not being relevant to single farmers, there are fewer than the maximum number of ratings for this elements-construct intersection (in this case: 12 stakeholders rated against C_2 by 49 farmers hypothetically provides up to 588 ratings).

I

	1-point end (negative pole)	E_A government: Government (national and local)	E_B researchers: Researchers	E_C advisors: Agricultural farm advisors	E_D farmers: Other farmers	E_E producer organization: My producer organization(s)	E_F fertilizer suppl.: My fertilizer supplier(s)	E_G crop protection suppl.: My crop protection supplier(s)	E_H machinery suppl.: My agricultural machinery supplier(s)	E_I bulk buyers: Buyer(s) of my products (not end-consumers)	E_J direct buyers: Direct buyers of my products (end-consumers)	E_K people general: People in general	E_L people soc.env.: People in my social environment	5-point end (positive pole)
biodiversity-related statements C_1	biodiversity protection in agriculture is not their goal at all	2.94 (0.15)	4.22 (0.12)	3.14 (0.16)	2.83 (0.15)	3.15 (0.20)	2.16 (0.22)	2.13 (0.20)	2.13 (0.17)	3.30 (0.18)	3.63 (0.18)	2.99 (0.15)	3.55 (0.15)	biodiversity protection in agriculture is one of their major goals
biodiversity-related statements C_2	doesn't/don't take on responsibility with regards to biodiversity	2.72 (0.15)	3.79 (0.15)	2.90 (0.16)	2.86 (0.12)	3.12 (0.18)	2.13 (0.19)	2.21 (0.22)	1.97 (0.17)	2.65 (0.18)	2.86 (0.17)	2.56 (0.13)	3.26 (0.14)	takes(s) on responsibility with regards to biodiversity
biodiversity-related statements C_3	isn't/aren't objective about biodiversity	2.49 (0.17)	3.96 (0.12)	3.02 (0.18)	2.76 (0.14)	3.16 (0.19)	2.53 (0.22)	2.50 (0.22)	2.47 (0.20)	3.00 (0.20)	3.11 (0.20)	2.50 (0.16)	3.27 (0.15)	is/are objective about biodiversity
biodiversity-related statements C_4	doesn't/don't treat me as a partner with regards to biodiversity	2.36 (0.16)	3.80 (0.14)	3.30 (0.16)	3.06 (0.16)	3.51 (0.20)	2.58 (0.22)	2.64 (0.23)	2.27 (0.18)	2.85 (0.20)	3.24 (0.21)	2.91 (0.17)	3.54 (0.16)	treat(s) me as a partner with regards to biodiversity
general statements C_5	doesn't/don't understand farmers' reality	2.20 (0.14)	3.13 (0.13)	3.93 (0.12)	4.31 (0.14)	3.87 (0.17)	3.49 (0.19)	3.44 (0.21)	3.53 (0.17)	3.02 (0.17)	2.89 (0.20)	2.41 (0.16)	3.41 (0.16)	understand(s) farmers' reality
general statements C_6	isn't/aren't trustwothy	2.59 (0.14)	3.96 (0.15)	3.65 (0.14)	3.57 (0.15)	3.75 (0.16)	3.13 (0.20)	2.97 (0.22)	3.27 (0.17)	3.26 (0.15)	3.41 (0.19)	3.04 (0.14)	3.91 (0.14)	is/are trustworthy
general statements C_7	hinder(s) me from farming in a future-proof way	2.71 (0.14)	3.68 (0.14)	3.82 (0.14)	3.71 (0.15)	4.09 (0.13)	3.66 (0.21)	3.58 (0.18)	3.55 (0.16)	3.55 (0.16)	3.55 (0.19)	3.14 (0.15)	3.86 (0.15)	enable(s) me to farm in a future-proof way
general statements C_8	isn't/aren't reliable with regards to their medium- and/or long-term behavior	2.31 (0.15)	3.98 (0.11)	3.75 (0.12)	3.69 (0.12)	3.82 (0.13)	3.34 (0.20)	3.15 (0.20)	3.14 (0.17)	3.01 (0.14)	3.25 (0.18)	3.04 (0.13)	3.79 (0.16)	is/are reliable with regards to their medium- and/or long-term behavior

II

	Ratings by constructs (across elements)
C_1	3.04 (0.05)
C_2	2.78 (0.05)
C_3	2.91 (0.05)
C_4	3.02 (0.06)
C_5	3.29 (0.05)
C_6	3.39 (0.05)
C_7	3.56 (0.05)
C_8	3.36 (0.05)

III

Ratings by elements (across constructs)	E_A	E_B	E_C	E_D	E_E	E_F	E_G	E_H	E_I	E_J	E_K	E_L
biodiv $C_{1...4}$	2.63 (0.08)	3.94 (0.07)	3.09 (0.08)	2.88 (0.07)	3.23 (0.10)	2.34 (0.10)	2.37 (0.11)	2.21 (0.09)	2.95 (0.10)	3.21 (0.10)	2.74 (0.08)	3.41 (0.08)
general $C_{5...8}$	2.45 (0.07)	3.68 (0.07)	3.78 (0.06)	3.82 (0.07)	3.88 (0.07)	3.40 (0.10)	3.29 (0.10)	3.38 (0.08)	3.20 (0.08)	3.27 (0.09)	2.90 (0.08)	3.74 (0.08)
overall $C_{1...8}$	2.54 (0.05)	3.81 (0.05)	3.44 (0.06)	3.35 (0.06)	3.55 (0.06)	2.86 (0.08)	2.82 (0.08)	2.79 (0.07)	3.08 (0.06)	3.24 (0.07)	2.82 (0.05)	3.57 (0.05)

Fig. 3. **(I)** Average matrix on arithmetic means $\bar{x}$ and standard error *se* of each $c \times e$ rating across the sample. **(II)** Average ratings ($\bar{x}$ and *se*) by constructs, across elements. **(III)** Average ratings ($\bar{x}$ and *se*) by stakeholders, across constructs and groups of constructs. Like in Bertin's (1974) displays, as cited in Heckmann (2022) for RGTs, darker shading indicates higher average ratings, lighter shading indicates lower average ratings. Shading is done in 0.5 increments. For more details on ratings, including number of ratings considered in calculating averages, see Supplementary Data 3.

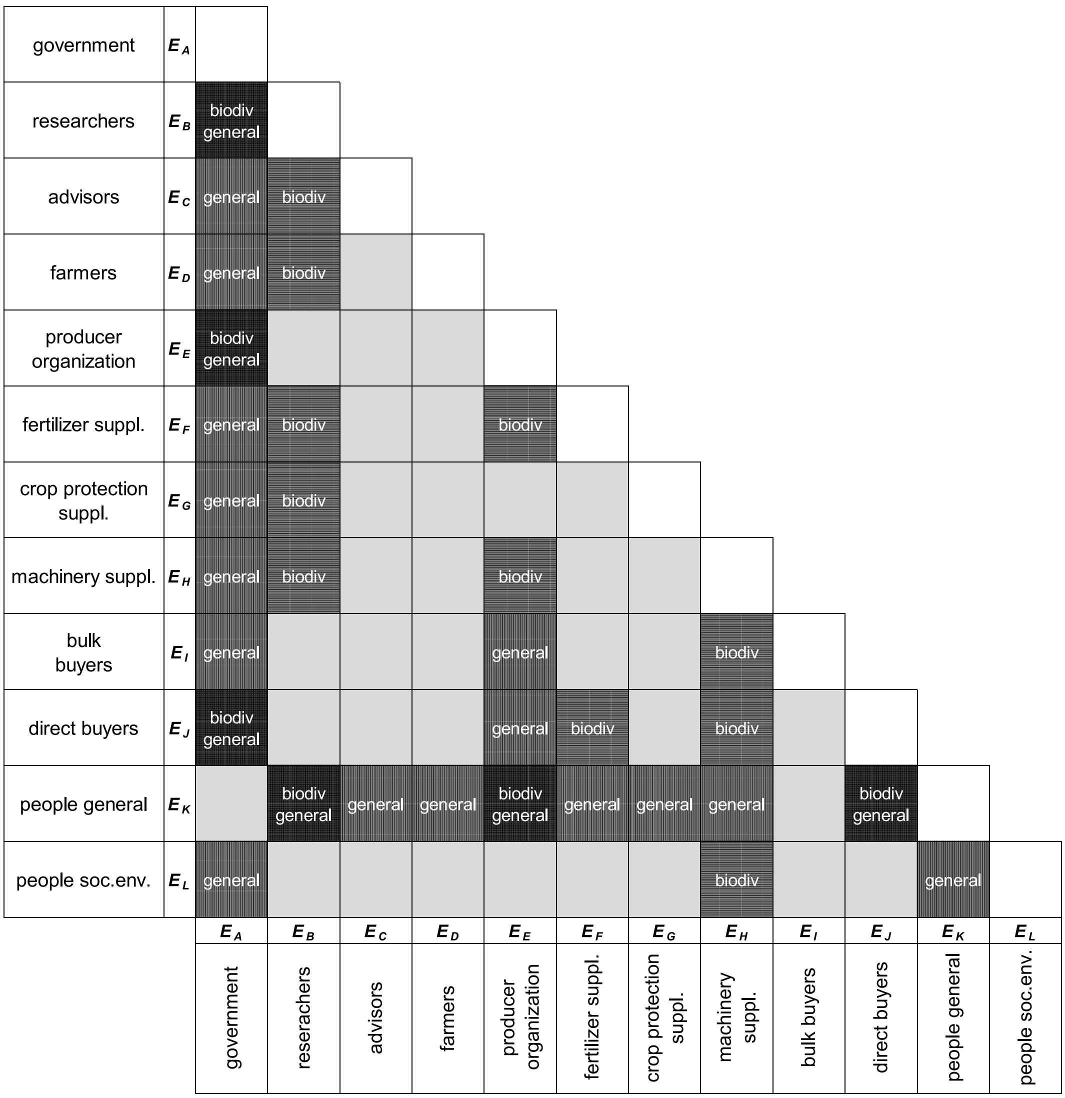

Fig. 4. parison of stakeholders indicating for which group(s) of constructs (with “biodiv” referring to $C_{1 \ldots 4}$, “general” referring to $C_{5 \ldots 8}$) perception ratings differ significantly ($P_{adjust} < 0.1$ as computed by Friedman tests). Horizontal stripes indicate that the corresponding stakeholders are perceived significantly differently regarding biodiversity-related constructs; vertical stripes indicate that the corresponding stakeholders are perceived significantly differently regarding general constructs; light grey shading indicates that significant differences were not observed for any group of constructs.

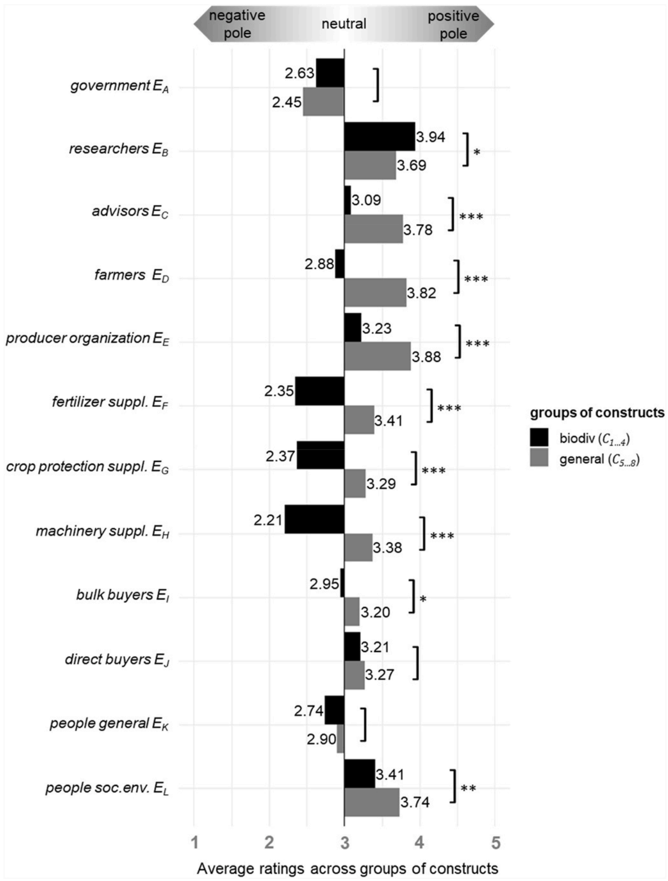

Fig. 5. *Stakeholder-wise comparison of averaged biodiversity-related constructs (biodiv, $C_{1...4}$) versus averaged general constructs (general, $C_{5...8}$) as presented in Fig. 3-III; ratings are presented relative to the neutral middle of 3. Significance of difference is indicated by* $^{***}P_{adjust} < 0.01$, $^{**}P_{adjust} < 0.05$, $^{*}P_{adjust} < 0.1$ *as computed through pairwise t-tests.*

4. Discussion

Aiming to inform the strategic design of potentially more effective biodiversity-friendly farming policies and campaigns, this study complemented previous research on how stakeholders from farmers' social and business environment *influence* their biodiversity-friendly farming through eliciting how farmers *perceive* these actors. To this end, we developed and administered a PM in an exploratory study with farmers across 10 European countries to capture perception trends and patterns from a trans-European perspective. In the following, we discuss key findings on the perception ratings, point to strengths and weaknesses of our approach, and highlight policy implications. For interpretation, the convenience sampling approach as well as resulting biases as outlined above need to be considered. Accounting for its exploratory nature, this study, however, aimed to capture and compare insights into perceptions of farmers across study areas and demonstrate the methodological value of PMs, while not aiming for representativeness.

4.1. Key findings

Participants held particularly negative perceptions towards government bodies in the context of biodiversity-friendly farming, wishing they had more profound insights into farmers' reality and followed a more reliable policy position. Empirical evidence from previous studies, such as evaluations of various agri-environmental programs, confirms challenging interactions between farmers and government bodies: In Hungary, for example, experts assumed that farmers have substantially lost trust towards certain state agencies (Kovács et al., 2021), while in Vermont, US, White et al. (2022) observed some distrust and perceived unfairness towards government or governmental programs. Despite negative perceptions farmers might have about government bodies, numerous studies identified them as influential, i.e. (most) relevant or preferred sources of information on environmentally sustainable management (e.g.: Hauck et al., 2016; Maas et al., 2021; O'Sullivan et al., 2022). This contrast is, however, not surprising. In the EU, for example, where biodiversity-friendly or, more general, sustainable farming is to a certain extent a mandatory requirement for obtaining agricultural subsidies through the Common Agricultural Policy (European Commission, n.d.a; European Commission, n.d.b), farmers depend on governmental information, regardless of potentially negative perceptions they hold about its source (also see Sutherland et al., 2013). However, following the findings of Adams et al. (2018) as outlined in the introduction, we suggest that government bodies could more effectively use their existing influence to motivate farmers' biodiversity-friendly farming through working towards, for example, increasing (long-term) reliability of their regulations, strategies, or programs. Considering the voluntary nature of several governmental agri-environmental tools promoting biodiversity-friendly farming, insights into perceptions towards government bodies are of particularly high relevance: Where farmers have agency, i.e. are free to choose, they might prefer not to follow governmental advice or join governmental programs if they hold negative perceptions about their source.

Similar to government bodies, we observed widely negative perceptions towards people in general. Increasing social pressure to farm in more biodiversity-friendly, or, more general, in sustainable ways (for further insights into corresponding perceptions of this sample see Schaller et al., 2022; also see, e.g.: Bakker et al., 2021; Reimer et al., 2022; Wittstock et al., 2022) could explain the low perception ratings of the public. Additionally, links between the farming industry and people in general have become fewer (Reimer et al., 2022). Through lacking (social) ties, appreciation or trust might further be decreased (e.g.: Mase et al., 2015; Stuart et al., 2018). Approaching biodiversity-friendly farming through initiatives driven by a non-agricultural community might therefore not necessarily motivate farmers' engagement, supporting the reasoning by Dessart et al. (2019). Instead, these authors suggest bottom-up media campaigns and involvement of all stakeholders.

In contrast, findings on perceptions towards the group of researchers gave indications that stakeholders elsewise perceived more negatively can win esteem and potential influence through creating personal relationships and familiarity. While empirical evidence indicates that researchers are not always perceived favorably (Stuart et al., 2018; Rust et al., 2022; see section 1), their advice is not always valued (Maas et al., 2021) and they can be perceived as disconnected from farming contexts (Reimer et al., 2022), we observed particularly high ratings compared to other stakeholders. This observation needs to be considered in light of potential social desirability bias (e.g. Grimm, 2010) which could occur in face-to-face interviews conducted by researchers. However, the outstandingly positive perceptions could also be explained by already existing, strong connections between the participants and researchers, including preceding scientific experiments on their farms (also see section 4.3). To facilitate the involvement of stakeholders with unique perspectives, but potentially weak reputation, our study therefore appears to support the conclusions by Stuart et al. (2018, p. 296): "Personal experiences with individuals", e.g. through facilitating the creation of "on-the-ground contacts", can compensate for skepticism, e.g. of a stakeholder's academic background.

Yet, even for stakeholders perceived positively on average, we reinforce the need to consider the multidimensional nature of perceptions. We found that perceptions on general characteristics do not necessarily predict perceptions on stakeholders' biodiversity-related behavior and *vice versa,* even though ratings on construct groups are likely to be influenced by each other (Thorndike, 1920). To contribute to informing who to involve in biodiversity-friendly farming initiatives and which roles to assign, this study highlights the value of assessing multi-faceted perceptions on stakeholders, rather than capturing only a single aspect, such as the commonly assessed construct of *trustworthiness*. To illustrate, farm advisors or other farmers were deemed to be particularly trustworthy. Given low ratings on their biodiversity-related behavior, they might, however, be ineffective partners for promoting or facilitating biodiversity-friendly farming. Yet, on the one hand, they can still play an essential role in complementing biodiversity-friendly farming initiatives, through bringing in the perspective of practical farming and acting as testimonials for economic and management benefits arising from more sustainable farm management. On the other hand, this observation highlights the importance of advisors expanding their know-how in biodiversity management to become more highly appreciated partners for farmers also in this context, with ongoing challenges in agriculture, such as an urgent need for biodiversity-friendly farming, calling for life-long learning in all related fields, including extension services. In contrast, the group of researchers might have been perceived positively regarding their biodiversity-related behavior. Therefore, they could serve as particularly promising partners for ensuring farmers' trust in the ecological dimension of a biodiversity-friendly farming initiative, while possibly not being able to score with being perceived as understanding farmers' realities.

Particularly for crop protection, fertilizer and agricultural machinery suppliers, where conflicting perceptions are most distinct, a more nuanced perspective into farmers' ratings could improve our understanding of their potential value in contributing to biodiversity-friendly farming initiatives. As shown in research on the use of information for sustainable farming, input suppliers might not be blindly trusted sources of information (Stuart et al., 2018). Nevertheless, they are important, valued, or powerful in several regions (Tucker and Napier, 2002; Houser et al., 2019; O'Sullivan et al., 2022). While participants, for example, found that these stakeholders can behave irresponsibly regarding biodiversity, they were still valued for supporting future-proof farming. Since conserving biodiversity is indisputably linked to the prosperous future of farming, e.g. through provision of pollination and regulatory ecosystem services (e.g. Allen-Wardell et al., 1998; Garibaldi et al., 2011; IPBES et al., 2019; European Commission, n.d.c), this finding could indicate that the farmers who participated in this study are not yet sufficiently aware of the importance of biodiversity for future proof farming. However, given the supposedly high conservation orientation and awareness of these participants, the finding could also indicate that even if disapproved in terms of their biodiversity behavior, these stakeholders are still appreciated as business partners by meeting particular production needs. Accordingly, such stakeholders should not be overlooked in the design of biodiversity-friendly farming initiatives. Yet, even beyond farmers' potentially conflicting perceptions about these stakeholders, their involvement needs careful consideration, since they are potentially less knowledgeable about, or familiar with sustainable action (Reimer et al., 2022).

Looking at trends across the set of stakeholders shows further, potentially promising ways of designing future biodiversity-friendly farming initiatives. The first observation is that of responsibility. Participants perceived the majority of stakeholders as taking insufficient responsibility for biodiversity. This finding indicates low levels of descriptive norms (Cialdini et al., 1990). Given that individuals tend to behave in a way they perceive others and particularly their peers normally do (also see, e.g.: Bonke and Musshoff, 2020; Bakker et al., 2021), farmers, consequently, might be demotivated from taking on action themselves if they perceive others do not engage. Relatedly, results suggested perceived value-action gaps (Blake, 1999), meaning that farmers view others as not living up to their claims. This result arises from the data showing that on the one hand participants acknowledge stakeholders' aims to protect biodiversity, while on the other hand they do not perceive that stakeholders take on corresponding responsibility to the same extent. To further enhance biodiversity-friendly farming, our findings suggest that attention needs to be paid to both descriptive norms and perceived value-action gaps, e.g. through not only motivating biodiversity conservation among diverse stakeholders, but also making already existing endeavors more visible.

The second observation is that participants felt particularly well-supported by stakeholders in future-proof farming. This observation can be interpreted as a positive influence on participants' agency, meaning that participants view most stakeholders in terms of providing possibilities rather than imposing constraints on their future farming (also see Darnhofer et al., 2016; Kuhmonen, 2020). Positive effects on farmers' perceived agency might be a valuable starting point for involving stakeholders, while stakeholders perceived as decreasing farmers' agency might, in contrast, have the opposite effect. To illustrate, government bodies were perceived as having negative effects on participants' agency. This perception could originate from issued regulations or contracts for agri-environmental programs, which the participants have perceived as too rigid and restrictive for their farming operations (Schaller et al., 2022). Notwithstanding the obligatory nature of governmental interventions and farmers' compliance, perceived restrictions and pressure, rather than incentives or equality, could potentially motivate protesting responses instead of pro-environmental action, as discussed by Bonke and Musshoff (2020).

The third observation refers to participants' perceived understanding of agricultural reality. Stakeholders closely related to agricultural production, as well as farm input suppliers, were perceived particularly positively regarding their practical insights, indicating that participants might appreciate them as like-minded partners in biodiversity-friendly farming initiatives. This consideration relates to discussions around the concept of social homophily, as summarized by Prell et al. (2010): stakeholders whom farmers perceive as similar to themselves are more likely to build social ties, have an easier mutual understanding and can effectively share information among themselves. This concept could apply to peer farmers and/or farm advisors in our research. However, due to social homophily or approaches building on it, the exchange of information between dissimilar groups, such as agricultural actors and nature conservationist, can be limited, which makes it hard for new information to diffuse in either direction. Rust et al. (2022) discussed such drawbacks with regard to – increasingly appreciated – information sourcing via social media. More profound consideration of like-mindedness, accounting both for advantages and disadvantages, could provide additional insights also into involving stakeholders in biodiversity-friendly farming initiatives.

Revealing overall perception patterns can help to encourage and support the strategic involvement of stakeholders in biodiversity-friendly farming initiatives, e.g. as part of the Common Agricultural Policies. Yet, for setting up real-life approaches, we highlight the need to assess perceptions within the local context, considering the political, economic and social environment. For example, farmers in the Netherlands increasingly perceive political pressure to adapt their farm management, notably driven by the need to cut agricultural nitrogen emissions, as well as a lack of understanding and respect for farming from the side of the general public (e.g.: Bouma et al., 2020). While only anecdotal, given the small size of the Dutch sub-sample,[9] such dynamics supposedly translated into comparatively more negative perceptions towards distant societal stakeholders, but more positive perceptions towards stakeholders closely related to agricultural production. In addition, even in post-socialist regions, showing some similarities in their former agricultural structure (Hagedorn, 2014), we found that ratings diverged widely. Findings on relatively more positive perceptions towards societal stakeholders or skepticism towards market-related stakeholders across post-socialist study areas appear to

[9] To ensure anonymity for all participants, ratings are not shown for sub-samples.

be plausible (e.g.: Sapsford and Abbott, 2006; Dimitrova-Grajzl et al., 2012). Yet, ratings on producer organizations, expected to be viewed in a rather negative way (e.g.: Hagedorn, 2014; Tuna and Karantininis, 2021), turned out to vary widely from outstandingly positive to outstandingly negative perceptions, which could reflect the highly specific context of post-socialist countries (Hagedorn, 2014). Given Europe's heterogeneous agricultural regions (Kryszak and Herzfeld, 2021) and the differences which became apparent also in this exploratory approach, we recommend to account for potential variations of farmers' views and networks at the local/regional level in follow-up research (also see, e.g.: Tucker and Napier, 2002; O'Sullivan et al., 2022).

4.2. Methodological insights

The following discussion points to the limitations arising from the design of this study and provides practical recommendations for its further application. It also outlines the strengths and weaknesses of PMs as a novel approach to elicit farmers' perceptions towards stakeholders in agri-environmental research.

Overall, the observations made in this study are plausible when compared to empirical evidence. Yet, the study's exploratory character limits their generalizability. This limitation not only results from the small sample size, but also from the expected sample bias towards participants who already have established bonds with researchers and, potentially, experience in biodiversity-friendly farming as well as from the bias towards large and organic farms, young and highly educated farmers. Also statistical comparability between sub-samples of farmers was limited due to this exploratory sample, even if it can be assumed that farmers with different farm characteristics might have different perceptions (see, e.g., Stuart et al., 2018). In future studies, the presented trends and recommendations, as well as potential differences in perceptions between groups of farmers, therefore need to be checked by means of a larger and more balanced sample, for which this study provides a useful tool and starting point.

Beyond limitations arising from the exploratory character of this study, the trans-national and linguistic context of this study was accompanied by certain challenges that need to be accounted for when applying a PM in a similar setting. First, potential errors in translation and misunderstandings of constructs when interviewing participants cannot be ruled out, making it obligatory to implement preventative measures. In this study, we used several feedback loops to check the PM for unambiguity and simplicity of wording, conducted a workshop with the local interviewers to generate a common understanding of the set-up PM, and accounted for linguistic nuances in the study areas with local interviewers themselves translating the PM. Second, elements need to comprise stakeholders potentially relevant in all study areas, coming at the expense of regionally specific insights. To allow for area-specific complementarity in this study, additionally relevant stakeholders could be named in free columns. Yet, these local elements were not considered in our analysis, because they were not comparable across study areas or participants. However, since the matrix was informed by inputs from all study areas, this step would have provided only additional insights and did not hinder the analysis of how participants perceived more overall relevant stakeholders relative to each other. Third, due to the multi-national scope, elements operated within different structures and did not share their institutional backgrounds. In this study, we therefore did not include stakeholders' specific affiliations to define the elements, but rather referred to their functional roles (Moon et al., 2015). For example, stakeholders providing advice for farmers can be associated with public bodies (e.g. research) in one country and private bodies (e.g. profit-oriented farm consultancies) in a different country, resulting in divergent elements. Still, they universally act as farm advisors, which was thus introduced as one element into the matrix. However, when applying the PM in a geographically more homogenous setting, we recommend to specify the stakeholders' affiliation to gain additional information, e.g. to differentiate between public farm advisors and those operating within environmental trusts.

Shedding light on the theoretical background of the methodological approach applied, the objectification and quantification of constructionist, qualitative RGTs towards PMs is generally discussed ambiguously in preceding research (also see Moon et al., 2017). For example, whereas Jankowicz (2004) finds the supply of elements hardly contentious, the author summarizes preceding, more critical scientific discussions about the supply of constructs. Specifically, the supply of constructs is argued to potentially reduce usefulness and meaning to the individual interviewees. We aimed to overcome this limitation through a careful PM design process, complementing potential elements and constructs named in the study areas with elements and constructs named by practicing farmers.

In contrast to the outlined drawback, several reasons advocate for the choice of PMs in settings investigating differences across multinational, multi-linguistic contexts. While PMs do not allow for in-depth insights into individuals' construct systems, they do provide a comparison of comprehensive perception data across individuals and groups (Moon et al., 2017). This asset clearly distinguishes them from other common ways of eliciting farmers' perceptions. Additionally, highly personal constructs revealed in an RGT are not only strong in individual meaning. They are also susceptible to misinterpretation (Kelly, 1955), a risk which can be reduced through a PM that allows *a priori* checking for clarity via a pre-test. Lastly, it is not clear whether supplied constructs limit or improve the reflection of an individual's rich and complex thinking (Collett, 1979; as cited in Jankowicz, 2004). In the latter event, this was theoretically enabled through supplying an extensive matrix, collecting up to 96 items per participant.

In summary, this study represents a successful application of the PM approach that proved to be particularly suitable for assessing perceptions in diverse settings. After having completed the critical phase of setting up the PM, it can be applied in studies involving multiple researchers or non-social scientists, multiple languages or regional contexts. While being standardized and straightforward to apply, it still provided insights into participants' perceptions that were both comprehensive and comparable. The approach of this study can further be used to reveal farmers' perceptions towards stakeholders in the systems of both private and public initiators, and, in a next step, to inform the design of biodiversity-friendly farming initiatives accordingly. Additionally, stakeholders can use the PM approach to determine how they are perceived compared to others and could work towards improving their image to become more valued partners for biodiversity-friendly farming within the farming community.

4.3. Implications for policy

While noting the limited generalizability of this exploratory study (see Section 4.2), the presented insights into participants' perceptions towards government bodies support the increasing involvement of non-governmental stakeholders (e.g. researchers, farm advisors, or producer organizations) in public biodiversity-friendly farming initiatives, such as the European Union's agri-environmental measures or eco-schemes. Acting through roles such as communicators or intermediaries, these stakeholders can act as a bridge between government bodies and their prescriptions on the one hand, and farmers and their management on the other (e.g. Prazan and Theesfeld, 2014; Schomers et al., 2015; Eanes et al., 2017; Sattler et al., 2023). Likewise, Stuart et al. (2018) advised government staff and researchers to collaborate with market stakeholders who farmers trust and whose existing sustainability programs can be made use of to this end. However, stakeholders might be able to accomplish contributions only in precisely specified fields, such as farm advisors or input suppliers testifying the biodiversity-friendly farming initiative's conduciveness for farming and providing practical advice. Yet, they might not, for example, be able to act as testimonials demonstrating the initiative's capacity to improve farmland biodiversity. Therefore, a multi-faceted analysis of how farmers perceive these stakeholders is needed to enable their well-targeted involvement and to avoid undesired side-effects. In this sense, the PM approach can be a helpful tool to reveal well-perceived stakeholders and their potential roles in supporting biodiversity-friendly farming initiatives.

To make use of perceived strengths amongst single stakeholders and, at the same time, compensate poor perceptions, we recommend further examination of involving *multiple* stakeholders in biodiversity-friendly farming initiatives. Besides potentially increasing acceptance and effectiveness of biodiversity-friendly farming initiatives, broad involvement could strengthen stakeholders' contribution to conserving biodiversity across society and make their efforts more visible. Accordingly, this networking approach implies opportunities to overcome low descriptive norms (also see Reimer et al., 2022) and perceived value-action gaps. Concentrating biodiversity action and information from several stakeholders into one initiative might also help to reduce excessive or conflicting information flow on environmentally sustainable management, as observed by other authors (O`Sullivan et al., 2022; White et al., 2022).

For setting up multi-stakeholder initiatives, we suggest accounting for the opportunities of locally-embedded approaches, such as collaborative initiatives, communication platforms, and interdisciplinary dialogue (Maas et al., 2021). Locally-embedded approaches account for perceptions and preferences that could diverge with area-specific context, while also benefitting from potentials arising from already existing relationships, as discussed for the group of researchers. In line with this recommendation, Reimer et al. (2022) report that farmers who aim to increase conservation agriculture wish to be more closely connected to diverse stakeholders along the value chain. Building on personal relationships and collaboration between various stakeholders additionally has the potential to increase trust (Stuart et al., 2018) and influence (Eanes et al., 2017) and could be examined as a way forward to decrease blame shifting, which is argued to hinder conservation action by accusing others of no or harmful action (Ranjan et al., 2019). Additionally, social ties between groups of different backgrounds, rather than within a homogenous group, might be fostered for the benefit of future cooperation (also see Yoder and Roy Chowdhury, 2018) and the more equal consideration of different i.e. agricultural and conservation-oriented perspectives (also see Prell et al., 2010). For an overview of stakeholder participation in environmental management, its potential (dis-)advantages and best practice, see, e.g., Reed (2008).

Aiming to account for interconnections along the supply chain and using the assets of its complementary stakeholders, the European Innovation Partnership (EIP, Regulation (EU) 2021/2115, Article 127 and Commission Regulation (EU) 2022/2472, Article 39) embodies the concept of a multi-stakeholder initiative based on personal relations within the current European Common Agricultural Policy. Not only do our findings, as outlined above, support the creation of such approaches. The methodological tool presented in this study can also benefit the set-up of EIP operational groups through revealing perceived strengths and weaknesses of potential stakeholders.

Further research will be needed to assess the efficiency of the outlined policy implications. Specifically, potentially improved environmental outcomes of multiple-stakeholder initiatives need to be put in relation with acceptance on the one hand and increased costs for policy and farmers on the other hand, comprising administration or transaction costs. Such costs potentially arise from increased discussion between diverse stakeholders and the need for trained mediators to tackle any arising tensions (also see Prell et al., 2010; Reed, 2008). Additionally, further research is required to investigate stakeholders' scope for contributions and their willingness to be involved (also see Eanes et al., 2017) as well as wider social implications, such as costs or benefits for the local community and economy.

5. Conclusions

Based on an exploratory study carried out across ten European countries, our study captured insights into how farmers perceive stakeholders in biodiversity-friendly farming, recognizing that research is scarce in this context. We found that perceptions are highly nuanced: average ratings do point to clear extremes. Yet, a multi-faceted assessment is required to understand conflicting perceptions and avoid misleading conclusions about how stakeholders could contribute to biodiversity-friendly farming initiatives. While perceived irresponsibility regarding biodiversity among several stakeholders calls for reinforced, more visible action, participants overall found stakeholders to be supportive for their farming endeavors, indicating a good starting point for working more collaboratively towards protecting biodiversity. Through setting up and applying the PM approach, we further the use of a tool novel for eliciting farmers' perceptions towards stakeholders in agri-environmental research. Although requiring a careful set-up process, the PM proved to be a useful approach for studies characterized by multiple geographical and linguistic contexts within a multi-disciplinary research project. Overall, our study can contribute to encouraging and facilitating a deeper examination of multi-stakeholder initiatives in biodiversity-friendly farming, potentially motivating action across society as called for by the Convention on Biological Biodiversity (2021, 2022) and supporting the green transition as strategized by the European Green Deal (European Commission, 2019). Given the exploratory nature of this study, additional investigation is needed to confirm the findings and recommendations at larger scale and by means of a representative sample to test for generalizability and to allow for a detailed analysis of area-specific preferences. Additionally, comparing perceptions between farmers who are involved in biodiversity initiatives and those who are not as well as extending the scope to other aspects of environmentally-friendly farming (e.g. soil or water conservation) can deliver further important insights for policy design. The presented PM can be applied, respectively adjusted also to this end.

Ethics declaration

This study adheres to the principles of good research practice, including confidentiality, written informed consent queries and anonymity of participants: It was carried out in fulfilment of the ethical requirements mandatory for EU Horizon 2020 project grant agreements, concerning a) the identification and recruitment of research participants, b) informed consent procedures implemented for the participation of humans and c) personal data processing and data protection in line with Regulation (EU) 2016/679 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data (General Data Protection Regulation).

CRediT authorship contribution statement

Verena Scherfranz: Conceptualization, Data curation, Formal analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. **Katie Moon:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Jochen Kantelhardt:** Funding acquisition, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Anneli Adler:** Data curation, Investigation, Writing – review & editing. **Sílvia Barreiro:** Data curation, Investigation, Writing – review & editing. **Flaviu Valentin Bodea:** Data curation, Investigation, Writing – review & editing. **Vincent Bretagnolle:** Data curation, Investigation, Writing – review & editing. **Viviane Brönnimann:** Data curation, Investigation, Writing – review & editing. **Jan Peter Reinier de Vries:** Data curation, Investigation, Writing – review & editing. **Alice Dos Santos:** Data curation, Investigation, Writing – review & editing. **Maura Ganz:** Data curation, Investigation, Writing – review & editing. **José M. Herrera:** Data curation, Investigation, Writing – review & editing. **Amelia S.C. Hood:** Data curation, Investigation, Writing – review & editing. **Friedrich Leisch:** Formal analysis. **Alice L. Mauchline:** Data curation, Investigation, Writing – review & editing. **Indrek Melts:** Data curation, Investigation, Writing – review & editing. **Razvan Popa:** Data curation, Investigation, Writing – review & editing. **Vanesa María Rivera Girón:** Data curation, Investigation, Writing – review & editing. **Andy Ruck:** Data curation, Investigation, Writing – review & editing. **Flóra Vajna:** Data curation, Investigation, Writing – review & editing. **Elena Velado-Alonso:** Data curation, Investigation, Writing – review & editing. **Lena Schaller:** Conceptualization, Funding acquisition, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

The authors wish to thank the interviewed farmers for their valuable contribution to this study. Additional thanks go to the three blind reviewers for their constructive comments and feedback on the previous draft of the paper. The study has received funding from the project SHOWCASE (SHOWCASing synergies between agriculture, biodiversity and Ecosystem services to help farmers capitalising on native biodiversity) within the European Union's Horizon 2020 Research and Innovation Programme (grant agreement No 862480). This publication reflects only the authors' view and the European Commission is not responsible for any use that may be made of the information it contains.

Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jrurstud.2024.103282.

References

Adams, V.M., Moon, K., Álvarez-Romero, J.G., Bodin, Ö., Spencer, M., Blackman, D., 2018. Using multiple methods to understand the nature of relationships in social networks. Soc. Nat. Resour. 31 (7), 755–772. https://doi.org/10.1080/08941920.2018.1425514.

Allen-Wardell, G., Bernhardt, P., Bitner, R., Burquez, A., Buchmann, S., Cane, J., Cox, P. A., Dalton, V., Feinsinger, P., Ingram, M., Inouye, D., Jones, C.E., Kennedy, K., Kevan, P., Koopowitz, H., Medellin, R., Medellin-Morales, S., Nabhan, G.P., Pavlik, B., Tepedino, V., Torchio, P., Walker, S., 1998. The potential consequences of pollinator declines on the conservation of biodiversity and stability of food crop yields. Conserv. Biol. 12 (1), 8–17.

Atieno, E.O., Kilwinger, F.B.M., Almekinders, C.J.M., Struik, P.C., 2023. How Kenyan potato farmers evaluate the seed: implications for the promotion of certified seed potato. Potato Res. https://doi.org/10.1007/s11540-022-09602-8.

Bakker, L., Sok, J., van der Werf, W., Bianchi, F.J.J.A., 2021. Kicking the habit: what makes and breaks farmers' intentions to reduce pesticide use? Ecol. Econ. 180, 106868 https://doi.org/10.1016/j.ecolecon.2020.106868.

Beethem, K., Marquart-Pyatt, S.T., Lai, J., Guo, T., 2023. Navigating the information landscape: public and private information source access by midwest farmers. Agric. Hum. Val. https://doi.org/10.1007/s10460-022-10411-5.

Blake, J., 1999. Overcoming the 'value-action gap' in environmental policy: tensions between national policy and local experience. Local Environ. 4 (3), 257–278. https://doi.org/10.1080/13549839908725599.

Bonke, V., Musshoff, O., 2020. Understanding German farmer's intention to adopt mixed cropping using the theory of planned behavior. Agron. Sustain. Dev. 40, 48. https://doi.org/10.1007/s13593-020-00653-0.

Bouma, J., Boot, P., Bredenoord, H., Dietz, F., van Eerdt, M., van Grinsven, H., Kishna, M., Ligtvoet, W., van der Wouden, R., Sanders, M., 2020. Balans van de Leefomgeving 2020. Burger in zicht, overheid aan zet. PBL Planbureau voor de Leefomgevin. Den Haag.

Burbach, M.E., Eaton, W.M., Kennedy, S.M., Brasier, K.J., 2023. Foundational conditions enabling participatory river management in watersheds of two regulatorily disparate states: a mixed methods study. River Res. Appl. 1–12 https://doi.org/10.1002/rra.4108.

Cialdini, R.B., Reno, R.R., Kallgren, C.A., 1990. A focus theory of normative conduct: recycling the concept of norms to reduce littering in public places. J. Pers. Soc. Psychol. 58 (6), 1015–1026.

Commission Regulation (EU) 271/2010. Commission Regulation (EU) 271/2010 of 24 March 2010 amending Regulation (EC) No 889/2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007, as regards the organic production logo of the European Union. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010R0271.

Commission Regulation (EU) 2022/2472. Commission Regulation (EU) 2022/2472 of 14 December 2022 declaring certain categories of aid in the agricultural and forestry sectors and in rural areas compatible with the internal market in application of Articles 107 and 108 of the Treaty on the Functioning of the European Union. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32022R2472&qid=1689151313824.

Convention on Biological Diversity, 2021. CBD/WG2020/3/3: first draft of the post-2020 global biodiversity framework. https://www.cbd.int/doc/c/abb5/591f/2e46096d3f0330b08ce87a45/wg2020-03-03-en.pdf.

Convention on Biological Diversity, 2022. CBD/COP/15/L.25: kunming-Montreal Global biodiversity framework: draft decision submitted by the President. https://www.cbd.int/doc/c/abb5/591f/2e46096d3f0330b08ce87a45/wg2020-03-03-en.pdf.

Darnhofer, I., Lamine, C., Strauss, A., Navarrete, M., 2016. The resilience of family farms: towards a relational approach. J. Rural Stud. 44, 111–122. https://doi.org/10.1016/j.jrurstud.2016.01.013.

David, P., Roemer, C., Anibaldi, R., Rundle-Thiele, S., 2022. Factors enabling and preventing farming practice change: an evidence review. J. Environ. Manag. 322, 115789 https://doi.org/10.1016/j.jenvman.2022.115789.

Dessart, F.J., Barreiro-Hurlé, J., van Bavel, R., 2019. Behavioural factors affecting the adoption of sustainable farming practices: a policy-oriented review. Eur. Rev. Agric. Econ. 46 (3), 417–471. https://doi.org/10.1093/erae/jbz019.

Dimitrova-Grajzl, V., Grajzl, P., Guse, A.J., 2012. Trust, perceptions of corruption, and demand for regulation: evidence from post-socialist countries. J. Soc. Econ. 41, 292–303. https://doi.org/10.1016/j.socec.2012.01.005.

Durgun, D., Günden, C., Ünal, V., 2020. Information source preferences of small-scale Fishers in the Aegean Sea coast of Turkey. Acta Ichthyol. Piscatoria 51, 47–52. https://doi.org/10.3897/aiep.51.63396.

Eanes, F.R., Singh, A.S., Bulla, B.R., Ranjan, P., Prokopy, L.S., Fales, M., Wickerham, B., Doran, P.J., 2017. Midwestern US farmers perceive crop advisers as conduits of information on agricultural conservation practices. Environ. Manag. 60, 974–988. https://doi.org/10.1007/s00267-017-0927-z.

European Commission, 2019. COM(2019) 640 final: the European green deal - communication from the commission to the European parliament, the European council, the council, the European economic and social committee and the committee of the regions. https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF.

Eurostat, 2024. Fully organic farms in the EU [WWW Document]. URL https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Fully_organic_farms_in_the_EU&oldid=631225#Organic_farms (accessed 25.April.2024).

European Commission, n.d.a. Cross-compliance [WWW Document]. URL https://agriculture.ec.europa.eu/common-agricultural-policy/income-support/cross-compliance_en (accessed 7.December.2023).

European Commission, n.d.b. New CAP: 2023-27 [WWW Document]. URL https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/new-cap-2023-27_en (accessed 7.December.2023).

European Commission, n.d.c. Enhancing agricultural biodiversity [WWW Document]. URL https://agriculture.ec.europa.eu/sustainability/environmental-sustainability/biodiversity_en (accessed 7.December.2023).

European Environment Agency, 2020. State of Nature in the EU: Results from Reporting under the Nature Directives 2013-2018. Publications, Office, LU.

European Union, 2018. Special Eurobarometer 481 – December 2018 "Attitudes of Europeans towards Biodiversity" – Report. https://doi.org/10.2779/456395.

Eurostat, 2022. Farms and farmland in the European Union - statistics [WWW Document]. URL https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farms_and_farmland_in_the_European_Union_-_statistics. . (Accessed 5 July 2023).

Eurostat, 2022. Farmers and the agricultural labour force - statistics [WWW Document]. URL https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farms_and_farmland_in_the_European_Union_-_statistics. , 2.2.24.

Field, A.P., Miles, J., Field, Z., 2012. Discovering Statistics Using R. Sage, London, Thousand Oaks, New Delhi, Singapore.

Garibaldi, L., Aizen, M., Klein, A., Cunningham, S., Harder, L., 2011. Global growth and stability of agricultural yield decrease with pollinator dependency. Proc. Natl. Acad. Sci. U.S.A. 108 (14), 5909–5914. https://doi.org/10.1073/pnas.1012431108.

Grimm, P., 2010. Social desirability bias. In: Wiley International Encyclopedia of Marketing. John Wiley & Sons, Ltd. https://doi.org/10.1002/9781444316568.wiem02057.

Hagedorn, K., 2014. Post-socialist farmers' cooperatives in central and eastern europe. Ann. Publ. Cooper. Econ. 85 (4), 555–577. https://doi.org/10.1111/apce.12051.

Hauck, J., Schmidt, J., Werner, A., 2016. Using social network analysis to identify key stakeholders in agricultural biodiversity governance and related land-use decisions at regional and local level. Ecol. Soc. 21 (2), 49. https://www.jstor.org/stable/26270396.

Heckmann, Mark, 2022. Package "OpenRepGrid" [WWW Document]. URL http://docu.openrepgrid.org/index.html. . (Accessed 27 February 2023).

Holm, S., 1979. A simple sequentially rejective multiple test procedure. Scand. J. Stat. 6, 65–70.

Houser, M., Marquart-Pyatt, S.T., Denny, R.C.H., Reimer, A., Stuart, D., 2019. Farmers, information, and nutrient management in the US Midwest. J. Soil Water Conserv. 74 (3), 269–280. https://doi.org/10.2489/jswc.74.3.269.

IPBES, 2019. In: Díaz, S., Settele, J., Brondízio, E.S., Ngo, H.T., Guèze, M., Agard, J., Arneth, A., Balvanera, P., Brauman, K.A., Butchart, S.H.M., Chan, K.M.A., Garibaldi, L.A., Ichii, K., Liu, J., Subramanian, S.M., Midgley, G.F., Miloslavich, P., Molnár, Z., Obura, D., Pfaff, A., Polasky, S., Purvis, A., Razzaque, J., Reyers, B., Roy Chowdhury, R., Shin, Y.J., Visseren-Hamakers, I.J., Willis, K.J., Zayas, C.N. (Eds.), Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. IPBES secretariat, Bonn.

Jankowicz, D., 2004. The Easy Guide to Repertory Grids. John Wiley & Sons Ltd, Chichester.

Kelly, G.A., 1955. The Psychology of Personal Constructs. Norton & Co, New York.

Kilwinger, F.B., Marimo, P., Rietveld, A.M., Almekinders, C.J., van Dam, Y.K., 2020. Not only the seed matters: farmers' perceptions of sources for banana planting materials in Uganda. Outlook Agric. 49 (2), 119–132. https://doi.org/10.1177/0030727020930731.

Kovács, E.K., Kalóczkai, Á., Czúcz, B., 2021. The role of politics in the life of a conservation incentive: an analysis of agri-environment schemes in Hungary. Biol. Conserv. 10, 109172 https://doi.org/10.1016/j.biocon.2021.109172.

Kryszak, Ł., Herzfeld, T., 2021. One or many European models of agriculture? How heterogeneity influences income creation among farms in the European Union. Agric. Econ. 67 (11), 445–456. https://doi.org/10.17221/154/2021-AGRICECON.

Kuhmonen, I., 2020. The resilience of Finnish farms: exploring the interplay between agency and structure. J. Rural Stud. 80, 360–371. https://doi.org/10.1016/j.jrurstud.2020.10.012.

Maas, B., Fabian, Y., Kross, S.M., Richter, A., 2021. Divergent farmer and scientist perceptions of agricultural biodiversity, ecosystem services and decision-making. Biol. Conserv. 256, 109065 https://doi.org/10.1016/j.biocon.2021.109065.

Mak, A.H.N., Lumbers, M., Eves, A., Chang, R.C.Y., 2013. An application of the repertory grid method and generalised Procrustes analysis to investigate the motivational factors of tourist food consumption. Int. J. Hospit. Manag. 35, 327–338. https://doi.org/10.1016/j.ijhm.2013.07.007.

Marks, B., Boerngen, M.A., 2019. A farming community's perspective on nutrient loss reduction. Agricultural & Environmental Letters 4, 190004. https://doi.org/10.2134/ael2019.02.0004.

Mase, A.S., Babin, N.L., Prokopy, L.S., Genskow, K.D., 2015. Trust in sources of soil and water quality information: implications for environmental outreach and education. J. Am. Water Resour. Assoc. 51 (6), 1656–1666. https://doi.org/10.1111/1752-1688.12349.

Moon, K., Blackman, D., 2014. A guide to understanding social science research for natural scientists. Conserv. Biol. 28 (5), 1167–1177.

Moon, K., Blackman, D.A., Brewer, T.D., 2015. Understanding and integrating knowledge to improve invasive species management. Biol. Invasions 17, 2675–2689. https://doi.org/10.1007/s10530-015-0904-5.

Moon, K., Blackman, D.A., Adams, V.M., Kool, J., 2017. Perception matrices: an adaptation of repertory grid technique. Land Use Pol. 64, 451–460. https://doi.org/10.1016/j.landusepol.2017.03.023.

O'Sullivan, L., Leeuwis, C., de Vries, L., Wall, D.P., Heidkroß, T., Madena, K., Schulte, R.P.O., 2022. Trust versus content in multi-functional land management: assessing soil function messaging in agricultural networks. Environ. Manag. 69, 1167–1185. https://doi.org/10.1007/s00267-022-01647-2.

Prazan, J., Theesfeld, I., 2014. The role of agri-environmental contracts in saving biodiversity in the post-socialist Czech Republic. Int. J. Commons 8 (1), 1–25. https://doi.org/10.18352/ijc.400.

Prell, C., Reed, M., Racin, L., Hubacek, K., 2010. Competing structure, competing views: the role of formal and informal social structures in shaping stakeholder perceptions. Ecol. Soc. 15 (4), 34. https://doi.org/10.5751/ES-03652-150434.

Ranjan, P., Church, S.P., Floress, K., Prokopy, L.S., 2019. Synthesizing conservation motivations and barriers: what have we learned from qualitative studies of farmers' behaviors in the United States? Soc. Nat. Resour. 32 (11), 1171–1199. https://doi.org/10.1080/08941920.2019.1648710.

Reed, M.S., 2008. Stakeholder participation for environmental management: a literature review. Biol. Conserv. 141, 2417–2431. https://doi.org/10.1016/j.biocon.2008.07.014.

Reimer, A., Doll, J.E., Boring, T.J., Zimnicki, T., 2022. Scaling up conservation agriculture: an exploration of challenges and opportunities through a stakeholder engagement process. J. Environ. Qual. 1–11. https://doi.org/10.1002/jeq2.20317.

Regulation (EU) 2021/2115. Regulation (EU) 2021/2115 of the European Parliament and of the Council of 2 December 2021 establishing rules on support for strategic plans to be drawn up by Member States under the common agricultural policy (CAP Strategic Plans) and financed by the European Agricultural Guarantee Fund (EAGF) and by the European Agricultural Fund for Rural Development (EAFRD) and repealing Regulations (EU) No 1305/2013 and (EU) No 1307/2013. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32021R2115.

Rogers, B., Ryals, L., 2007. Using Repertory Grid to access the underlying realities in key account relationships. Int. J. Mark. Res. 49 (5), 595–612. https://doi.org/10.1177/147078530704900506.

Rust, N.A., Stankovics, P., Jarvis, R.M., Morris-Trainor, Z., de Vries, J.R., Ingram, J., Mills, J., Glikman, J.A., Parkinson, J., Toth, Z., Hansda, R., McMorran, R., Glass, J., Reed, M.S., 2022. Have farmers had enough of experts? Environ. Manag. 69, 31–44. https://doi.org/10.1007/s00267-021-01546-y.

Sapsford, R., Abbott, P., 2006. Trust, confidence and social environment in post-communist societies. Commun. Post Commun. Stud. 39 (1), 59–71.

Sattler, C., Barghusen, R., Bredemeier, B., Dutilly, C., Prager, K., 2023. Institutional analysis of actors involved in the governance of innovative contracts for agri-environmental and climate schemes. Global Environ. Change 80, 102668. https://doi.org/10.1016/j.gloenvcha.2023.102668.

Schaller, L., Scherfranz, V., Kantelhardt, J., Kohrs, M., Häfner, K., Klebl, F., Parisi, A., Piorr, A., Ruiz, J., Adler, A., Velado Alonso, E., Barreiro, S., Bodea, F. V., Broenniman, V., Ganz, M., de Vries, R., Dos Santos, A., Hood, A., Mauchline, A., Melts, I., Möhring, N., Popa, R., Ruck, A., Vajna, F., 2022. Report on EBA incentives, drivers and key determinants of uptake of biodiversity man- agement by farmers. Deliverable D2.2 EU Horizon 2020 SHOWCASE Project, Grant agreement No 862480.

Schomers, S., Sattler, C., Matzdorf, B., 2015. An analytical framework for assessing the potential of intermediaries to improve the performance of payments for ecosystem services. Land Use Pol. 42, 58–70. https://doi.org/10.1016/j.landusepol.2014.06.025.

Stuart, D., Denny, R.C.H., Houser, M., Reimer, A.P., Marquart-Pyatt, S., 2018. Farmer selection of sources of information for nitrogen management in the US Midwest: implications for environmental programs. Land Use Pol. 70, 289–297. https://doi.org/10.1016/j.landusepol.2017.10.047.

Sühlsen, K., Hisschemöller, M., 2014. Lobbying the 'Energiewende'. Assessing the effectiveness of strategies to promote the renewable energy business in Germany. Energy Pol. 69, 316–325. https://doi.org/10.1016/j.enpol.2014.02.018.

Sullivan, G.M., Artino, A.R., 2017. How to create a bad survey instrument. Journal of Graduate Medical Education 9 (4), 411–415. https://doi.org/10.4300/JGME-D-17-00375.1.

Sutherland, L.-A., Mills, J., Ingram, J., Burton, R.J.F., Dwyer, J., Blackstock, K., 2013. Considering the source: commercialisation and trust in agri-environmental information and advisory services in England. J. Environ. Manag. 118, 96–105. https://doi.org/10.1016/j.jenvman.2012.12.020.

Thompson, L.-J., 2009. A farmer-centric approach to decision-making and behaviour change: unpacking the 'black-box' of decision- making theories in agriculture. Presented at the Australian Sociological Association Annual Conference. ANU, Canberra.

Thorndike, E.L., 1920. A constant error in psychological ratings. J. Appl. Psychol. 4 (1), 25–29. https://doi.org/10.1037/h0071663.

Tucker, M., Napier, T.L., 2002. Preferred sources and channels of soil and water conservation information among farmers in three midwestern US watersheds. Agric. Ecosyst. Environ. 92, 297–313. https://doi.org/10.1016/S0167-8809(01)00293-6.

Tuna, E., Karantininis, K., 2021. Agricultural cooperatives as social capital hubs – a case in a post-socialist country. Journal of Co-operative Organization and Management 9, 100134. https://doi.org/10.1016/j.jcom.2021.100134.

Vrain, E., Lovett, A., 2020. Using word clouds to present farmers' perceptions of advisory services on pollution mitigation measures. J. Environ. Plann. Manag. 63 (6), 1132–1149. https://doi.org/10.1080/09640568.2019.1638232.

White, A.C., Faulkner, J.W., Conner, D.S., Méndez, V.E., Niles, M.T., 2022. "How can you put a price on the environment?" Farmer perspectives on stewardship and payment for ecosystem services. J. Soil Water Conserv., 00041 https://doi.org/10.2489/jswc.2022.00041.

Wittstock, F., Paulus, A., Beckmann, M., Hagemann, N., Baaken, M.C., 2022. Understanding farmers' decision-making on agri-environmental schemes: a case study from Saxony, Germany. Land Use Pol. 122, 106371 https://doi.org/10.1016/j.landusepol.2022.106371.

Yoder, L., Roy Chowdhury, R., 2018. Tracing social capital: how stakeholder group interactions shape agricultural water quality restoration in the Florida Everglades. Land Use Pol. 77, 354–361. https://doi.org/10.1016/j.landusepol.2018.05.038.