Two experimental dairy systems built to decrease the Carbon footprint

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CONTRIBUTING TO THE DECREASE IN THE CARBON FOOTPRINT OF THE FRENCH DAIRY CHAIN

- State of situation and targets of the French Dairy chain

- How can experimental farms contribute to?
  - Optimize the current production systems
  - Test specific levers reducing the C footprint

- Will it limit possibilities for analytic experiments?

LIVESTOCK FARMING AT THE HEART OF MAJOR ENVIRONMENTAL ISSUES

Europe aims at being the first 'climate neutral' continent by 2050

The National Low Carbon Strategy foresees for the French agricultural sector, compared to 2015

-18 %

2030

-46 %

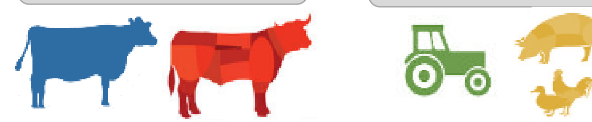
2050

In France, Cattle farms contribute to 9% of GHG emissions

Transport	Residential commercial	**Agriculture**	Industry	Energy	Others
27%	18%	21%	19%	10%	4%

Agriculture (21%):

9 %	7 %



Source: CITEPA, 2021

LA FERME LAITIÈRE BAS CARBONE

Cniel

-20% reduction in the carbon footprint of milk by 2025

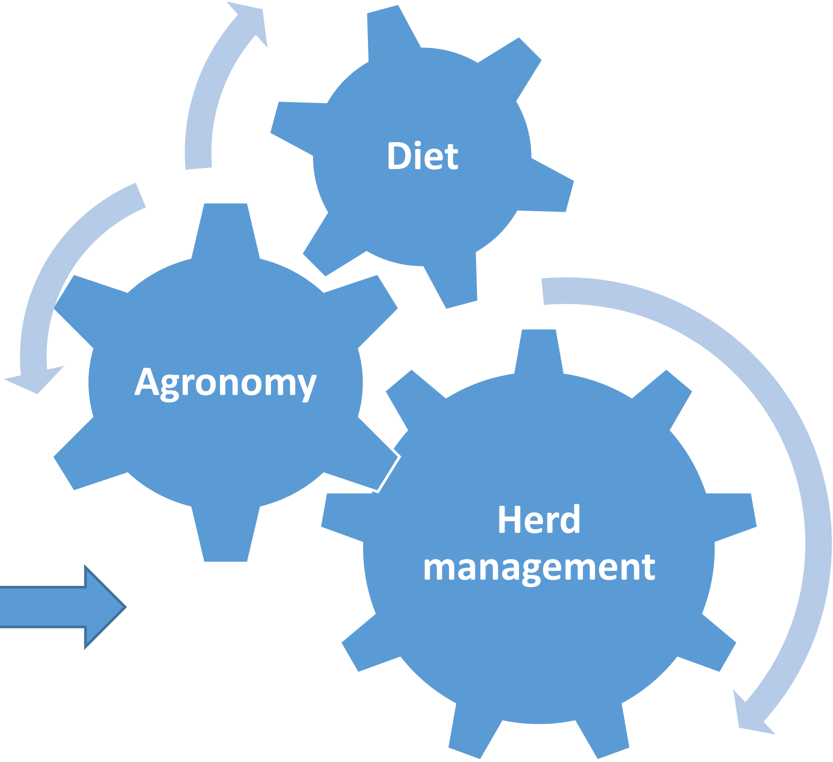
IN EXPERIMENTAL FARMS: TEST, MEASURE, APPLY, INNOVATE!

Tests on rations or feed supplements on enteric CH4 emissions

Soil observatory and effects of rotations on fertility, organic matter

Rearing young stock on grass and monitoring growth performance

Analytic test of levers



Global technical/economic/environmental analysis of farming systems

Reduction of production costs with no negative impact on other environmental factors and no production loss

ONE TOOL FOR ENVIRONMENTAL ASSESSMENT

CAP'2ER®

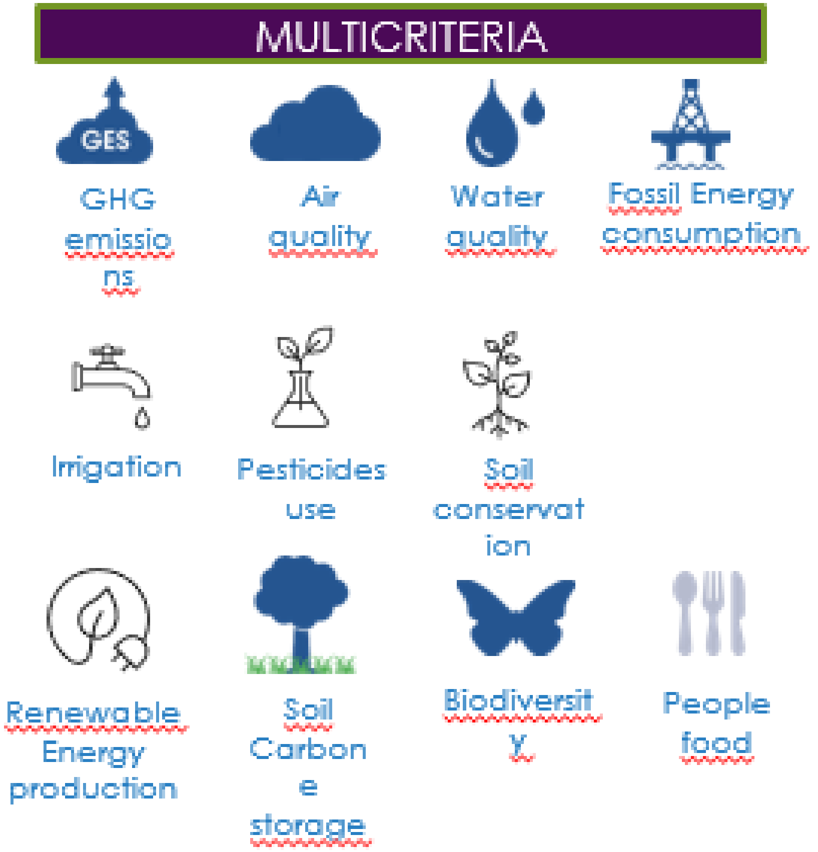
Understanding the GHG emission hotspots to prioritize mitigation options on farm.

- Environmental performance assessed with Life Cycle Analysis methodology.

- Includes farm products carbon footprint and other environmental impacts and positives contributions.

- Carbon footprint is based on international standard (IPCC-2006, tiers 3, FAO-2016 IDF 2010)

LCA at whole farm level



RAW OR NET CARBON FOOTPRINTS

Raw C emissions – **C storage** = **Net Carbon footprint**

–

=

kg CO_2 eq. l^{-1} milk

(standard)

CARBON FOOTPRINT OF FRENCH AND BRETON DAIRY FARMS

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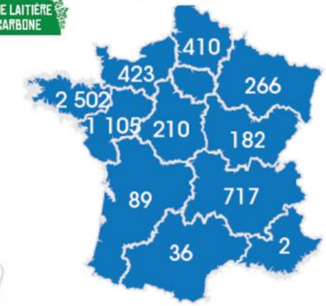
CAP'2ER®

Carbon Dairy

Cap'2R level 2 diagnoses

LA FERME LAITIÈRE BAS CARBONE



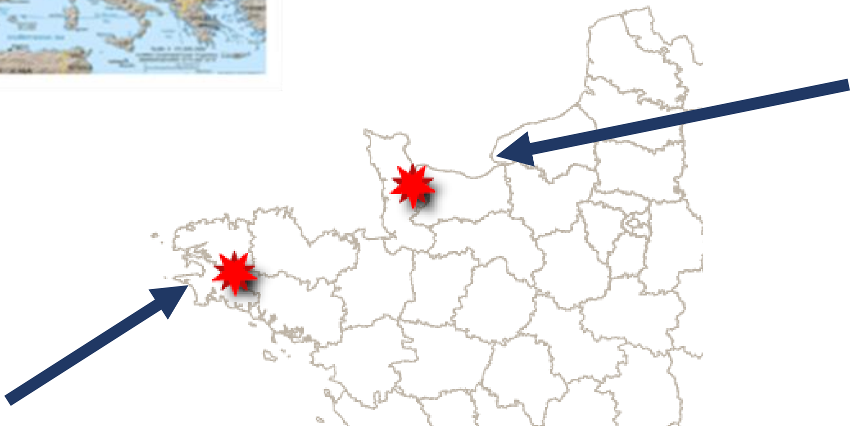
Raw GHG emissions – Carbon storage = Net Carbon footprint

kg CO_2 eq per l milk

	Raw GHG emissions	Carbon storage	Net Carbon footprint
France	0.97	0.14	0.83
Brittany	0.96	0.11	0.85

Differences between production systems = low, except on C storage

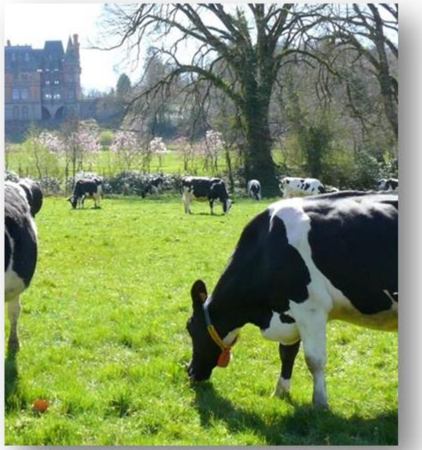
2 DIFFERENT PEDOCLIMATIC CONTEXTS



La Blanche Maison : 950 mm rainfall, silt-clay to clay soils

A mixed crop-dairy farming system in Normandy based on agroecology

88 cows Normande cows



Trévarez : 1,240 mm rainfall, silty-clay soils

A specialized dairy system
125 Holstein cows

2 DIFFERENT PEDOCLIMATIC CONTEXTS

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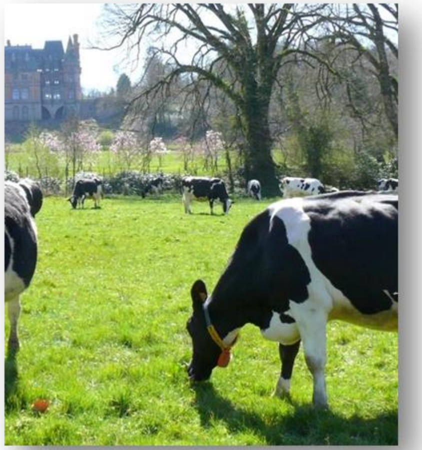
LE RÉSEAU DES FERMES PROFESSIONNELLES EXPÉRIMENTALES BOVINS LAIT ET VIANDE
Ferme expérimentale
Trévarez



<u>**Trévarez**</u> **:** 1,240 mm rainfall, silty-clay soils

A specialized dairy system
125 Holstein cows cows

TECHNICAL, ECONOMICAL AND ENVIRONMENTAL PERFORMANCES OF 2 CONTRASTED DAIRY SYSTEMS

Brocard V. & al., EAAP 2021

0.15 ha grazable per cow
60 ha / 59 cows
46% maize in FA
5.4 ha cereals

GHG emission	0.96
Net Carbon Footprint	0.86

0.40 ha grazable per cow
65 ha / 64 cows
28% maize in FA
4.2 ha cereals

GHG emission	0.94
Net Carbon Footprint	0.81

How to go further?

DESIGNING THE LOW C SYSTEM: STEPS

Global frame of the experimental farm system

Identification of main action levers

- Litterature review
  12 levers chosen

Choice of most efficient levers with simulations on CAP'2ER®

- 5 main levers
- 48 simulations

CAP'2ER®

Proposition of the Low C prototype

TREVAREZ BAS CARBONE

TRÉVAREZ, A DAIRY SYSTEM BUILT FOR A LOW CARBON FOOTPRINT

TREVAREZ BAS CARBONE

Global frame of the experimental farm system

125 Holstein cows → Aim = **8,000 kg produced per cow per yr**

Heifers →

65 % autumn calvings
35 % spring calvings
2 x 3 months calving periods

130 ha Agricultural Area

→ Grass, maize silage, cereal crops
0.25 ha grazed grass per cow (regional average)

48 SIMULATIONS TO ASSESS IMPACT OF 5 MAIN LEVERS

Production concentrate

- With
- Without

Protein concentrate

- Soja
- Rapeseed

Stage of harvest for grass silage

- Early harvest
- Normal/late harvests

Age at 1st calving

- 27 months
- 24 months

Calving period

- 100% Autumn
- 100% Spring
- 65% A – 35% S

THE AVERAGE NCF OF THE 48 SYSTEMS = LOWER THAN THE REGIONAL AVERAGE

AVERAGE EXPECTED IMPACT OF LEVERS

% potential decrease	
Replacing Soja by Rapeseed cakes	-6
Stopping production concentrate	-4
Reducing age 1st calving 28 to 24 m	-2
Early grass silage vs control	-1
Calving season	0

CONCLUSION: OUR PROTOTYPE OF LOW CARBON FOOTPRINT SYSTEM

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Production concentrate

- Without

Protein concentrate

- Rapeseed

TREVAREZ BAS CARBONE

0.25 ha grazed grass per cow

Stage of harvest for grass silage

- Early harvest

Age at 1st calving

- 24 months

Calving period

- 65% Autumn – 35% Spring

Estimated decrease of NCF=-20%

In the top 10% of NCF of Breton dairy farms

CAP'2ER®

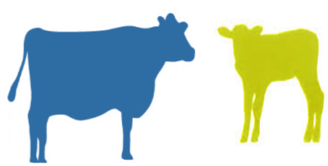
Economy, environment, workload?

Levers related to animal management

Reproduction: 90-100 gestations with Holstein IAs at herd level
(Limit non productive animals while keeping sufficient replacement rate)

Age at 1st calving:
aim = 24 months
(Limit non productive animals)

Calving intervals
Aim = 12 months
18 months if high persistancy
(Limit non productive periods)



Cull cows: sold directly after last milking if possible or after short period of finishing
(Limit non productive animals)

Keep culling and replacement rates below 30%
(Limit non productive animals)

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LE RÉSEAU DES FERMES PROFESSIONNELLES EXPÉRIMENTALES BOVINS LAIT ET VIANDE
Ferme expérimentale
Trévarez

THE RESULTS AFTER 3 YEARS OF IMPLEMENTATION

-20 % RAW EMISSIONS COMPARED TO REGIONAL REFERENCES

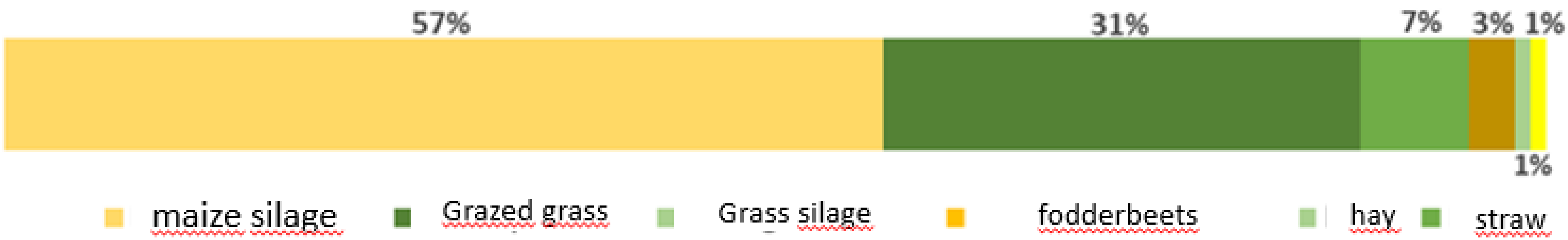
Raw GHG emisions – Carbon storage = Net Carbon Footprint

Kg $CO2_{eq}$ l^{-1}

	Raw GHG emisions	Carbon storage	Net Carbon Footprint
Regional reference Low C footprint (30% maize in FA)	0.96	0.09	0.87
2013-2017	0.95	0.11	0.84
TREVAREZ BAS CARBONE **2018**	0.91	0.09	0.82
TREVAREZ BAS CARBONE **2019**	0.81	0.08	0.73
TREVAREZ BAS CARBONE **2020**	**0.77**	**0.09**	**0.68**

8,000 KG OF MILK PRODUCED WITH 80 g OF RAPESEED CAKE PER LITRE

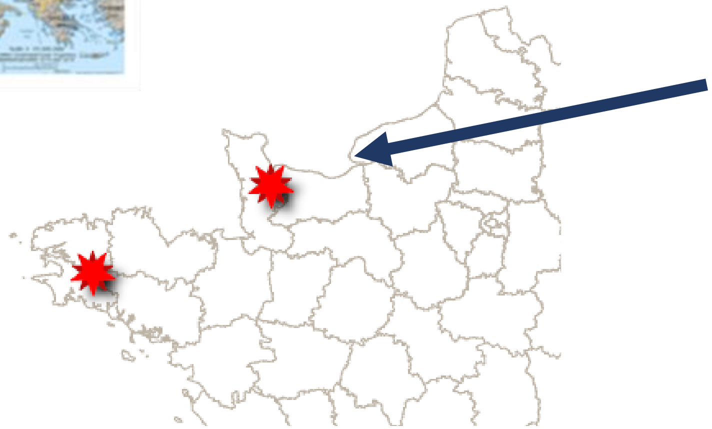
Annual diet of cows 2020



	TREVAREZ BAS CARBONE	Regional reference Low C footprint (30% maize in FA)
Protein self sufficiency (%)	**80**	**67**
Concentrate (kg cow^{-1})	635	1,148
Concentrates (g l^{-1})	80	148
Corrected milk* (kg cow^{-1})	7,917	7,756
Feeding cost (€ l^{-1})	63	82

(*4,0% fat-3,3% true proteins)

2 DIFFERENT PEDOCLIMATIC CONTEXTS



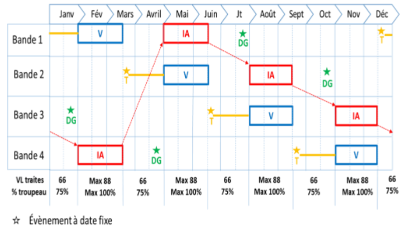
La Blanche Maison : 950 mm rainfall, silt-clay to clay soils

Ferme expérimentale Blanche Maison

F@RM XP

SYSTEM = CROPS+LIVESTOCK IN AGRO ECOLOGY

88 Normande cows

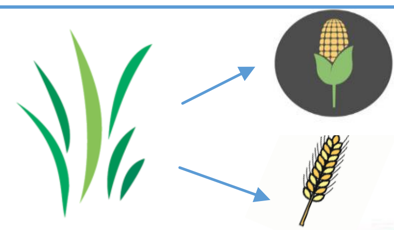


4 periods of reproduction

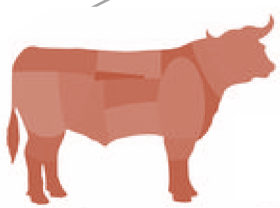
Herd replacement

Feeding: balance diet with forages

96 ha with grass at the heart of the rotation



Finishing of cows

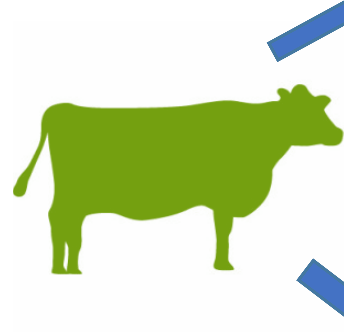


Beef unit

DECREASING CARBON FOOTPRINT- LEVERS RELATED TO FEEDING MANAGEMENT

Winter diet: 50 % grass silage in forages
(lower dependency to N concentrates)

Grazing 0.27 ha per cow
(agro ecological system based on grass)



Higher density in energy of diet during grazing periods
(use of maize cob silage to limit concentrate use)

Optimising concentrate distribution mode and use of rapeseed cakes
(better valorisation of concentrate and lower C footprint of rapeseed)

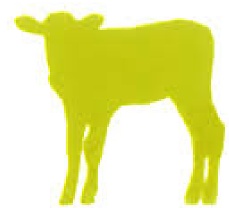
F@RM XP Ferme expérimentale Blanche Maison

+1,800 kg milk per cow
166 g conc per kg milk

LEVERS ON REPLACEMENT / HEIFERS

Rotational grazing for heifers
(less concentrate inputs)

Calves grazing at 10 d of age
(valorising grass from the start)



Reduce age at 1st calving
(Limit non productive periods)

Delivering non commercial milk + supplement of milk powder to calves
(avoid wastes)

F@RM XP Ferme expérimentale Blanche Maison 28 months

Average Normande France = 34 m

RESULTS: -29% OF GHG EMISSIONS

Raw GHG emisions – Carbon storage = Net Carbon Footprint

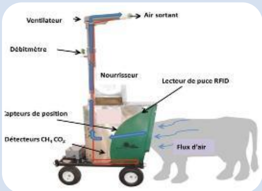
Kg $CO2_{eq}$ / l

simulations	0.98	0.13	0.85
2017	1.27	0.28	0.99
2018	1.04	0.19	0.85
2019	0.96	0.18	0.79
2020	0.90	0.17	0.73

Prod cost -30%

N use efficiency
+ 6 pt

CONCLUSION: IN EXPERIMENTAL FARMS: TEST, MEASURE, APPLY, INNOVATE!



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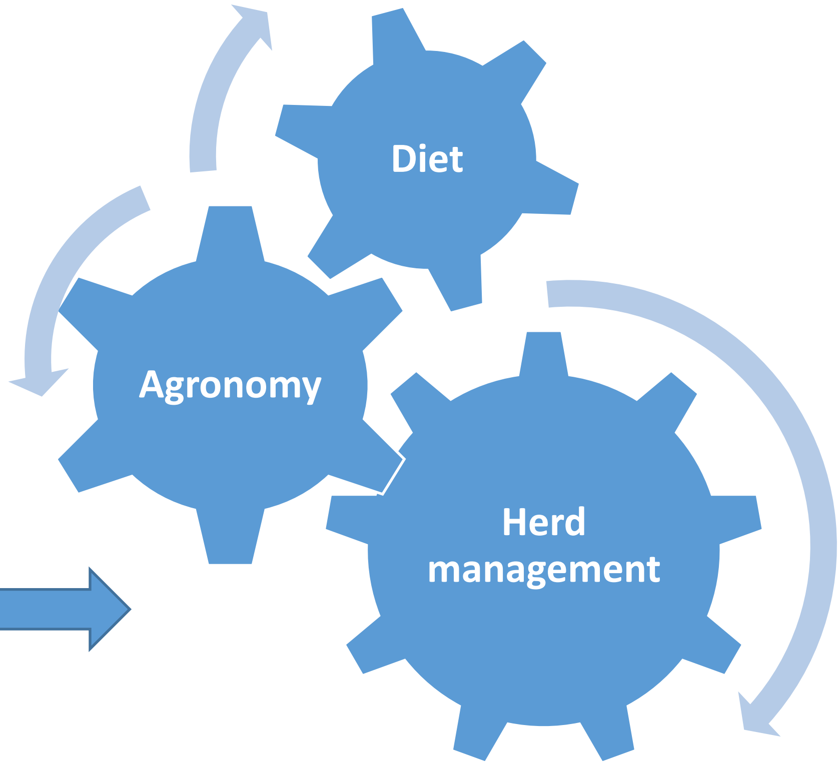
Analytic test of levers



Global technical/economic/ environmental analysis of farming systems

Reduction of production costs with no negative impact on other environmental factors and no production loss

PROSPECTS

TREVAREZ BAS CARBONE

Animal side

Experiments to reduce dependency on N inputs

MORE GRASS
MORE LEGUMES

Land side

Change rotations to maximise C storage

MORE GRASS
MORE LEGUMES

WHAT IS THE OPINION OF THE RESEARCHER DESIGNING EXPERIMENTS?

- Globally not incompatible with most of analytic experiments
  - Can lead to new experiments (feed additives)
- Issue with limited choice of animal for batches (reduction in replacement rate)
  - Risk: less heifers, lighter heifers, lower production in 1st lactation = improve calves/heifers management
  - But in line with 3Rs ethical approach of experiments with animals
- Change in the forage system
  - Control = maize based
- Strong role of demonstration
  - Farmers, advisers, dairy chain

LA FERME LAITIÈRE BAS CARBONE

OBRIGADO PELA SUA ATENÇÃO.

Questions?

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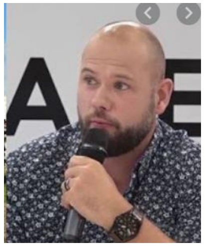

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Interreg Atlantic Area

Dairy 4 future

Interreg France (Channel Manche) England

ABCD

PRDAR Bretagne

Région Normandie

Avec la contribution financière du compte d'affectation spéciale développement agricole et rural CASDAR

MINISTÈRE DE L'AGRICULTURE ET DE L'ALIMENTATION

PRDAR Normandie

F@RMXP LE RÉSEAU DES FERMES PROFESSIONNELLES EXPÉRIMENTALES BOVINS LAIT ET VIANDE

aGRICULTURES & TERRITOIRES CHAMBRES D'AGRICULTURE

APCA
BRETAGNE
NORMANDIE
PAYS DE LA LOIRE
SAÔNE-ET-LOIRE

POTENTIAL LEVERS TO DECREASE C FOOTPRINT AND THEIR RELATIVE IMPACTS

- **Herd management: 10-15%**
  - Replacement, heifers, herd health
- **Feeding: 2-4%**
  - Forage quality, concentrates, protein self sufficiency, grazing
- **Crops management: 3-4%**
  - Yield, fertilisation
- **Energy consumption: 1-2%**
  - Fuel, electricity

- **Carbon storage: 2-8%**
  - Type of grasslands, livespan of the temporary grasslands, renewing/reseeding grasslands, new hedges, agroforestry