Assessing Dairy Farmers' Willingness to Participate in a Cap-and-Trade Scheme

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Abstract

The reduction of greenhouse gas (GHG) emissions from the agricultural sector is inevitable to achieve climate change targets, but there is no consensus on how to achieve this. This is especially true in Ireland where agricultural GHG emissions make up over one third of all GHG emissions. One policy option is a cap-and-trade scheme where farmers can trade carbon credits to achieve GHG reduction targets. In this study, we plan to conduct a survey with about 300 Irish dairy farmers to assess farmers' willingness to participate in a cap-and-trade scheme. As the price for carbon credits increases, farmers who plan to sell carbon credits are expected to have a higher willingness to participate, whereas farmers who believe they would be GHG emission credit buyers, will have a lower willingness to participate. In addition, willingness to participate in the cap-and-trade scheme is expected to be higher when the alternative is a harsher policy scheme. These findings can provide insight into farmers' acceptance of policies to achieve GHG emissions reductions.

Key words: Climate change, Greenhouse gas emissions, Dairy, Cap-and-trade scheme.

JEL code: Q12, Q13.

1 Introduction

One-third of all greenhouse gas (GHG) emissions originate from the food system which includes food production, processing, transport, and packaging (Crippa et al., 2021). Dairy production contributes significantly to GHG emissions from food production, and with global dairy demand on the rise, the mitigation of these emissions requires urgent action (OECD/FAO, 2022). One solution for reducing GHG emissions is the implementation of mitigation measures by farmers (Parlasca and Qaim, 2022). For Irish dairy farms, these measures include limiting the amount of fertilizer used on fields, reducing herd replacement rate, and including more clover in grassland. However, some farmers express concerns that the adoption of such technologies could negatively impact farm profits (Läpple, 2023), which may hinder adoption.

Thus, this study examines the willingness of Irish dairy farmers to participate in a cap-and-trade scheme. Such a system could offer market incentives to encourage farmers to adopt GHG emissions mitigation measures, alleviating concerns about these measures impacting farm profits. We assess the willingness of dairy farmers to engage with this scheme through a survey using a dichotomous choice method, framed as a referendum question. Additionally, we evaluate farmers' willingness to accept and pay for carbon credits within the cap-and-trade system.

This discussion paper offers an overview of the study's context and outlines how the dichotomous choice method is used to gauge farmer willingness to participate in a cap-and-trade system. Additionally, it delves into the willingness to accept and pay for carbon credits within this framework. Preliminary findings drawn from focus group discussions and background research are presented to prompt further discourse on survey design and potential policy implications.

2 Background

The Irish agricultural sector exhibits a strong focus on livestock, with nearly 90% of farms maintaining ruminant livestock (CSO, 2021). Out of the 135,037 farms in Ireland, approximately 100,000 rear ruminant animals. Around 90,000 farms primarily engage in cattle, dairy, or cattle related activities (CSO, 2021). The majority of ruminant farms are grass-based extensive systems, due to Ireland's favorable climate for year-round grass growth.

However, this emphasis on ruminant livestock contributes significantly to GHG emissions in the Irish agricultural sector, which accounts for 37.5% of all national GHG emissions (EPA, 2022). This high proportion of emissions from the agricultural sector in Ireland is the result of limited GHG emissions from the industrial sector as compared to other countries (EPA, 2022). This situation is somewhat unique among developed countries with the exception of New Zealand. In contrast, the European Union's agricultural sector typically contributes about 10% of GHG emissions.

The abolition of the EU milk quota in 2015 spurred considerable expansion and intensification of dairy production in Ireland, further exacerbating GHG emissions from agricultural sources. Over the past decade, milk production surged by 69%, accompanied by a 47% increase in dairy cow numbers (CSO, 2022). Herd expansions led to a rise in methane emissions from enteric fermentation. Stocking rates also increased as herds expanded, leading to increased fertilizer usage and pasture management intensification. This raised GHG emissions even further as nitrous oxide emissions rose from the more intensive fertilizer usage. Methane and nitrous oxide make up the largest proportion of agricultural GHG emissions, about two thirds and one third respectively. Carbon dioxide emissions from sources like the use of farming equipment make up a minimal proportion of agricultural GHG emissions. The expansion of herds after the repeal of the quota and production intensification have been driving the increase of GHG emissions from agriculture in recent years (EPA, 2022). While Irish agriculture has long been associated with pasture-based sustainability, recent years have seen growing scrutiny of its sustainability, particularly regarding the dairy sector (Balaine et al., 2022).

Moreover, the Irish government has set clear targets to mitigate agricultural GHG emissions, aiming for a 25% reduction by 2030 compared to 2018 levels, as part of its Climate Action Plan, which includes carbon budgets for each industry sector (Government of Ireland, 2022). The adoption of mitigation measures by farmers, with guidance provided through programs like the Teagasc Signpost Programme could help achieve these lower emissions. Farmers urgently need to adopt these measures as the reduction target deadline approaches with limited progress (EPA, 2023). Despite these guidance and media efforts, farmers appear hesitant to adopt such measures, possibly due to concerns about the possible impact on their profitability (Läpple, 2023). This arises both from concern about the cost of implementation of the mitigation measures as well as the

impact of adoption of the mitigation measures on production. Market-based strategies, such as carbon markets, including cap-and-trade systems, present potential solutions to address this reluctance.

3 Cap-and-trade and Agriculture

Cap-and-trade schemes in agriculture work similarly to cap-and-trade schemes in other industries. A cap on GHG emissions limits available tonnes of GHG emissions for the entire industry. All firms, or farms in this case, must have emission permits, or carbon credits, for every tonne of GHGs they emit. Farms can trade carbon credits amongst themselves, meaning if a farm adopts new GHG emission reducing methods and reduces its GHG emissions below the number of credits it currently holds, it can sell excess permits. Firms who do not adopt new measures will need to buy more credits to cover any excess GHG emissions. This creates a market where farms who adopt new GHG emission reducing measures are financially rewarded.

Methane and nitrous oxide emissions make up almost all GHG emissions in agriculture, therefore many of the GHG emission reducing measures in agriculture have to do with limiting emissions. Methane reducing measures often involve measures to reduce emissions from enteric fermentation, the main source of methane emissions. Specific measures include the limitation of concentrate feed fed to the herd and decreasing the replacement rate. Nitrous oxide measures often involve changes in fertilizer usage, the main source of nitrous oxide emissions. Specific measures include the use of protected urea and the reduction of chemical nitrogen applied to fields. Third party verification companies verify the creation of carbon credits after the adoption of new GHG emission reduction measures. This verification often involves farms following a strict protocol to ensure achievement of the GHG emission reduction (Verra, 2022).

After verification, credit buyers can purchase the agriculture carbon credit. In the cap-and-trade scheme presented in this study, only other Irish dairy farmers can buy credits. This limits the concern of GHG emission reductions leaving the agricultural industry. The cap-and-trade scheme presented in the survey also states The Irish Department for Agriculture and the Marie (DAFM) will act as the scheme administrator and regulatory body. Regulatory bodies for other similar environmental credit trading markets include the Scottish Forestry Industry which regulates the UK woodland carbon code and the Ministry for Agriculture and the Environment or regional

GmBH agencies for the MoorFutures carbon trading scheme (UK Woodland Carbon Code, 2019)(MoorFutures, 2019). These schemes, while both carbon teaching schemes, are voluntary in nature and therefore not strict cap-and-trade schemes. Other agricultural carbon trading schemes include a cap-and-trade market in Alberta, Canada, where the agricultural industry could provide credits to the regulated industry but was not regulated itself (Sellers et al., 2022) and IndigoAg and NORI, where farmers can sign up to voluntarily sell carbon credits from carbon soil sequestration actions (IndigoAG, 2023b; NORI, 2023).

The allocation of credits to regulated firms can occur through various means, either endowment, auction or some combination of the two . The choice of allocation method can have significant implications on both firm profits and governmental tax income (Goulder et al, 2010). If the scheme endows firms with credits, it can be done through grandfathering or benchmarking methods (Yang et al., 2020). Endowment via a grandfathering rule allocates credits to firms based mainly on the firm's historic emissions record. Benchmarking rules allocate credits based on both the benchmark carbon intensity of the industry as well as the production quantity of the individual firm. The type of credit allocation also impacts new entrants to the regulated industry. Grandfathering rules cannot apply to new entrants as they do not have historic emissions records. However, benchmarking with forecasted production could be a solution for endowed credits. Several countries applied this technique with new power producing firms at the beginning of the EU ETS trading system (Bartels and Müsgens, 2008). Another solution is auctioning credits to new entrants, but if previous firms were endowed credits, this approach may raise the issue of fairness (Bartels and Müsgens, 2008). The Irish dairy industry, as well as farming at large, is particularly concerned with new entrants to the farming industry, as the average age of farmers continues to increase. In 2020 almost one third of farmers in Ireland were 65 years old or older, as compared to just over one fifth in 1991 (CSO, 2021).The number of available credits will lower over time as the overall cap is lowered. This reduces the total amount of GHG emissions from the regulated sector over time and encourages the adoption of more GHG emission reducing measures as credit prices increase.

Although cap-and-trade systems have been implemented across various other industries, no long-term cap-and-trade has been established for agricultural GHG emissions. There are examples of carbon trading for the agricultural industry and other natural resources, however, as mentioned

previously. If concerns about a cap-and-trade scheme for agriculture can be properly addressed by policy makers the cap-and-trade scheme could offer flexibility and incentives for emissions reduction, especially within the Irish agricultural sector. By allowing farmers to trade credits, the scheme encourages emission reduction efforts and rewards those who achieve reductions. However, the success of such schemes relies on farmers' willingness to participate. Hence, we aim to assess Irish dairy farmers' willingness to participate in a cap-and-trade scheme by evaluating their willingness to participate through a survey at various carbon credit price points.

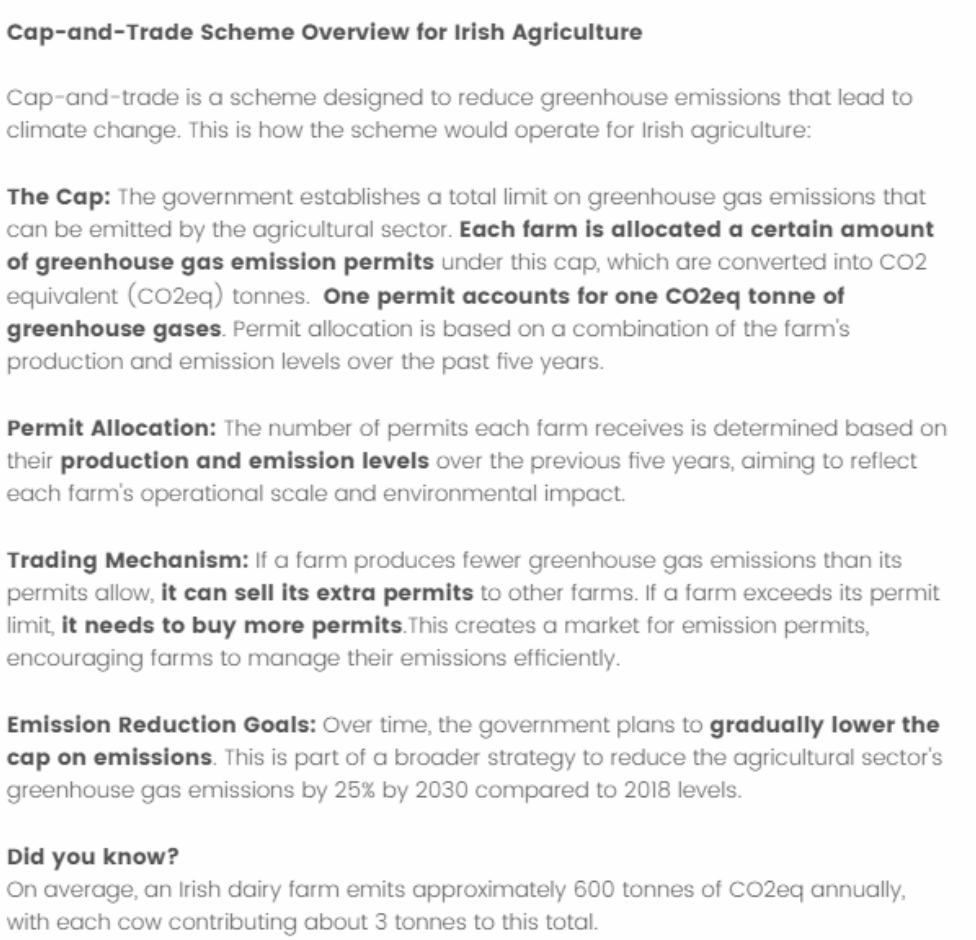
4 Methodology

We followed a two-step survey design process. We conducted a series of farmer interviews and focus groups to identify what information farmers needed to understand the cap-and-trade scheme and be able to answer the valuation questions. We then began the quantitative survey design. The resulting survey includes four major sections: pre-treatment controls, baseline information, the referendum section, and post treatment controls. We aim to achieve a sample size of 500 Irish dairy farmers. Data collection will occur from early April 2024 until the beginning of May 2024. e. Pre-treatment controls include two sub-sections, a farming characteristics section and a climate change attitude section. The farming characteristics section includes questions about land area, herd size, and milk production. It also includes a question about herd expansion after the abolition of the 2015 EU milk quota. The climate change attitude section includes questions about their overall level of concern about climate change and their level agreement with ten climate change statements using a five-point Likert scale. Table 1 includes the ten statements.

The baseline information section includes a description of the cap-and-trade scheme as it relates to the Irish dairy industry. Information about the GHG emission cap, GHG emission credits, or permits, and how the market for permits will function is also included. We also remind participants about Ireland’s agricultural GHG emissions goal of a reduction of 25% by 2030 as compared to 2018 and provide context about the level of GHG emissions from the average Irish dairy farm. Figure 1 presents the full text of the baseline information. A series of comprehension questions follow the baseline information to ensure participants have an accurate understanding of the cap-and-trade scheme.

Table 1: Climate Attitude Statements	
#	Statement
1	Addressing climate change is urgent.
2	I can contribute to mitigating climate change on my farm.
3	Reducing greenhouse gas (GHG) emissions on my farm will lower profits.
4	Climate change impacts my farming through weather change.
5	If I take steps to help mitigate climate change, I can encourage others to behave the same way.
6	The government should be primarily responsible for implementing measures against climate change.
7	Dietary change towards more plant-based products is important to tackle climate change.
8	The agricultural sector should be exempt from climate change mitigation targets.
9	I believe GHG emissions from agriculture to be an important issue.
10	The agricultural sector is often disproportionately blamed for GHG emissions.

The referendum section contains the main valuation methodology for the survey, a single bounded dichotomous choice question framed as a referendum vote. This referendum question includes one of five randomly assigned GHG emission permit prices. Participants vote in a hypothetical referendum to implement the cap-and-trade scheme or not given the randomly assigned price presented to them. These prices include €100, €250, €500, €750, and €1,000 per CO2eq tonne of GHG emissions. The price of carbon credits within the ETS system is the basis for the lower bound of the price range (World Bank, 2023). This can test the feasibility of Irish dairy carbon credits in the context of the wider international carbon market. The upper bound of the price range is based on the gross output per cow in Ireland and the average CO2eq tonne of GHG emissions per cow (Teagasc, 2022). This can test willingness to participate in the scheme with prices comparable to the breakeven price per CO2eq tonne of GHG emissions per cow. Figure 2 contains the full text of the referendum question, where the € takes the place of the randomly assigned GHG emission permit price.



Cap-and-Trade Scheme Overview for Irish Agriculture

Cap-and-trade is a scheme designed to reduce greenhouse emissions that lead to climate change. This is how the scheme would operate for Irish agriculture:

The Cap: The government establishes a total limit on greenhouse gas emissions that can be emitted by the agricultural sector. **Each farm is allocated a certain amount of greenhouse gas emission permits** under this cap, which are converted into CO2 equivalent (CO2eq) tonnes. **One permit accounts for one CO2eq tonne of greenhouse gases**. Permit allocation is based on a combination of the farm's production and emission levels over the past five years.

Permit Allocation: The number of permits each farm receives is determined based on their **production and emission levels** over the previous five years, aiming to reflect each farm's operational scale and environmental impact.

Trading Mechanism: If a farm produces fewer greenhouse gas emissions than its permits allow, **it can sell its extra permits** to other farms. If a farm exceeds its permit limit, **it needs to buy more permits**.This creates a market for emission permits, encouraging farms to manage their emissions efficiently.

Emission Reduction Goals: Over time, the government plans to **gradually lower the cap on emissions**. This is part of a broader strategy to reduce the agricultural sector's greenhouse gas emissions by 25% by 2030 compared to 2018 levels.

Did you know?
On average, an Irish dairy farm emits approximately 600 tonnes of CO2eq annually, with each cow contributing about 3 tonnes to this total.

Figure 1: Text of the Baseline Information

This section includes a series of follow up questions, including participant beliefs about if they will buy or sell GHG emission permits at the presented price, their voting behavior if the scheme includes one of two alternative clauses, their reasoning for their voting behavior, and their beliefs about the possibility of alternative climate policy schemes coming being implemented. Participants state if they would be GHG emission permit buyers or sellers at the permit price presented to them, if the referendum passed. This will allow us to estimate the willingness to pay or willingness to accept for GHG emission permits within the scheme. Participants can also choose an 'I do not know' option as well. This can give an indication to the level of uncertainty among participants. Participants answer two additional referendum questions, each including a different additional clause in the scheme. The first clause includes protection for new entrants into the Irish dairy industry, where new or young farmers can purchase a proportion of the available permits at a discounted rate. The second clause changes the regulating body of the scheme from the DAFM to

the dairy co-ops. All participants, regardless of their response to the first referendum question, answer both alternative clause questions.

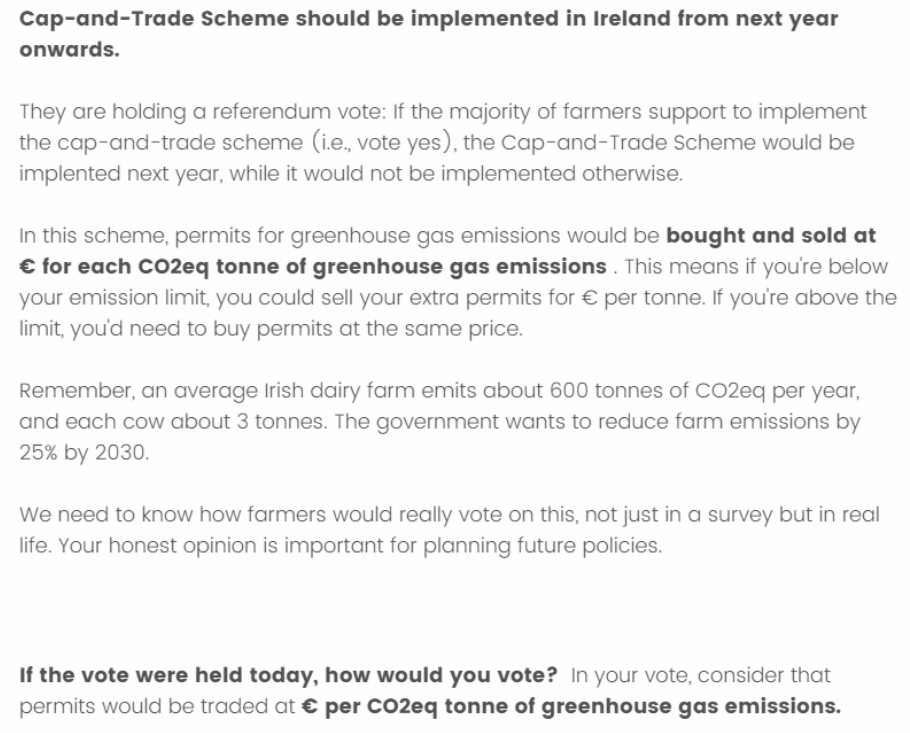


Figure 2: Text of the referendum question

The intangible nature of the GHG emission permits requires the use of stated preference methods over that of revealed preference methods (Endalew et al 2018). Of the stated preference valuation methods, the single bounded dichotomous choice method provides the simplest and most flexible valuation. The complexity of GHG emission permit pricing limits the practicality of open-ended stated preference methods. As we aim to test willingness to pay and except for GHG emission permits within the entire system and not specific aspects of the scheme, choice experiment methods are not the optimal valuation method. Lastly, the single bounded dichotomous choice method provides more incentive compatibility than a double or triple bounded dichotomous choice method (Johnston et al., 2017). Increased incentive compatibility is a concern due to current political and social discussions of agricultural climate policy in Ireland. This leads to concerns about strategic responses to potential policy scheme questions. This method limits the number of policies schemes the participant is exposed to as well.

Participants also choose their top three reasons in voting for or against the implementation of the cap-and-trade scheme from a list of reasons presented. Examples of reasons for voting for the implementation of the cap-and-trade scheme include the added revenue from the sale of permits, the avoidance of harsher schemes in the future, and the possibility of improvement of the Irish dairy industry's sustainability reputation. Examples of reasons for voting against the implementation of the cap-and-trade scheme include the cost of purchasing permits, the limitation of the growth of the Irish dairy industry due to the scheme, and the ineffectiveness of the scheme in reaching sustainability goals. Lastly, participants indicate their beliefs about the likelihood of alternative GHG emission reducing policy occurrences. These alternative outcomes include the implementation of a herd reduction scheme, the mandating of specific GHG emission reducing production practices, or the continuation of current climate policy.

Lastly, in the post-treatment control section, participants answer questions about their involvement with environmental information campaigns such as the Teagasc Signpost Programme, the implementation of climate action measures on their farm, participation in their co-op, and personal characteristics like age, gender, and education level.

5 Results and Discussion

We conducted five interviews and one focus group of three farmers to gather feedback on the survey topic and information. Copies of the survey including baseline information and the referendum question were provided to participants, who then answered questions and provided feedback. Four interview participants indicated they had never heard of a cap-and-trade scheme prior to reading the baseline information. All interview and focus group participants could not provide an answer to a reasonable GHG emissions permit price when asked. All participants stated the baseline information provided enough of an understanding of the scheme that they felt comfortable answering the referendum question.

Insights from focus group responses have provided valuable input for refining the survey. The participating farmers expressed concern about the cap-and-trade system as they were reluctant to engage with any policy that could possibly limit their production potential or farm expansion. This led to a discussion as to what alternative GHG emission reducing policies they believe will come

into effect in the future instead. Focus group participants did not indicate any one particular policy or scheme as more likely than another and expressed frustration with the lack of stable communication about future policies from the DAFM. A participants' beliefs about the alternative to a dichotomous choice question is important as it can have a large impact on the effectiveness of the method (Johnston et al., 2017). Different alternatives change the choice scenario and lead to different willingness to pay or accept estimates. For example, a farmer may more readily agree to participate in the cap-and-trade scheme if the alternative scheme is a herd reduction scheme as opposed to a less harsh scheme. This uncertainty about alternative beliefs led to the inclusion of the follow up question which asks participants their beliefs about the likelihood of other climate policy scheme outcomes.

Focus group participants also voiced several other concerns. These concerns included the impact the cap-and-trade scheme could have on young or new farmers and frustration with recent actions from the DAFM. A rapidly aging farming population has led to concerns about increasing barriers to entry for new or young farmers, as previously mentioned. Farmers also hope to continue the growth the Irish dairy industry has enjoyed in the last few decades. Farmers also discussed frustration due to unclear communication about future policy schemes from the DAFM, also previously mentioned. They stated they experienced several climate policy schemes and changes before the full implementation and effects of the previous policy or scheme could be realized. This was frustrating as compliance with these schemes cost farmers time and resources. We believe farmers may be more willing to participate in the cap-and-trade scheme if another regulatory institution is in charge. These concerns are major barriers to farmer's participation in the cap-and-trade scheme and we isolate farmers' willingness to participate from these concerns with the inclusion of the alternative clause questions.

Anticipated results are based on insights from focus groups and previous work within the SmartDairy project. This previous work includes previous dairy industry stakeholder interviews and a stakeholder workshop. We expect farmers to be more willing to participate in the cap-and-trade scheme when they believe the alternative will be a harsher GHG emissions policy scheme. We also predict the opposite, where if they believe the alternative will be no change in climate policy from the current policies, farmers will be less willing to participate in the cap-and-trade scheme. This reluctance toward change likely arises from farmers' preference for the current

system, enabling them to benefit as free riders within the production system without formal emissions reduction enforcement. Regarding willingness to pay and accept, we assume farmers expecting to sell credits will be more willing to participate when credit prices are higher, while buyers will be more willing to participate when prices are lower.

6 Conclusion

We use the dichotomous choice question framed as a referendum to assess the acceptability of a cap-and-trade scheme in the Irish dairy industry. This scheme could be used to achieve GHG emission reduction targets for the Irish agricultural industry. We also assess the impact of two additional policy options, a clause to limit the barriers to entry for new farmers, and a different program regulatory agency, on overall scheme acceptability.

Preliminary insights from focus groups and economic theory suggest farmers who anticipate being GHG emission permit sellers may be more inclined to participate when permit prices are high, whereas those expecting to buy credits prefer lower prices. Additionally, farmers will likely exhibit greater willingness to participate when they expect the alternative to the cap-and-trade scheme will be harsher than the cap-and-trade policy. Nonetheless, preliminary willingness to participate appears low due to frustrations with governmental policies and societal pressures to reduce GHG emissions. Concerns over policy structure and longevity further contribute to farmer confusion and frustration.

We aim to inform policymakers about the viability of a cap-and-trade scheme as a means to facilitate the transition to more climate-friendly production practices. Given farmers' resistance to policies constraining their production autonomy, it's crucial to demonstrate how such a scheme could provide an additional income stream while curbing GHG emissions. To that end, clear policy communication, even acknowledging uncertainties, can help repair the relationship between the government and farmers. Involving farmers in policy discussions can ensure practical and realistic solutions for those directly affected. Improved communication about shared challenges in agriculture and global emissions reduction can align research agendas, provide valuable insights from farmers, and unify policy efforts toward GHG emission reduction goals.

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