Reducing greenhouse gas emissions on farm through behaviour change: bringing together intervention and engagement opportunities

1. Introduction

Over 70% of the carbon emissions of a food product occur on or before the farm; for meat and dairy products, the figure is nearer 90% (Poore & Nemecek, 2018).

These emissions include direct outputs from field cultivations and ruminant methane, or indirect sources such as the manufacture and transport of farm supplies like artificial fertiliser. For example, while two-thirds of the carbon emissions of a loaf of bread occur on or before the farm, 40% of that total is the farm's use of ammonium nitrate fertiliser, including its manufacture and application (Goucher et al., 2017).

There are caveats to these figures. Emissions data are generally calculated using GWP100 methodology, which does not take into account the short-lived nature of methane or its actual warming potential (Allen et al., 2018). Furthermore, they do not include carbon removals, with woodland sequestration and renewable energy generation allocated to different accounting 'buckets' (IPCC, 2019; Drax, 2025). Finally, non-woodland sequestration (e.g., from permanent pasture) is still regarded as unpredictable and impermanent, and deemed too unpredictable for inclusion (IPCC, 2019). Despite such reservations, these are the figures allocated to the farming industry and therefore the ones it must address both physically and reputationally.

Various studies and reports identify interventions to reduce greenhouse gas emissions in farming, focusing on the areas with greatest reduction potential. However, many of these fail to take adoption into account, and where they do, financial mechanisms are the 'go-to' method on the assumption they are affordable and frictionless, with increasing incentives or penalties producing direct and proportionate changes in adoption. This is a flawed approach. It not only assumes everyone is motivated by money, but loses the opportunity to create collective ownership of the problem.

This short, non-scientific report brings together: i) current knowledge on effective areas for emissions reduction; and ii) insights into behaviour and behaviour change on farm. From these, it suggests the most impactful areas to address; key enablers and barriers to farmer adoption; and gaps in current research/priorities for further study. Two spreadsheets summarising the research and other literature informing this report provide the references.

2. Key Findings from Emissions Reduction Research

Drawing on over 60 studies, five priority interventions for on-farm reduction of emissions are identified below:

- **Livestock Interventions:** Feed additives (e.g., 3-NOP, linseed) can reduce methane by 10-40% without harming productivity. Precision livestock technologies, genetic selection, and improved manure management also offer substantial reductions, but adoption is limited by cost, regulatory uncertainty, perceptions of efficacy, and ethical or safety concerns among both consumers and farmers.
- **Cropping, Soil, and Land Use:** Reduced tillage, incorporating livestock into arable operations (e.g., mob grazing), cover cropping, and other regenerative practices can increase soil carbon and reduce nitrous oxide emissions, but effects are context-dependent and sometimes overstated. In particular, practices that reduce use of artificial fertiliser through alternative crop nutrition offer potential. Hedgerow planting and agroforestry provide significant carbon sequestration and biodiversity co-benefits. Peatland and wetland restoration offer large-scale abatement but require new incentive regimes.
- **Market and Policy Mechanisms:** Carbon markets and agri-environment schemes can incentivise emissions reduction but require robust verification, fair pricing, and better access for all. Financial incentives and multi-stakeholder collaboration are key to scaling up adoption, especially for interventions that are more capital-heavy.
- **Energy Efficiency and Renewables:** Solar, anaerobic digestion, wind, and infrastructure upgrades reduce fossil energy use, and field-scale technical innovation could optimise fertiliser and fuel use to reduce emissions and improve productivity. However, these need to be affordable and farmer-led to ensure adoption.
- **Behavioural and Social Factors:** Up to 50-60% of potential abatement may be lost if interventions are not acceptable to farmers or supply chains. Integrated, multi-component approaches combining technical, economic, and social interventions are most effective. Farmer-centred or co-designed, trusted, and practical advisory systems increase uptake. Accessible and trustworthy benchmarking and monitoring empower on-farm decision-making.

3. Key Findings from Behavioural Research

Based on over 80 studies, the following five factors are identified as important in considering behaviour change among farmers:

- **Farmer behaviour is shaped by a complex mix of psychological, social, economic, and contextual factors.** The most effective interventions are multi-component, participatory, and context-specific, combining trusted advice, peer learning, financial incentives, and tailored communication. For this reason, behaviour change models (e.g., COM-B, Theory of Planned Behaviour) underpin successful interventions, emphasising the need to address capability, opportunity, and motivation.
- **Social norms, peer influence, and farmer identity** are central to adoption. Past adoption is the strongest predictor of future uptake, and interventions must be tailored to both experienced adopters and those reluctant to change. Benchmarking and farmer-to-farmer communication are more powerful than top-down messages.
- **Economic barriers** (cost, risk aversion) and perceived complexity or challenge (especially at a time when many demands are placed on farmers) are major obstacles. Financial incentives, demonstration, and trusted advice can be effective solutions, but 'one size does not fit all'. Financial support works best when paired with advisory systems and market pull.
- **Co-design and participatory approaches** involving farmers directly increase relevance and buy-in; farmers engage more when solutions are developed collaboratively and tested locally. Farmers are most influenced by trusted intermediaries and advisory networks such as independent agronomists, vets, and peers—not government bodies.
- **Simplicity, coherence and alignment** leads to greater adoption. Interventions should work in harmony with business and even personal goals, offer clear co-benefits (e.g., profitability, soil health), and be supported by ongoing advice and peer support. Tools, schemes, and messages must be easy to use, locally relevant, and fit within existing routines. Policy coherence is important too, as confusing or overlapping schemes reduce trust and therefore engagement.

4. Greatest Opportunities for Change

Mapping potential interventions against behaviour change opportunities identifies the most feasible routes to reducing emissions, taking both the physical impact and the likelihood of adoption into account.

Observations include:

- **Technical interventions** have proven efficacy but low adoption due to economic, social, or perceptual barriers (e.g., feed additives, manure management, precision livestock technologies).
- **Social and psychological levers** (peer learning, trusted advice, co-design) can be used to build trust, demonstrate benefits, and support sustained change.
- **Interventions should be tailored** to farm type, context, and farmer identity (including personal goals and values), with financial and advisory support designed to address the bottlenecks which currently prevent action. As an aside, farmers are often treated as a homogenous group but are, in reality, extremely diverse in terms of farm type and size, system, approach and priorities.

Table: Mapping intervention opportunity against potential for adoption

Opportunity	Emissions reduction potential	Potential to change engagement levels	Notes
Feed Additives & Breeding	High	Moderate	Concerns about efficacy, market acceptance; requires adviser-led support and proof of acceptability
Precision Fertiliser Use	High	High	Strong fit with economic incentives and trusted advisory channels
Legumes & Diverse Rotations	Medium	High	Seen as agronomically and financially beneficial; on-farm demonstration and co-development helps
Manure Management	High	Moderate	Technical and capital-intensive; uptake improves with incentives and supportive planning (logistic and regulatory)
Agroforestry & Hedgerows	Medium	High	Strong emotional and stewardship appeal; land competition a constraint.
Renewable Energy	High	Moderate	Capital cost barrier; feasible with policy and market support.
Peatland Restoration	Very High	Low	Requires long-term funding and specialist management.

5. Research and Practice Gaps

A number of research and 'practice' gaps have been identified as part of this mapping exercise.

Research:

- **Quantitative evidence on perceived efficacy:** Few studies directly quantify how farmers perceive the effectiveness of specific GHG-reducing interventions, as opposed to general attitudes or adoption rates.
- **Within-Farmer Decision Processes**: Limited understanding of how individual farmers prioritise between competing intervention options.
- **Longitudinal studies:** There is a lack of research tracking changes in farmer perceptions, attitudes, and adoption over time, especially in response to new policies, market incentives, changing social norms or media attention.
- **Behaviour Change in High-Impact Areas**: Most behavioural studies focus on agri-environment schemes or soil health; few address livestock-specific practices such as feed additives or slurry handling.
- **Farm-level GWP* application:** While GWP* is recognised as a superior metric for methane, robust farm-level data and tools for its application are lacking, limiting its use in practical decision-making.
- **Soil carbon sequestration permanence:** More research is needed on the long-term permanence and trade-offs (e.g., N_2O emissions) of soil carbon sequestration practices, and on robust, scalable monitoring methods.
- **Hard-to-reach groups:** Small, tenant, and minority farmers remain under-studied and under-served by current research and engagement strategies.
- **Integration of behavioural and technical interventions:** There is limited research on how to best combine behavioural science with technical innovation for maximum and durable GHG reduction.

Practice:

- **Co-design at scale**: While small pilots have shown that co-design improves adoption, little work has been done to examine how this can be implemented across national schemes (e.g. ELMS).
- **Advisory system capacity**: With the disbanding of government-led extension support in England many years ago, there is a question around how practical and bespoke advice can be delivered on-farm. A more structured offering still exists in devolved nations through SRUC, Menter and other networks, but that is lacking in England other than through the levy board AHDB, which cannot provide one-on-one advice.

6. Opportunities

The identification of these gaps naturally highlights opportunities that can form next steps. These include the following:

1. **Surveying beliefs, understanding and adoption of emissions-reducing interventions among farmers**: Develop and deploy a national-scale survey assessing perceived effectiveness of specific interventions.

2. **Behavioural trials in livestock systems**: Test different framing, incentives, and advisory strategies to increase adoption of feed, breeding, and manure solutions.

3. **Advisory system mapping**: Assess current advisory coverage, skills, and gaps in delivering advice related to emissions reduction.

4. **Digital tools co-development**: Collaborate with farmers to design simple, intuitive benchmarking and planning tools.

5. **Exploring and scaling co-design**: Evaluate the extent to which co-design aids engagement and adoption in emissions reduction, and how co-design principles can be scaled in national programmes.

7. Conclusion

Substantial GHG reductions are possible through behaviour change, particularly when evidence-based interventions are paired with trusted advice, co-design, and simple delivery. The UK has a strong foundation of research on both technical practices and behavioural engagement. However, these two domains remain largely separate. Bridging that gap offers the chance of a climate-positive transformation for UK farming—shaping practical and effective interventions that complement farm businesses, improve the industry's reputation, and open up new opportunities.

In particular, feed additives, precision livestock technologies, improved manure management and regenerative land practices all have high technical potential, but their impact depends on trusted advice, peer learning, financial incentives, and robust evidence of benefits over drawbacks. For example, additives based on natural ingredients may attract greater support, especially if they are proven to work in harmony with the animal's biology.

Addressing research gaps—especially in quantifying the efficacy of interventions, tracking change over time, and integrating technical and behavioural approaches—will be crucial to unlocking further progress and ensuring that interventions are both effective and widely adopted.

References

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References from which the main body of this report has been synthesised can be found in the accompanying Emissions Reduction Literature and Behaviour Change Literature spreadsheets.

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