Journal of Rural Studies 123 (2026) 104050

Contents lists available at ScienceDirect

Journal of Rural Studies

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

Exploring farmer sentiment and decision-making on circular agricultural practices adoption in Europe: Evidence from Italy, Norway and the UK

Ffion Evans [a,b,*], James Gibbons [a], Luciana Bava [c], Dave Chadwick [a], Stefania Colombini [c], Valborg Kvakkestad [d], Lampros Lamprinakis [d], Vibeke Lind [d], Martina Pavesi [c], Prysor Williams [a], Sophie Wynne-Jones [a]

[a] School of Environmental and Natural Sciences, Bangor University, Gwynedd, Bangor, United Kingdom
[b] Countryside and Community Research Institute, University of Gloucestershire, Cheltenham, United Kingdom
[c] University of Milan, Agricultural and Environmental Science Department, Milan, Italy
[d] Norwegian Institute of Bioeconomy Research, NIBIO, Division of Food Production and Society, Ås, Norway

ARTICLE INFO

Keywords:
Agricultural policy
Behaviour change
Circular economy
Climate-smart agriculture
COM-B model
Sentiment analysis

ABSTRACT

Transitioning towards more circular farming systems, which prioritise using renewable and recycled resources to reduce reliance on external inputs, offers potential to improve nutrient cycling, enhance farm profitability and mitigate greenhouse gas emissions. However, widespread adoption remains limited. To support the wider adoption of circular farming practices across diverse rural and agroecological settings, we examined how psychological, contextual and motivational factors shape farmers' sentiment and decision-making. A mixed-methods approach—combining sentiment and thematic analysis—was applied to interviews and focus groups with 96 farmers and industry stakeholders across Italy, Norway and the UK. Sentiment towards circular farming practices varied across national contexts, with UK farmers expressing more positive views overall than Norwegian farmers, and Italian farmers positioned in between. These differences reflected how well practices aligned with existing knowledge, values and farming systems, while negative sentiment was primarily associated with policy impracticalities, investment costs and local constraints, highlighting key political and structural barriers to adoption. The findings underscore the need to align circular strategies with local contexts. To support wider adoption, we recommend (1) enhancing psychological capability (e.g. aligning practices with farmers' knowledge): through a flexible 'toolbox' of practices; (2) addressing physical opportunity barriers via co-designed, locally-adapted policies; and (3) strengthening reflective motivation by communicating and deliberating the broader co-benefits of circular practices. These informed insights provide more effective and inclusive strategies for sustainable agriculture and rural development across Europe.

1. Introduction

Agriculture is a major contributor to greenhouse gas (GHG) emissions in Europe, accounting for approximately 10 % of total emissions, primarily from methane and nitrous oxide (Mielcarek-Bocheńska and Rzeźnik, 2021). In response, the European Union (EU), Norway and United Kingdom (UK) have set ambitious climate targets that require substantial emissions reductions from the agricultural sector. Circular farming practices are increasingly promoted within national policy frameworks as a means of reducing reliance on external and finite inputs by replacing them with renewable or recycled alternatives, thereby enhancing nutrient cycling, and lowering GHG emissions and costs (de Boer and van Ittersum, 2018). Examples include substituting synthetic fertilisers with livestock manure or nitrogen-fixing legume cover crops, and replacing imported concentrate feeds with home-grown forages, crop residues or food processing by-products. Circular systems also promote the adoption of technologies that improve the utilisation and value of on-farm resources, such as anaerobic digestion, which generates renewable energy that can benefit local communities and contribute to rural development. A more detailed description of circular agricultural

* Corresponding author. School of Environmental and Natural Sciences, Bangor University, Gwynedd, Bangor, LL57 2UW, United Kingdom.
E-mail addresses: ffion.evans@bangor.ac.uk (F. Evans), j.gibbons@bangor.ac.uk (J. Gibbons), luciana.bava@unimi.it (L. Bava), d.chadwick@bangor.ac.uk (D. Chadwick), stefania.colombini@unimi.it (S. Colombini), valborg.kvakkestad@nibio.no (V. Kvakkestad), lampros.lamprinakis@nibio.no (L. Lamprinakis), vibeke.lind@nibio.no (V. Lind), martina.pavesi@unimi.it (M. Pavesi), prysor.williams@bangor.ac.uk (P. Williams), s.wynne-jones@bangor.ac.uk (S. Wynne-Jones).

https://doi.org/10.1016/j.jrurstud.2026.104050
Received 14 October 2025; Received in revised form 9 January 2026; Accepted 22 January 2026
Available online 29 January 2026

practices is provided in Evans et al. (2025). However, despite the technical feasibility of many circular and mitigation practices, uptake remains uneven, suggesting that policy ambition alone is insufficient to drive change.

A growing body of research indicates that farmers' decisions are shaped by more than economic incentives or regulatory requirements, reflecting a complex interplay of psychological, social, structural and contextual factors (Burton, 2014; Dessart et al., 2019; Prokopy et al., 2008). Central to this process is farmer sentiment (emotions, feelings, moods), which mediates how information, policies and technologies are interpreted and acted upon (Gosling et al., 2020; Lerner et al., 2015). Far from undermining rational decision-making, emotional responses can enhance judgement and strongly influence behavioural outcomes (Seo and Barrett, 2007), particularly in family farming contexts (Holloway et al., 2021) and in relation to innovation and sustainability transitions (Rieple and Snijders, 2018). Yet, the emotional and socio-psychological dimensions of circular agriculture remain underexplored, especially across differing national contexts.

Existing research on circular agriculture has primarily focused on technical potential, environmental outcomes and economic incentives, often treating farmer behaviour as a rational response to policy or market signals (Dagevos and de Lauwere, 2021; de Lauwere et al., 2022; Ghisellini and Ulgiati, 2020; Rótolo et al., 2022). While recent studies increasingly acknowledge the importance of attitudes and social factors, emotional and socio-psychological dimensions are frequently addressed in isolation or as secondary considerations, rather than as integral to decision-making processes.

In contrast, the rural sociology and decision-making literature has long emphasised the central role of farmer identity in shaping behaviour, particularly through socially embedded notions of the 'good farmer' and culturally valued farming practices (Burton, 2004; Shortall, 2022; Sutherland, 2013). These studies highlight how identity-based norms and peer recognition influence emotions, legitimacy and willingness to adopt new practices. However, it remains largely unexplored how circular farming practices align—or conflict—with farmers' identities, and how such alignment shapes sentiment and readiness to engage with circularity. Moreover, there is limited comparative evidence on how these socio-psychological and contextual dynamics operate across differing institutional, cultural and agroecological settings. As a result, it remains unclear why similar circular agriculture narratives and policy instruments generate divergent responses across countries.

To address this gap, this study examines the following research questions: (1) How do emotional, psychological and contextual factors jointly shape farmer sentiment and decision-making regarding circular farming practices? and (2) How do these dynamics differ across contrasting national contexts in Italy (an EU member), Norway and the UK? By answering these questions, the study contributes to a more nuanced understanding of farmer engagement with circular agriculture and offers insights relevant for both theory development and policy design.

Sentiment analysis—also known as opinion mining—is a technique in Natural Language Processing (NLP) that automatically identifies and interprets the emotional tone or attitude expressed in text. Originally developed for the business sector and social media analysis, sentiment analysis has since been applied across various domains, including the analysis of interview transcripts (Duncan et al., 2024). While its application in rural and agricultural social science research is relatively novel (Mahon et al., 2023), its potential is increasingly being recognised (Bermeo-Almeida et al., 2019).

In agriculture, sentiment analysis has provided valuable insights into public and farmer perceptions on topics such as precision agriculture (Ofori and El-Gayar, 2021), adoption of agricultural technologies (Yadav et al., 2023), antibiotic use in livestock (Steede et al., 2018) and One Health policies (Dicks et al., 2021). These studies highlight its potential to identify concerns, improve communication and inform decision-making to support sustainable practice adoption.

To interpret these insights within a structured behavioural framework, the COM-B (Capability/Opportunity/Motivation-Behaviour) model (Michie et al., 2011) offers a useful lens (Ambrose-Oji et al., 2022; Farrell et al., 2023; Regan et al., 2020). The COM-B model recognises that behaviour is shaped by three interrelated components:

- Capability: Farmers' knowledge systems, including traditional and tacit knowledges (Ingram, 2008a, 2008b; Šūmane et al., 2018),
- Opportunity: External factors such as biophysical characteristics, policy frameworks, market conditions and social norms, and
- Motivation: Emotional responses and perceptions relating to perceived impacts of proposed changes, directly tied to sentiment and shaped by capability and opportunity.

Applied to farmers' perceptions of circular practices, this approach could help identify key communication challenges—such as misalignments with existing knowledge and limited awareness of broader co-benefits—as well as practical barriers and enablers to adoption. A mixed-methods approach combining sentiment analysis with thematic analysis has been shown to provide a comprehensive framework for examining decision-making processes (Funnell et al., 2022; Mogaji et al., 2021; Olagunju et al., 2020). Sentiment analysis can identify overarching patterns in farmers' emotions, while thematic analysis offers deeper insights into the contextual and cognitive factors influencing these sentiments.

The aim of this study was to gain an improved understanding of the factors influencing farmers' sentiment and decision-making towards adopting circular practices across diverse national contexts. To achieve this, semi-structured interviews and focus groups were conducted with a total of 96 farmers and industry representatives in Italy, Norway and the UK. Sentiment and thematic analyses were combined to identify key drivers of decision-making among diverse stakeholders. The findings offer insights to inform culturally-sensitive policies, targeted incentives and more effective communication strategies to enhance positive emotions and support the adoption of circular practices, contributing to rural development, sustainable agriculture and GHG emission reduction efforts across Europe.

2. Materials and methods

2.1. Case study contexts

A comparative analysis of farmers' sentiment and decision-making on adopting circular farming practices in Italy, Norway and the UK offers valuable insights into how diverse farming systems, policy frameworks and social norms, among other factors, shape adoption. These countries were selected for their contrasting agricultural landscapes and distinct climatic, cultural, economic and political contexts, providing a strong basis for context-specific policy development and cross-border knowledge exchange.

Italy's Mediterranean agriculture combines speciality crops safeguarded by the EU's Protected Designation of Origin (PDO) system with a significant livestock sector, which accounts for 28 % of total national agricultural production (ISTAT, 2025). Farming is regionally specialised: northern regions focus on more intensive dairy, beef, pig and poultry production, while southern regions and islands (Sardinia, Sicily) emphasise small ruminant (sheep and goat), especially for dairy. Italian farmers benefit from the EU single market and Common Agricultural Policy (CAP) support through direct payments and rural development programmes, enhancing income stability. However, region-specific environmental challenges, such as water scarcity and soil erosion, necessitate tailored circular practices for sustainable agriculture.

Norway has one of the most highly supported agricultural sectors among OECD countries (Kvakkestad et al., 2015), with around 51 % of farm revenue (2020–22) from support measures such as border protection, market regulation and area- or livestock-linked payments (OECD, 2023), substantially higher than the EU (16 %) or UK (19 %) (OECD, 2023). Farms are relatively small, with only 40 % of national human calorie consumption produced domestically (Finci et al., 2023) due to the cold climate and limited arable land (3 % of land cover). Agriculture contributes roughly 10 % of national GHG emissions (Statistics Norway, 2024), and policy goals focus on food safety, emergency preparedness, maintaining agriculture throughout the country, value creation and sustainable, low-emission agriculture (Ministry of Agriculture and Food, 2024).

The UK presents a mix of intensive and extensive farming systems, with policy and trade landscapes undergoing significant changes post-Brexit and leaving the CAP. Each devolved nation is implementing new agricultural policies that prioritise environmental outcomes (e.g. Sustainable Farming Incentive (SFI) in England, Sustainable Farming Scheme (SFS) in Wales), adjusting to the absence of EU subsidies and developing strategies to address emerging trade relationships. These shifts provide a unique context for understanding how policy transformations may influence farmers' decision-making.

2.2. Data collection

Semi-structure interviews and focus groups were conducted in 2023–24 with early-adopter farmers—those who had implemented one or more of the prioritised circular practices listed in Table 2—as well as with industry experts, including policymakers, state administrators, researchers, advisory services, farmers' unions, veterinarians, agronomists, livestock nutritionists and supply chain actors. Farmer participants were selected using a purposive sampling strategy to capture diversity across key characteristics, including farm size and enterprise type (e.g. livestock, arable, mixed systems) within each country. Participants therefore represented a range of farming systems and socio-economic contexts across Italy, Norway and the UK (Table 1).

In each country, participants were recruited via 'gatekeeper' organisations—such as farming unions and representative bodies—as well as through researchers' existing networks, enabling access to farmers actively engaged with circular practices while maintaining diversity across the sampling frame. Interviews and focus groups were coordinated by local research teams, allowing discussions to take place in stakeholders' native languages. This helped preserve cultural nuances and emotional undertones, facilitating clearer communication, reducing cognitive strain and potentially encouraging more detailed and honest insights (Rhisiart et al., 2022). To ensure consistency and reliability of results, data collection was conducted following a standardised approach across the three countries.

In the UK, a larger budget and longer fieldwork period enabled in-depth, one-to-one interviews with farmers, allowing for deeper exploration of individual perspectives. In Italy and Norway, more limited time and resources necessitated the use of focus groups, which provided an efficient means of engaging multiple participants while also enabling interaction, discussion and the articulation of shared norms and points of divergence. While these approaches differ in format, both are well-established qualitative methods for examining farmer perspectives and

Table 1
Data collection engagement and stakeholder characteristics across the countries.

Country	Data Collection Method	Participants
Italy	Focus groups	13 industry and policy representatives (1 focus group) and 7 farmers from diverse systems (1 focus group)
Norway	Focus groups and semi-structured interview	9 industry and policy representatives (1 focus group), 34 farmers (2 focus groups in contrasting farming regions and 1 interview)
UK	Focus groups and semi-structured interviews	16 industry and policy representatives (2 focus groups) and 17 farmers from diverse systems (interviews)
		Total farmers = 58, Total industry = 38, Total participants = 96

Table 2
Prioritised circular farming practices explored in interviews and focus groups, listed by country.

Category	Circular practice	Description	Country prioritised list
Resource efficiency	Precision agriculture	Reduce the use of external inputs through precision agriculture (including better utilisation of fertiliser).	Norway
	Slurry (solid-liquid) separation	Includes mechanical methods, but also new technologies that can recover more nutrients and wastewater.	Italy, UK
	Anaerobic digestion	Includes treatment of organic by-products and waste in on-farm or centralised biogas plant to produce digestate (biofertiliser) and bioenergy.	Italy, Norway, UK
	Water management	Includes rainwater harvesting and reuse of treated wastewater, separating clean and dirty water, and improving water use efficiency.	Italy, UK
Soil and crop management	Clover	Growing clover to biologically fix nitrogen.	Norway
	Cover crops	e.g. legumes, brassicas, herbs, grasses, cereals – includes use as green manures, AD feedstock or livestock feed.	Italy, UK
	Pollinator strips	Sowing and managing strips of pollinator-friendly seed mixes on agricultural land to increase biodiversity.	Norway
	Soil health and carbon	Better soil health and carbon sequestration by using biochar, catch crops and improved grazing management.	Norway
	Composting	Includes treatment of organic by-products and waste, on-farm or centralised, in windrows, piles or sheeted (e.g. reused silage sheet).	Italy, UK
	Apply recycled biosolids	Nutrient-rich organic materials resulting from the treatment of domestic sewage in a wastewater treatment facility applied as an organic fertiliser and soil conditioner.	Italy, UK
Livestock and feed systems	Better grass yields	Improving the quality and productivity of grass through enhanced management practices, such as optimised grazing, fertilisation and reseeding, to increase forage availability, support livestock nutrition and promote sustainable land use.	Norway
	Enhance use of land and feed resources	Includes precision feeding, nutrition, feed efficiency and lifetime productivity (and quality) of livestock systems, grazing management and increasing legumes in	Italy

(continued on next page)

Table 2 (*continued*)

Category	Circular practice	Description	Country prioritised list
		rotation to reduce imported soybeans.	
	Pasture and feed efficiency	Improve the use of pasture and feed resources (e.g. precision feeding, use and management of pastures).	Norway
	Alternative feed ingredients	Includes crop residues and cover crops, waste and by-products from food processing, and new technologies such as turning food waste into insect protein and growing duckweed in slurry.	Italy, Norway, UK
	Replace suckler with dual-purpose cow	Combined milk and meat production (replacing suckler cow production).	Norway
	Mixed crop-livestock system	A system that grows crops and raises livestock on the same farm or on neighbouring farms within a region.	UK
Collaboration and rural development	Sharing resources	Sharing, swapping and contracting labour, machinery and resources to minimise farm expenses and enhance farmer wellbeing through social connections.	Italy, UK
	Rural economy	Support the local economy and living rural communities through tourism, farm shops, support for local entrepreneurs and businesses.	Norway
	Renewable energy	e.g. solar PV, wind turbines, hydroelectricity – for self-sufficiency and to sell to the grid.	Italy, Norway, UK

sentiment. Importantly, data collection across all three contexts was guided by a common topic guide and analytical framework, ensuring conceptual consistency and comparability. This mixed qualitative design reflected contextual constraints while allowing for rich and complementary insights into farmer sentiment and decision-making across contrasting national settings.

Each interview and focus group began with a 5-min animated video introducing the principles and practices of circular agriculture. The video, originally in English, was translated into Norwegian and Italian to ensure consistent presentation of circularity to all stakeholders. Researchers from each country selected and prioritised 10 or 11 circular practices, tailored to reflect the practices most relevant to their farmers and farming systems. The prioritised practices for each country varied slightly and are detailed and categorised in Table 2.

Reactions were initially coded by specific circular practices, then grouped analytically into four broader categories for cross-country comparison: collaboration and rural development, livestock and feed systems, resource efficiency, and soil and crop management (Table 2). These categories were developed by the researcher and not presented to farmers or industry stakeholders. Categorisation was based on how farmers themselves framed the practices. For instance, the inclusion of clover in grazed pastures was discussed primarily in relation to soil health and crop productivity and was therefore grouped under 'soil and crop management' rather than 'resource efficiency'—the latter would have been more appropriate had farmers emphasised its role in reducing mineral fertiliser use.

The interviews and focus groups explored stakeholders' perceptions of circular practices, presented as prioritised lists for each country (Table 2). Key areas of questioning included:

- Key factors underpinning the uptake of circular practices
- Limitations/barriers to uptake
- Why farmers have moved away from circular practices (where relevant)
- Existing collaborative practices and social networks
- Future opportunities for enhanced uptake of circular practices

2.3. Data preparation for sentiment analysis

Focus groups and interviews were digitally recorded, transcribed verbatim and translated to English. To ensure participant confidentiality, all identifying information was removed from the transcripts. The transcripts were then cleaned and formatted for analysis, which included removing irrelevant side conversations, interviewer questions, prompts or explanations (unless providing necessary context), as well as repeated phrases or filler words that did not contribute to sentiment. The data were subsequently organised in Microsoft Excel®, with each row representing an individual stakeholder and containing all associated text relating to each specific circular practices, ranging in length from single sentences to full paragraphs.

2.4. Sentiment analysis

Sentiment analysis, leverages NLP to evaluate the emotional tone of text, typically identifying how positive or negative it is (Sánchez-Rada and Iglesias, 2019; Sharma and Goyal, 2023). This study employed the VADER (Valence Aware Dictionary for sEntiment Reasoning) lexicon—a rule-based tool validated by human raters and shown to perform well across domains (Hutto and Gilbert, 2014). VADER assigns sentiment intensity scores to words, adjusted using heuristics such as punctuation, capitalisation, modifiers (e.g. "very") and negation.

The sentiment analysis was conducted using Orange Data Mining (version 3.38; 2024), an open-source toolkit for data visualisation, machine learning and data mining. Pre-processed interview transcripts were imported into Orange as a text corpus. The *Text Preprocessing* widget in Orange was used to prepare interview transcripts for sentiment analysis. This involved several key steps to clean and standardise the textual data, ensuring consistency and improving the accuracy of the analysis. First, all text was converted to lowercase to avoid treating the same word in different cases as separate tokens. Then, tokenisation was applied to split the text into smaller units (individual words or phrases), which is essential for analysing text at a granular level. A filtering step followed, which involved uploading a manually curated stopwords file to remove common, non-informative words (e.g. "the", "and", "it") that might obscure key patterns. Finally, normalisation techniques—including stemming (reducing words to their root form, e.g. "farming" to "farm") and lemmatisation (converting words to their dictionary form, e.g. "better" to "good")—were applied to standardise different forms of the same word, making it easier to compare terms across the dataset. These preprocessing steps ensured that the data fed into the sentiment analysis was clean, consistent and analytically meaningful.

The *Sentiment Analysis* widget was applied to the corpus using the VADER lexicon (Hutto and Gilbert, 2014), assigning predefined sentiment values to words. Each farmer's response to a specific circular practice was treated as a separate document for analysis. Sentiment analysis generated four scores for each text: positive, negative, neutral and compound. The compound score is a normalised, weighted composite that summarises the overall sentiment, ranging from −1 (most negative) to +1 (most positive). This score integrates the individual positive, negative and neutral values into a single metric. The compound score was used to assign an overall sentiment label to each response and served as the basis for subsequent analysis.

Two methodological limitations should be acknowledged in relation to the sentiment analysis. Because the VADER lexicon is based on English vocabulary, interviews and focus group discussions were translated into English prior to analysis. Translation was undertaken by native speakers of the source languages and subsequently checked by a native English speaker to preserve meaning; nevertheless, some linguistic and cultural nuances—particularly those related to emotional expression—may have been attenuated in the process. As VADER was developed for general English-language text, it may also be less sensitive to domain-specific language or subtle emotional overtones present in translated agricultural discourse.

Accordingly, sentiment scores are interpreted as indicative patterns rather than precise measures of emotional intensity. To address this limitation, sentiment analysis was combined with qualitative thematic analysis, enabling emotional patterns identified computationally to be contextualised and interpreted using participants' narratives. Importantly, thematic coding was conducted independently of the sentiment analysis; sentiment patterns did not inform the coding process but were applied as a complementary, parallel diagnostic tool to support interpretation of findings (Fig. 1).

2.5. Thematic analysis

All interview and focus group transcripts were analysed using Braun and Clarke's (2006, 2013) six phase reflexive approach to thematic analysis. As outlined earlier, the COM-B model (Michie et al., 2011) provided a structured and consistent framework for coding and analysis of the data. The primary analysis was conducted by the first author, with research team members from each country reviewing and cross-checking the coding to ensure accurate and contextually meaningful representation of key themes.

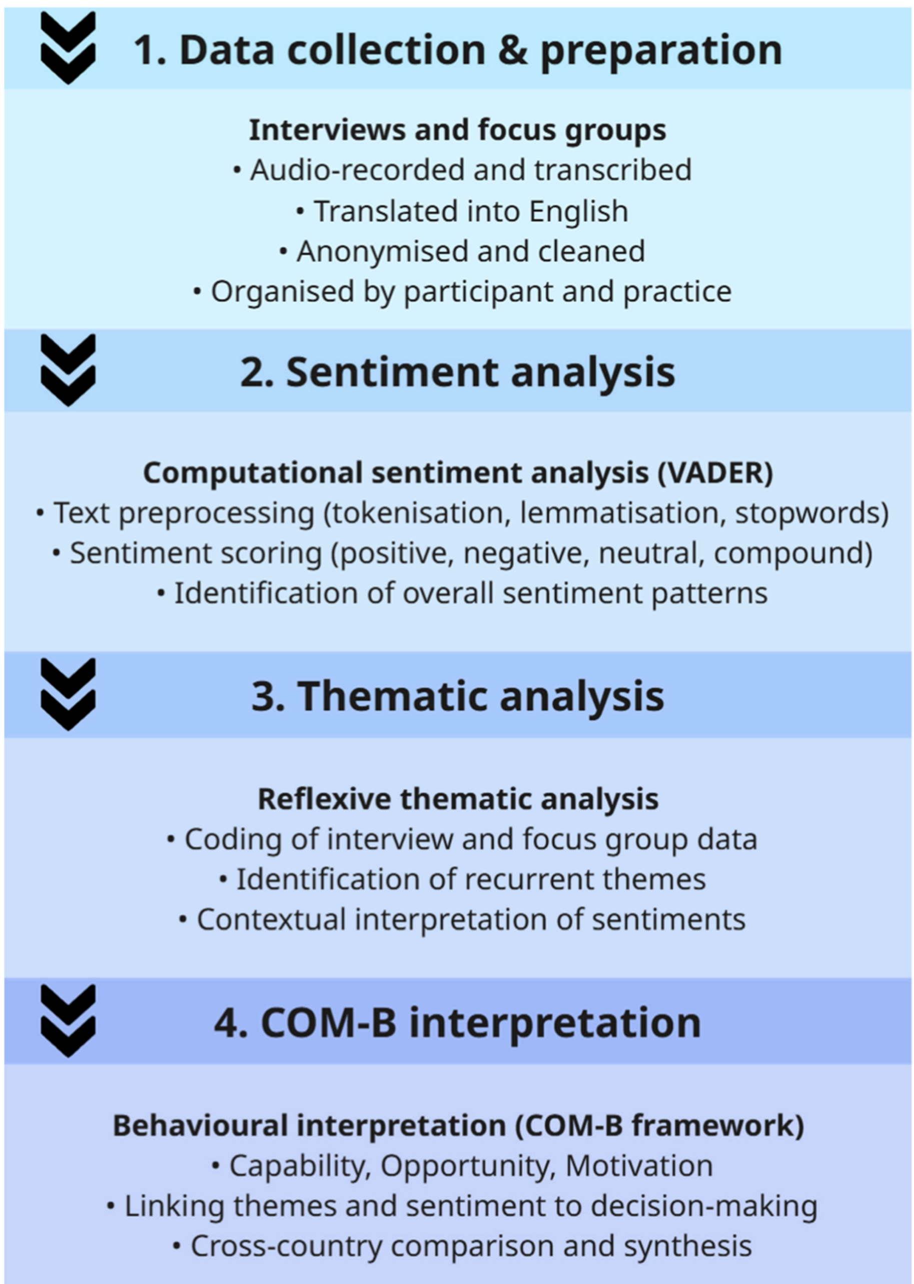

Fig. 1. Analytical workflow illustrating the integration of sentiment analysis, thematic analysis and the COM-B framework.

2.6. Statistical analysis

A three-way analysis of variance (ANOVA) was conducted in R (R Core Team, 2023) to evaluate the effects of circular practice category, country and stakeholder type (farmer versus industry) on mean compound sentiment scores for specific circular practices. The three-way ANOVA tested for main effects and interaction effects among variables. Where significant effects were detected, post-hoc comparisons were carried out using Tukey's Honest Significant Difference (HSD) test (Tukey, 1949). Bonferroni-corrected t-tests were applied to further explore significant interactions (Armstrong, 2014). To determine whether sentiment score distributions deviated significantly from symmetry around the sample mean, a Wilcoxon signed-rank test was employed (Wilcoxon, 1992). Statistical significance was defined as $p < 0.05$.

The results were visualised using line plots generated in R (R Core Team, 2023) to illustrate sentiment scores related to circular farming practices (integrating the prioritised lists from each country). Complementing this, the qualitative thematic analysis, structured by the COM-B model (Michie et al., 2011), provided deeper insights into sentiment scores, identifying the factors influencing farmers' sentiment and decision-making.

3. Results

3.1. Sentiment towards circular farming practices

Sentiment analysis showed similar distributions of positive, negative and neutral sentiments across circular practice categories, countries and stakeholder types (Fig. 2). However, compound sentiment scores varied significantly (Fig. 2 and Table 3).

Median compound sentiment scores appear to be slightly higher than the mean (Table 3), suggesting that a small number of strongly negative responses may have skewed the mean downward, moderating the overall positive tone associated with certain practices. However, this difference between the mean and the median was not statistically significant based on the Wilcoxon signed-rank test ($p = 0.336$).

A three-way ANOVA assessed the effects of circular practice category, country and stakeholder type on mean compound sentiment scores (Table 4). The ANOVA revealed a statistically significant main effect of country ($F(2, 207) = 6.148$, $p = 0.003$). Tukey's HSD post-hoc test showed that scores were significantly higher in the UK compared to Norway (mean difference = 0.25, $p = 0.002$), while other pairwise comparisons between countries were not significant ($p > 0.05$; Table 4).

A significant interaction effect between country and stakeholder type ($F(2, 207) = 4.775$, $p = 0.009$) indicated that the effect of stakeholder type on sentiment varied by country. Bonferroni-corrected t-tests confirmed a significant difference between UK and Norwegian farmers ($p < 0.001$), while all other pairwise comparisons between country and stakeholder types were not statistically significant ($p > 0.05$). Stakeholder type and circular practice category showed no significant main effects, and no other interactions were significant (all $p > 0.05$; Table 4).

Overall, sentiment towards circular farming practices was generally positive across stakeholders, with UK farmers expressing the highest mean compound sentiment score (0.65), followed by Italian farmers (0.42) and Norwegian farmers (0.27). No significant differences were observed between different circular practices categories, suggesting that all practices were perceived as broadly valuable. Stakeholder sentiment within each country was generally aligned, indicating a shared perspective between farmers and industry representatives. These quantitative patterns provided a foundation for the subsequent thematic analysis, which explored the factors shaping stakeholder sentiment.

3.2. Key factors influencing farmer sentiment and decision-making

Table 5 integrates sentiment analysis with key thematic factors to clarify their influence on decision-making. As these factors emerged across all countries and stakeholder groups—albeit to varying

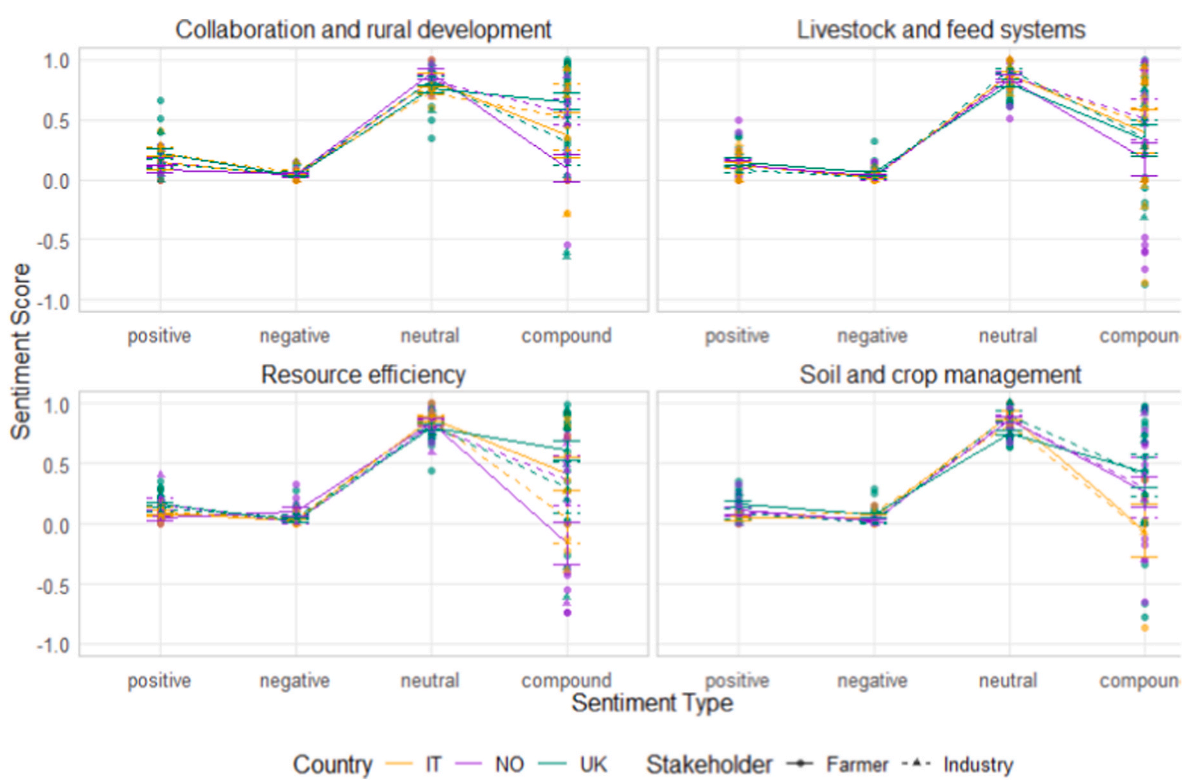

Fig. 2. Line chart showing mean sentiment scores with standard deviations (error bars) across circular practice categories, countries and stakeholder types for each sentiment type.

Table 3
Descriptive statistics for median and mean compound sentiment scores, and standard deviations (SD), across four circular practice categories, three countries and two stakeholder types, including the number of stakeholder observations used to calculate these scores.

Country	Circular practice category	Farmers				Industry/policy representatives			
		Median compound score	Mean compound score	SD	Number of stakeholders	Median compound score	Mean compound score	SD	Number of stakeholders
UK	Collaboration and rural development	0.76	0.65	0.30	21	0.66	0.32	0.57	9
	Livestock and feed systems	0.27	0.33	0.53	17	0.46	0.36	0.39	9
	Resource efficiency	0.79	0.61	0.35	21	0.35	0.30	0.55	8
	Soil and crop management	0.56	0.43	0.54	19	0.36	0.40	0.40	6
Norway	Collaboration and rural development	0.00	0.10	0.33	9	0.52	0.56	0.22	5
	Livestock and feed systems	0.24	0.17	0.57	18	0.46	0.50	0.38	6
	Resource efficiency	−0.38	−0.16	0.53	10	0.51	0.36	0.47	6
	Soil and crop management	0.36	0.27	0.46	14	0.30	0.31	0.44	4
Italy	Collaboration and rural development	0.39	0.37	0.42	6	0.72	0.52	0.48	4
	Livestock and feed systems	0.59	0.40	0.53	10	0.59	0.46	0.42	11
	Resource efficiency	0.57	0.42	0.40	9	0.27	0.06	0.31	3
	Soil and crop management	0.03	−0.05	0.43	5	−0.08	−0.08	0.00	1

Note: The total number of stakeholder observations may exceed the number of stakeholders interviewed in each country, as individuals could provide input on multiple circular practices within each category.

Table 4
Three-way ANOVA results showing the main and interaction effects of circular practice category, country and stakeholder type on mean compound sentiment scores derived from sentiment analysis.

Source	*df*	*SS*	*MS*	*F*	*p*
Country	2	2.83	1.4143	6.148	0.002**
Stakeholder (type)	1	0.05	0.0458	0.199	0.656
Circular practice (category)	3	0.44	0.1473	0.640	0.590
Country × Stakeholder	2	2.20	1.0983	4.775	0.009**
Country × Circular practice	6	2.36	0.3927	1.707	0.121
Stakeholder × Circular practice	3	0.25	0.0846	0.368	0.776
Country × Stakeholder × Circular practice	6	1.17	0.1942	0.844	0.537
Residuals	207	47.61	0.2300		

Note: *df* = degrees of freedom; *SS* = sum of squares; *MS* = mean square; *F* = F-statistic; *p* = p-value. Significance codes: **p < 0.01.

degrees—they point to shared underlying drivers of sentiment and decision-making around circular practices. The following section explores these factors in detail, linking them to sentiment scores.

3.2.1. *Collaboration and rural development*

The *Collaboration and Rural Development* category—which encompassed practices such as resource sharing in Italy and the UK, support for local food networks in Norway, and the adoption of renewable energy across all three countries—received the highest mean compound sentiment score in the dataset (0.65) among UK farmers. It was also rated most positively by industry representatives in Norway (0.56) and Italy (0.52) (Table 3).

UK farmers expressed strong positive sentiment towards collaboration with neighbours, particularly through contracting and machinery sharing. These arrangements were perceived as mutually beneficial, improving efficiency, resilience and community support. Such collaborative practices represent a clear social opportunity within the COM-B model, enabling behaviour by fostering supportive relationships and shared resources within local farming networks: *"We do a lot of resource-sharing with five farms right around us [...] We know who to call when we need help. They know who to call when they need help" (UK Farmer 13).* There was also enthusiasm for cooperative renewable energy projects, with social values being a key motivator: *"It would be nice to do something like that* [local, cooperative renewable energy generation] *where everyone benefits" (UK Farmer 17).*

Industry representatives reinforced the broader cultural and knowledge-sharing opportunities of collaboration and rural development. An Italian industry stakeholder noted that resource-sharing could foster peer-to-peer networks and facilitate knowledge exchange: *"Sharing resources is also important in a cultural perspective of networking and competence sharing" (IT Industry 10).* This suggests that collaborative approaches could enhance social opportunity and serve as a foundation for broader sustainability initiatives, encouraging farmers to engage with new practices through established relationships.

In Norway, collaboration and local networks were viewed positively by an industry representative, who linked this aspect of circularity to culturally valued practices such as small-scale and local food production: *"Local food producers, small-scale production, farm shops etc., that type of thing is more circular" (NO Industry 6).* This suggests that positive sentiment towards circular farming may be stronger when practices align with existing knowledge systems and values, potentially enhancing stakeholders' psychological capability and reflective motivation—two key components of the COM-B model—to engage.

3.2.2. *Livestock and feed systems*

Mean compound sentiment score for the *Livestock and Feed Systems* category ranged from 0.17 among Norwegian farmers to 0.50 among Norwegian industry representatives (Table 3). Among UK farmers, this

Table 5
Summary of the key factors influencing farmer sentiment and decision-making towards adopting circular practices, organised by the COM-B model and coded sub-themes.

Capability	Opportunity	Motivation
Positive sentiment		
• **Alignment with existing knowledge** (e.g. local food production in Norway; anaerobic digestion in Italy; cover crops in the UK)	•**Collaboration** (e.g. resource sharing in the UK and Italy) • **Regulatory compliance** (e.g. slurry separation in Italy)	• **Social values** (e.g. renewable energy in the UK; local food production in Norway) • **Environmental values** (composting in the UK and Norway) • **Economic resilience and self-sufficiency** (e.g. anaerobic digestion in Italy)
Negative sentiment		
• **Misalignment with existing knowledge** (e.g. dual-purpose (milk-meat) cows in Norway; pollinator strips in Norway) • **Additional skillset and workload** (e.g. mixed crop–livestock systems in the UK)	• **Impractical government policies** (e.g. cover crops in Italy) • **Farming system and regional (biophysical) limitations** (e.g. mixed crop–livestock systems in the UK; grassland improvement practices and pollinator strips in Norway) • **High capital investment costs** (e.g. insect feed in the UK and Italy; anaerobic digestion and barn construction to support dual-purpose (milk-meat) cows in Norway) • **Low social acceptance** (e.g. slurry separation in Norway)	• **Socio-economic trade-offs** (e.g. dual-purpose (milk-meat) cows in Norway)

category received the lowest mean compound sentiment score (0.33), yet it remained higher than the highest-scoring circular practice category for Norwegian farmers. Italian farmers (0.40) and industry representatives (0.46) expressed favourable sentiment toward this category, especially the use of alternative feed ingredients.

In the UK, negative sentiment towards mixed crop–livestock systems often stemmed from physical opportunity barriers, such as unsuitable climate, soil and topography to grow crops, particularly in Wales. Some farmers also viewed the practice as requiring new skills and increased labour, highlighting a physical capability barrier. Similarly, scepticism around alternative feeds—such as replacing soya with insects for poultry—reflected physical opportunity constraints, including high capital investment and restrictive policy environments. These concerns were echoed in Italy: *"A limit to the insect meals is related to the legislative intervention […] and the costs are increasing" (IT Industry 1)*.

Negative sentiments among Norwegian farmers towards this category stemmed from a perceived misalignment between some circular practices and their existing knowledge, representing a psychological capability barrier to engagement. In particular, the suggested shift from suckler cow production to dual-purpose (milk-meat) cows conflicted with established experience and expertise. Farmers did not view suckler cow systems as incompatible with circular principles and felt the proposed shift overlooked key sustainability aspects: *"I don't see suckler cow production as a villain when it comes to circular thinking. Switching to milk production and relying on more external inputs, as feed demanding as it is […] It's strange it's on the list at all" (NO Farmer 25)*. This highlights the need to align circularity strategies with farmers' perspectives, enhancing their psychological capability to engage and avoiding practices that could unintentionally stigmatise or alienate certain production systems. Additionally, high barn construction costs were cited as a key argument against the adoption of dual-purpose cows in Norway. Given the high costs associated with agricultural infrastructure, particularly barn construction, it becomes more economically viable to keep high-yielding dairy cows to maximise returns on investment. This represents a physical opportunity barrier, as the high capital costs constrain farmers' ability to adopt alternative, lower-yield systems such as dual-purpose breeds.

Some Norwegian farmers viewed the adoption of grassland improvement practices as unnecessary in regions where grass supply already exceeded demand. This perceived lack of practical benefit represents a physical opportunity barrier to engagement, as regional biophysical conditions and current farming system needs did not justify the effort or investment required: *"There are large parts of northern Norway where the problem isn't that we don't produce any grass, but that we don't have use for all the grass. No one is cutting grass, so areas are going out of use." (NO Farmer 24)*. This surplus contributed to land abandonment and potential broader socio-economic challenges, such as the loss of (traditional) agricultural landscapes and rural depopulation (van der Zanden et al., 2017). Such outcomes conflicted with farmers' values (Kvakkestad et al., 2015), representing a reflective motivation barrier to engagement. While generating a negative sentiment here in the context of circularity, abandoned land has the potential to make an important contribution to carbon sequestration and wider biodiversity and environmental policy goals, if managed accordingly (Fayet et al., 2022a; van der Zanden et al., 2017).

While industry representatives expressed greater acceptance (higher sentiment score) of dual-purpose cow production, they also acknowledged potential socio-economic trade-offs, particularly job losses due to increased efficiency and centralisation: *"Combined milk and meat production. Even I could agree, but then it has gone in a different direction because people have specialised and made it more efficient and centralised production on fewer hands" (NO Industry 5)*. This underscores the importance of considering broader socio-economic impacts when promoting circular practices, ensuring that proposed changes do not inadvertently accelerate farm consolidation or reduce rural employment. Such outcomes may conflict with farmers' values and Norwegian policies which give high priority to supporting rural communities (Hemmings, 2016), thereby representing a potential reflective motivation barrier to engagement.

3.2.3. *Resource efficiency*

The *Resource Efficiency* category had the highest mean compound sentiment score among Italian farmers (0.42). In contrast, Norwegian farmers expressed the most negative sentiment toward this category, with a mean compound score of −0.16, the lowest across the entire dataset (Table 3). This likely reflects differences in farming system intensity—higher in Italy and lower in Norway—leading to varying needs for improving resource efficiency.

Italian farmers expressed positive sentiments towards circular practices such as anaerobic digestion and slurry separation, reflectively motivated by their economic and environmental ('win-win') benefits: *"I see it* [anaerobic digestion] *as an opportunity, as an economic advantage […] probably gives big advantages on emission reduction" (IT Farmer 7)*. Anaerobic digestion also aligned well with their understanding of sustainable resource management, enhancing their psychological capability to engage: "[Anaerobic digestion] *is also a circular approach, because then the energy is used, the digestate is used as fertiliser" (IT Farmer 1)*. Similarly, solid-liquid slurry separation was valued for easing manure disposal challenges, particularly for farmers with limited land, representing a physical opportunity to act: *"This [solid-liquid slurry separation] lightens us a little of disposal conventions, because we do not have a lot of land" (IT Farmer 7)*. Overall, these practices were well understood and perceived as practical solutions that improve resource efficiency, reduce environmental impact and support regulatory compliance, addressing all three COM-B components (capability, opportunity and motivation) and thereby enabling adoption.

Conversely, many Norwegian farmers expressed negative sentiments towards circular practices in this category, particularly precision agriculture for organic manure management, anaerobic digestion and slurry separation. This likely reflects limited physical opportunity to act, given the low livestock densities and small farm sizes in the studied areas of Tynset and Alstahaug, which result in insufficient manure volumes to provide a viable feedstock for economically sustainable anaerobic digestion. Other key concerns included high implementation (capital investment) costs and low social acceptance, limiting their opportunity to adopt. One farmer acknowledged the benefits of slurry separation but noted the stigma surrounding its use: *"We have started to separate the manure to improve its utilisation. We've tried it as bedding too, but not everyone wants to use it … we mix a little in the chippings, so it doesn't look so bad" (NO Farmer 14)*. These responses highlight both practical and social (opportunity) barriers that may contribute to farmers' negative sentiments, emphasising the need for targeted financial support and communication strategies to improve acceptance.

3.2.4. Soil and crop management

The *Soil and Crop Management* category had the highest mean compound sentiment score among UK farmers (0.43) and was the most positively rated category for Norwegian farmers (0.27). In contrast, Italian farmers expressed a slightly negative sentiment (−0.05), primarily due to concerns over restrictive policies on cover crop use.

Norwegian farmers expressed positive sentiments towards using clover and composting, valuing their alignment with traditional knowledge and self-sufficiency. This familiarity supported psychological capability and reinforced reflective motivation to engage. One farmer linked clover use to past 'good farming' practices: *"I'd like to see more clover back in the meadow. We've been good at it in the past" (NO Farmer 8)*. Similarly, a UK farmer connected cover crops to circularity principles, demonstrating alignment with existing knowledge and thereby supporting psychological capability to engage: "[Cover crops] *does good to the soil. Then, the sheep graze it and put nutrients back into the field" (UK Farmer 9)*. Composting was also seen as beneficial for soil health and reducing reliance on external inputs, reflectively motivating adoption in both countries.

However, Norwegian farmers were sceptical about pollinator strips, particularly in naturally biodiverse regions. One farmer questioned their relevance in certain landscapes: *"I understand it* [pollinator strips] *in monocultures in eastern Norway, but not up here in Nordland, where there are scattered small plots and weeds on every other field" (NO Farmer 24)*. This highlights the importance of aligning circular practices with regional contexts and farmers' existing knowledge systems to strengthen physical opportunity and psychological capability and thereby enhance engagement.

Italian farmers expressed frustration with restrictive CAP regulations, which were seen to limit physical opportunity and add complexity to cover crop management, thereby hindering adoption: *"In recent years, the CAP has imposed increasingly restrictive regulations, sometimes making it very difficult to manage cover crops" (IT Farmer 2)*. One farmer criticised impractical rules, stating: *"I can't use cover crops. I must buy seed, but I'm not allowed to harvest or graze the* [cover] *crop, so it doesn't make a lot of sense for me" (IT Farmer 6)*. Another rejected the requirement to plough cover crops, arguing: *"It is absolutely useless to use cover crops like that" (IT Farmer 5)*. These perceptions of cover cropping as illogical or ineffective indicate a misalignment with farmers' existing knowledge and experience, undermining both their psychological capability and reflective motivation to engage — *"unless they* [farmers] *are paid" (IT Farmer 6)*.

Similarly, a UK farmer criticised grant scheme conditions that conflicted with their environmental values: *"I got a grant to put a diverse* [multi-species] *ley in. I hadn't read the small print, and I found out that you must spray 'Round-up'* [glyphosate herbicide] *on the field. I refused to do it. It's stupid" (UK Farmer 16)*. These responses highlight a disconnect between policy and practical farming realities, where misaligned requirements create opportunity barriers to adoption and generate negative sentiment.

4. Discussion

This section integrates findings from the sentiment and thematic analyses, exploring the relationship between influential factors, sentiment and decision-making. It also highlights key policy implications and recommendations for supporting farmers in adopting circular farming systems across Europe (Table 6).

Strong negative sentiment was most commonly associated with three key COM-B barriers (Table 6). First, capability barriers arose when circular practices misaligned with farmers' existing knowledge systems, underscoring the need for flexible, contextually framed 'toolbox' approaches that allow adaptation. Second, opportunity barriers emerged when practices did not fit with local landscapes or farming systems, or were associated with impractical regulations, highlighting the importance of co-designing context-appropriate solutions with farmers. Third, motivation barriers were linked to perceived socio-economic trade-offs, emphasising the need for policies to clearly communicate long-term co-benefits and minimise unintended negative impacts.

Beyond identifying distinct barriers, the COM-B framework enabled a more nuanced understanding of how capability, opportunity and motivation interacted to shape farmers' readiness to adopt circular practices. Across all countries, familiarity with practices and alignment with existing knowledge enhanced psychological capability and reinforced motivation when opportunities were perceived as feasible and

Table 6
Linking COM-B components to farmer sentiments and policy recommendations to support the adoption of circular farming systems across Europe.

COM-B component	Farmer sentiment	Policy recommendation
Capability	**Positive:** • Alignment with existing knowledge **Negative:** • Misalignment with existing knowledge • Additional skillset and workload	**1. Provide a flexible 'toolbox' of practices**, enabling farmers to select and adapt options suited to their knowledge, capacities and specific farm contexts.
Opportunity	**Positive:** • Collaboration • Regulatory compliance **Negative:** • Impractical government policies • Farming system and regional (biophysical) limitations • High capital investment costs • Low social acceptance	**2. Co-design practices and policies with farmers** to ensure compatibility with local landscapes and farming systems, affordability and social legitimacy, supported by enabling policy frameworks.
Motivation	**Positive:** • Social values • Environmental values • Economic resilience and self-sufficiency **Negative:** • Socio-economic trade-offs	**3. Communicate the broader co-benefits** (environmental, social and economic) of circular practices to strengthen reflective motivation and long-term engagement.

locally relevant. Conversely, constrained physical opportunities—most notably inflexible policies or system impracticalities—often triggered negative sentiment even where motivation to engage was present. In some contexts, social opportunities, including trust, collaboration and local networks, acted as a buffering mechanism, reducing perceived risk and enhancing feasibility, particularly in the UK and Norway. These findings highlight that adoption is driven by the dynamic interplay of COM-B components, suggesting that effective policy design should combine multiple instruments that simultaneously strengthen capability, opportunity and motivation within specific socio-institutional contexts.

4.1. Flexible 'toolbox' approach to enhance psychological capability

Farmers across all countries recognised when circular practices aligned with their existing knowledge, which consistently generated strong positive sentiment. An example of this was observed with anaerobic digestion in Italy, where strong positive sentiment emerged due to the practice's alignment with farmers' existing knowledge and their appreciation of its combined economic and environmental ('win-win') benefits (Moran et al., 2013), such as reduced GHG emissions and increased resource efficiency. Similarly, in Norway, the cultivation of clover generated strong positive sentiment, as this practice resonated with farmers' traditional knowledge and reinforced their identities as 'good farmers' (Burton, 2004). This example illustrates how rural sociological dynamics—particularly local identities, social norms and community ties—shape the perception, acceptance and adoption of agricultural practices within farming communities.

Another finding was the absence of significant differences in sentiment across the various categories of circular practices. This suggests that stakeholders perceived all practice areas as equally important and valuable, even when some were not directly applicable to their own systems or contexts. The perception that these practices were broadly relevant across different sectors and farming systems may have fostered a sense of fairness, which in turn enhanced stakeholders' willingness to engage (Hou et al., 2024). Some practices—particularly those involving resource-sharing—relied on collective action and were associated with strong positive sentiment. Successful collaboration depended on trust, social norms and informal agreements, illustrating how social capital within local farming communities can be translated into tangible, jointly managed outcomes. The prominence of collaboration in eliciting positive sentiment suggests that collective action may be an effective mechanism for implementing agri-environmental policies (Amblard, 2021).

By prioritising circular practices that could be adapted to a wide range of farming contexts within each country, the study aimed to ensure greater relevance and inclusivity. This flexible approach likely enhanced the perceived fairness, acceptability and positive sentiment towards circularity, while also helping to avoid marginalisation and supporting broad stakeholder engagement. However, it may have contributed to more generalised responses. Future research could build on this by examining whether particular farmer demographics or farm types exhibit distinct sentiments toward specific categories of circular practices.

Our results highlight the value of a flexible 'toolbox' approach, offering a menu of unranked options rather than prescribing specific practices. Farmers require the flexibility to adopt a combination of practices that best suit their individual systems and circumstances, rather than being constrained by a limited set of options or externally determined recommendations about what is most appropriate for their farms. Such an approach could help avoid privileging certain practices, farm or farmer types (Hyland et al., 2016), and supports broader engagement and uptake across diverse farming contexts (Lewis and Rudnick, 2019; Notenbaert et al., 2017).

4.2. Co-designing context-appropriate circular practices to increase physical opportunity

The only significant difference in sentiment scores was between UK and Norwegian farmers, with UK farmers expressing significantly more positive sentiment across all circular practice categories. While all stakeholders were introduced to circularity through the same animation video, the prioritised lists of circular practices differed by country. In the UK, the list was refined with input from a National Advisory Board to ensure contextual relevance and acceptability. In contrast, in Norway and Italy, the practices were selected by the research team and discussed directly in stakeholder focus groups, without prior piloting. At the time, the influence of these lists on stakeholder sentiment was not anticipated, and the aim was to ensure national relevance rather than methodological standardisation. However, the way in which these lists shaped stakeholder reactions emerged as a key analytical finding, underscoring the importance of contextual framing. Although the lists were not presented hierarchically, some stakeholders may have perceived certain practices as more important than others.

The inclusion of two controversial practices in Norway—dual-purpose (milk-meat) cows and pollinator strips—appeared to misalign with farmers' understanding of their systems, contributing to alienation and rejection. This reflects a psychological capability barrier to engagement. Further, these practices were seen as irrelevant in certain contexts; for example, sowing pollinator strips in already biodiverse regions was seen as incompatible with existing landscapes and farming systems, representing a key physical opportunity barrier to adoption.

Another key physical opportunity barrier to adoption linked to strong negative sentiment was impractical government policies, such as restrictive CAP regulations associated with managing cover crops in Italy. Consistent with the findings of Fayet et al. (2022b), Italian farmers expressed a sense of disconnection from EU-level agricultural policies, voicing frustration that standardised requirements often overlook local farming realities. They stressed the need for more regionally tailored approaches to increase the relevance, acceptance and uptake of sustainable practices. Our findings indicate that, to be effective, the promotion of circular practices should be embedded within policies that incorporate careful spatial planning that accounts for biophysical, socioeconomic and cultural differences across regions (Fayet et al., 2022b).

In this respect, the post-2027 CAP's emphasis on simplification, flexibility and a more farmer-centred approach (European Commission, 2025) is broadly aligned with our results. We show that farmer sentiment towards circular practices is strongly shaped by local knowledge systems, values and perceived feasibility, suggesting that reduced prescriptiveness and greater national discretion could improve policy relevance and uptake. However, our findings also caution that increased flexibility alone will be insufficient unless accompanied by meaningful engagement with local contexts. Stronger support for collective action, alongside measures that build on existing social capital and local identities, is likely to foster more positive sentiment and sustained participation. Such an approach would enhance the capacity of the CAP to support circular farming transitions while contributing more effectively to the objectives of the European Green Deal (European Commission, 2019).

Beyond policy design, these perceived opportunity barriers may also have fostered broader negativity, dampening sentiment towards other, potentially more acceptable, practices. Additionally, the group discussion format may have reinforced negative sentiment, as one farmer's strong opposition could have influenced others, leading to a collective shift towards neutral or negative perceptions (Koudenburg et al., 2019). In contrast, UK farmers participated in individual semi-structured interviews, reducing the risk of sentiment bias caused by group dynamics (Farnsworth and Boon, 2010; Hollander, 2004).

Together, these findings highlight a key policy implication: researchers, industry stakeholders and policymakers should carefully construct and tailor circular practice portfolios to specific regional and farming contexts. To support this process, the prioritisation framework proposed by Notenbaert et al. (2017) for climate-smart agriculture interventions could be adapted to identify context-appropriate circular practices. This framework enables assessment of adoption potential and estimation of impacts, providing a more evidence-based approach for refining broad lists of possible strategies into targeted, practical and acceptable actions. However, it is essential to include farmers in this prioritisation process. Rather than prioritising practices on their behalf, these circular strategies should be co-designed with them (Andrieu et al., 2019). Andrieu et al. (2019) presented a methodological framework for co-designing climate-smart farming systems with local stakeholders, which could be adapted to support circularity.

Co-design approaches are increasingly recognised for their effectiveness in implementing sustainable farming practices, such as groundwater-friendly farm management (Richard et al., 2020), biodiversity conservation in agricultural landscapes (Hölting et al., 2022), crop diversification (Grahmann et al., 2024), and climate-smart agriculture interventions (Andrieu et al., 2019). Furthermore, co-design is increasingly embraced by governments worldwide and has been widely used by the UK's devolved administrations to shape post-Brexit reforms to agricultural policies and funding schemes. Notable examples include the Sustainable Farming Incentive, a programme within the broader Environmental Land Management (ELM) scheme in England (Hurley et al., 2022; Tsouvalis et al., 2025) and the Sustainable Farming Scheme in Wales (Welsh Government, 2023). Co-designing circular strategies with farmers and industry stakeholders early in the process could help identify and address potentially contentious practices, preventing negative spillover effects that may undermine acceptance of otherwise well-aligned strategies. However, co-design can pose challenges, including farmers' action-oriented mindsets and frustration with overly structured research processes (Eastwood et al., 2022).

4.3. Communicating broader co-benefits to strengthen reflective motivation

Our results suggest that government-promoted circular practices—such as cover crops under the CAP or pollinator strips in Norway—are sometimes implemented in ways that misalign with farmers' priorities and contextual realities. As a result, stakeholders indicated that adoption was often driven more by access to subsidies than by a recognition or consideration for the practices' broader environmental, biodiversity or climate benefits. This aligns with previous research highlighting similar dynamics, including Kathage et al. (2022) for cover crops in the EU and Osterman et al. (2021) for pollinator strips in Norway. However, some farmers understood the importance of these practices but were discouraged by poorly designed policies that failed to reflect on-the-ground realities. This highlights the need for policymakers to promote circular practices that are contextually relevant, rather than applying uniform requirements across diverse farming regions—an approach that can conflict with farmers' practical knowledge and values (Ingram, 2008a, 2008b; Šūmane et al., 2018).

To support long-term adoption of circular practices, it is important to strengthen reflective motivation by clearly communicating their broader environmental and socio-economic benefits—beyond compliance or subsidy access. Positioning financial incentives as enablers of transition, rather than the primary reason for adoption, can help ensure that practices are seen as meaningful and worthwhile. For example, clover and cover crops were commonly framed by farmers in this study as tools to improve soil health and crop productivity, which is why they were grouped under soil and crop management. However, explicitly highlighting the potential of leguminous cover crops to reduce mineral fertiliser use could help farmers recognise additional co-benefits such as cost savings and climate mitigation, thereby broadening their appeal. Furthermore, as Osterman et al. (2021) argue, incorporating local knowledge when designing biodiversity-friendly practices—such as pollinator strips—can enhance alignment with farmers' ecological understanding and values, supporting psychological capability and reflective motivation to engage.

4.4. Role of sentiment analysis in exploring farmer decision-making

Sentiment analysis contributed to this study by highlighting the factors that elicited the strongest positive and negative emotional responses among stakeholders across diverse national contexts. While thematic analysis provides rich, nuanced insights into the content of farmer perceptions, it does not always indicate which factors carry the greatest emotional or motivational weight. By quantifying sentiment, this approach enabled us to prioritise the issues most salient to participants, complementing qualitative coding and guiding attention toward factors likely to influence decision-making.

Beyond its immediate application, sentiment analysis offers a promising tool for agricultural research more broadly. It can be integrated into participatory rural research frameworks to systematically capture the emotional and cognitive dimensions of stakeholder engagement, helping to identify areas of alignment or conflict between policy initiatives and farmer perceptions. By linking sentiment to thematic insights, researchers and policymakers can better understand not only what farmers think, but how strongly they feel about specific practices, policies or innovations.

It is important to note that sentiment analysis does not establish causal relationships; this study did not directly test whether positive or negative sentiment drives adoption. However, combining computational sentiment analysis with qualitative approaches provides a rigorous, mixed-methods pathway for exploring the role of emotion in agricultural decision-making. Future research should investigate how positive sentiment may facilitate adoption, and how interventions could reinforce positively perceived factors while mitigating those perceived negatively.

4.5. Limitations and further research

Our study engaged early-adopter farmers, recruited through 'gatekeeper' organisations or researchers' networks based on their interest in circularity. Their sentiment may have been more positive due to their enthusiasm for the topic, or more neutral because of deeper, more critical reflection. As a result, their responses may not fully represent broader farming communities across the studied countries. This study did not account for farmer heterogeneity within each country, but rather focused on exploring how climatic, cultural, economic and political contexts shape sentiment across countries. However, as previous research has shown, attitudes towards the environment and changing farming practices are also likely to vary between different farmer and farm types within countries (Hyland et al., 2016). Nevertheless, involving national-level agricultural industry representatives (e.g. policymakers, state administrators, researchers, advisory services, farmers' unions, veterinarians, agronomists, livestock nutritionists, and supply chain actors) in each country, with broad sectoral knowledge, ensured that the findings reflected the experiences of a diverse range of farmers.

Further research should examine variations in sentiment and decision-making across farmer demographics within each country to refine policy and support targeted adoption strategies. Conducting semi-structured interviews with Italian and Norwegian farmers, as was done with UK farmers, may yield richer insights and reduce group influence on responses (Koudenburg et al., 2019). A larger sample beyond this initial scoping dataset (Willig, 2013) would also strengthen the role of sentiment analysis by enabling the identification of extreme sentiments and their links to key COM-B decision-making factors.

5. Conclusions

This study demonstrates how emotional and contextual factors jointly shape farmers' readiness to adopt circular practices across Europe. The novel combination of sentiment and thematic analysis allowed this research to link specific influencing factors with strong emotional responses, revealing key drivers and barriers to adoption. Insights from 96 farmers and industry stakeholders highlight critical areas for targeted policy interventions to support the out-scaling of circular practices.

Within each country, farmers and industry representatives expressed broadly consistent sentiment, with all circular practice categories considered valuable. Positive sentiment was strongest when circular practices aligned with farmers' existing knowledge, were well-suited to local landscapes and farming systems, and offered broader environmental or socio-economic co-benefits. Conversely, negative sentiment was primarily linked to practical barriers, including high investment costs, regional biophysical constraints, farm system incompatibilities and impractical or poorly designed policy measures.

To support wider adoption of circular practices, this study offers three key recommendations: 1) adopt a flexible 'toolbox' approach that enables farmers to select and adapt practices suited to their specific contexts; 2) integrate farmer input to ensure practices align with local landscapes and farming systems, and are supported by policies that are practically grounded and regionally appropriate; and 3) clearly communicate the broader environmental and socio-economic co-benefits of circular practices—beyond regulatory compliance or financial incentives. Together, these recommendations inform more effective, inclusive and context-sensitive strategies and policy design for sustainable agriculture, climate action and rural development across Europe. Future research could extend this approach to larger multilingual datasets, explore cross-national farmer typologies, and further integrate mixed NLP–qualitative methods to deepen understanding of farmer sentiment and decision-making across diverse contexts.

Funding

This study was funded by the ERA-NET CircAgric-GHG project, led by Vibeke Lind (no. 52/2021). The project received support under the Joint Call of the Cofund ERA-Nets SusCrop (grant no. 771134), FACCE ERA-GAS (grant no. 696356), ICT-AGRI-FOOD (grant no. 862665) and SusAn (grant no. 696231). The views expressed in this paper are solely those of the authors and do not necessarily reflect those of the affiliated organisations within the CircAgric-GHG project.

CRediT authorship contribution statement

Ffion Evans: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. **James Gibbons:** Supervision, Writing – review & editing. **Luciana Bava:** Data curation, Investigation, Writing – review & editing. **Dave Chadwick:** Funding acquisition, Supervision. **Stefania Colombini:** Data curation, Investigation, Validation, Writing – review & editing. **Valborg Kvakkestad:** Conceptualization, Data curation, Investigation, Methodology, Validation, Writing – review & editing. **Lampros Lamprinakis:** Conceptualization, Methodology, Writing – review & editing. **Vibeke Lind:** Investigation, Writing – review & editing. **Martina Pavesi:** Data curation, Investigation. **Prysor Williams:** Supervision, Writing – review & editing. **Sophie Wynne-Jones:** Conceptualization, Investigation, Methodology, Supervision, Writing – review & editing.

Declaration of interest statement

The authors declare that they have no known competing financial or other interests that could have influenced the work reported in this article.

Acknowledgements

The authors sincerely thank all the farmers, industry experts and policy representatives who contributed to this research. Their insights and experiences were invaluable in shaping this study. We also acknowledge their ongoing efforts in supporting a more sustainable and resilient farming and food system. We also acknowledge support from the Land Use for Net Zero Hub (LUNZ-Hub) project and express our sincere appreciation to the anonymous reviewers for their insightful comments and constructive suggestions.

Data availability

Data will be made available on request.

References

Amblard, L., 2021. Collective action as a tool for agri-environmental policy implementation. The case of diffuse pollution control in European rural areas. J. Environ. Manag. 280, 111845. https://doi.org/10.1016/j.jenvman.2020.111845.

Ambrose-Oji, Bianca, Goodenough, Alice, Urquhart, Julie, Hall, Clare, Karlsdóttir, Berglind, 2022. 'We're Farmers Not Foresters': Farmers' Decision-Making and Behaviours towards Managing Trees for Pests and Diseases. Forests 13 (7), 1030. https://doi.org/10.3390/f13071030. https://www.mdpi.com/1999-4907/13/7/1030. (Accessed 30 June 2022).

Andrieu, N., Howland, F., Acosta-Alba, I., Le Coq, J.-F., Osorio-Garcia, A.M., Martinez-Baron, D., Gamba-Trimiño, C., Loboguerrero, A.M., Chia, E., 2019. Co-designing climate-smart farming systems with local stakeholders: a methodological framework for achieving large-scale change. Front. Sustain. Food Syst. 3, 37. https://doi.org/10.3389/fsufs.2019.00037.

Armstrong, R.A., 2014. When to use the Bonferroni correction. Ophthalmic Physiol. Opt. 34 (5), 502–508. https://doi-org.bangor.idm.oclc.org/10.1111/opo.12131.

Bermeo-Almeida, O., del Cioppo-Morstadt, J., Cardenas-Rodriguez, M., Cabezas-Cabezas, R., Bazán-Vera, W., 2019. Sentiment analysis in social networks for agricultural pests. In: ICT for Agriculture and Environment: Second International Conference, CITAMA 2019, Guayaquil, Ecuador, January 22-25, 2019, Proceedings, vol. 2. Springer International Publishing, pp. 122–129. https://doi.org/10.1007/978-3-030-10728-4_13.

Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qual. Res. Psychol. 3 (2), 77–101. https://doi.org/10.1191/1478088706qp063oa.

Braun, V., Clarke, V., 2013. Successful Qualitative Research: a Practical Guide for Beginners. Sage Publications, London. https://www.torrossa.com/en/resources/an/5017629. (Accessed 4 June 2025).

Burton, R.J.F., 2004. Seeing through the 'Good Farmer's' Eyes: towards Developing an Understanding of the Social Symbolic Value of 'Productivist' behaviour. Sociol. Rural. 44, 195–215. https://doi.org/10.1111/j.1467-9523.2004.00270.x.

Burton, R.J.F., 2014. The influence of farmer demographic characteristics on environmental behaviour: a review. J. Environ. Manag. 135, 19–26. https://doi.org/10.1016/j.jenvman.2013.12.005.

Dagevos, H., de Lauwere, C., 2021. Circular business models and circular agriculture: perceptions and practices of Dutch farmers. Sustainability 13, 1282. https://doi.org/10.3390/su13031282.

de Boer, I.J., van Ittersum, M.K., 2018. Circularity in Agricultural Production. Wageningen University, & Research. https://edepot.wur.nl/470625. (Accessed 4 June 2025).

de Lauwere, C., Slegers, M., Meeusen, M., 2022. The influence of behavioural factors and external conditions on Dutch farmers' decision making in the transition towards circular agriculture. Land Use Policy 120, 106253. https://doi.org/10.1016/j.landusepol.2022.106253.

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, 417–471. https://doi.org/10.1093/erae/jbz019.

Dicks, F., Marks, T., Karafillakis, E., Chambers, M.A., 2021. Vaccination as a control tool in bovine tuberculosis: social media monitoring to assess public response to government policy development and implementation. Vaccines 9, 314. https://doi.org/10.3390/vaccines9040314.

Duncan, Andrew J., Henry, Madeleine K., Lamont, Kate, 2024. Combining sentiment analysis and text mining with content analysis of farm vet interviews on mental wellbeing in livestock practice. In: Chima, Sylvester Chidi (Ed.), PLOS ONE 19 (5), e0304090. https://doi.org/10.1371/journal.pone.0304090. https://dx.plos.org/10.1371/journal.pone.0304090. (Accessed 22 May 2024).

Eastwood, C.R., Turner, F.J., Romera, A.J., 2022. Farmer-centred design: an affordances-based framework for identifying processes that facilitate farmers as co-designers in addressing complex agricultural challenges. Agric. Syst. 195, 103314. https://doi.org/10.1016/j.agsy.2021.103314.

European Commission, 2019. The European green deal. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en. (Accessed 6 January 2026).

European Commission, 2025. The CAP 2028–2034 proposal explained: fairer, better targeted income support for farmers. https://agriculture.ec.europa.eu/media/news/

cap-2028-2034-proposal-explained-fairer-better-targeted-income-support-farmers-2025-11-10_en. (Accessed 6 January 2026).

Evans, F., Gibbons, J., Chadwick, D., Gittins, H., Williams, P., Wynne-Jones, S., 2025. “It's ‘common-sense’ farming”: exploring farmers' decision-making and behaviours towards adopting circular agricultural practices. J. Rural Stud. 120, 103844. https://doi.org/10.1016/j.jrurstud.2025.103844.

Farnsworth, J., Boon, B., 2010. Analysing group dynamics within the focus group. Qual. Res. 10, 605–624. https://doi.org/10.1177/1468794110375223.

Farrell, Sarah, Benson, Tony, McKernan, Claire, Regan, Áine, Burrell, Alison M.G., et al., 2023. Factors influencing dairy farmers' antibiotic use: An application of the COM-B model. J. Dairy Sci. 106 (6), 4059–4071. https://doi.org/10.3168/jds.2022-22263. https://linkinghub.elsevier.com/retrieve/pii/S0022030223001510.

Fayet, C.M.J., Reilly, K.H., Van Ham, C., Verburg, P.H., 2022a. What is the future of abandoned agricultural lands? A systematic review of alternative trajectories in Europe. Land Use Policy 112, 105833. https://doi.org/10.1016/j.landusepol.2021.105833.

Fayet, C.M.J., Reilly, K.H., Van Ham, C., Verburg, P.H., 2022b. The potential of European abandoned agricultural lands to contribute to the green deal objectives: policy perspectives. Environ. Sci. Pol. 133, 44–53. https://doi.org/10.1016/j.envsci.2022.03.007.

Finci, A., Svennerud, M., Smedshaug, C.A., Rustad, L.J., 2023. Norsk selvforsyning av matvarer – status og potensial. NIBIO Rapp. 9 nr. 137. Ås: NIBIO. https://www.agrianalyse.no/getfile.php/138075-1701762474/Dokumenter/Dokumenter%202023/NIBIO_RAPPORT_2023_9_137.pdf. (Accessed 19 June 2025).

Funnell, E.L., Spadaro, B., Martin-Key, N., Metcalfe, T., Bahn, S., 2022. mHealth solutions for mental health screening and diagnosis: a review of app user perspectives using sentiment and thematic analysis. Front. Psychiatr. 13, 857304. https://doi.org/10.3389/fpsyt.2022.857304.

Ghisellini, P., Ulgiati, S., 2020. Circular economy transition in Italy. Achievements, perspectives and constraints. J. Clean. Prod. 243, 118360. https://doi.org/10.1016/j.jclepro.2019.118360.

Gosling, C.J., Caparos, S., Moutier, S., 2020. The interplay between the importance of a decision and emotion in decision-making. Cognit. Emot. 34 (6), 1260–1270. https://doi.org/10.1080/02699931.2020.1741340.

Grahmann, K., Reckling, M., Hernández-Ochoa, I., Donat, M., Bellingrath-Kimura, S., Ewert, F., 2024. Co-designing a landscape experiment to investigate diversified cropping systems. Agric. Syst. 217, 103950. https://doi.org/10.1016/j.agsy.2024.103950.

Hemmings, P., 2016. Policy Challenges for Agriculture and Rural Areas in Norway. OECD Economics Department Working Papers, No. 1286. OECD Publishing, Paris. https://doi.org/10.1787/5jm0xf0r676c-en.

Hölting, L., Busse, M., Bülow, S., Engler, J.O., Hagemann, N., Joormann, I., Kernecker, M.L., Larondelle, N., Sturm, A., Turkelboom, F., Wätzold, F., 2022. Co-design: working with farmers in Europe to halt the loss of biological diversity. Ecol. Solut. Evid. 3 (3). https://doi.org/10.1002/2688-8319.12169.

Hollander, J.A., 2004. The social contexts of focus groups. J. Contemp. Ethnogr. 33, 602–637. https://doi.org/10.1177/0891241604266988.

Holloway, L.A., Catney, G., Stockdale, A., Nelson, R., 2021. Sustainable family farming futures: exploring the challenges of family farm decision making through an emotional lens of ‘belonging’. Sustainability 13 (21), 12271. https://doi.org/10.3390/su132112271.

Hou, B., Xu, Y., Wang, Z., Hou, J., 2024. The role of social fairness perceptions in farmers' continued participation in environmental governance: a China scenario. Agric. Res. (Wash. D. C.) 13 (2), 319–327. https://doi.org/10.1007/s40003-023-00688-1.

Hurley, P., Lyon, J., Hall, J., Little, R., Tsouvalis, J., White, V., Rose, D.C., 2022. Co-designing the environmental land management scheme in England: the why, who and how of engaging ‘harder to reach’ stakeholders. People Nat. 4 (3), 744–757. https://doi.org/10.1002/pan3.10313.

Hutto, C., Gilbert, E., 2014. VADER: a parsimonious rule-based model for sentiment analysis of social media text. Proc. Int. AAAI Conf. Web Social Media 8, 216–225. https://doi.org/10.1609/icwsm.v8i1.14550.

Hyland, J.J., Jones, D.L., Parkhill, K.A., Barnes, A.P., Williams, A.P., 2016. Farmers' perceptions of climate change: identifying types. Agric. Hum. Val. 33, 323–339. https://doi.org/10.1007/s10460-015-9608-9.

Ingram, J., 2008a. Agronomist–farmer knowledge encounters: an analysis of knowledge exchange in the context of best management practices in England. Agric. Hum. Val. 25, 405–418. https://doi.org/10.1007/s10460-008-9134-0.

Ingram, J., 2008b. Are farmers in England equipped to meet the knowledge challenge of sustainable soil management? An analysis of farmer and advisor views. J. Environ. Manag. 86, 214–228. https://doi.org/10.1016/j.jenvman.2006.12.036.

ISTAT, 2025. Stima preliminare dei conti economici dell'agricoltura. Anno 2024. Rome: Istituto Nazionale Di Statistica. https://www.istat.it/wp-content/uploads/2025/01/stima-andamento-economia-agricola-2024.pdf. (Accessed 4 July 2025).

Kathage, J., Smit, B., Janssens, B., Haagsma, W., Adrados, J.L., 2022. How much is policy driving the adoption of cover crops? Evidence from four EU regions. Land Use Policy 116, 106016. https://doi.org/10.1016/j.landusepol.2022.106016.

Koudenburg, N., Greijdanus, H., Scheepers, D., 2019. The polarizing effects of group discussion in a negative normative context: integrating societal-, group-, and individual-level factors. Br. J. Soc. Psychol. 58, 150–174. https://doi.org/10.1111/bjso.12282.

Kvakkestad, V., Rørstad, P.K., Vatn, A., 2015. Norwegian farmers' perspectives on agriculture and agricultural payments: between productivism and cultural landscapes. Land Use Policy 42, 83–92. https://doi.org/10.1016/j.landusepol.2014.07.009.

Lerner, J.S., Li, Y., Valdesolo, P., Kassam, K.S., 2015. Emotion and decision making. Annu. Rev. Psychol. 66 (1), 799–823. https://doi.org/10.1146/annurev-psych-010213-115043.

Lewis, J., Rudnick, J., 2019. The policy enabling environment for climate smart agriculture: a case study of California. Front. Sustain. Food Syst. 3, 31. https://doi.org/10.3389/fsufs.2019.00031.

Mahon, N., Holloway, L., Clark, B., Proctor, A., 2023. The application of a sentiment analysis approach to explore public understandings of animal agriculture. J. Rural Stud. 103, 103127. https://doi.org/10.1016/j.jrurstud.2023.103127.

Šūmane, S., Kunda, I., Knickel, K., Strauss, A., Tisenkopfs, T., Rios, I. des I., Rivera, M., Chebach, T., Ashkenazy, A., 2018. Local and farmers' knowledge matters! how integrating informal and formal knowledge enhances sustainable and resilient agriculture. J. Rural Stud. 59, 232–241. https://doi.org/10.1016/j.jrurstud.2017.01.020.

Michie, S., van Stralen, M.M., West, R., 2011. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. Implement. Sci. 6, 42. https://doi.org/10.1186/1748-5908-6-42.

Mielcarek-Bocheńska, P., Rzeźnik, W., 2021. Greenhouse gas emissions from agriculture in EU countries—state and perspectives. Atmosphere 12, 1396. https://doi.org/10.3390/atmos12111396.

Ministry of Agriculture and Food, 2024. Meld. St. 11 (2023–2024), strategi for auka sjølvforsyning av jordbruksvarer og plan for opptrapping av inntektsmoglegheitene i jordbruket. Oslo 2024. https://www.regjeringen.no/no/dokumenter/meld.-st.-11-20232024/id3028626/. (Accessed 9 June 2025).

Mogaji, E., Balakrishnan, J., Kieu, T.A., 2021. Examining consumer behaviour in the UK energy sector through the sentimental and thematic analysis of tweets. J. Consum. Behav. 20, 218–230. https://doi.org/10.1002/cb.1820.

Moran, D., Lucas, A., Barnes, A., 2013. Mitigation win–win. Nat. Clim. Change 3, 611–613. https://doi.org/10.1038/nclimate1922.

Notenbaert, A., Pfeifer, C., Silvestri, S., Herrero, M., 2017. Targeting, out-scaling and prioritising climate-smart interventions in agricultural systems: lessons from applying a generic framework to the livestock sector in Sub-Saharan Africa. Agric. Syst. 151, 153–162. https://doi.org/10.1016/j.agsy.2016.05.017.

OECD, 2023. Agricultural Policy Monitoring and Evaluation 2023: Adapting Agriculture to Climate Change. OECD Publishing, Paris. https://doi.org/10.1787/b14de474-en.

Ofori, M., El-Gayar, O., 2021. Drivers and challenges of precision agriculture: a social media perspective. Precis. Agric. 22, 1019–1044. https://doi.org/10.1007/s11119-020-09760-0.

Olagunju, T., Oyebode, O., Orji, R., 2020. Exploring key issues affecting African Mobile eCommerce applications using sentiment and thematic analysis. IEEE Access 8, 114475–114486. https://doi.org/10.1109/ACCESS.2020.3000093.

Osterman, J., Landaverde-González, P., Garratt, M.P.D., Gee, M., Mandelik, Y., Langowska, A., Miñarro, M., Cole, L.J., Eeraerts, M., Bevk, D., Avrech, O., Koltowski, Z., Trujillo-Elisea, F.I., Paxton, R.J., Boreux, V., Seymour, C.L., Howlett, B.G., 2021. On-farm experiences shape farmer knowledge, perceptions of pollinators, and management practices. Glob. Ecol. Conserv. 32, e01949. https://doi.org/10.1016/j.gecco.2021.e01949.

Prokopy, L.S., Floress, K., Klotthor-Weinkauf, D., Baumgart-Getz, A., 2008. Determinants of agricultural best management practice adoption: evidence from the literature. J. Soil Water Conserv. 63, 300–311. https://doi.org/10.2489/jswc.63.5.300.

Regan, Áine, Douglas, John, Maher, John, O'Dwyer, Tom, 2020. Exploring farmers' decisions to engage in grass measurement on dairy farms in Ireland. J. Agric. Educ. Ext. 27 (3), 355–380. https://doi.org/10.1080/1389224x.2020.1858892. https://www.tandfonline.com/doi/full/10.1080/1389224X.2020.1858892. (Accessed 15 December 2020).

Rhisiart, D., Rhys, M., Bundy, C., James, D.H., 2022. The role of native language use in motivational interviewing. International. J. Pharm. Pract. 30, i29–i30. https://doi.org/10.1093/ijpp/riac019.040.

Richard, A., Casagrande, M., Jeuffroy, M.-H., David, C., 2020. A farmer-oriented method for co-designing groundwater-friendly farm management. Agron. Sustain. Dev. 40, 26. https://doi.org/10.1007/s13593-020-00622-7.

Rieple, A., Snijders, S., 2018. The role of emotions in the choice to adopt, or resist, innovations by Irish dairy farmers. J. Bus. Res. 85, 23–31. https://doi.org/10.1016/j.jbusres.2017.11.039.

Rótolo, G.C., Vassillo, C., Rodriguez, A.A., Magnano, L., Milo Vaccaro, M., Civit, B.M., Covacevich, M.S., Arena, A.P., Ulgiati, S., 2022. Perception and awareness of circular economy options within sectors related to agriculture in Argentina. J. Clean. Prod. 373, 133805. https://doi.org/10.1016/j.jclepro.2022.133805.

Seo, M.G., Barrett, L.F., 2007. Being emotional during decision Making—good or bad? An empirical investigation. Acad. Manag. J. 50 (4), 923–940. https://doi.org/10.5465/amj.2007.26279217.

Sharma, H.D., Goyal, P., 2023. An analysis of sentiment: methods, applications, and challenges. Eng. Proc. 59, 68. https://doi.org/10.3390/engproc2023059068.

Shortall, O.K., 2022. A qualitative study of Irish dairy farmer values relating to sustainable grass-based production practices using the concept of ‘good farming’. Sustainability 14 (11), 6604. https://doi.org/10.3390/su14116604.

Sánchez-Rada, J.F., Iglesias, C.A., 2019. Social context in sentiment analysis: formal definition, overview of current trends and framework for comparison. Inf. Fusion 52, 344–356. https://doi.org/10.1016/j.inffus.2019.05.003.

Statistics Norway, 2024. Lågare utslepp frå jordbruket i 2023. https://www.ssb.no/jord-skog-jakt-og-fiskeri/jordbruk/artikler/lagare-utslepp-fra-jordbruket-i-2023. (Accessed 10 June 2025).

Steede, G., Meyers, C., Li, N., Irlbeck, E., Gearhart, S., 2018. A sentiment and content analysis of Twitter content regarding the use of antibiotics in livestock. J. Appl. Commun. 102. https://doi.org/10.4148/1051-0834.2225.

Sutherland, L.A., 2013. Can organic farmers be ‘good farmers’? Adding the ‘taste of necessity’to the conventionalization debate. Agric. Hum. Val. 30 (3), 429–441. https://doi.org/10.1007/s10460-013-9424-z.
Tsouvalis, J., Burns, C., Fajardo-Escoffié, J., Rose, D.C., Hartley, S., Little, R., 2025. Co-Design in practice: bringing STS to post-brexit agricultural policy. Sci. Technol. Human Value. https://doi.org/10.1177/01622439241311973, 01622439241311973.
Tukey, J.W., 1949. Comparing individual means in the analysis of variance. Biometrics 99–114. https://doi.org/10.2307/3001913.
van der Zanden, E.H., Verburg, P.H., Schulp, C.J.E., Verkerk, P.J., 2017. Trade-offs of European agricultural abandonment. Land Use Policy 62, 290–301. https://doi.org/10.1016/j.landusepol.2017.01.003.
Welsh Government, 2023. Sustainable farming scheme: co-design findings. https://www.gov.wales/sustainable-farming-scheme-co-design-findings. (Accessed 9 April 2025).
Wilcoxon, F., 1992. Individual comparisons by ranking methods. In: Breakthroughs in Statistics: Methodology and Distribution. Springer New York, New York, NY, pp. 196–202. https://doi.org/10.1007/978-1-4612-4380-9_16.
Willig, C., 2013. Introducing Qualitative Research in Psychology, third ed. McGraw-Hill Education, Maidenhead https://books.google.co.uk/books?id=yDtFBgAAQBAJ. (Accessed 4 June 2025).
Yadav, J., Yadav, A., Misra, M., Rana, N., Zhou, J., 2023. Role of social media in technology adoption for sustainable agriculture practices: evidence from Twitter analytics. Commun. Assoc. Inf. Syst. 52, 833–851. https://doi.org/10.17705/1CAIS.05240.