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Village de Camembert, Calvados - Cliché : M. Marie, 2009

TECHNICAL, ECONOMIC, AND COGNITIVE BARRIERS TO GHG REDUCTION LEVERS IN DAIRY FARMS: INSIGHTS FROM FRANCE

InTerACT UP 2018.C102 UniLaSalle

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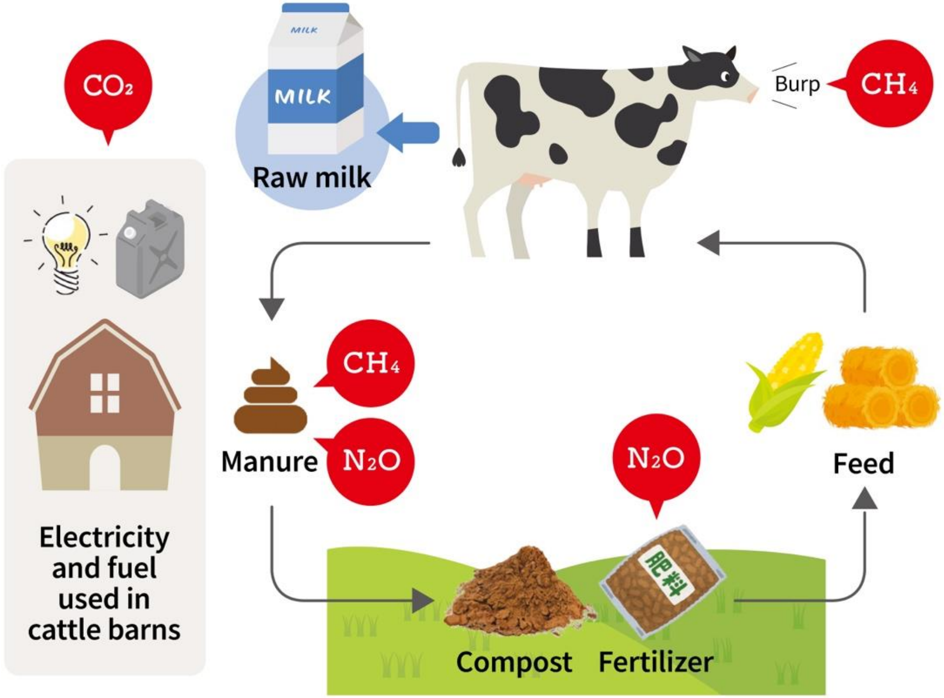
Plan

Introduction & Background

Why dairy farming? A key challenge for carbon neutrality



1. A sector with a significant environmental impact

- In France, dairy farming accounts for ~48% of GHG emissions from agriculture.
- Dairy farming is one of the major contributors to emissions of methane (CH_4), nitrous oxide (N_2O) and CO_2.

2. A lever for climate action

- High reduction potential: change in practices, innovation, system optimisation.
- Potential for carbon storage in grasslands and agricultural soils.
- Benefits of the low-carbon label: rewarding reduction efforts.

3. Economic and social challenges

- Milk = strategic sector for rural areas.
- Reconciling **economic viability** and **environmental performance**.
- Anticipating transitions: adaptation to climate change and new public policies.

The Dairy Farming Paradox

1

Dual Environmental Role

Dairy farming is both a major source of greenhouse gas emissions (enteric fermentation, effluent management) and a key player in carbon sequestration via permanent pastures.

2

The Adoption Gap

Despite tools like CAP'2ER and programmes like the Low Carbon Label, the actual adoption of mitigation levers remains low. Increased awareness does not automatically translate into behavioural change.

19%

Agricultural Emissions

Share of agriculture in total GHG emissions in France (High Council for Climate, 2022).

20%

2030 Target

Emission reduction targeted by the Paris Agreement for participating nations.

3

Regions Studied

Qualitative analysis conducted in Normandy, Brittany, and Hauts-de-France.

What is preventing farmers from adopting effective mitigation measures?

Initial diagnosis — 1

Definition of priorities and levers, development of a joint action plan between the farmer and advisor

2 — **Action phase (5 years)**

Gradual implementation of changes.

Second assessment — 3

Assessment of progress and new opportunities.

- Between current assessments – too long a delay for effective follow-up.
- The lack of regular follow-up between assessments reduces the effectiveness of the process.
- The farmer does not adopt the levers discussed and validated with the advisor

The number of CAP2ER assessments is not an indicator of involvement in the low-carbon transition

?

- Understanding the real reasons behind the non-adoption of the proposed action plans: The technical, economic and psychological barriers that impact farmers' behaviour **(interviews with farmers and advisers: June-November)**
- Identify innovative levers and understand their technical feasibility
- Inventory of policies, regulations and multi-scale economic incentives (European/national/regional/farm level)

Problem and Research Objectives

- ## Problem Statement

- ❑ Dairy farmers receive CAP'2ER recommendations, but only **1–2 mitigation levers** are actually implemented.
- ❑ There is a **gap between theoretical mitigation potential** and **what is feasible in real farming systems**.
- ❑ Barriers are multidimensional:
  - ✓ **Economic** (investment costs, low ROI)
  - ✓ **Technical** (complexity, skills, compatibility)
  - ✓ **Cognitive** (habits, risk aversion, overload)
  - ✓ **Institutional** (MAEC/LBC contradictions, administrative burden)
- ❑ Advisors struggle to transform recommendations into actionable plans due to **limited time, training, and structural constraints**.

Core Problem:

👉 *Why are mitigation levers recommended by CAP'2ER not implemented by farmers, and what determines their real-world feasibility?*

- ## Our main objectives are to:

→ **Identify Barriers**

Analyze multidimensional obstacles: technical, economic, cognitive, and institutional.

→ **Understand Interactions**

Study how policies, advice, and agricultural realities mutually Influence each other.

→ **Compare Perceptions**

Contrast the viewpoints of farmers and advisors.

→ **Propose Trajectories**

Define the conditions for feasible, acceptable, and scalable mitigation actions.

1- Theoretical & Conceptual Framework

Theoretical Framework: A Multidimensional Typology of Barriers

Our research leverages agricultural economics and behavioural sociology to deconstruct obstacles. These dimensions do not act in isolation but create a system of lock-ins.

Technical Barriers

Complexity of integrating new practices (e.g., ration formulation), lack of specific skills, and uncertainty about local agronomic performance.

Economic Barriers

Heavy initial investments, uncertain return on investment in the face of dairy market volatility, and additionality conflicts in funding.

Cognitive Barriers

Risk aversion (fear of negative outcomes), the weight of social norms, peer influence, and professional identity ("my way of doing things").

Institutional Barriers

Fragmentation of agricultural advice, misalignment between diagnostic tools and financial instruments, and lack of consistency in trajectories.

2- Methodology

Methodology: Investigating Three Distinct Dairy Regions

This qualitative study relies on semi-structured interviews conducted in 2025 with 35 dairy farmers and agricultural advisors. The research focuses on three major dairy-producing regions in northwestern France, selected for their diverse agro-ecological contexts and varying levels of engagement with climate mitigation strategies.

Normandy

Accounting for 12% of national milk production, region features predominantly grassland-based benefits from strong institutional support but challenges in scaling pilot projects to commercial

Hauts-de-France

A heterogeneous region where dairy is often into mixed crop-livestock systems. It faces challenges, including an ageing farming less widespread implementation of the CAP' 2ER

Brittany

The leading dairy region (20% of national volume), characterised by intensive systems and strong networks. Brittany is at the forefront of carbon diagnostics, with widespread deployment of tools.

Regional Disparities in Dairy Systems and Emissions

Understanding the barriers to adoption requires analysing the structural differences between these regions. The variation in herd size, crop distribution, and feeding systems means that a "one-size-fits-all" mitigation strategy is ineffective. The table below highlights these critical distinctions.

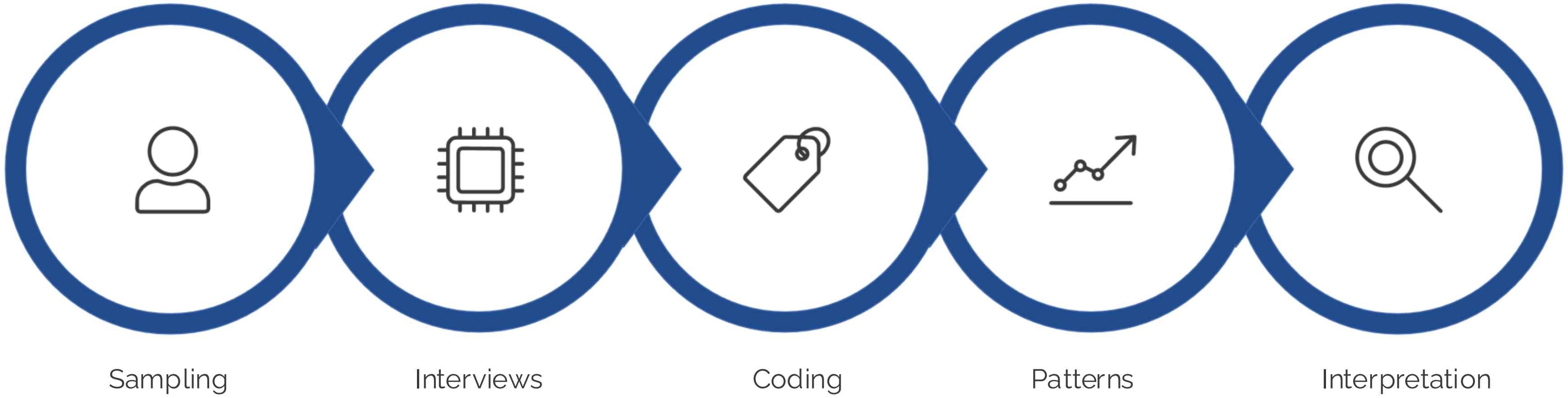
Indicator	Normandy	Hauts-de-France	Brittany
CAP'2ER Diagnostics	851 diagnostics	578 diagnostics	2,897 diagnostics
Farm Structure	Specialised dairy, permanent grasslands	Mixed crop-livestock, high silage silage maize	Intensive systems, high stocking rates
Feeding System	Grass and corn forage	Grass and corn silage	Grass and corn forage
Primary Emissions	CH_4 (59%), CO_2 (22%)	CH_4 (55%), CO_2 (24%)	CH_4 (60%), CO_2 (20%)

These regional specificities highlight the need for tailored mitigation pathways. For instance, Hauts-de-France relies heavily on cash crops (39%), whereas (39%), whereas Normandy utilises significant permanent grasslands (38%), influencing their respective carbon sequestration potentials.

In-depth Methodology: Qualitative Design

Our qualitative approach, based on abductive reasoning, allowed for a detailed exploration of the dynamics at play. We collected data from 30 dairy farmers and a panel of advisors, following a rigorous process.

- **Farmer Sampling (N=35):** Selected for their diversity in production systems, farm size, CAP'2ER experience, and generational age.
- **Advisor Sample (N = 7):** Representatives from Chambers of Agriculture, cooperatives, and private consultants.
- **Data Collection:** Semi-directive interviews with adaptive probes, all fully recorded and transcribed.
- **Thematic Analysis:** Rigorous thematic coding (manual), integrating theoretical codes and emerging themes.
- **Comparative Analysis:** Cross-case and cross-actor study, complemented by regional and systemic interpretation.



In-depth Methodology: Questionnaire Structure

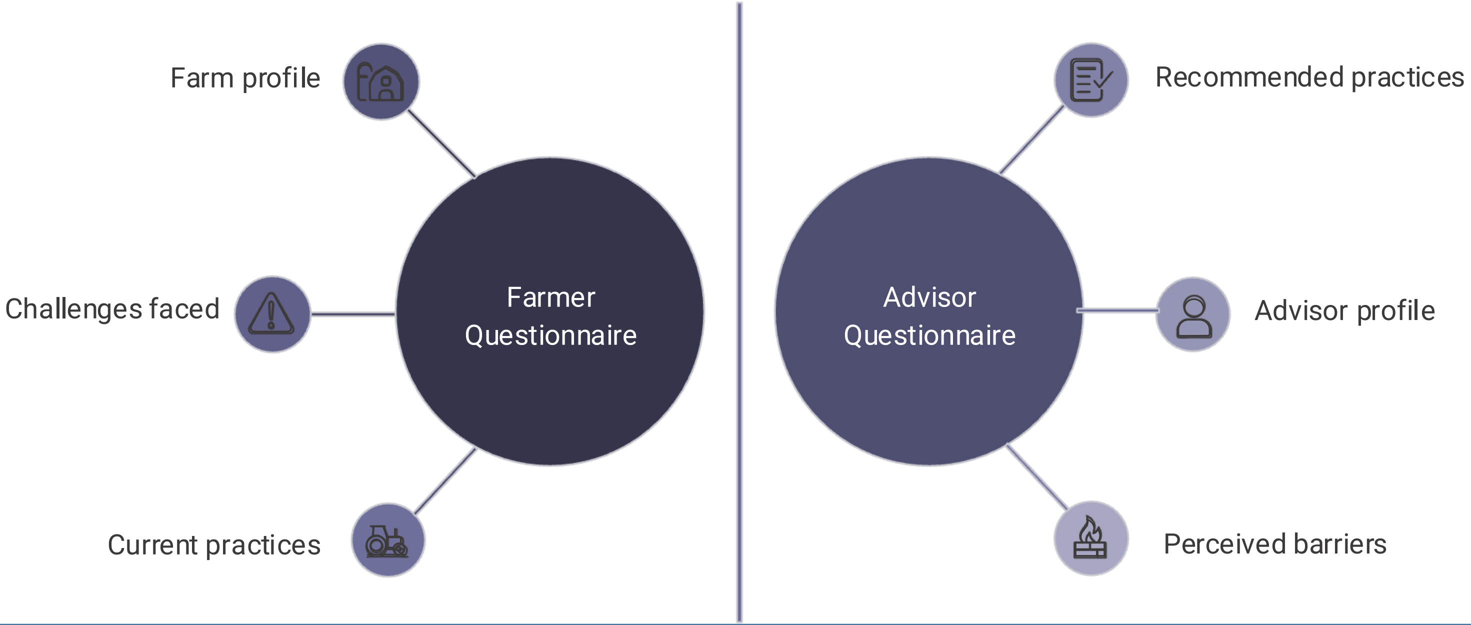
Our questionnaires were designed with mirror structures to allow for direct comparative analysis of perceptions between farmers and advisors, thus highlighting points of convergence and divergence.

Farmer Questionnaire

1. **Farm Profile:** structure, history, production system.
2. **Climate Perception:** awareness, importance, perceived responsibility.
3. **CAP'2ER Experience:** motivation, understanding, follow-up.
4. **Practices:** implemented and those encountering resistance.
5. **Multidimensional Barriers:** technical, economic, social, institutional.
6. **Visions:** of future transitions.

Advisor Questionnaire

1. **Professional Identity:** role, training, constraints.
2. **Territorial Context:** collective dynamics, political environment.
3. **CAP'2ER Utilisation:** method, limitations, training.
4. **Perceived Farmer Profiles:** differentiated typologies.
5. **Leverage Assessment:** feasibility, risks, acceptance.
6. **Policy Instruments:** Agri-environment-climate measures (AECM), Carbon Budget Law (CBL), understanding of the carbon market.



3- Results: Farmers' Perspectives

The Farmer's Perspective: From Diagnosis to

While farmers generally view the CAP’2ER tool as a useful diagnostic resource for self-assessment, the transition from diagnosis to action is often fraught with obstacles. The initial motivation, driven by curiosity or cooperative initiatives, frequently stalls due to a lack of post-diagnosis support.

Initial Engagement

Most farmers conducted their first between 2019 and 2023, motivated by curiosity or cooperative-led initiatives. valued identifying emission sources, particularly enteric fermentation.

Identification of Levers

Farmers identified three accessible strategies: strategies: maintaining permanent grasslands, grasslands, enhancing forage autonomy (e.g., (e.g., alfalfa), and reducing high-protein concentrates like imported soy.

Implementation Gap

Despite identifying levers, implementation is inconsistent. Farmers report a "void" after the diagnosis, with no professional follow-up to guide them through the complex changes required.

Barriers identified

1

Cognitive barriers

- Resistance to change, especially among older farmers who are attached to their current production system.
- Lack of confidence in the CAP'2ER diagnostic tools or results, which are sometimes perceived as too theoretical.
- Fear of failure or the unknown, particularly when it comes to investing in practices that are unfamiliar or not widely used locally.
- Negative view of climate policies, perceived as a constraint or a top-down injunction.
- Decision fatigue, linked to the high mental load of the farming profession, limiting the ability to engage in new projects.
- Lack of social recognition, as environmental efforts are not always recognised or encouraged in the local professional community.

2

Technical barriers

- Mismatch between certain levers and the farming system (e.g. soil types, climate, herd size, land structure).
- The CAP'2ER diagnosis (or other diagnosis) captures a snapshot in time. Climate hazards and contradictions between objectives are not taken into account.
- Lack of recognition → Farms that are already performing well receive little reward from the carbon credit system.
- Complexity of implementing certain practices such as crop rotation diversification, legume integration or slurry pit covering.
- Lack of regular technical support, particularly after the initial assessment phase.
- Unsuitable equipment or infrastructure, for example for rotational grazing, methanisation or effluent storage.
- Labour constraints: changes in practices often require additional time and organisation.
- Lack of knowledge or uncertainty about the expected performance of the levers (e.g. actual effectiveness of additives, improved digestibility).

3

Economic barriers

- High initial investment costs, not accessible to all farms (e.g. photovoltaic panels, methane digesters, replacement of spreading equipment).
- No quick return on investment for certain environmental practices.
- Dependence on public or private subsidies, often perceived as unstable or poorly understood.
- Lack of economic recognition for environmental efforts, apart from a few marginal initiatives (Low Carbon Label, carbon credits).
- Hidden costs of certain transitions (time, training, risk of temporary drop in productivity).
- Uncertainties in agricultural markets: volatile milk and input prices that make investments risky.

Cognitive Barriers: The Cost of Transition

Beyond economic and technical constraints, farmers face mental and psychological pressures that limit their ability to adopt new practices. Cognitive barriers reflect how farmers process uncertainty, protect stability, and manage daily overload. These mechanisms significantly reduce openness to experimentation.

Risk Aversion

- *"When you've been doing something the same way for 20 years, you don't change it overnight."*
- *"I can't take risks with the herd — one bad decision can ruin a whole year."*
- *"New practices look good, but you never know how they'll turn out on your farm."*

Habit and Routine

- *"We already have our rhythm. Changing everything for one lever is too disruptive."*
- *"Even if a practice is better on paper, it's hard to break old habits."*
- *"We stick to what we know works, especially when workdays are already overloaded."*

Cognitive Overload / Lack of Mental Bandwidth

- *"Between paperwork, animals, crops, and administration, I don't have the headspace for more complexity."*
- *"CAP'2ER gives good information, but when you're exhausted, it's hard to think about climate strategies."*
- *"I'm willing to try things, but there are too many decisions already. Adding more just feels overwhelming."*

Cognitive barriers do not reflect resistance to change but the mental burden of farming.

They highlight why farmers prioritize stability and hesitate to engage in practices that require additional mental effort or risk processing.

Focus on Risk Aversion: A Social Construct

Agricultural identity is deeply rooted in community norms. The refusal to adopt certain practices isn't just about rational calculation, but about managing social and psychological risk.

1 Cognitive Dimension

- **Loss Aversion:** The fear of losing a stable yield outweighs the hope of an uncertain gain.
- **Ambiguity Aversion:** Rejection of solutions whose local results are not guaranteed.
- **Status Quo Bias:** Preference for familiar and proven routines.

2 Social Dimension

- **Peer Norms:** The influence of neighbours and the perception of other farmers ("the good farmer").
- **Reputation:** Fear of judgment in case of visible failure (e.g., poor crops).
- **Institutional Trust:** Scepticism towards advisors perceived as out of touch.

Technical Barriers: The Cost of Transition

Despite farmers' motivation, many levers remain technically out of reach due to system constraints, skill requirements, and mismatches with the physical or organisational structure of farms. Technical feasibility is highly context-dependent, and small structural differences can make certain levers impossible to implement.

Lack of Knowledge / Skills

- *"Some levers require skills I just don't have. I'd need training, and who pays for that time?"*
- *"Optimizing age at calving sounds easy, but it's really technical. One mistake and you lose money."*
- *"I don't feel confident enough to change my ration or grazing without someone guiding me."*

System Incompatibility

- *"My parcels are too far apart for grazing. It's simply not possible."*
- *"The lever might work elsewhere, but not with my herd size or my land."*
- *"A lot of advice assumes a perfect farm. But real farms don't work like that."*

Technology or Equipment Requirements

- *"They talk about sensors and robots, but we can't all afford high-tech solutions."*
- *"Technology is great when it works. When it breaks, it's expensive and stressful."*
- *"I need simple solutions, not tools that require constant calibration or updates."*

Overall, farmers see technical barriers not as a lack of willingness, but as the result of structural and operational constraints that make certain levers unrealistic on their farms.

Economic Barriers: The Cost of Transition

Economic constraints remain the most cited barrier to adopting climate-smart practices. Even when technically feasible, many practices are viewed as economically unattractive due to upfront capital requirements and uncertain returns. The "no-stacking" rule of subsidies further complicates financial planning.

Investment Risks

- *"I'm not against making changes, but I can't risk the farm for a lever that may or may not work."*
- *"All these investments look good on paper, but if the milk price drops, I'm the one who pays the price."*
- *"We already carry loans for equipment and buildings; adding another one just to reduce emissions isn't realistic."*

Hidden Costs

- *"They tell you it's a simple change, but there are always hidden costs: labour, maintenance, repairs…"*
- *"Even when the lever doesn't require big investment, the time and organization behind it cost money."*
- *"Every new practice brings extra work. People don't count that, but for us it's a real cost."*

Subsidy Complexity

- *"I've tried applying for subsidies, but the paperwork is a nightmare. I gave up."*
- *"You never know if you're eligible, or when or if you'll actually get paid."*
- *"The aid is too complicated to access. I don't have time to chase documents for months."*
- *"If subsidies were simpler and more predictable, we'd adopt more climate practices."*

Furthermore, farmers expressed skepticism regarding carbon markets. Many view carbon credit schemes as opaque and administratively pricing that makes long-term financial planning difficult.

Low-carbon transition: identified drivers and obstacles encountered

Category of lever	Examples of levers	Types of obstacles identified	Perceived feasibility
Herd management	Reduction in replacement rate, improvement in IVV	Technical: adaptation of the breeding system Economic: investment in genetic material	Usable, subject to technical support
Feeding	Increased protein self-sufficiency, adjustment of concentrates	Technical: formulation of complex rations Economic: high cost of concentrates and mixed grain Psychological: fear of reduced production	Chosen by some, difficult to generalise
Effluent management	Covering pits, reducing burial time	Economic: cost of covering, additional labour time	Usable but requires investment
Agronomic practices	Planting legumes, extending crop rotation	Technical: control of itineraries Economic: uncertain yield of new crops	Difficult to implement without support
Energy	Installation of photovoltaic panels, pre-cooler	Economic: high installation costs Technical: lack of local expertise	Not very accessible without assistance
Carbon storage	Valorisation of permanent grasslands, planting of hedges	Psychological: lack of visibility of benefits Economic: low return on investment in the short term	Usable but not prioritised without strong incentives

Incentives to adopt low-carbon levers

•**Financial assistance**
Subsidies for CAP'2ER diagnostics, investment grants (e.g. hedges, equipment, energy).

•**Support for sectors**
Requests from cooperatives or dairies (e.g. CAP'2ER imposed or recommended in certain quality procedures).

•**Social incentives**
Participation in exchange groups or networks of committed farmers (knock-on effect).

•**Personal motivations**
Desire to pass on a sustainable farm, technical curiosity, or anticipation of future constraints.

•**Environmental recognition**
Growing interest in labels (Low Carbon Label) if procedures are simplified and there is real added value.

4.1- Results: Advisors' Perspectives & Lever Feasibility

The Advisor's Perspective: The Missing Link

Agricultural advisors act as critical intermediaries between policy, research, and on-farm practice. However, interviews reveal that their potential is limited by structural impediments, lack of funding continuity, and the fragmentation of advisory networks.

> The CAP’ 2ER tool is widely known, most cases, it is used primarily as a diagnostic instrument rather than the step of a longer advisory pathway.
>
> **Systemic Disconnect**

> Farmers are more likely to act when they see they see tangible benefits or can draw on on peer experiences. Demonstration farms farms are powerful motivators.
>
> **Peer Influence**

> We need a more integrated approach. Advisors must be recognised not just technical agents but as institutional translators who navigate policy
>
> **Role Evolution**

Advisors emphasised that while awareness is rising, engagement varies significantly by farm size. Larger, capital-intensive farms are better positioned to adopt positioned to adopt advanced levers, creating a risk of stratification where smaller farms are left behind.

The Systemic Discrepancy: The Advisors' Perspective

Unlike farmers who focus on operational feasibility, advisors reveal structural flaws in the governance of the transition.

Diagnosis (CAP'2ER)

Often carried out too early or too late, without an organic link to the farm's overall strategy.

Breakdown in Advisory Support

Lack of time and funding for in-depth post-diagnosis support.

Fragmentation

Total disconnection between technical advice, economic support, and political instruments.

Overload

The farmer is overwhelmed by contradictory injunctions (market vs. environment).

There is a shared "blind spot": farmers underestimate institutional barriers, while advisors sometimes underestimate daily practical constraints.

4.2- Feasibility Assessment of Greenhouse Gas Mitigation Levers in Dairy Farming

Adjusting Inputs

Levers	Feasibility	GHG Reduction Potential	Advisor Comments
Optimizing concentrate quantities	High	Moderate (↓ enteric CH_4)	Easy to implement; requires monitoring
Switching to non-GMO concentrates	Low	Negligible	Little GHG impact; higher cost
Self-consuming cereals	Moderate	Moderate (↑ autonomy, ↓ transport)	Depends on land and storage capacity
Covering slurry pits	Low (cost barrier)	High (↓ CH_4 from manure)	Very effective but extremely costly
Optimizing mineral fertilizers	Moderate	Moderate (↓ N_2O emissions)	Regulatory limits; agronomic constraints

Optimizing Herd Management 🐄

Levers	Feasibility	GHG Reduction Potential	Advisor Comments
Reducing age at first calving	Moderate–High	Moderate (↑ lifetime efficiency)	Requires follow-up; common lever
Optimizing calving age	Moderate	Moderate (improves productive days)	Technically difficult; needs training
Reducing replacement rate	Moderate	Moderate (↓ non-productive animals)	Effective but costly replacements
Reducing discarded milk	Low	Low	Rarely chosen; low impact
Increasing milk from concentrates	Moderate	Low–Moderate	Requires precise ration balancing

Valorising Forage Areas 🌱

Levers	Feasibility	GHG Reduction Potential	Advisor Comments
Increasing grazing	Moderate	Moderate–High (↓ concentrates & N_2O)	Not always easy; depends on land layout
Introducing mixed crops (méteil)	Low–Moderate	Moderate (↑ protein autonomy)	Complex; theory–practice gap

System Change & Digital Monitoring 🔄📡

Levers	Feasibility	GHG Reduction Potential	Advisor Comments
Conversion to organic farming	Very Low	Low–Moderate (↓ inputs but ↓ yields possible)	Unfavorable economic context; some farms reverting
Digital health & reproduction tools	Moderate	Indirect (↑ efficiency, ↓ unproductive periods)	Useful but costly; uneven adoption

Increasing Carbon Storage 🌳

Levers	Feasibility	GHG Reduction Potential	Advisor Comments
Introducing temporary grasslands	Moderate	Moderate (↑ soil C storage)	Feasible in certain rotations
Planting hedgerows	Low	High (↑C storage, biodiversity)	EXPensive; requires maintenance
Extending lifespan of temporary grasslands	Moderate	Moderate (↓ soil disturbance)	Feasible when already present
Increasing permanent grasslands	Low	High (stable long-term C sink)	Not aligned with all farm goals

Energy & Technologies ⚡

Levers	Feasibility	GHG Reduction Potential	Advisor Comments
Solar panels / Biogas	Moderate–Low	Moderate–High (↓ CO_2 if replacing fossil energy)	Feasible mainly for collective projects
Heat recovery	Low	Low–Moderate	Financial & technical barriers
Robotics	Low	Indirect only	High cost; little GHG difference observed

5- Comparing Perceptions & Proposing Trajectories

Comparing Perceptions: Farmers vs. Advisors

Misalignments in Feasibility

- **Farmers** judge levers based on daily realities: workload, risk, stability, cash flow.
- **Advisors** evaluate feasibility through through technical potential and system system optimisation.

Misalignments in Priorities

- **Farmers** prioritise herd health, and economic security.
- [illegible]

Misalignments in Risk

- **Farmers** see risks as threats to stability ("one mistake ruins the
- **Advisors** see risks as manageable with with guidance and monitoring.

Implication

Misalignments explain why levers with high theoretical potential are not widely adopted.

Proposing Trajectories for Feasible Mitigation

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- Prioritise low-risk, low-investment levers as as entry points.
- Provide step-by-step guidance to build confidence and skills.

Make Actions Acceptable

- Align mitigation advice with farmers' routines, routines, identity, and constraints.
- Co-design solutions with farmers to relevance and appropriateness.

Make Actions Scalable

- Strengthen advisory capacity (time, training, training, climate expertise).
- Simplify access to subsidies, MAEC, and Label Bas Carbone.
- Support collective transitions (cooperatives, (cooperatives, local groups, demo farms).

Outcome

A pathway where farmers progress from simple, feasible changes towards more ambitious, high-impact levers as confidence and support increase.

Conclusion

Conclusion

❑ Key Findings from the Field

- ✓ Clear gap between CAP'2ER recommendations and what is feasible on farms.
- ✓ Farmers motivated but constrained by economic, technical, and cognitive factors.
- ✓ Advisors confirm strong differences in feasibility across lever families.
- ✓ Highest-potential levers (carbon storage, energy technologies) = lowest feasibility.

❑ What Limits Adoption

- ✓ Economic: high investment costs, uncertain returns.
- ✓ Technical: complexity, skills required, system compatibility issues.
- ✓ Cognitive: risk aversion, habits, workload overload.
- ✓ Institutional: MAEC/LBC contradictions, administrative burden.
- ✓ Advisory services lack time, training, and institutional support.

❑ Implications for the Transition

- ✓ Climate tools must integrate farmers' system constraints.
- ✓ Strengthening advisory systems is essential to enabling change.
- ✓ Effective transition requires: simplified policies, better incentives, and collective learning.