Extended Abstract

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Paper/Poster Title	Farmers' Expectations of Climate Action: Evidence from an Information Experiment

Abstract prepared for presentation at the 98th Annual Conference of The Agricultural Economics Society will be held at The University of Edinburgh, UK, 18th - 20th March 2024.

Abstract	***200 words max***

A key measure to reduce chemical fertilizer application, and thereby reduce GHG emissions from agriculture, is the introduction of clover into grazing grass. Yet, adoption of this measure remains low, and it is unknown how farmers incorporate information about clover into their expectations. In this paper, we used an experiment to assess how providing information affects farmers' expectations about clover and subsequent attitudes. Over 300 dairy farmers in Ireland, were randomly assigned into two information treatment groups and one active control group. To elicit farmers' expectations, we combined qualitative open-ended questions and quantitative point estimates. As for the subsequent attitudes, we elicited farmers' intentions and willingness to accept. We provide evidence that farmers have biased expectations about clover adoption. They underestimate the reduction of chemical fertilizer that is possible with adoption, and our information treatments reduce misperceptions by up to 19%. Through the text analysis, we discovered that information increases the likelihood of having not only a positive change, but also a negative change in opinions. Lastly, no meaningful impact was found on intentions and WTA, which underlines the complexity of adoption decisions. Nonetheless, our findings are relevant to help construct accurate expectations that can facilitate widespread adoption of clover.

Keywords	expectations, information provision, economic experiment, behavioural economics.
JEL Code	C90, C93, D83, D91, Q12, Q16, Q56

Introduction	***100 – 250 words***

A strong greenhouse gas (GHG) with a long atmospheric life is nitrous oxide (N_20). The world's agricultural activity accounts for around three-quarters of global N_20 emissions (Mbow et al., 2020). The main driver of these emissions is the application of chemical N fertilizer at the farm-level (Tian et al., 2020). In Ireland, agriculture is responsible for 92.6% of national N_20 emissions, and chemical N fertilizers are responsible for 40% of national N_20 emissions (Environmental Protection Agency [EPA], 2022a; Department of Agriculture, Food and the Marine [DAFM], 2020). One key farm practice, to reduce the application of chemical N fertilizer and mitigate GHG emissions is the incorporation of clover into grazing swards (Lanigan et al., 2018; Buckley et al., 2020; Climate Change Advisory Council [CCAC], 2021). This practice allows for natural N fixation, and its benefits are well established in the literature (e.g., Caradus et al., 1995; Humphreys et al., 2012; Egan et al., 2018). Unfortunately, uptake of clover has remained low (EPA, 2022b).

Theoretically, available information of an innovation should impact the expected benefits of the farmer, which in turn should influence their subsequent behaviour of adoption or non-adoption (Feder et al., 1985; Chavas & Nauges, 2020). However, information provision in agriculture is a complex process, and there is no exploration of how farmers update their expectations in response to information about clover. In this paper, we used an information experiment to estimate the causal effect of information on expectations about clover. Then, we explored how information affects farmers' subsequent adoption intentions and willingness to accept (WTA) clover through their update in expectations.

Methodology	***100 – 250 words***

We implemented an information experiment embedded in an online survey with 318 dairy farmers in Ireland. In our experimental design, first, we elicited farmers' expectations about implementing clover (i.e. prior expectations). To this end, we combined qualitative open-ended questions and quantitative point estimates. Qualitatively, farmers expressed their opinions on the latest clover adoption recommendation. Quantitatively, under the hypothetical scenario of adoption, we asked farmers whether they believe chemical N fertilizer application on their farms will increase, decrease, or have no change. Farmers who stated it will increase or decrease, provided a point estimate.

Then, we randomly provided respondents with exogenous information. Our sample was divided into three groups: two groups received an information treatment, and one active control group. While farmers in the treatment groups were exposed to the same information about clover, the framing of the information was different in each treatment group. Our first information treatment consisted of a scientific frame where information was based only on scientific studies. Our second treatment involved a peer frame, where additional information based on some farmers' experiences with clover was presented. Then, all respondents' expectations were re-elicited (i.e. posterior expectations), using the same qualitative and quantitative approach. Lastly, we also captured farmers' WTA and intentions to adopt clover.

We estimated treatment effects by employing a two-stage least squares regression (2SLS). To examine responses from the open-ended questions, we used three text analysis methods: wordclouds, keyness, and topic analyses. The experiment received ethical approval and was pre-registered on Open Science Framework.

Results	***100 – 250 words***

On average, farmers' prior expectations denoted a perceived reduction of 20.50% in chemical N fertilizer application. Overall, providing information significantly increases farmers' updated expectations by 18.91%. Informing participants using a scientific frame significantly increases the expected reduction in chemical N fertilizer application by 17.62%. The effect is higher when presented with a peer frame; where farmers increase their expected reduction by 19.64%. However, we could not reject the null hypothesis that the two treatment coefficients are equal. Then, there were no significant effects of the updated expectations on intentions and WTA in the 2SLS.

Wordclouds provided a descriptive insight that the most frequent words presented in farmers' responses changed after treatment. From the keyness analysis, we observed differences in the keywords between the prior and posterior expectations. While keywords on the prior expectations were centered around issues from clover adoption ("*management*", "*time*", "*difficult*", "*establishment*", "*bloat*", etc.), keywords on the posterior expectations were related to benefits from adoption (e.g., "*reduction*", "*possible*", "*nitrogen*", and "*save*"). Ex-ante, topic analysis showed that the majority of farmers focus their attention on concerns of adoption, especially on those related to clover management and animal health (e.g., weeds control, maintenance, bloat, etc.). After treatment, we identified changes in farmers' opinions. We found that information increases the probability of having a positive change (by up to 12%), and a negative change in opinions (by up to 10%).

Discussion and Conclusion	***100 – 250 words***

We documented that farmers underestimate the reduction of chemical N fertilizer that can be achieved with clover adoption. We showed that information interventions can correct farmers' misperceptions about clover adoption, and increase their expected reduction of chemical N fertilizer. We did not find a significant effect of the updated expectations on intentions and WTA. But, we know that intentions are not equal to final adoption decision, and in general, information provision is not a panacea to identify causal effects of adjusted expectations on self-reported attitudes. Also, farmers' opinions focused mainly on clover management issues. Lastly, we discovered that information provision can change farmers' opinions about clover positively and negatively.

Our first policy recommendation is to promote the existing financial incentives to adopt clover (DAFM, 2023b); which are most likely unknown by farmers. Awareness of these incentives may induce farmers to put more effort into improving the accuracy of their expectations. Our second policy recommendation is to increase resources devoted to knowledge transfer of clover, and other agricultural GHG mitigation measures. Our last policy recommendation is that information about clover not only should highlight benefits from adoption, but also focus on mitigation of concerns.

We strongly recommend that future survey experiments use multiple measurements of beliefs, especially to include open-ended questions. Combining a quantitative and qualitative measurement of expectations allowed us to have a more deep understanding of our treatment effects. While our study did not assess the persistency of treatment effects over time, we suggest future research to include follow-up surveys to address any consistency concerns.

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