Joint technical and economic assessment of feed autonomy in organic cattle farms

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Abstract

Increasing the level of feed autonomy (self-sufficiency) is usually considered as a prerequisite for conversion of cattle farms to organic farming. Technically it requires adjusting fodder production and feed purchases in terms of quantity and quality to the requirements of the herd. A joint technical and economic assessment of feed autonomy in organic cattle farms was conducted. Data were collected in 2014 and 2015 on 11 Belgian farms located in distinct agricultural regions and characterised by different proportions of grassland area. Dry matter yield and nutritional quality were determined at each harvest for each fodder crop, including permanent and temporary grasslands, immature cereal-legume crops and grain crops. Animal productions and economic data, including all cash inflows and outflows, were recorded. Economically efficient farms had high levels of feed autonomy, ranging from 89 to 100%. Three economically-efficient feeding strategies were identified for organic cattle production. Strategies differed from each other according to the proportion of grassland area, level of animal production and the achieved level of feed autonomy.

Keywords: grassland, dairy farm, beef farm, organic, feed autonomy, economic efficiency

Introduction

Increasing the level of feed autonomy (self-sufficiency) is usually considered as a prerequisite for conversion of cattle farms to organic farming. The EU policy imposes that animals raised in organic conditions have permanent access to pastures or rough fodder. High prices of organic feeds encourage farmers to limit feed purchases as much as possible. Increasing the level of feed autonomy is not easy to complete. It requires adjusting fodder production and feed purchases in terms of quantity and quality to the requirements of the herd which depend on the animal performances. The right adjustment is found when the difference between incomes and total feed costs is maximised. Options for fodder production are grazed pastures, temporary grasslands, immature cereal-legume crops, grain cereal crops and protein crops, each of them with a large diversity of options regarding the species composition. The choice of fodder crops is constrained by the agro-ecological conditions of the cultivation area.

To date, feed autonomy in Walloon cattle farms has been studied from technical or economic data independently (Bernes *et al*., 2011; Lebacq *et al*., 2014). In this paper, a joint technical and economic assessment of feed autonomy in organic cattle farms was conducted in order to identify efficient strategies for organic cattle production.

Materials and methods

Data were collected in 2014 and 2015 on 11 organic farms, six dairy and five beef farms. Farms were located in distinct agricultural regions in Wallonia (Belgium) and numbered by type of production, milk (M) or beef (B), and increasing percentage of permanent grassland area (PPG) in the total cultivated area (Table 1). Out of the beef farms, farms B2, B4 and B5 were sucklers only ('breeders'), while B1 and B3 were also fatteners ('breeders-fatteners').

Fodder production was characterised in terms of quantity and nutritional quality (Van Es, 1975; Tamminga *et al*., 1994). Dry matter (DM) production from grazed pastures was estimated by analysing

grazing calendars using the model developed by Delagarde *et al*. (2017). For dairy farms, milk production was recorded by the farmer and expressed per dairy cow. For beef farms, the annual liveweight production was calculated over the entire herd and expressed per suckler cow. This was achieved by taking into account livestock variations and by estimating the weight of each animal as a function of its age using a growth model parameterized on breed-respective data. All cash in- and outflows were recorded. For the sake of comparability, feed production costs were restricted to crop inputs and fodder storage costs.

Different indicators were computed to assess the farm performances. Those included the level of feed autonomy (FA) and the weighted average crude protein (CP) content of self-produced and purchased DM. The technical feed efficiency (TE) was computed as the ratio between total amount of produced milk or liveweight and total amount of consumed DM. The economic feed efficiency (EE) was computed as one minus the ratio between total feed cost (feed production costs and feed purchases) and gross product without subsidies. Finally, the cost price of consumed self-produced dry matter (CostP-self) and the cost price of the total consumed feeds (CostP-tot) were computed. Data were analysed using the R software.

Results and discussion

The PPG increased from 33 to 100% in dairy farms and from 62 to 86% in beef farms (Table 1). Dairy farms M5 and M6, located in Ardenne, had permanent grasslands only. Grain cereal crops were found in all farms with the exception of M5 and M6 and two beef farms, B2 and B5. Average dry matter yields, computed over grazed pastures and fodder and grain crops, were highest in farms located in the Loam region (M1 and B1) and lowest in farms located in Famenne (M3 and B2). In terms of animal productions, farms M1 and B1 were the most intensive ones, and, on the opposite, farms M2 and B2, B4, and B5, the least intensive ones.

FA ranged between 78 and 100%, with highest levels found in farms M1, M2, B1, B3 and B4 (≥ 98%) and lowest levels in farms M3 and B2, located in Famenne. The average CP content of self-produced feed increased from 11.5 to 17%. It was highest in M5 and M6, the two farms that included permanent grasslands only. The average CP content of purchased feeds was highest in farms M1 and B1, which were also characterised by the highest TE. Farms with high TE also had high EE but no relationship was observed between TE and EE.

A focus was put on farms with EE higher than 80% (thus farms M3 and B2 were discarded). Economically efficient farms had high FA, ranging from 89 to 100%. FA was lower in farms with only grasslands ($P < 0.001$). These farms were also characterised by lower CostP-self ($P < 0.05$). The relationship between CostP-tot and PPG was not significant, suggesting that low CostP-self were at least partly compensated by larger feed purchases.

Based on this survey we identified three economically-efficient feeding strategies for organic cattle production. Strategy 1 is characterised by a grass-based production with FA of 89-94%. It includes dairy farms with an intermediate milk production level and breeder beef farms (farms M5, M6 and B5). Strategy 2 is characterised by a multiple crops-based production with FA of 94-99%. It includes dairy farms with a high milk production level and breeder-fattener beef farms (farms M1, M4, B1 and B3). Strategy 3 is characterised by both grassland and crop productions, with FA close to 100%. It includes dairy farms with a relatively low milk production level and breeder beef farms (farms M2 and B4).

Table 1. Fodder productions, animal productions and technical and economic performance of 11 organic cattle farms in Belgium, over two years, 2014 and 2015.

	Milk farms[1]						Beef farms[1]				
	M1	M2	M3	M4	M5	M6	B1	B2	B3	B4	B5
Agricultural region	Loam region	Sandyloam region	Famenne	Ardenne	Ardenne	Ardenne	Loam region	Famenne	Ardenne	Ardenne	Condroz
Fodder production											
Permanent grasslands (%)	33	48	63	78	100	100	62	68	72	81	86
Temporary grasslands (%)	37	15	14	6	0	0	10	3	19	6	14
Immature cereal-legume crops(%)	0	9	9	0	0	0	18	29	0	0	0
Grain cereal crops(%)[2]	30	27	14	9	0	0	5	0	9	13	0
Protein crops(%)	0	0	0	7	0	0	5	0	0	0	0
Average dry matter yield (kg DM ha^{-1})	7,381	5,509	4,220	4,980	6,329	5,607	7,208	3,702	4,530	5,200	5,926
Animal productions											
Milk production (kg milk dairy cow^{-1} $year^{-1}$)	7,292	3,629	5,267	6,596	5,263	5,466	-	-	-	-	-
Beef production (kg liveweight suckler cow^{-1} $year^{-1}$)	-	-	-	-	-	-	618	239	332	227	227
Animal production sale price (€ kg milk or $liveweight^{-1}$)	0.45	0.36	0.56	0.43	0.49	0.48	3.33	1.38	1.71	1.69	1.91
Technical and economic performances											
Stocking rate (LU ha^{-1}) [3]	1.34	1.43	1.09	1.14	0.98	1.18	1.90	1.02	0.93	1.24	1.68
Level of feed autonomy (%)	99	100	78	94	93	89	98	85	98	99	94
Crude protein content of self-produced DM (%)	14.6	14.2	13.8	15.6	17.0	16.8	15.4	13.4	13.8	11.5	13.0
Crude protein content of purchased DM (%)	48.8	0	13.6	11.2	12.2	15.1	25.5	14.5	15.9	4.7	11.4
Feed technical efficiency (kg of milk or liveweight/100 kg of consumed DM)	73.5	64.3	64.9	85.4	67.3	70.6	8.4	6.0	5.6	4.7	3.9
Feed economic efficiency (%)	89.3	80.7	61.8	83.8	92.4	89.3	87.3	47.3	89.1	91.2	89.1
Cost price of self-produced feed (€ tDM^{-1})	27.0	36.6	69.2	21.7	8.0	17.0	17.2	26.4	9.1	4.4	13.0
Cost price of total consumed feed (€ tDM^{-1})	36.8	46.6	139.5	53.9	26.8	40.0	33.9	40.4	18.5	5.8	15.6

[1] Farms are numbered according to their % of permanent grasslands. Out of the beef farms, farms B2, B4 and B5 are sucklers only ('breeders'), while B1 and B3 are also fatteners ('breeders-fatteners'); [2] Grain cereal crops include both pure cereal crops and cereal-legume mixtures cultivated for grain.; [3] LU - livestock unit.

Conclusion

This study focused on the joint analysis of technical and economic data from organic dairy and beef farms. Based on 11 farms analysed over two years, it enabled three distinct economically-efficient feeding strategies to be identified for organic cattle production.

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