Towards sustainable dairy sheep farms based on self-sufficiency: patterns and environmental issues

Thénard V., Choisis J.P., Pagès Y.

in

Casasús I. (ed.), Lombardi G. (ed.).
Mountain pastures and livestock farming facing uncertainty: environmental, technical and socio-economic challenges

Zaragoza : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 116

2016
pages 81-85

Towards sustainable dairy sheep farms based on self-sufficiency: patterns and environmental issues

V. Thénard[1], J.P. Choisis[2] and Y. Pagès[3]

[1]INRA-UMR1248 AGIR, F-31326 Castanet Tolosan (France)
[2]INRA-UMR1201 DYNAFOR, F-31326 Castanet Tolosan (France)
[3]Chambre d'agriculture d'Aveyron, 12400, Vabres-l'Abbaye (France)

Abstract. Agroecology can provide a framework to ensure the sustainability of farming systems in regard to environmental issues of agriculture. In the case of livestock productions, the improvement of feeding systems is one way to limit their environmental impacts. In southern France, development of dairy sheep production under the Roquefort label has led to most of farms to using a high level of input. But over the past few years, groups of farmers have shared perspectives and ideas to test innovative sustainable practices to improve their farms adaptability, mainly increasing farms' self-sufficiency. We developed a research project on self-sufficiency patterns and their environmental impacts assessment. Based on a participatory approach, we organised focus-groups on self-sufficiency definition and agro-environmental performances. We carried on 20 farmers' interview to collect data about practices and environmental features. Four self-sufficiency patterns were identified and a set of 20 indicators which addressed agronomical and environmental features was built. Feed self-sufficiency is different for each pattern. The main differences of environmental impacts (based on input use) are linked to the Organic pattern. The use of wide diversity of meadows and species increases the concentrate sufficiency. This study is an important milestone to implement agroecological practices in dairy sheep production.

Keywords. Agroecology – Livestock farming system – Feed self-sufficiency – Diversity – Milk ewe.

Développer l'autonomie pour des systèmes ovin lait durable : modèles et problèmes environnementaux

Résumé. *L'agroécologie peut fournir un cadre pour assurer la durabilité des systèmes agricoles, en particulier face aux enjeux environnementaux de l'agriculture. En élevage, l'amélioration des systèmes d'alimentation est un moyen de limiter leurs impacts environnementaux. Dans le sud de la France, le développement de la production de lait de brebis en zone Roquefort a conduit la plupart des exploitations agricoles à augmenter les intrants. Cependant au cours des dernières années, des groupes d'agriculteurs ont partagé des expériences et des idées pour tester des pratiques innovantes et durables pour améliorer leur capacité d'adaptation, en augmentant leur autonomie alimentaire. Ce projet de recherche vise à expliciter les différentes formes d'autonomie et d'évaluer leurs impacts environnementaux. Dans le cadre d'une démarche participative, nous avons organisé des « focus-group » pour définir l'autonomie et ses impacts agro-environnementaux. Nous avons réalisé 20 enquêtes d'éleveurs pour collecter des données sur les pratiques et les caractéristiques environnementales des fermes. Quatre modèles d'autonomie ont été identifiés et 20 indicateurs agronomiques et environnementaux ont été élaborés. L'autonomie se révèle liée aux différents modèles d'autonomie. Les principales différences d'impacts environnementaux, basé sur l'usage d'intrants sont à relier avec le modèle d'élevage biologique. L'usage d'une large diversité de prairies et d'espèces cultivées contribue à améliorer l'autonomie en concentré des élevages. Cette étude est une étape importante dans la mise en œuvre de pratiques agroécologiques en production de lait de brebis.*

Mots-clés. *Agroécologie – Système d'élevage – Autonomie alimentaire – Diversité – Lait de brebis.*

I – Introduction

Mainly in less favoured areas, the model of development based on agriculture intensification weakens the sustainability of farms and jeopardises their adaptation to global change (Darnohfer *et al.,* 2010). As an alternative way, agroecology is a theoretical and conceptual framework suggested to address the challenges of global change adaptation of agricultural systems: on one hand to increase and on the other hand to secure feed production (Altieri, 2002). Within this framework, five principles were suggested by Dumont *et al.* (2013) to design agroecological livestock systems. Thénard *el al.* (2014) proposed a method to translate these agroecological principles into levers for action to design and to assess new farming systems based on agroecological properties. In some cases, the feed self-sufficiency of animals is a favoured stake to design agroecological livestock systems. In southern France, the development of dairy sheep production under the Roquefort label has led most farms to use a high level of input. We developed a participative project with a farmers' group who wants to improve the feed self-sufficiency of their farms. We examined how farmers develop different patterns for self-sufficiency and we proposed to assess these patterns using some agronomical and environmental indicators. We present different patterns of self-sufficiency identified and some indicators to assess the agroecological value of these farms.

II – Methodology

1. A participatory research with a group of dairy sheep farmers

The study site is the PDO Roquefort cheese made with raw ewe's milk. Traditionally, sheep grazed local grassland regarded as less-favoured pastures. To overcome the constraints of the area milk production has increased the feed purchases and inputs in farms. Until the 2000s, intensification increased forages harvesting to the detriment of grazing. A wide gradient of resources are used by farmers. Since 2000, the PDO specifications have included new requirements: ewes should be fed with forage coming for 75% from the PDO area and ewes should graze two or three months during the grazing period.

Since 2012, we have carried out a research project with a group of ten farmers supported by a farm adviser. The farmers called themselves "Economical and Locally grown Farms" (ELF): they seek to use the local forage resources and to reduce farm input requirements. The main stake of this participatory research is to test innovative sustainable practices to improve farms adaptability. To limit the dependence on fluctuating input prices and climate variability farmers want to improve the feed self-sufficiency of farms. In the first study, we exposed practices diversity and identified four contrasting farming systems (Thénard *et al.*, 2014). While all farmers want to limit inputs, we observed that the level of self-sufficiency achieved could be different. We then conducted a second study on how self-sufficiency was built by farmers and proposed some indicators to assess the different patterns.

2. Methods to analyse and assess different patterns of self-sufficiency

Within the agroecological framework, we used a participatory approach in order to favour exchanges between farmers, advisers and researchers. In a first step, we carried out work sessions to share the different views on the practices linked to self-sufficiency; and to explain the consequences of self-sufficiency on the farms, their agronomical properties and their impact on the environment. The sessions gave us which main stakes were identified by farmers to assess the impact of their practices on environmental issues. The exchanged knowledge highlighted the influence of practices on four main environmental stakes (soil preservation, no renewable resources use, wild and cultivated biodiversity). Also a set of 20 indicators were identified with farmers to assess the agronomical and environmental impacts of self-sufficient practices. In a second step, we surveyed farmers to describe the diversity of self-sufficiency practices and to collect data used to calculate the indicators. During spring 2014, 3-hours semi-directive interviews were carried out among 20 farmers from the “ELF” group and others selected by experts as pursuing self-sufficiency. Farms were described in relation to different practices: concentrates purchase, fertilisation, diversity of meadows and crops, pure legume stands, tillage and the pesticides used. Data was analysed with a comprehensive method (Girard, 2006) to define patterns of self-sufficiency practices. Kruskal-Wallis test and Nonparametric Multiple Comparisons were performed to identify significant differences between patterns. Statistical analyses were computed with R software (R Core team, 2012).

III – Results and discussion

Four self-sufficient patterns were identified based on the practices (Fig. 1): a Standard pattern limiting input, while most of the farms use input, this pattern limits them increasing diversity of forages; a Diversity pattern limiting input while increasing diversity of species in crops and forages; a Sufficiency pattern with no ewe-feed purchase; and an Organic pattern without N-mineral and pesticides input but with concentrates purchase. The farms with Standard or Diversity patterns produce milk mainly during the winter period, with harvested forages. These farms ought to produce more milk per ewe (although there were not significative differences – Table 1) and they were not sufficient for concentrates. On the other side, farms which developed Self-sufficient and Organic patterns produce milk mainly during spring. Only the Sufficiency pattern purchased no forage and no concentrate. The use of fuel to produce forages and crops is common and non-discriminating.

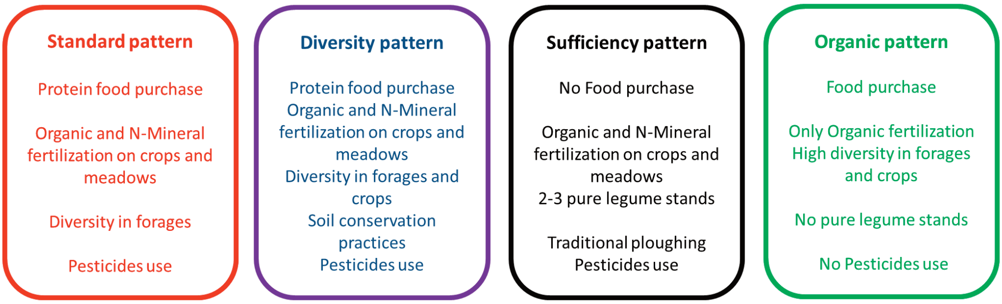

Fig. 1. Classification of the self-sufficiency patterns developed by farmers.

The set of indicators is presented in the Table 1, and all significant differences are detailed. **Standard pattern** was developed in farms with few intensive meadows mainly harvested and based on simple covers like alfalfa and orchard-grass. Farmers had difficulties to achieve self-sufficiency because the ewe requirements were important mainly during winter and farmers needed to buy protein concentrates. **Sufficiency pattern** was developed in farms with large parts of natural grassland combined to a wide diversity of sown meadows. Self-sufficiency was built with association of poor grassland used during summer and intensive meadows (pure stands and simple mixtures) harvested and grazed. **Diversity pattern** was developed in farms with a wide diversity of meadows mainly based on mixtures species, and crops mixtures for animal fed. Although farmers have engaged soil conservation practices, the related indicators were not significantly different in this group. Self-sufficiency was based on the wide diversity of forages included during summer period with specific meadows or original mixtures (alfalfa, sainfoin, grass). **Organic pattern** was developed mainly in farms producing milk for organic label. Because of organic label requirements, the contrast with the others groups was important for all indicators related to fertilisation and pesticides used. We observed that the duration of the meadows was longer and the parts of the mixtures in the meadows and crops were similar to the Diversity pattern.

Table 1. Set of indicators to assess agronomical and environmental impacts of the four different self-sufficiency patterns in dairy sheep farms

	Standard pattern		Diversity pattern		Sufficiency pattern		Organic pattern		P =
Number of farms	5		4		6		5		
Milk per ewe (l)	270		276		231		217		0.129
Forage sufficiency	97%		99%		100%		88%		0.168
Concentrate sufficiency	80%	a	77%	a	100%	b	77%	a	0.043
Area of grassland/AA	29%	ab	36%	a	69%	b	63%	ab	0.080
Area with legumes/AA	64%	ab	62%	a	54%	a	71%	b	0.095
Annual crops/AA	36%		28%		34%		32%		ns
Meadows and crops mixtures /AA	29%	ab	69%	ac	27%	b	84%	c	0.006
Diversity of meadows (nb of meadows)	3	ab	5	b	5	b	3	ab	0.028
Duration of meadows (years)	4	a	5	ab	4.6	a	5	b	0.025
Species on meadows (nb)	2		2.7		2.9		2.75		ns
Hill Index†	1.03		1.21		1.38		1.40		ns
Area with manure/AA fertilised	50%	a	35%	a	59%	a	100%	b	0.000
N-mineral/Total Nitrogen used	49%	a	45%	a	49%	a	0%	b	0.000
N-mineral unit per ha	29	a	39	a	48	a	0	b	0.000
Nitrogen loses per ha AA	16.1	a	32.1	ab	20.5	ab	3.3	b	0.001
Nitrogen efficiency††	2.5		2.0		2.7		3.3		ns
Treatment frequency index (TFI)†††	2.5	a	5.3	a	2.4	a	0.0	b	0.000
Soil working index††††	2.7		2.2		3.9		2.3		ns
Fuel consumption (litre per cultivated ha)	37.0		36.1		42.8		41.6		ns
Cultural operations per field (nb)	5.7		5.8		6.9		6.0		ns

Medians for each group and P value for Kruskal-Wallis test. Within an indicator, medians with different letters differ at $P<0.05$ for Nonparametric Multiple Comparisons.

† Hill Index assess the proportional abundance of cultivated species based on Shannon and Simpson index: Hill = (1 / D) / eH ‘ (with 1 / D: the inverse of Simpson index and eH ‘: the exponential of Shannon index).

†† Nitrogen efficiency 2 (kg protein produced/ kg N introduced in farm).

††† TFI is based on the calculation of frequency and dose for each pesticides used for crops at farm level.

†††† Soil working index is based on the depth soil working with 1 point for no-tillage, 2 for superficial soil working, 3 for no-deep tillage and 4 for deep tillage. Calculation is a weighted average by ha for each crop.

IV – Conclusion

Animal feed self-sufficiency is often defined as a way to increase sustainability of the farms, mainly in the less-favoured areas. Nevertheless this study showed that farmers could develop different patterns to improve self-sufficiency. The level of this feed sufficiency is linked to a trade-off between production, purchases and local resources use. Farms without purchases are probably very rare, and each self-sufficiency pattern should be assessed in relation to environmental issues. Agroecological transition needs to improve knowledge about agronomical practices and their environmental impacts. This study is an important milestone to improve the agroecological practices in dairy sheep production.

Acknowledgments

The authors thank Coralie Di Bartolomeo who carried out interviews, farmers and partners who have contributed to this work, and Ray Worman who has reviewed the paper. The project was supported financially by the research Project ANR-13-AGRO-0006-01 *TATA-BOX*.

References

Altieri M., 2002. Agroecology: the science of natural resource management for poor farmers in marginal environments. *Agric. Ecosyst. Environ.,* 93: 1-24.

Darnhofer I., Bellon S., Dedieu B. and Milestad R., 2010. Adaptativeness to enhance the sustainability of farming systems: a review. *Agronomy for Sustainable Development,* 30: 545-555.

Dumont B., Fortun-Lamothe L., Jouven M., Thomas M. and Tichit M., 2013. Prospects from agroecology and industrial ecology for animal production in the 21st century. *Animal,* 7(6): 1028-1043.

Girard N., 2006. Catégoriser les pratiques d'agriculteurs pour reformuler un problème en partenariat. Une proposition méthodologique. *Cah. Etud. Rech. Francophones Agricultures,* 15(3): 261-272.

Thénard V., Jost J., Choisis J.P. and Magne M.A., 2014. Applying agroecological principles to redesign and to assess dairy sheep farming systems. *Options Méditerranéennes Series A*, 109: 785-789.

R Core Team, 2012. *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL *http://www.R-project.org/*