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Farm's social and economic factors and the adoption of agricultural best management practices

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Sciences du vivant | Agriculture
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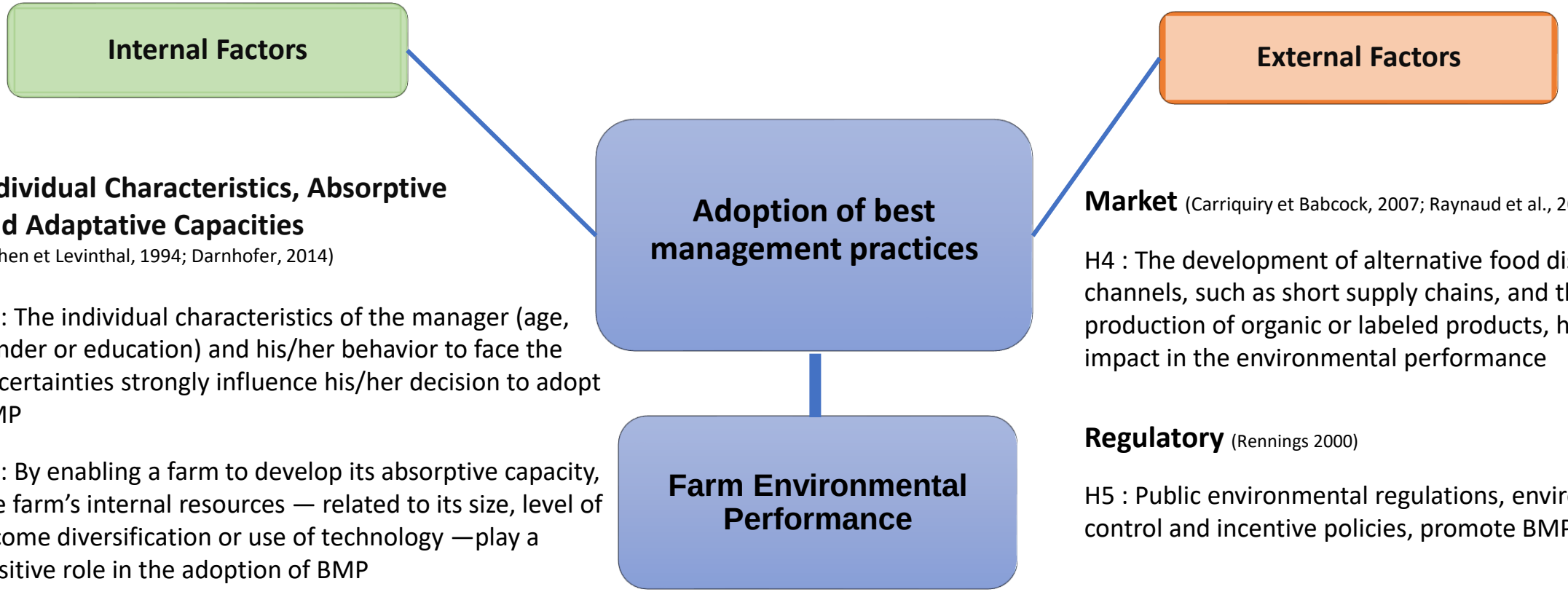
Introduction

- Best management practices BMP= practices producing positive environmental externalities/contributing to the provisioning of ecosystem services
- Environmental performance can be considered as the results of BMP adoption
- Studies about the adoption of best management practices (Prokopy et al., 2008; Baumgart-Getz et al., 2012; Yoder et al., 2019)
  - ➢ *Adoption of one or two practices and little comparative analysis*
  - ➢ *Mainly based on case studies or small sample of farms*
  - ➢ *Focused only on farm's internal factors*
  - ➢ *Few studies about the dairy sector*
    - ✓ *Important user of resources and environmental externalities*
    - ✓ *Diversity of organizational and production design*

⇒Study the main social and economical factors related to dairy farms environmental performance

Analytical Framework and Hypothesis

Innovation and Environmental economics (Horbach et al., 2012)



Individual Characteristics, Absorptive and Adaptative Capacities
(Cohen et Levinthal, 1994; Darnhofer, 2014)

H1: The individual characteristics of the manager (age, gender or education) and his/her behavior to face the uncertainties strongly influence his/her decision to adopt BMP

H2: By enabling a farm to develop its absorptive capacity, the farm's internal resources — related to its size, level of income diversification or use of technology —play a positive role in the adoption of BMP

Form of governance (Davies et Hodge, 2006, Van der Ploeg, 2008)

H3: Governance based on the non-separation of ownership and use of the means of production has a positive effect on the adoption

Market (Carriquiry et Babcock, 2007; Raynaud et al., 2009)

H4 : The development of alternative food distribution channels, such as short supply chains, and the production of organic or labeled products, has a positive impact in the environmental performance

Regulatory (Rennings 2000)

H5 : Public environmental regulations, environment control and incentive policies, promote BMP adoption

Spatial and sectorial (cluster/spillover)
(Galliano et al., 2015; Vicente et Suire, 2007; Esparcia, 2014)

H6 : Network dynamics and proximity-related mimicry positively influence the decision to adopt best environmental practices. These processes must be controlled for by the pedoclimatic conditions in the territory

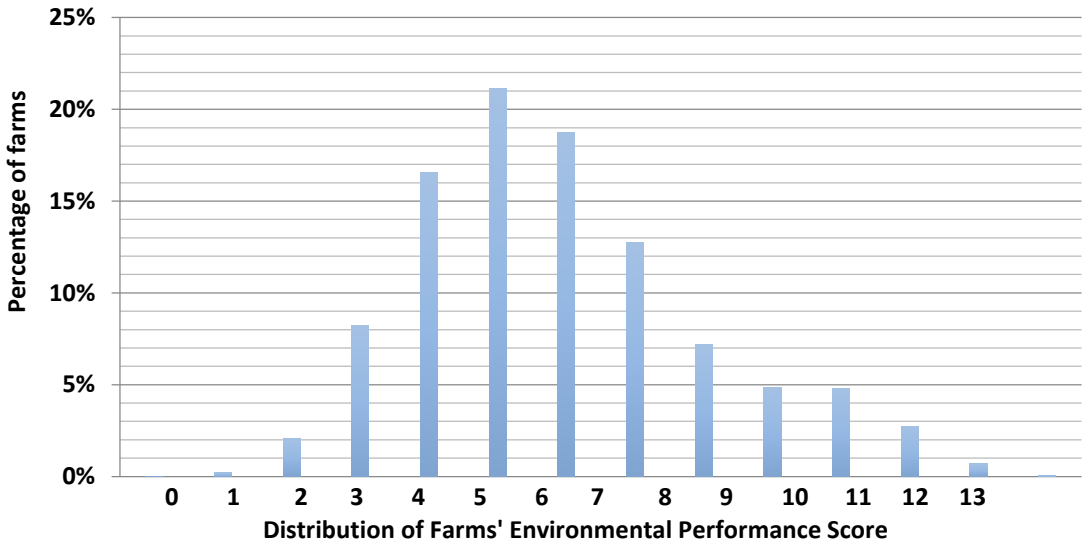
Data and methods

French Agricultural Census (2010)

47211 specialized dairy farms

Environmental performance as a result of the adoption of 9 agricultural practices (Score 0-13): Literature + experts validation

- Presence of agro-ecological structures (wood, line of trees, hedges) (0-2)
- Area of permanent grassland (0-3)
- Presence of leguminous fodder (0-1)
- Area without synthetic fertilizers (0-1)
- Area without chemicals (0-1)
- Treatment of manure (0-2)
- Conservation tillage/No-till (0-1)
- Non-use of irrigation (0-1)
- Crop rotation (0-1)



Econometric approach (correlation)

Ordered Probit : *Models used in the case of qualitative multinomial ordered variables (Greene, 2003)*

1. General Model and 4 Models without spatial variables

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

Results - General Model

EXPLANATORY VARIABLES		GENERAL Model
INTERNAL FACTORS		
Characteristics of the farmer	Education (Diploma)	0.0073
	Age	0.0017***
	Male	-0.012
Uncertainty	Known Successor	0.011
	Subscription to agricultural insurance	-0.076***
Fam structure/absorptive capacity		
Diversified	No	Réf
	Yes (without dairy)	0.054**
	Yes (dairy processing)	0.074*
	Size/turnover	-0.17***
	ICTs - specialized accounting software	-0.00078
	ICTs - specialized technical software	0.037***
Farm Governance		
Legal Status:	Individual Property	Réf
	Partnership farms	0.025
	Holdings/Firms/Others	-0.033**
	Owned land	0.059***
	Family work	-0.11***
EXTERNAL FACTORS		
Market		
Organic Conversion	No	Réf
	Desired	0.23***
	Yes/under conversion	1.22***
Quality label	No	Réf
	Yes (except dairy products)	0.032
	Yes (dairy products)	0.060***
Commercialization through short market chains	No	Réf
	Yes (except dairy products)	0.027
	Yes (dairy products)	0.11***
Regulatory	Paid for environmental services	0.28***
Spatial environment		
Agglomeration rate of dairy farms		0.0092
Neighbourhood adoption behaviour		3.53***
Geographical area:	Plain	Réf
	Disadvantaged	0.0031
	Piedmont	-0.18***
	Mountain	0.024
	High Mountain	0.15***
r2_p		0.17

Internal

H1	Individual characteristics of the manager and his/her behavior to face the uncertainties **do not influence that much as we expected** **Only Age and Insurance** are correlated And… the last **plays a more important** role than the manager characteristics
H2	Farm's internal resources enabling the development of the absorptive capacity **have a positive influence except the Size (-)**
H3	The way in which a farm is **governed play a significant role** Holdings (-) compared to Individual property and owned land (+) To go further : Place of the family work(-)

External

H4	Short circuits, labeled or organic production (mainly) have a **very significant and positive role**
H5	Receiving payments for environmental services **contributes positively**
H6	**Network dynamics and proximity-related mimicry are strong correlated** with the decision to adopt best environmental practices. The average environmental performance score of dairy farms in the canton has a **MAJOR** influence **Pedoclimatic conditions** : High Mountain + compared with lowland

Results – Spatial Models

EXPLANATORY VARIABLES		M1 General Model	M2 no-spatial var	M3 pedoclimatic	M4 neighborhood	M5 agglomeration
INTERNAL FACTORS						
Characteristics of the farmer	Education (Diploma)	0.0073	-0.080***	0.0066	-0.047***	0.0073
	Age	0.0017***	-0.0029***	0.0016**	0.0011*	0.0017***
	Male	-0.012	-0.050***	-0.012	-0.0060	-0.012
Uncertainty	Known Successor	0.011	0.093***	0.011	0.079***	0.0098
	Subscription to agricultural insurance	-0.076***	-0.12***	-0.076***	-0.089***	-0.074***
Fam structure/absorptive capacity						
Diversified	No	Ref	Ref	Ref	Ref	Ref
	Yes (without dairy)	0.054**	0.16***	0.055**	0.12***	0.053**
	Yes (dairy processing)	0.074*	0.53***	0.086**	0.38***	0.074*
	Size/turnover	-0.17***	-0.40***	-0.18***	-0.031***	-0.18***
	ICTs - specialized accounting software	-0.00078	-0.095***	0.00028	-0.091***	-0.0015
	ICTs - specialized technical software	0.037***	0.056***	0.038***	0.041***	0.037***
Farm Governance						
Legal Status:	Individual Property	Ref	Ref	Ref	Ref	Ref
	Partnership farms	0.025	0.079***	0.028*	-0.16***	0.025
	Holdings/Firms/Others	-0.033**	-0.14***	-0.033**	-0.19***	-0.033**
	Owned land	0.059***	-0.082***	0.056***	-0.16***	0.057***
	Family work	-0.11***	-0.27***	-0.11***	-0.22***	-0.11***
EXTERNAL FACTORS						
Market						
Organic Conversion	No	Ref	Ref	Ref	Ref	Ref
	Desired	0.23***	0.13***	0.22***	0.15***	0.23***
	Yes/under conversion	1.22***	0.71***	1.21***	0.94***	1.22***
Quality label	No	Ref	Ref	Ref	Ref	Ref
	Yes (except dairy products)	0.032	0.040**	0.034*	-0.046**	0.033*
	Yes (dairy products)	0.060***	0.099***	0.060***	0.01	0.063***
Commercialization through short market chains	No	Ref	Ref	Ref	Ref	Ref
	Yes (except dairy products)	0.027	0.0097	0.025	-0.026	0.027
	Yes (dairy products)	0.11***	0.070**	0.12***	0.091***	0.11***
Regulatory	Paid for environmental services	0.28***	0.85***	0.28***	0.55***	0.28***
Spatial environment						
Agglomeration rate of dairy farms		0.0092		0.013**	0.13***	
Neighbourhood adoption behaviour		3.53***		3.54***		3.54***
Geographical area:	Plain	Ref			Ref	Ref
	Disadvantaged	0.0031			0.48***	-0.0043
	Piedmont	-0.18***			0.52***	-0.18***
	Mountain	0.024			0.93***	0.023
	High Mountain	0.15***			1.42***	0.14***
r2_p		0.17	0.067	0.17	0.089	0.17

Results – The role of the Spatial Variables

1. Low effect of the sectorial agglomeration rate
2. Relative effect of pedoclimatic conditions
3. Dominant effect of the neighborhood environmental performance
   - Change the role of farms' social and economic factors (all factors become significant)
   - Change the role of the pedoclimatic conditions
   - Highlights the central role of mimetic effects/networks/exchange of knowledge and experience in proximity

$\Rightarrow$ Consonant with qualitative results

Conclusion

- **Strong interaction between farm's internal organization (social and economic factors) and its environment in the choice of best agricultural practices**
  - Do not to study the farm as an isolated element

- **Central role of the farm's spatial environment and, more specifically, interactions with a neighborhood having an environmentally friendly behavior**
  - But still missing the empirical observation of the farm's local networks, the links with the partners or advisors, etc.

- **To go further…**
  - Quantitative and qualitative network analysis.
  - Does it exist a best organizational design and governance to preserve the environment ?
    - Firms ? family farms ? Jointly run farms?
  - Sectorial comparison (between dairy and crop production ?)

Thank you for your attention

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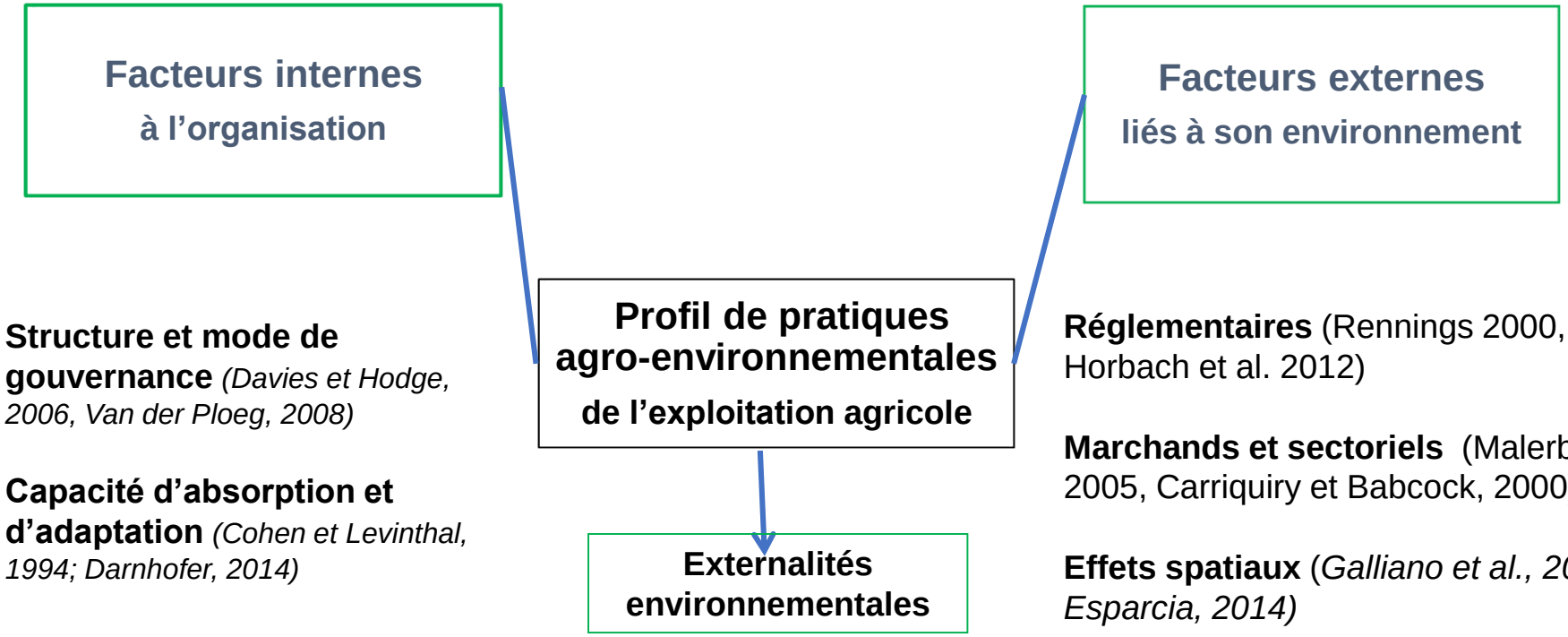
1. Cadre analytique : Economie de l'innovation & économie de l'environnement *(Porter, Van der Linde 1995)*



Structure et mode de gouvernance *(Davies et Hodge, 2006, Van der Ploeg, 2008)*

Capacité d'absorption et d'adaptation *(Cohen et Levinthal, 1994; Darnhofer, 2014)*

Réglementaires (Rennings 2000, Horbach et al. 2012)

Marchands et sectoriels (Malerba 2005, Carriquiry et Babcock, 2000)

Effets spatiaux (*Galliano et al., 2015; Esparcia, 2014)*

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

Données et Méthode

- Recensement agricole 2010
  - 47. 562 Exploitations laitières spécialisées *(+66% de la PBS)*

- Profil environnemental construit à travers 9 pratiques (Score 0-13) – Littérature et validation des experts
  - Prairies permanentes (0-3)
  - Légumineuses (0-1)
  - Fertilisation minérale (0-1)
  - Phytosanitaires (0-1)
  - Infrastructures agro-écologiques (0-2)
  - Traitement des effluents (0-2)
  - Travail du sol de conservation (0-1)
  - Irrigation (0-1)
  - Rotation de cultures (0-1)

$$\begin{cases} PEi = 0\,pratiques \\ PEi = 1\,pratiques \\ \quad . \\ \quad . \\ \quad . \\ PEi = 13\,pratiques \end{cases}$$

- Econometric approach (correlation)
  - Ordered Probit:
- Ces modèles sont utilisés dans le cas de variables qualitatives multinomiales ordonnées (Greene, 2003).

EXPLANATORY VARIABLES	DESCRIPTION
INTERNAL FACTORS	
Characteristics of the farm manager	
Education	2-value variable: the manager has received no graduate education, or he has received graduate education (bac, bac +3 or bac+5)
Age	Continuous variable: Age of the manager (When there is more than one manager, the age of the youngest is considered)
Gender	2-value variable: The manager is either a man or a woman
Succession	2-value variable: Succession known or unknown
Agricultural insurance	2-value variable: Presence or absence of agricultural insurance
Governance of the farm	
Legal status	3-value variable: sole ownership, GAEC (jointly run farms) or other types of corporate farms (excl. GAEC)
Surface area owned	Continuous variable in log form: ratio between the surface area of useful land owned and the total useful area
Family labor per year	Continuous variable in log form: ratio between the annual family labor input and the total labor input
Structural characteristics of the farm	
Diversification of activities	3-value variable: Absence of diversification, diversification to non-dairy production, diversification to dairy processing activities
Size/total turnover	Continuous variable in log form: Standard Gross Product of the farm (in €)
Information technologies Accounting software	2-value variable: Use or non-use of specialized accounting software
Technical software	2-value variable: use or non-use of specialized technical software (land parcel or livestock herd management, etc.)
EXTERNAL FACTORS	
Regulatory and market environment	
Organic production	3-value variable: intended conversion to organic production within the next five years, converted or in the process of conversion, does not wish to convert to organic production in the next five years.
Quality label*	3-value variable: Non-dairy production with quality label, Dairy production with quality label, no production with quality label
Short supply chain**	3-value variable: distribution through short supply chains, excl dairy products, distribution through short supply chains of dairy products, No distribution through short supply chains
Payment for environmental services	2-value variable: 1 if the farm has received payment for environmental services, 0 otherwise
Spatial environment	
Concentration rate of dairy farms	Continuous variable in log form: RATIO OF [the number of dairy farms in the canton divided by the total number of farms in the canton] TO [the average number of dairy farms in French cantons divided by the average number of farms in French cantons]
Score of practices of neighboring dairy farms	Continuous variable in log form: Ratio of the score of the farm's practices on the score of practices of the dairy farms in the canton, without considering the practice score of the farm analyzed.
Geographical zone	5-value variable: lowland area, disadvantaged area (affected by « biophysical constraints »), foothills, mountain, or high mountain