



# What drive the environmental performance of dairy farms ?

## A comparative analysis of the adoption of best environmental practices

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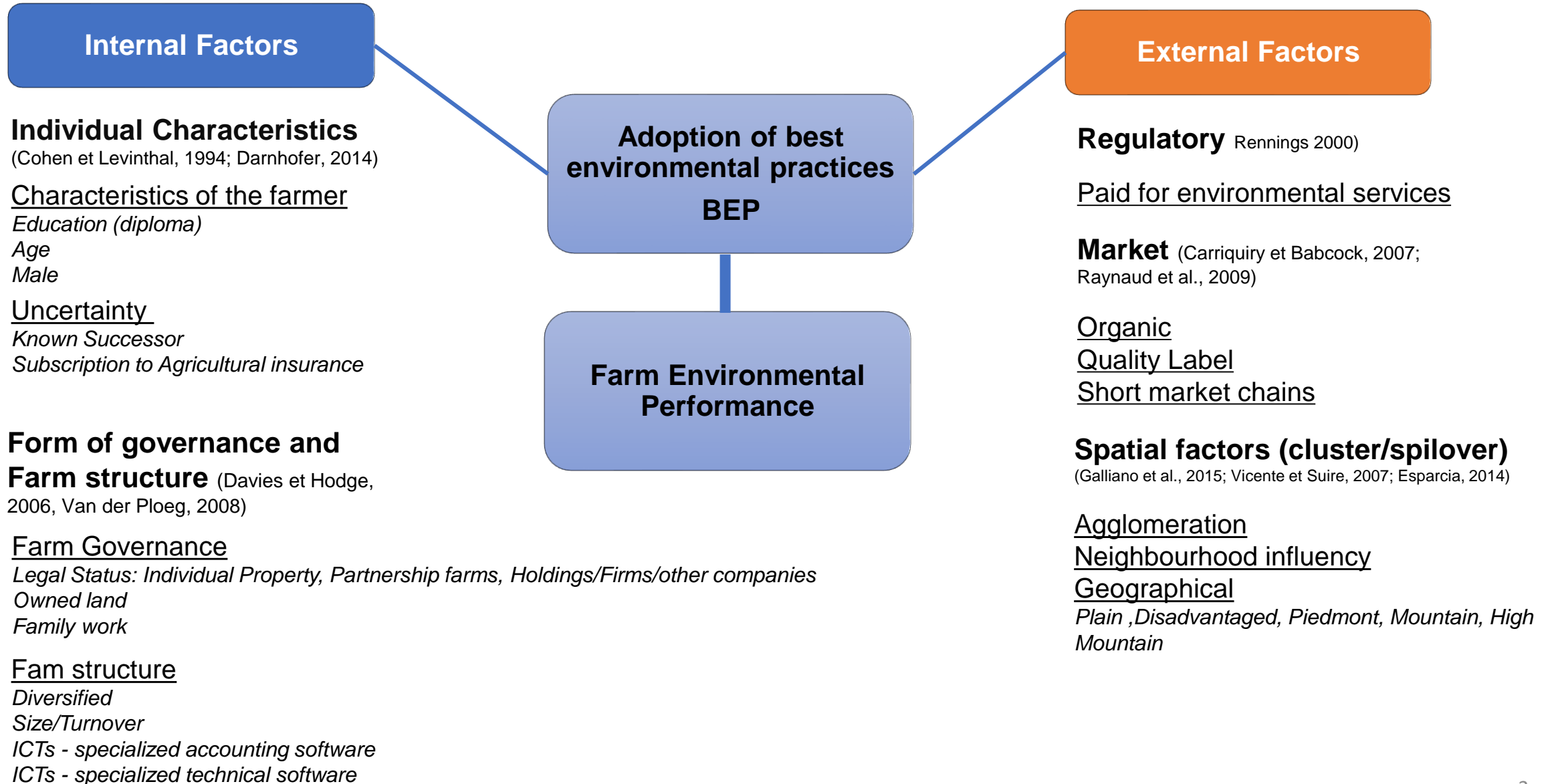
# Introduction

- Large literature on the adoption of best management practices (Prokopy et al., 2008; Baumgart-Getz et al., 2012; Yoder et al., 2019)
- Survey about the adoption of one or two practices and little comparative analysis
- Mainly based on case studies or small sample of farms
- Few studies about the dairy sector

## Goals

- Study the determinants of the adoption of best environmental practices
- Consider a large set of farm's environmental practices
- Make a comparative analysis between the practices
- Make an exhaustive analysis of French dairy farms
- Use a theoretical framework that allows to understand the influence of internal and external factors on the adoption of the practices

# Analytical Framework



# Data and Methods

## French Agricultural Census (2010)

47211 specialized dairy farms

Comparative analysis of 9 agricultural practices :

Area of permanent grassland (%)

Presence of leguminous fodder (Y/N)

Area without synthetic fertilizers (%)

Area without chemicals (%)

Presence of agro-ecological structures (wood, line of trees, hedges) (Y/N)

Treatment of manure (Y/N)

Conservation tillage/No-till (Y/N)

Non-use of irrigation (Y/N)

Crop rotation (Y/N)

## Econometric approach (correlation)

Linear regressions (quantitative variables) and probit models (qualitative variables)

p-values : \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

# Results

	Permanent grassland	Leguminous fodder	Non-synthetic fertilizers	Non-Chemical crop protection	Agroecological structures	Treatment of manure	Conservation tillage/No-till	Non- Irrigation	Crop rotation
<b>FACTEURS INTERNES</b>									
<b>Characteristics of the farmer</b>									
Education (diploma)	-0.032***	0.0096	-0.00084	-0.0035*	0.066***	0.058***	0.14***	-0.033	0.0076
Age	-0.00049***	-0.0016*	0.00078***	0.000035	0.0055***	0.0020***	0.0017**	-0.0017	-0.00031
Male	0.016***	0.0016	0.013***	0.019***	-0.069***	-0.072***	-0.062***	0.14***	-0.033*
<b>Uncertainty</b>									
Known Successor	0.016***	0.018	-0.0015	0.00085	0.0054	-0.021	-0.069***	0.099***	-0.055***
Subscription to Agricultural insurance	-0.017***	-0.17***	-0.044***	-0.014***	0.15***	0.072***	-0.13***	-0.018	-0.11***
<b>Farm Governance</b>									
Legal Status:									
Individual Property	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Partnership farms	-0.032***	0.18***	0.038***	0.019***	0.0093	0.11***	0.15***	-0.40***	0.015
Holdings/Firms/Others	-0.054***	0.079***	0.0070**	-0.014***	0.081***	0.068***	0.14***	-0.20***	0.031*
Owned land	-0.044***	-0.092***	0.0082*	0.014***	0.46***	0.031	-0.0100	0.055	-0.035
Family work	-0.0026	-0.074**	-0.024***	-0.0031	-0.064**	-0.15***	-0.10***	0.16***	0.076**
<b>Fam structure</b>									
Diversified									
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes (without dairy)	0.0037	0.091***	-0.0078	-0.016***	0.056**	0.066***	0.037	-0.0039	-0.058**
Yes (dairy processing)	0.013*	0.25***	0.043***	0.023***	-0.21***	-0.13***	0.24***	0.13	0.17***
<b>Size/Turnover</b>									
ICTs - specialized accounting software	-0.061***	-0.16***	-0.12***	-0.13***	0.17***	0.14***	0.098***	-0.19***	-0.13***
ICTs - specialized technical software	-0.014***	0.080***	0.0040	-0.0067***	-0.060***	0.041***	0.12***	-0.22***	0.068***
	-0.0095***	0.053***	-0.0076***	-0.016***	0.039***	0.027**	0.097***	-0.023	0.021
<b>EXTERNAL FACTORS</b>									
<b>Commercial and Regulatory environments</b>									
Organic Conversion									
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Desired	-0.00028	0.16***	0.12***	0.074***	0.11***	0.13***	0.16***	-0.14***	0.051
Yes/under conversion	-0.018***	0.30***	0.56***	0.30***	0.0087	0.43***	0.043	-0.0064	0.82***
Quality label:									
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes (except dairy products)	0.0089**	-0.053*	-0.015***	0.0011	-0.020	0.11***	0.018	0.032	-0.0018
Yes (dairy products)	-0.036***	0.11***	-0.0055**	0.0041**	0.14***	0.085***	0.19***	0.063***	0.052***
Commercialization on short market chains:									
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes (except dairy products)	0.0070	0.058*	0.013**	0.020***	0.052**	0.11***	-0.029	-0.42***	-0.036
Yes (dairy products)	0.0052	0.041	0.052***	-0.00032	-0.041	0.19***	-0.038	-0.17***	-0.054
Paid for environmental services	0.087***	0.098***	0.11***	0.097***	-0.065***	0.058***	0.025	0.11***	-0.0076
<b>Spatial environment</b>									
Agglomeration rate of dairy farms	-0.0057***	-0.16***	-0.012***	0.042***	-0.12***	0.098***	-0.037***	0.49***	0.10***
Neighbourhood adoption behavior	0.92***	1.99***	0.22***	0.26***	-0.46***	0.95***	0.85***	2.17***	0.74***
Geographical area:									
Plain	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Disadvantaged	0.023***	0.18***	0.038***	0.061***	0.029	-0.050***	0.068***	-0.61***	0.052**
Piedmont	-0.0057	-0.28***	0.035***	0.12***	0.22***	0.24***	-0.23***	-0.95***	-0.27***
Mountain	-0.026***	-0.053**	0.037***	0.14***	0.26***	0.20***	0.027	-1.04***	-0.075***
High Mountain	-0.017*	1.04***	0.32***	0.18***	-0.87***	-0.057	0.70***	-2.34***	0.47***
N	47211	47211	47211	47211	47211	47211	47211	47211	47211
chi2		7983.8			2617.2	4635.5	3087.7	6472.7	2089.1
r2_p		0.16			0.032	0.055	0.049	0.26	0.036

# MAIN RESULTS AND DISCUSSION

**The same drivers can have + and - correlations with the adoption of sustainable practices : it depends of the BEP**

Higher level of education is: **+** to the treatment of the manure, **-** permanent grassland covering, **0** non-use of synthetic fertilizers

## INTERNAL

**Uncertainty (related to insurance subscription) is more important than individual features in the adoption of BEP**

Insurance Subscription: 8/9\*\*\* 6 **+** & 2 **-**

**Governance Influence in BEP adoption is ambiguous**

Significative differences between individual and holdings  
Share of owned land and family labor are not highly correlated

**Farm size is negatively correlated to the most BEP**

**Diversification (mainly by dairy processing) is positively correlated to almost all BEP**

## EXTERNAL

**Payment for environmental services has a positive correlation to the adoption**

**Alternative markets (organic, labeled and short supply chains) are positively correlated with the adoption of the largest part of BEP**

**Spatial variables (mainly neighborhood adoption behavior) is the most important driver (explanatory factor) of BEP adoption**

Mimetic behavior and spillovers effect can explain it

## MAIN CONCLUSION

**Policies to promote farmer's exchange and to supporting diversification, labeled products and short circuits can further the adoption of environmental practices on dairy farms.**



# *Thank you for your attention*

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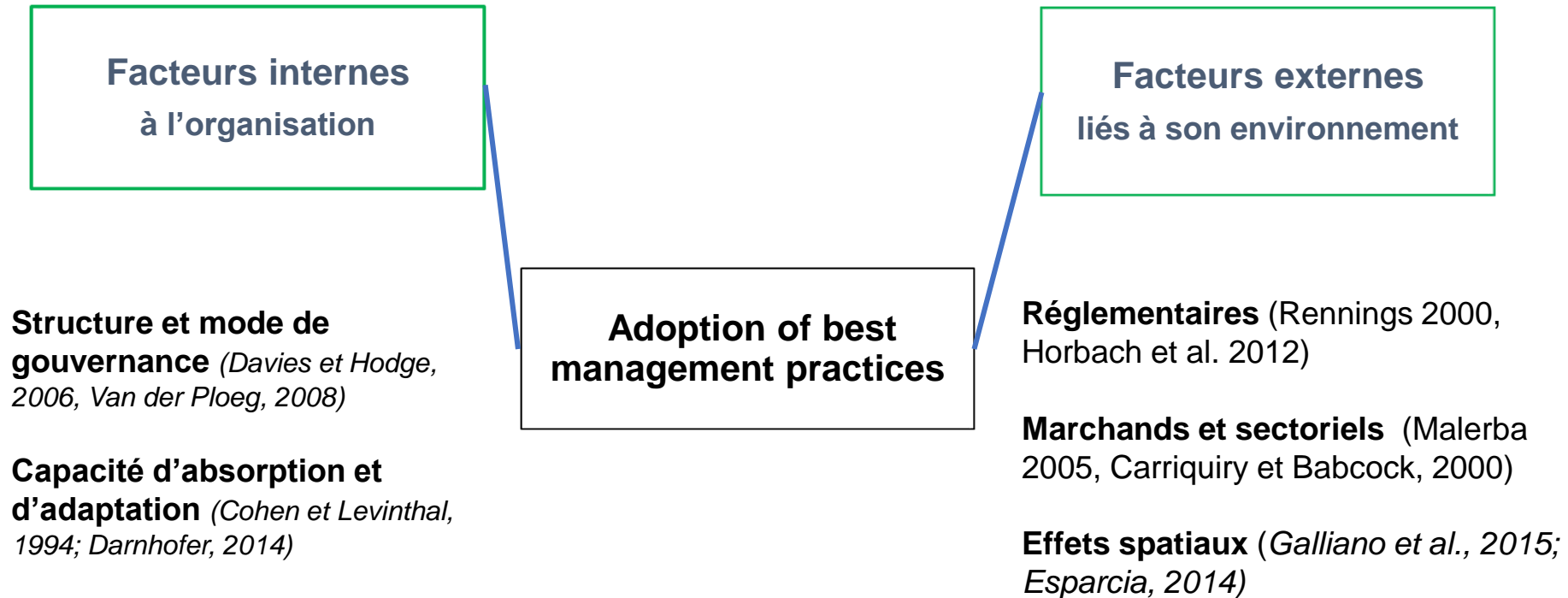
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# Cadre analytique : Economie de l'innovation & économie de l'environnement (*Porter, Van der Linde 1995*)



$$\Rightarrow PE = FI_i \beta_i + FE_i \beta_i + \varepsilon_i$$

# RESULTS : INTERNAL FACTORS\*\*\*

## Characteristics of the farmer

### *Agricultural insurance (+)*

Education (diploma), Age, Male, Known Successor

- + permanent grassland, leguminous fodder, non-synthetic fertilizers, no chemicals, no-till, crop rotation
- agro-ecological structures, treatment of manure

## Farm Governance

### *Legal Status: Individual Property (ref) (+)*

### *Family work (+)*

Owned land

- + leguminous fodder, non-synthetic fertilizers, no-till, treatment of manure
- permanent grassland, no-irrigation

- + leguminous fodder, non-synthetic fertilizers, no-till, treatment of manure
- no-irrigation, crop rotation

## Fam structure

### *Size/Turnover (-)*

### *Diversified (+)*

### *ICTs-specialized accounting software (?)*

### *ICTs - specialized technical software\**

- + agro-ecological structures, treatment of manure, no-till
- permanent grassland, leguminous fodder, non-synthetic fertilizers, no-chemicals, no-irrigation, crop rotation

- + permanent grassland\*, leguminous fodder, non-synthetic fertilizers, no chemicals, no-till, crop rotation
- agro-ecological structures, treatment of manure

- + leguminous fodder, treatment of manure, no-till, crop rotation\*( )
- Permanent grassland, no chemicals, agro-ecological\*(+)

\* ( - ) non-synthetic fertilizers,

# RESULTS : EXTERNAL FACTORS\*\*\*

## Regulatory

*Paid for environmental services (+)*

## Market

*Organic (+)*

*Quality Label (+)*

Short market chains ( only 3 factors)

## Spatial factors

*Agglomeration rate of dairy farms*

*Score of the neighborhood practices*

*Geographical area:* Plain (ref)

Mountain

High Mountain

+ permanent grassland, leguminous fodder, non-synthetic fertilizers, no chemicals, treatment of manure, no-irrigation  
- agro-ecological structures

+ leguminous fodder, non-synthetic fertilizers, no chemicals, treatment of manure, crop rotation  
- permanent grassland

+ leguminous fodder, no chemicals, agro-ecological structures, treatment of manure, no-till, no-irrigation, crop rotation  
- permanent grassland, non-synthetic fertilizers

+ non-synthetic fertilizers, treatment of manure

+ no chemicals, treatment of manure, no-irrigation, crop rotation  
- permanent grassland, leguminous fodder, non-synthetic fertilizers, agro-ecological structures, no-till

+ ALL ( strong influence of the neighborhood)

+ non-synthetic fertilizers, no chemicals, agro-ecological structures, treatment of manure  
- permanent grassland, leguminous fodder, no-irrigation, crop rotation

+ leguminous fodder, non-synthetic fertilizers, no chemicals, no-till, crop rotation  
- permanent grassland, agro-ecological structures, no-irrigation

- Exploring the relationship between farm's social and economic factors and the adoption of agricultural best management practices is useful to tackling the environmental challenges faced by the animal production. This study used the data of 47211 dairy farms from the 2010 French Agricultural Census to study the statistical correlations between these factors and the adoption of nine agricultural best management practices. First, we tested the internal factors related to the characteristics of the farmer, farm's structure, and governance. Second, we tested the external factors related with commercial and regulatory followed by spatial features. The results show that the internal factors like farm size and the contracting any agri-environmental insurance are negatively correlated with the adoption of most of the practices. Communication and information technologies are both positively or negatively correlated with the practices. In terms of governance, farms with individual and corporative legal status have statistically significant adoption behavior. The share of familial annual working unit is negatively correlated with most of the practices. On the contrary, the diversification has an important positive correlation. Education, age, knowing the succession and the share of land under property have not significant correlation with most of the practices. In terms of external factors, the statistical analysis highlights the significant positive correlation of positioning on alternative markets, short circuits, organic products, or quality markets and the adoption of almost all practices. As the literature commonly suggests, the results show that environmental regulations also drive the adoption. The spatial environment of the farm and, more specifically, the environmental behavior of neighboring farms is highly correlated with the adoption. Finally, policies to promote locally farmer's experience exchange and to supporting diversification, high quality products and short circuits can further the adoption of agricultural best management practices reducing the environmental impacts of dairy farms.