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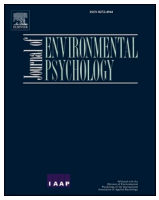

Good intentions, limited action: When do farmers' intentions to adopt sustainable farming practices turn into actual behaviour?

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ABSTRACT

A vast body of literature has developed to predict farmers' pro-environmental attitudes, intentions, and behaviour to develop effective policy for supporting farmers' adoption of sustainable practices. This literature relies heavily on measures of intentions, self-reported behaviours, and cross-sectional approaches. Yet evidence from across the social and psychological sciences demonstrate a prevalent gap between intentions and actions, which is also observed among farmers, and that intentions do not necessarily predict actions. We examine the nature and prevalence of farmers' intention-action gap, whether predictors of intentions also predict actions, and which predictors can explain whether intentions turn into behaviour. To do so we use survey and objective behavioural data from Norwegian horticultural farmers to examine their intentions to adopt and actual adoption of cover crops, a sustainable farming practice that can offer both mitigation and adaptation benefits. We survey farmers before the 2023 growing season to measure their farming preferences, environmental attitudes and concerns, and their intentions to apply for a cover crops subsidy (i.e. their intention to adopt). We subsequently access records of farmers' application for the cover crops subsidy at the end of the farming season, six months later, to measure their actual adoption of cover crops. In line with the intention-action gap we found that whereas 49% intended to apply for the cover crops subsidy, only 16% of our sample applied for the subsidy in 2023. Past use and knowledge of cover crops, perceived need for adaptation, being risk seeking in farming, and using advisory services predicted intentions, whereas only past use of cover crops predicted both intention and actual adoption. Moreover, only the strongest level of reported intentions had some value in predicting actual behaviour. Our results offer timely evidence of the intention-action gap in agricultural decision-making, the urgent need to address a widespread reliance on intentions as predictors of behaviour, and the importance of behavioural measures and longitudinal approaches to understand the intention-action gap.

1. Introduction

Agriculture in the 21st century is faced with daunting and interlocking challenges. Growing populations require efficient food production, but agricultural productivity is hampered by the rapidly unfolding consequences of climate change and biodiversity loss. At the same time the global food system is identified as the primary driver of biodiversity loss and emits approximately 25% of global greenhouse gas emissions (Clark et al., 2020; IPCC, 2022; Masson-Delmotte, 2019). Agriculture is thus a key contributor to the very crises that threaten it.

To protect the environment, secure reliable and adequate food production, and safeguard the livelihoods of farmers, an urgent transformation of agricultural systems to stop deforestation, diversify crop systems, and sustainably use agricultural inputs is needed (Crippa et al., 2021; Hertel et al., 2021; Poore & Nemecek, 2018). While governments and industry are critical to realise this transformation, the role of individual farmers should not be underestimated. Individual farmers can for example shift towards sustainable farming practices to reduce greenhouse gas emissions and enhance carbon sequestration and the resilience of soils, that in aggregate significantly contribute to more sustainable agricultural systems (Clark et al., 2020; Poore & Nemecek, 2018).

Developing an effective institutional context to support farmers in adopting sustainable farming practices requires an accurate understanding of what motivates and hinders them in implementing such practices. Critically, farmers' decision-making processes and adoption

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behaviour are not driven solely by external factors such as policies, financial flows, and market constraints (Piñeiro et al., 2020). A growing literature demonstrates that psychological and behavioural factors also play a key role (Dessart et al., 2019; Feola et al., 2015; Mills et al., 2017). For example, a recent meta-analysis demonstrates that farmers' attitudes towards sustainable farming practices, their perceived usefulness, and considerations of environmental problems play important roles in decisions to adopt them (Swart et al., 2023). Such findings have led to a new direction of policy recommendations for how policy makers can promote sustainable farming practices. Instead of focusing only on financial stimuli, policy makers should also consider interventions that target the psychological predictors of behaviour, for example interventions that address possible barriers to increase farmers' capacity to act (see for example Rose et al., 2018; Rust et al., 2020; Swart et al., 2023).

Many studies that examine these psychological predictors of sustainable farming behaviours are cross-sectional in nature and predominantly assess farmers' intentions to adopt. Studies using longitudinal designs that measure actual behaviour at a later time point are rare (Milliet et al., 2024; Swart et al., 2023). Yet, there are two critical pitfalls associated with only studying farmers' intentions. First, intentions do not always translate into behaviour, i.e. there is an observable intention-action gap (Kollmuss & Agyeman, 2002). Recent studies show that while many farmers report intentions to adopt environmental practices the actual adoption rates remain low (Hasler et al., 2022; Mills et al., 2020). For example, a study considering Dutch farmers' level of awareness and adoption of mitigation measures including greenhouse gas emissions reduction, energy saving, and renewable energy use found that reported intentions predicted emissions reduction measures but were not predictive of energy saving measures (Moerkerken et al., 2020). Within the literature on sustainable agricultural farming, it is currently not clear how big this gap is (or can get) or when and why intentions do (or do not) turn into actions.

Second, and even more critically, some studies suggest that psychological predictors of intentions are not necessarily also predictors of the actual behaviour. For example, Niles et al. (2016) surveyed farmers in New Zealand to examine the relationship between their intended and actual adoption of climate change mitigation and adaptation measures. They found that attitudes and beliefs were associated with intended, but not actual, adoption of mitigation practices, and only farmers' perceived capacity and self-efficacy were important predictors of both intention and action (Niles et al., 2016). Another cross-sectional survey considering the link between Danish farmers' perceptions of climate change risk and mitigation and adaptation actions found no correlation between perceptions of climate change and their self-reported on-farm mitigation action (Jørgensen & Termansen, 2016). In a similar vein, albeit with households, a study examining the drivers of household-level adaptation decisions found that perceptions of climate change and perceptions of local risks were associated with intentions to implement adaptation measures, but not actual behaviour, which was determined by self-efficacy and outcome efficacy (van Valkengoed et al., 2023).

These inconsistencies between what predicts intentions and what predicts actual behaviour have key implications for conclusions that are currently drawn in the literature. First, as intentions are often used as a proxy for actual behaviour in the agricultural context, psychological factors that have been found to predict intentions to implement pro-environmental practices are often interpreted as if they are also predictors of actual behaviour (see for example Mitter et al., 2019; Wensing et al., 2019; Werner et al., 2017). However, given that predictors of intentions are not necessarily also predictors of behaviour, it is currently unclear which psychological factors can actually predict behaviour change (or the lack thereof). Second, recommendations for the design of interventions to promote sustainable agricultural practices are often based on the results of studies that have looked at intentions. Yet, if the predictors of intentions and actual behaviour differ, interventions that are developed based on studies that have looked at intentions are likely limited in their effectiveness to promote actual adoption of sustainable farming practices.

Moreover, shortcomings associated with asking for intentions cannot be resolved by simply asking farmers for behaviours they already implemented in the past, which is also commonly done (see Swart et al., 2023). As explained by Weinstein et al. (1998), the relationship between psychological factors and behaviour is often not one-directional, as engaging in behaviour can also alter psychological factors. For example, while we often assume that a positive attitude towards a behaviour motivates people to engage in this behaviour, it can also be the case that people's attitudes towards a behaviour may become more positive *after* they have implemented the behaviour and can experience its benefits (e.g. Fishbein & Ajzen, 2011). Studies that simply correlate people's current levels of psychological variables with past instances of behaviour, are unable to uncover the causal relationship linking these two sets of variables (Weinstein et al., 1998).

To effectively promote the uptake of sustainable agricultural practices among farmers, it is therefore necessary to measure predictors and occurrences of actual behaviour and to use longitudinal study designs to evaluate the effect of interventions. In this article, we contribute to the literature by studying farmers' intentions to adopt and their actual adoption of cover crops. Cover crops represent a sustainable farming practice consisting of crops that are planted alongside or after the main cash crop. In addition to covering fields between seasons they offer various benefits to agricultural systems and surrounding communities, including carbon sequestration, yield increases, increasing soil organic matter, nutrient fixation, and preventing soil erosion and compaction (Büchi et al., 2018; Kaye & Quemada, 2017; Lugato et al., 2020). To realise these co-benefits many governments seek to stimulate farmers' uptake by introducing subsidies, as there are direct (monetary) and indirect (time and labour requirement) costs for adopting cover crops (Bøe et al., 2019; European Commission, Joint Research; European Commission Joint Research Centre, 2019; Kathage et al., 2022). However, responses to such policies have been varied and uptake remains low. Focusing on this context, we specifically address the following questions.

1) What is the magnitude of farmers' intention-behaviour gap?
2) Are the predictors of intentions also predictors of behaviour?
3) Which predictors explain whether intentions turn into behaviour?

Recent reviews and meta-analyses have identified various predictors that play a role in farmers' intentions to adopt sustainable farming practices (Bartkowski & Bartke, 2018; Brown et al., 2021; Dessart et al., 2019; Swart et al., 2023). In this article, we consider ten variables grouped into five categories that are consistently found to predict intentions to implement sustainable farming practices, and by extension are also often interpreted as drivers of actual adoption behaviour. These categories are knowledge, experience, environmental and farming attitudes, social influence, and the use of advisory services. Given their prevalence in efforts to understand agricultural decision-making, they represent a suitable set of variables to expand our understanding of the intention-action gap in this context. We discuss the theoretical relevance and empirical background for explaining the adoption of sustainable farming practices of each of them in more detail below, italicising their labels when introduced. Importantly, we stress here that unless otherwise stated, the studies reviewed have looked at farmers' intentions to adopt sustainable farming methods, but not actual behaviour.

1.1. *Knowledge*

One of the first and most intuitive explanations for why farmers may not take up sustainable agricultural practices is a lack of knowledge of them. The literature points to distinct differences between *subjective knowledge* (i.e. self-reported level of knowledge about an issue) and objective knowledge (i.e. an assessed measure of specific knowledge of

an issue), where subjective knowledge is particularly important for understanding people's reactions to an issue (Kellstedt et al., 2008; Stoutenborough & Vedlitz, 2014). Indeed, recent reviews and studies across contexts find that farmers' self-reported knowledge (i.e. subjective knowledge) of agricultural practices relate to their decisions to adopt (Barnes et al., 2022; Feola et al., 2015). Farmers seek out knowledge of practices and relevant information on climate conditions, soil conditions, and new technologies to inform their decisions (Soubry et al., 2020). A survey of Iowa farmers showed that whether an environmental practice is easy to use and perceived as useful was important for widespread (self-reported) uptake (Arbuckle & Roesch-McNally, 2015).

Similarly, an interview-based study with Dutch farmers found that farmers' self-reported knowledge of their environmental impacts was positively related to their self-reported uptake of mitigation practices (Gomes & Reidsma, 2021). In a scoping review of nearly 18 000 papers, Piñeiro et al. (2020) found that one of the strongest positive predictors of farmers' adoption of sustainable practices was farmers' knowledge of the perceived benefits for either their farms, the environment, or both.

1.2. Experience

Experience with and *past use of farming practices* also relate to uptake (Foguesatto et al., 2020; Kuehne et al., 2017; Rizzo et al., 2024). Farmers who have previously employed particular measures are more likely to continue or take up the same measure again, and the number of years of experience in farming has been positively related to intended adoption of sustainable farming practices (Doran et al., 2020; Meijer et al., 2015). Similarly, farmers who already adopted an adaptation measure have been found to be more likely to adopt a mitigation measure, and vice versa (Niles et al., 2016). However, there are also conflicting findings. Some studies suggest that lower levels of experience, e.g. recently established farms, can be more open to innovation and novel practices since more established farms have routines that can be more difficult to change (Barnes et al., 2019; Gütschow et al., 2021; Rosenbusch et al., 2011). Experience is also related to the concept of self-efficacy, or the belief in one's own skills to perform an action. Theoretically, people judge their level of self-efficacy based on various sources including their actual experiences (successes and failures), vicarious experiences (through observation of similar peers), and persuasion (Bandura, 2006; Bandura et al., 1963; Sewell et al., 2017). Self-efficacy is widely recognised to be an important behavioural predictor, including in agriculture (Bandura, 2006; Brown et al., 2022; Perry & Davenport, 2020).

1.3. Environmental and farming attitudes

Farmers' environmental attitudes, i.e. their positive or negative evaluation about the environment and climate change, are frequently cited to positively influence farmers' decisions to adopt (Swart et al., 2023). In particular, perceptions of the risks of climate change including the *belief in* and *concern for climate change* are related to uptake, where farmers who more strongly believe in and worry about higher risks from climate change can be more likely to express intentions to adopt (Arbuckle et al., 2013; Mitter et al., 2019; Nguyen & Drakou, 2021). This relationship is however not clear, as some farmers do not connect extreme weather events and climate change, and stronger beliefs in climate change do not always relate to their self-reported on-farm mitigation and adaptation efforts (Jørgensen & Termansen, 2016; Niles et al., 2016).

Moreover, perceived risks of climate change are related to the *perceived need to adapt to climate change*. This literature predominantly focused on farmers' intentions or self-reported adaptation behaviour, and suggests that farmers who are more concerned about climate change, perceive higher risks, and have stronger capacity for action intend to undertake further adaptive measures to protect against threats from climate change (Kreft et al., 2021; Nainggolan et al., 2023; Skevas et al., 2022; Woods et al., 2017).

Finally, literature focusing on farmers' *risk preferences in farming* (i.e. tolerance for making risky decisions about farming operations without knowing the outcomes) suggests that risks associated with the adoption can hinder uptake (Azadi et al., 2019; Eitzinger et al., 2018; Menapace et al., 2013; Meraner & Finger, 2019; Schaub et al., 2023). In the context of reducing pesticide use, survey-based studies with farmers show that while the perceived risk of large production losses is a main obstacle for willingness to lower usage (Chèze et al., 2020), environmental attitudes can offset risk perceptions associated with lower pesticide levels (Bakker et al., 2021). Farming-related risk preferences thus play an important role in farmers' decision to adopt a measure.

1.4. Social influence

Peer effects are also widely discussed in literature concerning farmers' pro-environmental behaviour (Batáry et al., 2015). Peer effects are powerful influences on behaviour that offer information on what to do in complex decision environments (*informational influence*) and opportunities to stimulate fundamental needs for social belonging (*social influence*). They can boost the production of new knowledge, connect different insights and experiences, and facilitate social learning (Kreft et al., 2023; Milliet et al., 2024). For example, farmers' participation in agricultural conservation programs that help farmers share experiences and offer peer support have been found to increase uptake of biodiversity management practices (Byerly et al., 2021; Knook et al., 2020). Bakker et al. (2021) found that Dutch farmers' intentions to reduce pesticide use were strongly determined by the extent to which other farmers also act, and that knowledge exchange with peers could foster intentions to reduce pesticide use. There is however some mixed evidence, with some reporting null effects of social interventions targeting farmers' uptake of environmental practices (Milliet et al., 2024). For example, Niles et al. (2016) found no evidence that social influence predicted farmers' intentions or actions in the context of climate change adaptation in New Zealand agriculture. Still, little research has been conducted on actual on-farm pro-environmental behaviour, with a prevalent focus on self-report measures.

1.5. Use of advisory services

Finally, the *use of agricultural advisory services,* by facilitating the diffusion of information, can facilitate farmers' adoption of sustainable agricultural practices (Piñeiro et al., 2020), such as soil management (Mills et al., 2017), participation in voluntary agri-environmental schemes (Schaub et al., 2023), and reducing pesticide use (Bakker et al., 2021; Chantre & Cardona, 2014). These advisory services can boost knowledge as previously discussed, and in addition encourage uptake by providing further information, delivering technical advice, and facilitation to support farmers in transitioning their farm operations and management (Ingram et al., 2022).

1.6. Current research

In summary, the aim of this study is to explore the intention-action gap in the context of farmers' adoption of sustainable agricultural practices. Specifically, we aim to 1) examine how big farmers' intention-action gap is, 2) test whether predictors of intentions also predict actions, and 3) investigate which predictors can explain whether intentions turn into behaviour (summarised in Fig. 1). To do so, we use a dataset of Norwegian farmers' intentions to adopt as captured in a survey and their actual adoption of cover crops objectively measured six months later. In Norway, farmers can retroactively apply for a cover crops subsidy. That is, if adopting cover crops during the farming season, farmers pay for the related expenses up front and subsequently apply for the subsidy via an online form in October the same year. The level of subsidy varies somewhat between municipalities, however the

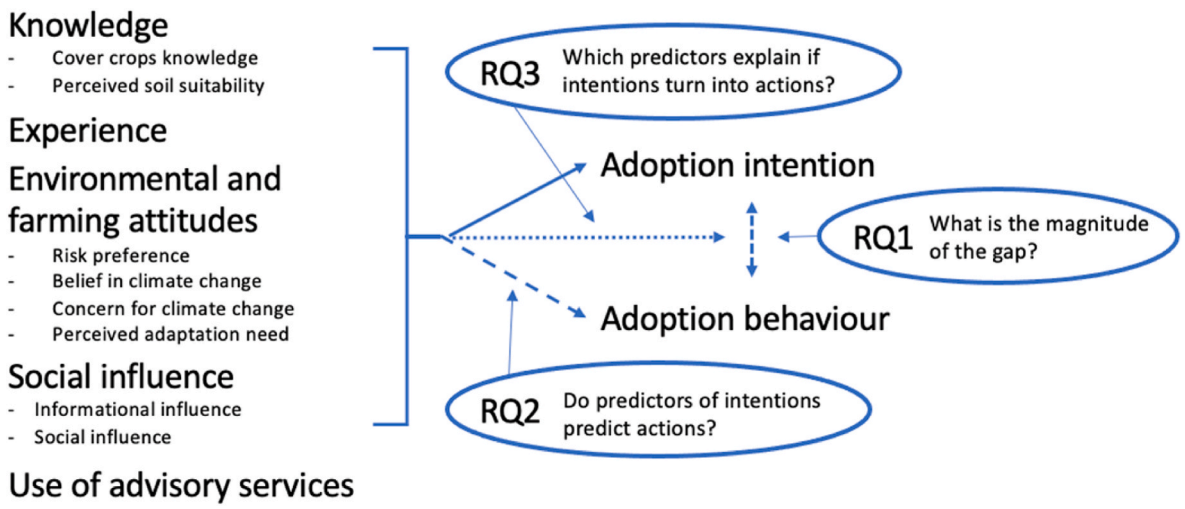

Fig. 1. Summary of the main concepts and research questions of this paper.

application process is streamlined and for most farmers it covers the costs associated with adoption (Bøe et al., 2019). Due to the economic and time investments associated with the use of cover crops, it is therefore highly likely that those who adopt cover crops apply for the subsidy to obtain a refund, making the application for subsidies a reliable indicator of whether farmers engaged in the behaviour. In our study we use data from a survey with 513 Norwegian horticultural farmers conducted in spring 2023 and a record of the same farmers' application for the cover crops subsidy six months later. We thus collect data on both intentions to apply for and actual applications for the cover crops subsidy. The survey further measured psychological and farm-specific variables, allowing us to examine a range of characteristics that influence farmers' intention-action gap.

2. Methods

2.1. Study context

The Norwegian agricultural sector contributes significantly to national food security, economy, and environmental goals. In 2019 the Norwegian government and farmer unions negotiated a climate agreement to reduce agricultural emissions and increase carbon sequestration in soils by 5 million tonnes CO2e by 2030 (Bondelaget, 2020). Recent years have also seen multiple shocks including the Covid-19 pandemic, energy crises, and extreme weather events that have further raised sustainable domestic food production on the political agenda. Norwegian horticultural farmers thus operate within a sector going through comprehensive scrutiny and change. To support the implementation of sustainable farming practices the agricultural and environmental authorities focus on information provision and consultancy services, as well as subsidies which are available on a voluntary basis for various practices, such as cover crops (OECD, 2021). Farmers can choose between different cover crop options depending on their agronomic conditions and main crop, including grasses, legumes, and other species. These are implemented either parallel with the main crop or after harvest. To satisfy requirements for the cover crops subsidy farmers must submit an online application by October and meet certain conditions including that the cover crops have been sufficiently established, refrain from using pesticides on the covered area, and avoid tillage by March 1st the following year.

2.2. Participants and procedure

We use responses from an online survey conducted with 513 Norwegian horticultural farmers in February–April 2023. The survey was designed and administered in collaboration with the Norwegian Institute for Bioeconomy (NIBIO) and leveraged connections with the National Agricultural Agency and the Farmer Advisory Service (Norsk Landbruksrådgivning, NLR) for participant recruitment.

The study was coded in Qualtrics and emailed to 2076 potential participants. It was also included in online newsletters. The survey was introduced as examining horticultural farmers' experience with and use of cover crops in farming systems. The response rate of the emailed farmers was 24%. All participants provided their informed consent before responding. The sample was 82.4 percent male and had a mean age of 53.18 (SD = 10.97). The median education was "Professional certificate" (completed high school with further professional education) and the median income level from farming was NOK 300-399k (approximately EUR 25-34k). For further details see the Appendix, Table A1. Bases on statistics of the farmer population we considered these sample characteristics to be well representative (SSB, 2021).

The survey measured farmers' practices and preferences in farming, environmental attitudes and concerns, their support for agricultural mitigation policy, and intentions to adopt cover crops. These items were drawn predominantly from previous surveys conducted with farmers by NIBIO and piloted with a small number of farmers prior to roll-out to ensure they were clearly understood. Details and descriptive statistics of the dependent measures are indicated in Table 1, and the independent measures in Table 2. At the end of the survey respondents were thanked for their participation and could provide additional comments. As compensation for their time they could enter a lottery to win a voucher valued at NOK 1000 (EUR 90).

Independent of the survey, in November 2023, we obtained participants' decision to apply for the cover crops subsidy in the 2023 growing season as a proxy for their adoption. This was measured by extracting the records of submitted subsidy applications from the Norwegian Agricultural Agency which were then matched to participants' survey responses.

Table 1
Dependent variables and descriptive statistics.

Variable name	Definition	Description	Mean
Application	Binary = 1 if applied for subsidy	Post-intervention decision to adopt cover crops in 2023 as measured by applying for subsidy	0.16
Intention to apply	Ordinal, 7-point Likert scale	How likely are you to apply for a subsidy to establish cover crops in 2023?	4.19 (SD = 1.95)

Table 2
Independent variables, their descriptive statistics, and where they were adopted from. We strived to use items that have been used and validated in the past. Most items were developed based on past surveys by NIBIO and NLR.

Variable category	Variable name	Definition	Description	Mean	SD	Adapted from
Knowledge	Cover crops knowledge	Measured on 7-point Likert scale	To what extent do you have sufficient knowledge of growing cover crops under your cultivation conditions?	3.6	1,7	NIBIO/NLR
Knowledge	Perceived soil suitability	Measured on 7-point Likert scale	How suitable do you consider your soil to be for establishing cover crops?	5.5	1.3	NIBIO/NLR
Experience	Past use of cover crops	Binary = 1 if "yes"	Are you currently using or have you previously used cover crops?	0.38		NIBIO/NLR
Environmental and farming attitudes	Climate belief	Measured on 5-point Likert scale	To what extent do you agree with the statement: climate change is happening	4.1	0.88	Aasen et al. (2019)
Environmental and farming attitudes	Climate concern	Measured on 5-point Likert scale	To what extent do you agree with the statement: I am concerned about climate change	3.5	1.1	Aasen et al. (2019)
Environmental and farming attitudes	Perceived need for climate adaptation	Measured on 7-point Likert scale	To what extent do you agree with the statement: there is increasing need for climate adaptation on the farm	4.9	1.5	NIBIO/NLR
Environmental and farming attitudes	Risk preference in farming	Measured on 7-point Likert scale	How willing are you to try out something new in farming, without knowing the outcomes for other farmers who have tried it?	4.5	1.4	NIBIO/NLR
Social influence	Considering other farmers (social influence)	Measured on 7-point Likert scale	How important are relationships to other farmers for your farming?	5.1	1.2	NIBIO/NLR
Social influence	Information from other farmers (informational influence)	Measured on 7-point Likert scale	How important is information from other farmers for the decisions you make in your farming?	4.3	1.6	NIBIO/NLR
Use of advisory services	Use advisors in farming	Measured on 7-point Likert scale	How important is information from advisory services (NLR) for the decisions you make in your farming?	5.1	1.4	NIBIO/NLR

Note: All answer options for the Likert-scale items were labelled, e.g. 1 = "not at all," 2 = "very low," 3 = "low," 4 = "neutral," 5 = "somewhat," 6 = "high," and 7 = "very high." NIBIO: Norwegian Institute for Bioeconomy. NLR: Farmer Advisory Service (Norsk Landbruksrådgivning).

2.3. Measures

The dependent variables and their descriptive statistics are reported in Table 1. Participants' intention to apply was measured on a 7-point Likert scale. The independent variables (translated from Norwegian) and their descriptive statistics are reported in Table 2. They were decided based on discussions with agricultural advisors, researchers, and the Agricultural Agency. In terms of subjective knowledge, we include two items that are kept separate in analysis to measure participants' knowledge of cover crops and their knowledge of related soil conditions and suitability. For personal experience we include past use of cover crops. For environmental and farming attitudes we include four measures, namely belief in and concern for climate change, perceived need for adaptation, and risk preference in farming. To assess the role of social influence we include measures of the extent to which participants considered other farmers' affairs in their farming decisions, and their use of information from peers. Lastly, we evaluate farmers' reliance on advisors as an information source for their farming decisions.

2.4. Ethics

The Oxford University Central Ethics Review conducted an ethical review following local legislation and institutional requirements and provided a research permit for conducting the survey (certificate number SOGE C1A-23-2). The survey (but not the specific research questions addressed in this paper) was pre-registered in the Open Science Framework website (link to pre-registration here: osf.io/5tnc4).

2.5. Analytical strategy

To address our three research questions, we examine the relationship between farmers' intentions and actions in three parts. First, to evaluate the magnitude of the intention-action gap we calculate the correlation coefficient between farmers' intended and actual adoption. Thereafter, to evaluate predictors of farmers' intentions to apply and predictors of their actual applications we use regression models (linear for the Intention outcome variable and logistic for the Final application variable). We entered predictors into the model in blocks based on their expected effects as inferred from conversations with farming experts and the literature. In the final step of the logistic regression estimation for actual behaviour we include the measure of Intention to adopt to examine if the strength of participants' reported intention is relevant for the predictive power of intentions on behaviour.

Finally, to examine the predictors of the intention-action gap we partition our sample to contain only those participants who stated their intention to apply in the survey. We then use logistic regressions to compare those who followed up on their intentions to those who did not (i.e. intention + no application vs intention + application).

In piloting the survey we received feedback that enforcing answers would deter respondents. There are therefore some missing values throughout the dataset, hence the reduced n in certain regression models. We performed several checks of our regression models to ascertain that the missing values did not bias our results or interpretation thereof (including regressions with additional control variables and regressions using only complete surveys, for statistical details see Tables A2 and A3 in the Appendix). Furthermore, in exploratory analyses we tested for potential interaction effects (no important effects were found, reported in the Appendix, Table A4).

3. Results

3.1. Prevalence of the intention-action gap

We started by examining the extent to which intentions translated into actual behaviour. To do this we considered participants who reported an intention stronger than 4 ("neutral") on a 7-point Likert scale to have a high intention, and those with a score of 4 or below to have a low intention. As Table 3 shows, we found that 49% of participants reported having an intention to adopt cover crops in 2023 (column 2). Yet,

Table 3
Distribution of participants' intentions and applications: raw counts of observations and share of respondents in percent in parentheses. Percentages may not add to 100 due to rounding. Column 1, "Low intention" signifies 4 ("neutral") or lower on a 7-point Likert scale, whereas column 2, "High intention" indicates 5 ("somewhat") or above.

	Low intention	High intention
No application	187 (47%)	150 (38%)
Application	16 (4%)	46 (12%)

only 16% of farmers actually adopted cover crops as measured by the applications for the subsidy (row 2), meaning only one in three farmers that reported having intentions to adopt actually did so. This estimate is somewhat higher that the number for the overall farmer population (7%). This could be explained by the fact that the overall farmer population also includes farmers that cannot adopt cover crops in their production, for example because they farm animals only or cultivate grass. Additionally, it could be the case the current survey oversampled farmers who were already using cover crops, as the topic of the survey was explicit in the invitation (see Discussion). In assessing the strength of the association between reported intentions and actual behaviour we found a small to moderate correlation ($r(397) = 0.27$, $p < .001$), which corresponds to an R^2 of 0.07, explaining only about 7% of the variance of the actual adoption behaviour.

Interestingly, we further uncovered that only strong intentions to apply predicted actual application. That is, based on intentions the likelihood of adopting cover crops was similar across the scale up until an intention of 7 ("very high"), such that participants reporting an intention to adopt of 2 ("very low") had a similar likelihood to adopt as those reporting an intention of 5 ("somewhat"). The gap between participants' intention to apply and their application was significantly smaller only for participants who reported the strongest intention, i.e. 7 on the 7-point scale. Fig. 2 demonstrates this pattern.

3.2. Predictors of intentions and actions

Next, using linear regression models, we examine whether knowledge, experience, environmental and farming attitudes, social influence, and reliance on advisors (see Table 2 for details on their measurement) are statistically significant predictors of both intentions to act as well as actual behaviour. When estimating the likelihood of actual behaviour we run a conditional model which in addition to all others also includes intention as a predictor. We observed that participants who reported past use of cover crops, higher levels of knowledge about cover crops, being more willing to take risks in the farming context, higher perceived need for climate adaptation, and more reliance on advisory services reported significantly higher levels of intentions to apply for the cover crops subsidy (Table 4). These findings align with previous literature and demonstrates the relevance of these variables for explaining intentions to adopt sustainable farming practices. However, variables we expected to be significant based on recent results and meta-analyses, including climate beliefs, climate concern, and peer information, were not significant predictors of intentions to apply when accounting for all other factors.

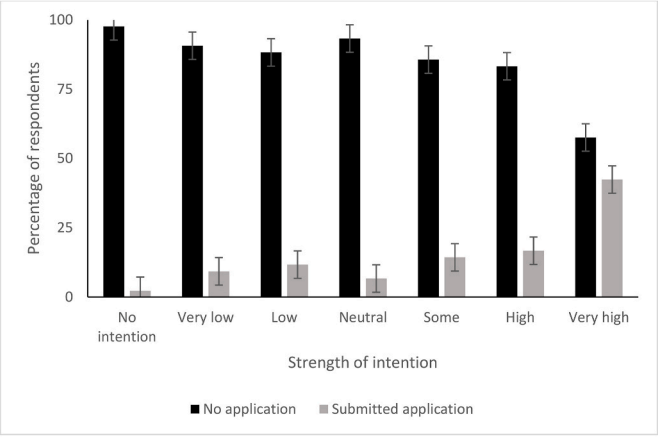

Fig. 2. The relationship between strength of self-reported intentions to apply and final application. The x-axis represents participants' intention strength (measured on a 7-point Likert scale), and the y-axis represents the share of respondents. Error bars represent the standard error.

With respect to actual applications (Table 5), using logistic regressions, we only found that past use of cover crops was a significant predictor, with cover crops knowledge as a marginally significant predictor. We also found that participants' intention to adopt was a significant predictor, driven by those reporting strong intentions (i.e. reporting a score of 7 ("very high")), as described above. We checked the robustness of these results by including additional control variables and found consistent results (for statistical details see the Appendix, Tables A2 and A3).

In sum, our data show that predictors of intention do not necessarily predict actions and suggest that only strong intentions have predictive value for actions.

3.3. When do intentions translate into action

We now turn to the predictors that explain when intentions lead to actions by considering adoption only for participants who held high intentions to apply (i.e. 5 ("somewhat") or higher on a 7-point Likert scale) in the survey. The results of our logistic regressions show that the only significant predictor for application for the subsidy is past use of cover crops. Model statistics (Table 6) reveal that participants who self-report past use of cover crops have significantly higher odds of adopting cover crops, compared to their counterparts who have not used cover cops in the past. Overall, we thus find that participants' intention to adopt cover crops is not a reliable predictor for their actual adoption, nor are other predictors that significantly predict intentions, such as use of advisory services, risk preference, and perceived need for climate adaptation. We caution that for these analyses our sample size is relatively low, and therefore we do not claim that our lack of evidence necessarily proves a lack of effect.

4. Discussion

An established literature underlines the importance of variables beyond economic motives for farmers' decisions: psychological variables also influence decisions to adopt sustainable farming practices. Yet this work has predominantly relied on intentions as proxies for behaviour, which is noteworthy as some studies warn that predictors of intentions are not necessarily predictors of actual behaviour. Because policy recommendations to change behaviour are formulated based on studies looking at intentions, it is urgent to quantify the intention-action gap and examine whether predictors of intentions also predict actual behaviour. Our paper is in direct relevance to a recent meta-analysis that highlighted intentions as one of the most important predictors of farmers' adoption of sustainable farming practices (Swart et al., 2023). We present further evidence that there are important differences in the predictors associated with farmers' stated intentions and their actual behaviours, specifically in the context of adopting cover crops as a sustainable farming practice. We examined the size of the intention-action gap, whether predictors of intentions also predict actions, and finally, which predictors could explain whether intentions turn into behaviour. Taken together our approach offers a novel contribution to help overcome limitations to the existing literature which focused primarily on intentions, self-report behaviours, and cross-sectional research designs.

Our results demonstrate a significant prevalence of the intention-action gap and further quantify it in the agricultural context. Whereas 49% of farmers reported intentions to adopt cover crops, only 16% followed through. Predictors of intentions included knowledge and past use of cover crops, perceived need for climate adaptation, being more willing to take risks in agricultural decisions, and use of advisory services, all of which had a positive relationship with intentions. However, except for past use of cover crops, these predictors of intentions did not predict actual behaviour.

These results offer a critical perspective on which policy recommendations can be derived from studies that only examine farmers

Table 4
Intention to adopt (Linear).

	(1)			(2)			(3)			(4)			(5)		
	b	***SE***	***CI***	***b***	***SE***	***CI***	***b***	***SE***	***CI***	***b***	***SE***	***CI***	***b***	***SE***	***CI***
Cover crops knowledge	0.25***	0.07	[0.11, 0.40]	0.16*	0.07	[0.02, 0.30]	0.15*	0.07	[0.01, 0.29]	0.18*	0.07	[0.03, 0.32]	0.16*	0.07	[0.01, 0.30]
Perceived soil suitability	0.23**	0.09	[0.06, 0.40]	0.08	0.08	[-0.09, 0.25]	0.06	0.08	[-0.11, 0.22]	0.06	0.09	[-0.12, 0.23]	0.10	0.09	[-0.07, 0.28]
Past use				1.39***	0.22	[0.96, 1.83]	1.31***	0.22	[0.88, 1.74]	1.35***	0.23	[0.90, 1.80]	1.41***	0.23	[0.97, 1.85]
Climate belief							−0.26	0.15	[-0.56, 0.03]	−0.35*	0.16	[-0.67, −0.04]	−0.27	0.16	[-0.58, 0.04]
Climate concern							−0.01	0.13	[-0.26, 0.24]	0.06	0.14	[-0.22, 0.34]	−0.005	0.14	[-0.28, 0.27]
Perceived need for adaptation							0.32***	0.09	[0.14, 0.51]	0.27**	0.10	[0.07, 0.47]	0.24*	0.10	[0.04, 0.44]
Risk preference							0.17*	0.08	[0.02, 0.33]	0.17*	0.09	[0.005, 0.34]	0.20*	0.08	[0.04, 0.37]
Considering peers										0.12	0.10	[-0.07, 0.31]	0.13	0.09	[-0.05, 0.31]
Using information from peers										0.08	0.07	[-0.07, 0.22]	0.003	0.07	[-0.14, 0.15]
Using advisors													0.27***	0.08	[0.12, 0.42]
Constant	2.16***	0.49	[1.19, 3.13]	2.75***	0.47	[1.82, 3.68]	1.62*	0.70	[0.24, 3.00]	0.93	0.88	[-0.80, 2.66]	−0.43	0.93	[-2.25, 1.39]
Observations	304			294			286			260			252		
R^2	0.08			0.20			0.25			0.26			0.31		
Adjusted R^2	0.08			0.19			0.23			0.23			0.29		

Note: Results from the linear regression models on participants' intention to adopt cover crops. *$p < .05$; **$p < .01$; ***$p < .001$. The outcome variable for columns 1–5 is "Intention to apply" (for the cover crops subsidy), measured on a 7-point Likert scale. "Past use" is the only binary predictor, for which 0 (no past use) is the reference category.

intentions, but not actual behaviour. For example, we replicated previous findings demonstrating that predictors including experience, knowledge, stronger perceived need for climate adaptation, and use of advisory services are positively associated with intentions to adopt sustainable agricultural practices (Bakker et al., 2021; Kuehne et al., 2017; Mills et al., 2020; Niles et al., 2016). Policy recommendations to promote the adoption of sustainable practices derived from such findings would recommend for example interventions for capacity building, agricultural advisory services, and peer learning aimed to enhance farmers' knowledge.

However, while such interventions may increase farmers' *intentions,* we have shown in this article that this does not necessarily lead to the actual adoption of sustainable farming practices. This is in line with previous studies that also suggest an intention-action gap among farmers (Floress et al., 2018; Niles et al., 2016; Zhou et al., 2023). In our study only around 1/3 of farmers that reported intentions did in fact adopt the sustainable practice. Moreover, we found that only participants who reported the strongest intentions were more likely to act on them.

Focusing on our findings pertaining to the role of experience, our study offers further indications of how to promote farmers' uptake of sustainable farming practices. We specifically found that more experienced farmers were most likely to translate intentions into behaviours. In designing interventions to promote the uptake of sustainable farming practices, policy makers should not only try to increase intentions, but also consider what happens between intentions and behaviours, and how this step can be facilitated (Conner & Norman, 2022; Laffan et al., 2023). Our study shows that stronger intentions to adopt are more likely to translate into behaviour, and that experience with a practice such as cover crops predicts uptake. This would suggest that interventions such as workshops and demonstrations to build farmers' experience could be useful. Experience positively relates to their confidence that they can successfully perform an action and follow up on their intentions, i.e. self-efficacy (Brown et al., 2022; Perry & Davenport, 2020). In fact, several studies suggest that self-efficacy is a key factor in explaining the intention-action gap (e.g., Sniehotta et al., 2005; van Valkengoed et al., 2023) and that self-efficacy is needed to transform intentions into action (Bandura, 2006; Feola et al., 2015; Kreft et al., 2023). Interventions to increase farmers' sense of self-efficacy in implementing the sustainable practice can be promising for reducing the intention-action gap (Gebrehiwot & Van Der Veen, 2015; Niles et al., 2016).

The findings that the strength of intention is important for the relationship between intentions and actions and that experience is associated with a stronger positive relationship between intentions and actions are noteworthy. Whereas few participants overall followed up on their intentions, those with the strongest intentions to apply for the subsidy were significantly more likely to actually apply for it. Theoretically, stronger intentions are assumed to be more stable over time, less susceptible to change when challenged, and to have greater influence of information processing at the cognitive level (Conner & Norman, 2022). In turn, stronger intentions are more reliable predictors of behaviours. In our case, experience emerged as the strongest predictor of behaviour for those who already held high intentions. Past research suggests that experience initially enhances the power of intention to predict action, but as experience grows stronger it weakens the predictive power of intentions via habit formation (Sheeran & Webb, 2016). We offer further empirical evidence for the role of experience on the intention-action relationship and demonstrate the importance of evaluating the strength of intentions (i.e. not simply as a binary option). To further understand it and develop policy and practitioner recommendations it is necessary to consider the dynamic interplay of intentions and experience, including intention strength.

Critically, we do not mean to argue that studies that have examined intentions are altogether not worthwhile or useful in designing interventions or policies that are aimed at promoting the uptake of

Table 5
Actual application (logistic).

	(1)			(2)			(3)			(4)			(5)			(6)		
	OR	***SE***	***CI***	***OR***	***SE***	***CI***	***OR***	***SE***	***CI***	***OR***	***SE***	***CI***	***OR***	***SE***	***CI***	***OR***	***SE***	***CI***
Cover crops knowledge	1.42 **	0.12	[1.13; 1.81]	1.36 *	0.13	[1.06; 1.77]	1.34 *	0.14	[1.03; 1.77]	1.43 *	0.14	[1.09; 1.92]	1.40 *	0.14	[1.07; 1.88]	1.32	0.15	[1.00; 1.78]
Perceived soil suitability	1.14	0.14	[0.88; 1.52]	0.98	0.15	[0.73; 1.34]	0.99	0.16	[0.73; 1.36]	1.04	0.17	[0.76; 1.47]	1.06	0.17	[0.76; 1.50]	1.03	0.18	[0.73; 1.47]
Past use				4.09 ***	0.39	[1.96; 9.10]	3.70 **	0.40	[1.74; 8.37]	3.93 **	0.41	[1.82; 9.04]	4.12 **	0.41	[1.89; 9.59]	2.57 *	0.45	[1.08; 6.36]
Climate belief							0.93	0.25	[0.57; 1.53]	0.85	0.26	[0.50; 1.42]	0.83	0.27	[0.49; 1.40]	0.92	0.28	[0.53; 1.59]
Climate concern							1.01	0.21	[0.68; 1.53]	0.97	0.23	[0.62; 1.54]	0.97	0.23	[0.61; 1.55]	0.95	0.24	[0.59; 1.54]
Perceived need for adaptation							1.04	0.15	[0.78; 1.42]	1.08	0.16	[0.79; 1.51]	1.09	0.17	[0.79; 1.53]	1.02	0.17	[0.73; 1.44]
Risk preference							0.98	0.14	[0.74; 1.30]	1.01	0.15	[0.75; 1.38]	0.99	0.15	[0.74; 1.36]	0.91	0.16	[0.66; 1.25]
Considering peers										0.99	0.16	[0.72; 1.35]	0.98	0.16	[0.72; 1.34]	0.93	0.16	[0.68; 1.29]
Using information from peers										1.20	0.12	[0.95; 1.54]	1.22	0.13	[0.95; 1.59]	1.23	0.13	[0.95; 1.62]
Using advisors													0.94	0.13	[0.72; 1.22]	0.86	0.14	[0.65; 1.14]
Intention to apply																1.45 *	0.14	[1.13; 1.92]
Constant	0.02 ***	0.83	[0.00; 0.09]	0.02 ***	0.88	[0.00; 0.12]	0.03 *	1.26	[0.00; 0.33]	0.01 **	1.60	[0.00; 0.22]	0.02 *	1.73	[0.00; 0.47]	0.02 *	1.81	[0.00; 0.50]
Observations	328			318			291			263			254			252		
AIC	278.42			249.89			246.82			232.54			228.23			220.79		

Note: Results from logistic regression models on Application for the cover crops subsidy. Effect sizes are reported as odds ratios (OR). *$p < .05$; **$p < .01$; ***$p < .001$. The outcome variable for columns 1–6 is the Actual application for the subsidy, a binary measure (0 if did not apply). "Past use" is the only binary predictor, for which 0 (no past use) is the reference category.

Table 6
Logistic regression results: predictors of Actual application (including only those who reported an intention to apply).

	(1)			(2)			(3)			(4)			(5)		
	OR	***SE***	***CI***	***OR***	***SE***	***CI***	***OR***	***SE***	***CI***	***OR***	***SE***	***CI***	***OR***	***SE***	***CI***
Cover crops knowledge	1.05	0.02	[1.00; 1.09]	1.04	0.02	[0.99; 1.09]	1.04	0.02	[0.99; 1.09]	1.04	0.03	[0.99; 1.10]	1.04	0.03	[0.99; 1.10]
Perceived soil suitability	1.05	0.03	[0.99; 1.11]	1.02	0.03	[0.97; 1.08]	1.03	0.03	[0.97; 1.09]	1.04	0.03	[0.98; 1.11]	1.04	0.03	[0.98; 1.11]
Past use				1.20*	0.07	[1.04; 1.38]	1.22*	0.08	[1.05; 1.41]	1.24**	0.08	[1.06; 1.46]	1.23*	0.08	[1.05; 1.45]
Climate belief							0.96	0.05	[0.87; 1.07]	0.97	0.06	[0.87; 1.08]	0.95	0.06	[0.85; 1.07]
Climate concern							1.00	0.04	[0.92; 1.10]	0.99	0.05	[0.90; 1.08]	0.99	0.05	[0.90; 1.10]
Perceived need for adapt.							1.01	0.03	[0.95; 1.07]	1.02	0.03	[0.95; 1.08]	1.02	0.03	[0.95; 1.08]
Risk preference							0.98	0.03	[0.93; 1.04]	0.98	0.03	[0.92; 1.04]	0.97	0.03	[0.91; 1.04]
Considering peers										1.00	0.03	[0.94; 1.07]	0.99	0.03	[0.93; 1.06]
Using info from peers										1.02	0.02	[0.97; 1.07]	1.03	0.03	[0.98; 1.08]
Using advisors													0.98	0.03	[0.92; 1.04]
Constant	0.81	0.17	[0.58; 1.13]	0.85	0.17	[0.61; 1.17]	1.02	0.27	[0.60; 1.74]	0.86	0.35	[0.43; 1.71]	1.03	0.39	[0.48; 2.24]
Observations	170			166			162			148			144		
AIC	195.72			182.36			184.38			178.47			175.89		

Note: Results from logistic regression models including only participants who held an intention to apply for the cover crops subsidy. *$p < .05$; **$p < .01$; ***$p < .001$. Dependent variable: Actual application of subsidy for cover crops, a binary variable measured by whether or not an application for the cover crops subsidy was submitted (0 is reference category). "Past use" is the only binary predictor, for which 0 (no past use) is the reference category.

sustainable agricultural practices. Rather, we argue that interventions that focus on variables that are known predictors of farmers' intentions may be relatively inefficient in promoting actual behaviour. Such interventions do not cover the entire decision-making process that culminates in the actual adoption of behaviour, as demonstrated in our study where only the minority of farmers with intentions actually implemented the behaviour.

4.1. Limitations and avenues for future studies

A notable strength of our study is combining the use of survey data with an objective behavioural measure collected using a longitudinal approach. Future studies that use longitudinal and experimental methods to close the intention-action gap are imperative for policy design.

We also acknowledge several limitations to our study and additional insights for future research. First, our study focuses specifically on the adoption of cover crops, and whether the predictors of farmers' intentions also predict their actions. The study was framed as a survey on cover crops, and while it explicitly invited participation from farmers with any level of experience with cover crops, there could be selection bias in terms of attracting more interest from those with more experience or interest in the topic (we note, however, that our sample was well representative in terms of observable characteristics and we therefore have minor concerns about this). If this did in fact happen—farmers with more experience self-selected into the study—the uncovered predictive effect of experience with cover crops would be closer to the upper bound and the intention-action gap would likely be even larger. Thus, whereas our study offers supportive evidence of an agricultural intention-action gap and inconsistencies between predictors of intentions and predictors of actions, further studies are needed to evaluate the exact prevalence and characteristics of the intention-action gap to different agricultural practices and contexts.

While not the core aim of the study, the current analyses could not fully explain when intentions (did not) turn into behaviour. Given that commonly used predictors in the literature did not predict actual behaviour, it may be necessary to consider other types of variables that are not yet examined within the literature. Due to time and monetary constraints and concerns for participant burden we did not conduct a follow-up survey to collect further data, e.g. on economic, environmental, or other factors that influenced their (non-)adoption. Future exploratory studies may therefore be necessary to determine which barriers farmers encounter when they already have a strong intention to adopt a measure, but have not yet turned this intention into action. Qualitative methods may be particularly useful at this stage to determine such barriers, that could relate to e.g. the subsidy application process in terms of administrative hurdles or requirements that hinder application. For example, future studies could randomly select individuals that did and did not adopt the practice and qualitatively examine their motivations and perceptions regarding their behaviour. Such studies should strive to mitigate potential selection bias of farmers that are more interested in or knowledgeable about practices like cover crops or that are more technologically apt. Considering the predictors and consequences of having strong intentions and when they (do not) translate into actions represent enticing areas for research to help inform both policy and practitioner approaches.

We further recognise limitations and weaknesses about our measurements. For one, our behavioural measure, the application for the cover crops subsidy, is not a perfect measure of behaviour. We cannot exclude the possibility that farmers adopted cover crops without applying for the subsidy. For example, they could have forgotten the deadline, not known where to apply, or not wanted to go through the application process (e.g. perceived it as a bureaucratic hurdle). However, given the significant cost of both time and money that farmers must absorb when using cover crops it is unlikely that they would have foregone applying for the subsidy to obtain a refund. We also recognise that the predictors included in our survey are predominantly based on previous surveys used with Norwegian farmers, and that such differences in measurement could also influence the discrepancies we observed from the literature.

Future studies could also specifically address the identified predictors of the intention-action gap to test tailored strategies including application reminders, the communication and framing of policies, other initiatives to overcome bureaucracy, or interventions promoting farmers to collectively sign up for the subsidy. Critically, our results indicate that only the strongest intentions are likely to translate into action, suggesting that interventions based on intentions must shift intentions to the strongest level to influence behaviour.

5. Conclusion

Taken together, our findings show that predictors of intentions to adopt sustainable farming practices do not always predict actual behaviour and hold important implications for researchers, policymakers, and practitioners. As intentions may not be predictive of behaviour, our study underlines recent calls to move beyond measures of intention in efforts to promote behaviour change for climate mitigation and adaptation, and behaviour change in general (Lange et al., 2023; Nielsen et al., 2021). Agricultural climate policies and interventions often rely on individual efforts by farmers, whose collective agricultural practices contribute to climate and environmental change. However, interventions to help farmers implement sustainable practices should not only focus on increasing farmers intentions to do so, but also help them to actually bridge the gap between intentions and behaviours. Supporting this change requires a sound understanding of the factors that motivate farmers to change their practices, and the coordinated and cooperative action required by various stakeholders across sectors and policy domains.

CRediT authorship contribution statement

Andrea Byfuglien: Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Anne M. van Valkengoed:** Writing – review & editing, Validation, Methodology, Conceptualization. **Stefania Innocenti:** Writing – review & editing, Supervision, Conceptualization.

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Appendix

Sample characteristics

Table A1 shows an overview and comparison of key characteristics of the population of farmers in Norway (surveyed via the Statistics Norway, 2024) and the sample in this study.

Table A1
Overview of key sample characteristics and population characteristics.

Variable	Population (SSB)	Sample (current survey)
Age	55.9	53.2
Gender	82.7% male	82.4% male
Area farmed	M = 262 daa	M = 395/median = 246 daa
Farm Income	NOK 275 100	NOK 300k-399k (median)

Further statistical analyses of predictors of intentions and actions

We performed additional checks of our regression models to ascertain that missing values did not bias our results or interpretation thereof, and the inclusion of additional control variables. Table A2 reports results of our main regression models of Intention to apply for the cover crops subsidy including additional demographic control variables to check for consistent effects, and Table A3 reports on Actual application for the subsidy. We note that the results are largely similar as those reported in the main results section.

Table A2
Intention to apply for the cover crops subsidy, including demographic controls (linear)

	(1)			(2)			(3)			(4)			(5)			(6)		
	b	***SE***	***CI***	***b***	***SE***	***CI***	***b***	***SE***	***CI***	***b***	***SE***	***CI***	***b***	***SE***	***CI***	***b***	***SE***	***CI***
Cover crops knowledge	0.25***	0.07	[0.11, 0.40]	0.16*	0.07	[0.02, 0.30]	0.15*	0.07	[0.01, 0.29]	0.18*	0.07	[0.03, 0.32]	0.16*	0.07	[0.01, 0.30]	0.22**	0.08	[0.06, 0.38]
Perceived soil suitability	0.23**	0.09	[0.06, 0.40]	0.08	0.08	[-0.09, 0.25]	0.06	0.08	[-0.11, 0.22]	0.06	0.09	[-0.12, 0.23]	0.10	0.09	[-0.07, 0.28]	0.07	0.10	[-0.11, 0.26]
Past use				1.39***	0.22	[0.96, 1.83]	1.31***	0.22	[0.88, 1.74]	1.35***	0.23	[0.90, 1.80]	1.41***	0.23	[0.97, 1.85]	1.39***	0.24	[0.91, 1.87]
Climate belief							−0.26	0.15	[-0.56, 0.03]	−0.35*	0.16	[-0.67, −0.04]	−0.27	0.16	[-0.58, 0.04]	−0.31	0.17	[-0.64, 0.03]
Climate concern							−0.01	0.13	[-0.26, 0.24]	0.06	0.14	[-0.22, 0.34]	−0.005	0.14	[-0.28, 0.27]	0.06	0.16	[-0.25, 0.36]
Perceived need for adaptation							0.32***	0.09	[0.14, 0.51]	0.27**	0.10	[0.07, 0.47]	0.24*	0.10	[0.04, 0.44]	0.29**	0.11	[0.07, 0.50]

(*continued on next page*)

Table A2 (*continued*)

	(1)			(2)			(3)			(4)			(5)			(6)		
	b	***SE***	***CI***	***b***	***SE***	***CI***	***b***	***SE***	***CI***	***b***	***SE***	***CI***	***b***	***SE***	***CI***	***b***	***SE***	***CI***
Risk preference							0.17*	0.08	[0.02, 0.33]	0.17*	0.09	[0.005, 0.34]	0.20*	0.08	[0.04, 0.37]	0.23*	0.09	[0.04, 0.41]
Considering peers										0.12	0.10	[-0.07, 0.31]	0.13	0.09	[-0.05, 0.31]	0.06	0.10	[-0.15, 0.27]
Using information from peers										0.08	0.07	[-0.07, 0.22]	0.003	0.07	[-0.14, 0.15]	0.09	0.08	[-0.06, 0.25]
Using advisors													0.27***	0.08	[0.12, 0.42]	0.19*	0.08	[0.03, 0.35]
Age																−0.02*	0.01	[-0.04, −0.002]
Education																−0.09	0.24	[-0.57, 0.38]
Income																−0.30	0.23	[-0.76, 0.16]
Constant	2.16***	0.49	[1.19, 3.13]	2.75***	0.47	[1.82, 3.68]	1.62*	0.70	[0.24, 3.00]	0.93	0.88	[-0.80, 2.66]	−0.43	0.93	[-2.25, 1.39]	0.76	1.14	[-1.46, 2.99]
Observations	304			294			286			260			252			214		
R^2	0.08			0.20			0.25			0.26			0.31			0.35		
Adjusted R^2	0.08			0.19			0.23			0.23			0.29			0.31		

Note: Results from the linear regression on participants' intention to adopt including demographic controls. *$p < .05$; **$p < .01$; ***$p < .001$. The dependent variable Intention to apply for the cover crops subsidy, measured on a 7-point Likert scale. Past use is a binary predictor, for which 0 (no past use) is the reference category. Education is a binary predictor signifying holding higher education or not, for which no higher education is the reference category. Income is a binary predictor signifying household income, for which under 499k is the reference category.

Table A3
Application for the cover crops subsidy, including demographic controls (logistic)

	(1)			(2)			(3)			(4)			(5)			(6)			(7)		
	OR	***SE***	***CI***	***OR***	***SE***	***CI***	***OR***	***SE***	***CI***	***OR***	***SE***	***CI***	***OR***	***SE***	***CI***	***OR***	***SE***	***CI***	***OR***	***SE***	***CI***
Cover crops knowledge	1.42 **	0.12	[1.13; 1.81]	1.36 *	0.13	[1.06; 1.77]	1.34 *	0.14	[1.03; 1.77]	1.43 *	0.14	[1.09; 1.92]	1.40 *	0.14	[1.07; 1.88]	1.32	0.15	[1.00; 1.78]	1.46*	0.18	[1.04; 2.13]
Perceived soil suitability	1.14	0.14	[0.88; 1.52]	0.98	0.15	[0.73; 1.34]	0.99	0.16	[0.73; 1.36]	1.04	0.17	[0.76; 1.47]	1.06	0.17	[0.76; 1.50]	1.03	0.18	[0.73; 1.47]	0.90	0.19	[0.62; 1.34]
Past use				4.09 ***	0.39	[1.96; 9.10]	3.70 **	0.40	[1.74; 8.37]	3.93 **	0.41	[1.82; 9.04]	4.12 **	0.41	[1.89; 9.59]	2.57 *	0.45	[1.08; 6.36]	3.32*	0.51	[1.24; 9.39]
Climate belief							0.93	0.25	[0.57; 1.53]	0.85	0.26	[0.50; 1.42]	0.83	0.27	[0.49; 1.40]	0.92	0.28	[0.53; 1.59]	0.89	0.31	[0.48; 1.64]
Climate concern							1.01	0.21	[0.68; 1.53]	0.97	0.23	[0.62; 1.54]	0.97	0.23	[0.61; 1.55]	0.95	0.24	[0.59; 1.54]	0.95	0.27	[0.55; 1.64]
Perceived need for adaptation							1.04	0.15	[0.78; 1.42]	1.08	0.16	[0.79; 1.51]	1.09	0.17	[0.79; 1.53]	1.02	0.17	[0.73; 1.44]	0.87	0.20	[0.59; 1.30]
Risk preference							0.98	0.14	[0.74; 1.30]	1.01	0.15	[0.75; 1.38]	0.99	0.15	[0.74; 1.36]	0.91	0.16	[0.66; 1.25]	1.01	0.20	[0.69; 1.52]
Considering peers										0.99	0.16	[0.72; 1.35]	0.98	0.16	[0.72; 1.34]	0.93	0.16	[0.68; 1.29]	1.10	0.20	[0.74; 1.65]
Using information from peers										1.20	0.12	[0.95; 1.54]	1.22	0.13	[0.95; 1.59]	1.23	0.13	[0.95; 1.62]	1.17	0.16	[0.86; 1.63]
Using advisors													0.94	0.13	[0.72; 1.22]	0.86	0.14	[0.65; 1.14]	0.80	0.17	[0.57; 1.11]
Age																			1.03	0.02	[0.99; 1.08]
Education																			1.85	0.47	[0.75; 4.75]
Income																			0.53	0.47	[0.21; 1.31]
Intention to apply																1.45 *	0.14	[1.13; 1.92]	1.43*	0.15	[1.07; 1.98]
Constant	0.02 *	0.83	[0.00; 0.09]	0.02 *	0.88	[0.00; 0.12]	0.03 *	1.26	[0.00; 0.33]	0.01 *	1.60	[0.00; 0.22]	0.02 *	1.73	[0.00; 0.47]	0.02 *	1.81	[0.00; 0.50]	0.00	2.28	[0.00; 0.26]
Observations	328			318			291			263			254			252			214		
AIC	278.42			249.89			246.82			232.54			228.23			220.79			183.29		

Note: Results from logistic regression models on Application for the cover crops subsidy including demographic controls. *$p < .05$; **$p < .01$; ***$p < .001$. The dependent variable is the Actual application for the subsidy, a binary measure (0 if did not apply). Past use is a binary predictor, for which 0 (no past use) is the reference category. Education is a binary predictor for which no higher education is the reference category. Income is a binary predictor signifying household income for which under 499k is the reference category.

Visuals of the strength of intention' effect on actual application

Figure A1 shows an alternative visualisation of the intention strength effect, indicating that those who hold the strongest level of intention (i.e. 7 ("very high") on the 7-point Likert scale) have a higher probability of following up on their intention and actually applying for the cover crops subsidy.

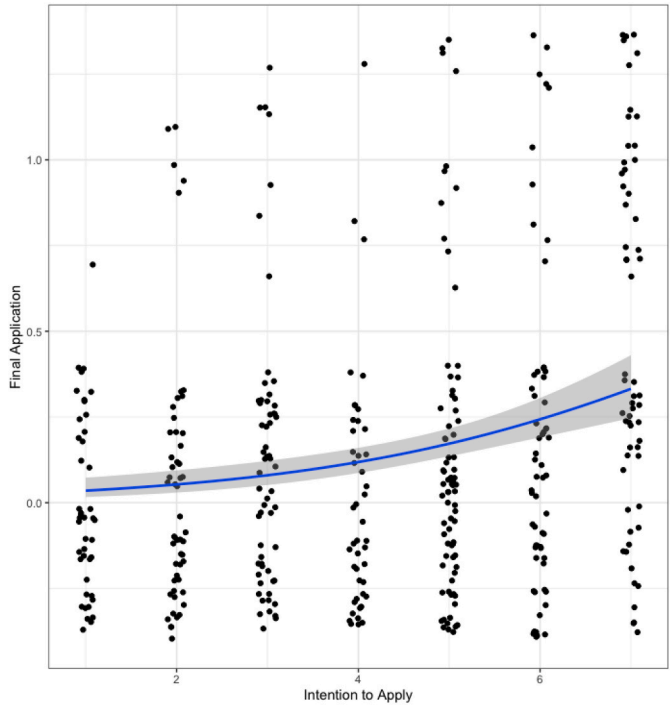

Fig. A1. Probability of applying for cover crops subsidy based on participants' intention to apply as measured on the 7-point Likert scale.

Figure A2 shows the raw counts of participants' strength of intention by application submission status, showing a largely similar pattern as the figure based on percentage of respondents which is displayed in the main text (Fig. 2).

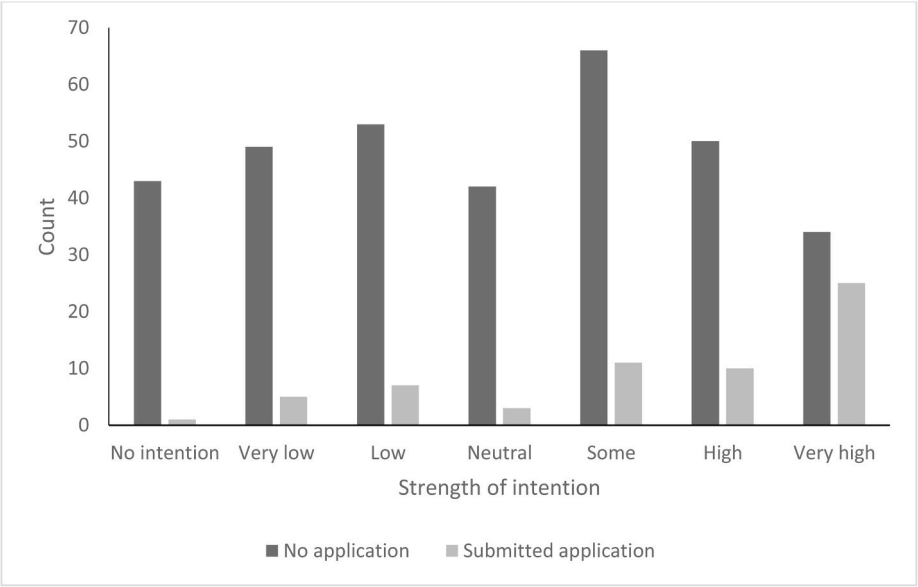

Fig. A2. The relationship between strength of self-reported intention to apply and final application. The X-axis represents participants' intention strength (measured on a 7-point Likert scale), and the Y-axis represents the count of respondents.

Interaction effects

In exploratory analyses we performed linear regressions including interaction terms to further understand the relationships between the predictors and their effects on participants' intention to adopt (Table A4). Analyses revealed a significant interaction effect between cover crops knowledge and past use (coef. = 0.27, 95% CI [0.03, 0.50]), suggesting that the effect of cover crops knowledge on adoption intention is strengthened among those who have used cover crops in the past. We did not have a priori hypotheses and interpret these effects with caution.

Table A4
Interaction effects on Intention to adopt (measured on a 7-point Likert scale).

Predictor Variable	Estimate	Std. Error	95% CI
Perceived need for adaptation	0.22**	0.08	[0.07; 0.38]
Risk preference	0.29***	0.08	[0.14; 0.44]
Cover crops knowledge	0.15*	0.07	[0.02; 0.27]
Using advisors	0.36***	0.08	[0.20; 0.52]
Past use	1.29***	0.21	[0.89; 1.69]
Perceived need for adaptation * Risk preference	0.06	0.04	[-0.01; 0.13]
Cover crops knowledge * Using advisors	0.02	0.03	[-0.05; 0.10]
Perceived need for adaptation * Past use	−0.21	0.12	[-0.46; 0.04]
Risk preference * Past use	−0.03	0.14	[-0.30; 0.24]
Cover crops knowledge * Past use	0.27*	0.12	[0.03; 0.50]
Using advisors * Past use	−0.18	0.14	[-0.45; 0.09]
Constant	3.68***	0.11	[3.47; 3.89]
Observations	360		
R^2	0.38		
Adjusted R^2	0.36		

Note: Results from linear regression models on participants' intention to apply for the cover crops subsidy including interaction effects. *$p < .05$; **$p < .01$; ***$p < .001$. The dependent variable is Intention to adopt. "Past use" is the only binary predictor, for which 0 (no past use) is the reference category.

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