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Organic dairy farming in Europe

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Abstract

Organic milk production has gained importance in Europe. The European Union introduced regulations to standardise organic production throughout all member countries. The market for organic products is constantly increasing and still has not reached market stability. The differential price of organic products could maintain farms in marginal environments. In many cases, the market is still encouraging as the limit seems to be the availability of organic products. There is a large body of research comparing organic and conventional livestock farming systems, but most of them ignore local and specific factors. Different feeding systems characterise organic and conventional farming. Limits of the use of concentrates in the feed ration diminish production levels of milk. Quality of dairy products has not been changed in European dairy farming by the application of organic regulations. The more "natural" dairy management in organic farms is felt to improve animal welfare and animal health. However, reality does not always resemble this common belief. A greater use of pasture vs. more intensive dairy system for conventional herds certainly improves animal welfare, but because of the limit to drug use in organic systems, animal health is not always enhanced. Organic farming systems are more "environment-friendly" than conventional management, especially for the lower eutrophication potential of organic herds. Nevertheless, in organic production, the same amount of milk is obtained by exploiting a larger area of pasture.

Keywords: Marketing; Animal health; Product quality

1. Introduction

Organic milk production, practised according to European and national regulations on organic farming, has impacted in recent years on livestock systems, animal feeding, forage management, reproduction behaviour, and animal health, in particular. In addition, animal welfare, product quality, environmental issues, and economic results have been discussed and will be analysed in the present paper.

However, little experimental data comparing biological, technical, and economical traits between the two systems, organic and conventional, are available in the literature. On the other hand, descriptive data have been published in several countries (Switzerland, Austria, France, etc.). Selected data will be summarised and discussed in the light of the present development in organic milk production.

The development of organic milk production in some European countries is shown in Table 1 from

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Table 1
Developments of organic milk production in selected countries (percent of activities of dairy herds)[a]

Country	Dairy cow	Swine
Austria	15	1.1
Switzerland	10[b] (2)	–
Denmark	7	0.8
Sweden	4.3	0.9
Germany	1.2	0.2
The Netherlands	0.5	0.04

[a] Cunningham (2003), EAAP.
[b] As percent of total herds and agricultural land (Mosimann and Suter, 2003).

data produced by Cunningham (2003). Austria has the highest percentage of dairy cows in organic herds followed by Switzerland and Scandinavian countries. Germany and The Netherlands, the other two important countries for milk production, have a lower percentage of organic farms. Similar figures, but with lower percentages relative to conventional farming system, can be seen for swine production, probably due to the fact that monogastric animals are less dependent on land availability than dairy cows.

2. Regulations

The European Union (EU) issued and defined organic farming in two regulations: 2092/91 and, later, 1804/99. Standards and guidelines have also been produced by Food and Agriculture Organization (FAO), the International Federation of Organic Agriculture Movements, and the Codex Alimentarius Commission. The 1804/99 EU regulations describe in detail the allowed organic livestock management in Europe. The issuing of this regulations does not completely fulfill management needs; nevertheless, it covers many of the required aspects (von Borell and Sorensen, 2004).

3. Economic and marketing aspects

The market of organic food is increasing. There is still a large difference in countries and among organic products: drinking organic milk has higher market shares when compared to processed organic milk and organic meat. The market for organic food is promising. Many authors have discussed future market possibilities.

Recently, increasing problems with animal product safety have pushed, at least temporarily, European consumers to purchase more organic food. The image of safety given by organic food increases consumers' demand, thereby boosting production of organic animal origin. The marketing of this product is growing, but expansion is heterogeneous because it is influenced by the episodic crisis image occurring in animal products. Consumer awareness of organic food increased in the recent years. Nowadays, consumers are more experienced about the quality and meaning of organic food.

The attitudes towards animal products have changed sharply in Europe in the last decades, but obviously, there is a great difference among and within countries. Leveling the diverse attitudes in the different regions of Europe, we can assert that until 30 years ago, the concerns towards meat purchasing were mainly dedicated to price, but just a few years later, the attention moved towards quality, health, and diet issues (Woodward, 1988). In the last 20 years, the health issue has become more and more important, as experienced by the long list of animal product crises (Kirk et al., 2002): *Listeria*, *Salmonella*, *Escherichia coli*, BSE, tuberculosis, swine fever, and foot and mouth disease. Because of media attention and dietary issues, consumers no longer regard animal products as healthy products. Organic producers must consider this incredible shift of attitude to gain market share. It can also be shown that organic farming was stimulated as a reaction to the different problems in animal product appearance. Nowadays, European consumers believe that organic food is free from residues, produced in an environment-friendly manner and in consideration of animal welfare, has better taste, and is more healthy. Since organic food is regarded as more expensive to produce, a higher price is also considered to be justified. Obviously, all these beliefs are not scientifically proven, but this does not seem to be of great importance for consumers (Kirk et al., 2002; Roddy et al., 1996).

Market stability for organic products has not been reached yet because, although some constraints still remain, consumer demand for organic food in Europe is still on the rise. EU statistics show that the growth of organic farming has been consistently around 25% per year in the decade from 1990 to 2000. In a recent analysis by Kirk and Slade (2002), the organic food market accounts for 7–8% of the total food market in the United Kingdom, with a value of more than £1 billion, while it was only £100 million in 1993. In Italy, the trend from 1992 to 2000 for producing forage areas dedicated to organic cattle breeding increased 32 times, from 8128 to 265,000 ha (Pirani and Gaviglio, 2002). A more detailed analysis of this trend showed that after the introductory stage, there was a steady—but not a very high—rise with 56,500 ha until 1996, and then there was the development stage with a very high increase. A similar prediction was made by Lampkin (1999) showing that the level of utilisable agriculture areas in the EU devoted to organic farming will be 10% by 2005 and 30% by 2010. However, in the case of organic milk, this goal will be difficult to reach if "organic cows" produce 20–30% less milk per lactation.

The limits and potentiality of this specific market must be considered to improve the market share for organic food in Europe. Analysis of the limits was conducted by questioning consumers in Ireland (Roddy et al., 1996). The existing reasons of the adverse attitudes towards organic products are price, availability, and lack of special value felt by many consumers. The adverse attitudes in the European consumers diminished when moving from low to high educational level and when moving from low to high level of income. Furthermore, the place of residence and the frequency of buying foods at supermarkets become very important.

The availability problem seems to be, for some researchers, the most important limit to the expansion of the organic food market (Treager et al., 1994; Krystallis and Fotopoulos, 2002). The idea that the "availability limit" is more important than the "price limit" is encouraging because among the actual *nonbuyers*, there are many consumers with problems of finding organic food. Rendering the organic food more available will change, almost automatically, *nonbuyers* into *buyers*. Therefore, larger availability of the products is needed, following the mentioned research, to improve the organic food market in Europe.

The economic aspects of organic products are prejudiced by low variability of input costs and by the lower productivity of plants or animals. However, it has been well documented that gross margin and farm incomes are still higher than for conventional farming systems.

The economic aspect and the consistency of demand are crucial for the sustainability of every organic farm, together with environmental reliability and technical feasibility. The environmental aspect is also very important for EU strategies in relations to the general role of agriculture in preserving the environment. For the particular management system required in organic farming, farmers using organic livestock systems are often helped by specific government financing (as in Switzerland). Technically, the systems of organic production have different management needs in relation to conventional systems, but the big challenge is primarily related to economic aspects, as the sustainability of organic farming is mainly due to the existence of the price difference with products from conventional farms. Whether this difference can be maintained is the main issue for the future of organic livestock system.

Organic farming, in general, and organic livestock farming, in particular, can create additional incomes in circumstances where it is difficult to maintain business activities and, therefore, full employment. Organic farming helps to maintain—if not to enlarge—rural employment. Many examples of unfavourable agriculture location were revived by the adoption of organic farming. This creates good examples to follow for the future. The last is true, especially for small farm businesses, niche activities, and farms in mountainous regions.

Occasionally, the positive trend of organic milk production throughout the years is not fulfilled due to market problems with low consumer demand, high production costs, shortage of means of production, or other more specific local reasons. The Swiss example can be explanatory for some of the listed problems. Total Swiss-produced organic milk is 0.15 Mt/year, which is less than 5% of total national milk production (3.2 Mt/year milk). Organic milk is mainly produced in hill farming. Nowadays, Swiss producers are facing a surplus of organic milk relative to consumer demand, thus creating serious economic problems not fully covered by reduction in production costs and subsidies from the state.

4. Comparison among organic and conventional dairy farming

Research on organic livestock farming has focused in the last few years on the growing interest in this type of animal rearing. The real dissimilarities between conventional and organic livestock farming promote different research objectives. Due to the fact that organic farming is strongly related to the environment in which it operates, the research objectives of organic animal rearing are different for each region and are applied to management livestock farming system.

Sundrum (2001) described the difficulty in comparing conventional and organic dairy products because of the difference within and between organic and conventional production systems. An attempt to achieve the differences in milk composition produced by organic and conventional dairy sheep farms was described by Pirisi et al. (2002). Milk was analysed from both systems: the organic system in which the ewes eat forages fertilised according to EU regulations for organic productions and forages fertilised conventionally. Differences were found for the milk yield; higher milk production per hectare of forages was found, due to the higher forage production, in conventional systems. Milk composition was similar, with the exception of a larger production of casein for the conventional system. Nevertheless, the cheese-making potential of milk from organic or conventional dairy systems was the same. Zervas et al. (2000) found that milk yield of dairy sheep from conventional farming is higher than organic farming, due to a lower efficient use of energy for the imbalance of energy and protein in the diet of organic-fed group.

Weller (2002) carried out another comparison between two systems of organic dairy farming: one with a high stocking density using brought-in concentrates, and the other a self-sufficient system. Obviously, the self-sufficient system creates more problems for energy balance, causing lower milk production and more postcalving health problems and a reduction in reproductive performance. Weller (2002) also showed that there is large difference among cows within the systems, and when productions for organic dairy systems are compared, the difference existing among individual cows is as significant as the difference among breeds.

5. Feeding and management

One of the major issues in animal feeding in organic dairy farming is protein, mineral, and trace elements deficiencies, especially for animals reaching high production (Coonan et al., 2002). Due to the restricted type of feeding, as imposed by EU regulations, in organic dairy farms, a clear deficiency in zinc, molybdenum, selenium, copper, and iodine can occur. The correct balance of minerals and trace elements must be constantly achieved. A specific forage mineral analysis must be done to provide the correct supplementation that is particularly sensitive in certain areas of acid soils.

A comparison of technical characteristics between conventional intensive and organic dairy farms in French Holstein herds (Table 2) illustrates the need for a larger number of hectares of farmland for organic farms and the relative lower production of milk per hectare (−29%) of farmland per year. This can be easily explained with the lower level of concentrate, about half, given to cows in organic herds.

There are different ways to manage organic dairy herds, while following specific legislation and having the flexibility of the rules, to ensure incomes of farmers. Mosimann and Suter (2003) described two complete different feeding systems and production levels in Switzerland (Table 3) to show that both can

Table 2
Comparison of technical characteristics of intensive vs. organic dairy farms in France (Primiparous Holstein animals)

	Intensive	Organic
Labour force	2	1
Milk quota (1000 l/year)	254	190
Number of dairy cows	32	35
Hectares of farm land	35	37
Hectares of “forages”	27	37
Maize silage + fodder beets	44	0
Milk (l/ha/year)	7260	5130
Fat corrected milk/cow/year	8900	6000
Days on pasture (100% diet)	82	141
Concentrate (kg/cow/year)	1150	570
Concentrate (g/kg milk)	128	95
Feeding cost (€/l milk)	20.4	19.3
Nitrogen balance		
N (kg excess/hectare/ year)	105	55

Table 3
Synopsis of the feeding program of two dairy organic herds operatives in Switzerland (after Mosimann and Suter, 2003)

	Farm average production	
	6000 kg/year (FDP)	8000 kg/year (MC)
Summer	Pasture	Pasture+hay cereals+concentrate <4 kg/day
Winter	Grass silage, organic barley, Faba beans	Maize silage (1/3 basic diet) hay (2/3 basic) concentrate <4 kg/day

FDP and MC explained in the text.

Table 5
Milk yield per year and composition, and milk production efficiency in winter periods expressed as feed efficiency (energy requirements over actual energy intake) and as energy and dry matter intake over produced energy-corrected milk (ECM) (after Sehested et al., 2003)

	Group		
	L	N	L^+
Per cow per year			
ECM (kg)	5090	6723	6230
Milk (kg)	5030	6646	6027
Milk protein (kg/%)	165/3.28	225/3.39	203/3.36
Milk fat (kg/%)	210/4.18	273/4.11	259/4.31
Winter			
Feed efficiency (%)	98	84	97
kg ECM/7.89 MJ NE (1SFU)	1.21	1.17	1.31
kg ECM/kg DM	0.97	1.04	1.08

L=0% concentrate; L^+=19% concentrate; N=38% concentrate.

be successful and respect organic legislation. In the FDP herd engaged in green tourism, the production level is lower compared to the MC herd, since no concentrate was used; while the MC herd, thanks to a more intense feeding system, the average production is comparable to conventional herds.

Mosimann and Suter (2003) also described differences in Switzerland for feeding systems between conventional and organic dairy herds and the consequence for milk yield (Table 4). Research shows that due to a higher level of concentrates per cow per year, milk production is larger in conventional herds (+11%). It can even be estimated that the percentage of milk from concentrates can be estimated as 20% in a selection of Swiss conventional herds, while it is 15% in a selection of organic herds. The relative large number of herds observed gives a good reliability to this research. The conclusion of this specific research shows that 5% less concentrates in the feeding ratio produce 11% less milk.

Protein resources are very scarce in Europe, particularly in Switzerland, which is only 15% self-sufficient in protein supply for animal feeding. Protein requirements for dairy cows are essentially covered by the use of leguminous plants in pastures (white and red clover); high milk yield is only achieved by the use of imported concentrates containing 16–35% crude protein, but the massive use of concentrates is against the policy of organic farming. The uncertainty of the principal protein source worldwide [i.e., soybean meal consistently spiked with genetically modified organism (GMO)] is another difficulty in the development of organic milk production.

In an interesting study conducted in Denmark (Sehested et al., 2003), the effect of diminishing the level of concentrates for highly productive dairy cows was estimated (in 2005, the level of roughage in the feed ration must reach at least 60%). The research was conducted by giving three different feed rations in terms of concentrate levels to a group of dairy cows. Each feed ration has less than 40% concentrates, but on different levels (0%, 19%, and 38%). Milk production obviously decreases at a lower level of concentrates (Table 5) as well as protein kilogram and percent. Fat kilogram also decreases but, as expected, fat percentage is not statistically different for different

Table 4
Statistic for organic vs. conventional milk production in Switzerland (Plain) (adapted from Mosimann and Suter, 2003)

	Number of herds	Number of cows per herd	Milk (kg/cow/year)	Concentrate (kg/cow/year)	Milk from concentrate (% of total)
Conventional	40	24	7280	680	20
Organic	17	27	6550	450	15

Table 6
Daily production of milk, ECM, milk fat, and milk protein per day in lactation (least square means and standard errors; after Sehested et al., 2003)

	Group				*P* value
	All	L	N	L^+	
Milk (kg)	19.4±0.3	17.0±0.7[a]	21.1±0.6[b]	19.4±0.4[c]	0.0001
ECM (kg)	19.9±0.3	17.0±0.6[a]	21.2±0.6[b]	20.0±0.4[c]	0.0001
Fat (g)	823±10	694±25[a]	852±23[b]	828±16[b]	0.0001
Fat (%)	4.22±0.05	4.08±0.11[a]	4.04±0.10[a]	4.27±0.07[a]	0.17
Protein (g)	649±8	556±19[a]	715±18[b]	651±13[c]	0.0001
Protein (%)	3.35±0.02	3.27[a]±0.04[a]	3.39±0.04[b]	3.36±0.03[b]	0.016

L=0% concentrate; L^+=19% concentrate; N=38% concentrate.
Different letters in superscript indicate significant differences between the groups (same line).

feed ration. The same type of information, but for daily production, can be observed in Table 6.

6. Quality of products

For the majority of consumers, organic farming is felt as having higher-quality products due to the guaranteed process standards. However, it is not easy to have a common understanding of "quality." One important aspect of quality of a product is whether it can be considered healthy or not. Organic farming should assure a lower level of drugs and pesticides used in the process, so organic products must be free of GMO and food poisoning in general. What the consumers know less is that products from organic livestock farming have a higher risk of contamination by microorganisms from manure and by animal parasites. A better knowledge of this last aspect is required to protect consumers and to better define the real advantages of consuming organic products.

It is commonly agreed that most consumers do not choose organic food for better taste. This was specifically proven by sensory evaluation of organic lamb meat compared to conventional lamb meat (Kirk and Slade, 2002). Nevertheless, when such consumers were asked why they purchase organic food, one of the reasons given was the taste (Gruner and Hull, 1995), together with other issues as value, environmental aspects, health consciousness, and ethical issues.

The quality of milk can be expressed in many different ways, but one of the ways most internationally accepted by researchers and the milk industry is somatic cell count in the tank. Somatic cell count is a trait expressing the level of stress of cows and udder disease, mainly mastitis. Decante (2002) took milk samples from 264 organic herds, both certified and in accession, and estimated the cell count in the tanks. The data obtained were then compared with the average of conventional herds. The results, shown in Table 7, prove that no difference in quality of milk, for somatic cell count, can be established for conventional and organic herds.

The level of somatic cell count is also an expression of animal welfare. Organic management obliges farmers to increase the level of animal welfare. However, because of the avoidance of using chemicals, there were restrictions to the use of antimicrobials for treatment of mastitis. Research conducted in Denmark (Vaarst et al., 2003) estimates the yearly trend in organic vs. conventional dairy farming for somatic cell count and milk production before and after conversion to organic systems for conventional dairy herds. In the 20 examined herds, average daily milk yield remains more or less the same, with a small decrease in the first year after conversion, and returning to the original

Table 7
Organic or conventional milk production: effect on quality of milk expressed by the number of cell counts in the tank as percent of samples (Institut de I'Elevage, 2000 in Decante, 2002)[a]

	Cell counts ($\times 10^3$/ml)		
	<300	200–400	>400
264 Herds, certified or in accession (%)	45%	44	12
Conventional herds (average) (%)	46%	40	14

[a] Samples from two regions west of France and one region east of France.

production already on the second year. Average somatic cell counts slightly increase for the first year of conversion to organic system and returns to the original level on the second year. Veterinary mastitis treatments changed according to the average somatic cell counts. Thus, research shows that no severe impact was noticed for milk yield and for somatic cell count on the second year after conversion, while some minor problems arose the very first year, mainly due to animal and farmer adjustment to the new management systems.

7. Health and animal welfare aspects

There is in Europe, but especially in Northern countries, increasing attention to animal health and welfare. Organic farming management does not automatically reduce health risk to reared animals. Exact comparisons between conventional and organic farming are difficult to make, due to difficulties in defining the type of prevention and therapy to be used in either situation and for the complexity to classify the level of disease. Organic farming does not protect dairy cows from mastitis despite only two treatments per year being allowed for each cow. Nevertheless, organic livestock milk management requires controlling disease only with certain allowed measures and prevention can only be done by few permitted management techniques. Therefore, animal health must be improved by more "natural management." The same conclusion can be drawn about welfare: organic farming standards are planned mainly to satisfy consumers' requests, such as open air rearing and not for directly seeking animal welfare. Nevertheless, there are some possibilities to improve animal welfare in the framework of organic livestock farming.

A complete survey analysis was conducted in the United Kingdom showing that mastitis and fertility problems were the most important health issues for dairy organic farming (Margerison et al., 2002). These were also the two most important reasons for culling. However, the results obtained in this research were comparable at least in one case to those found in similar situations of conventional farming (Royal et al., 2000).

Accurate indicators of the effect of the organic system on the health of the dairy cow are still lacking in the literature. Thus, very little data are available on the physiological pattern of dairy cow in the postcalving period in case of animals intensively selected for high milk yield. In particular, physiological parameters such as calcium and phosphorus levels of the blood in the beginning or at the peak of lactation have only recently been investigated. Preliminary results observed in Austria seem to indicate that "organic cows" can maintain serum calcium level at a physiological value, but the level of phosphorus seemed to deteriorate during the first 2 weeks of lactation (Podstatzky, 2003). These results are of particular importance as long-term indicators of the appropriate balance of the "organic diet" in minerals, for instance, when the cow is particularly sensitive to milk fever.

8. Physiological and reproductive aspects

The comparison of reproductive performances between organic and conventional dairy herd management was extensively studied, but the results were

Table 8

Comparative study of reproductive performance in organic (O) and conventional (C) dairy husbandry in Norway (after Reksen et al., 1999)

System	Year					
	1994		1995		1996	
	O	C	O	C	O	C
Calving interval (days)	378.4	377.8	376.4	375.1	369.0[a]	374.1[a]
Calving to first AI (days)	77.7	80.0	82.2[b]	76.3	78.7	80.9
Energy-adjusted milk, 305 days (kg)	4854[a]	6212[b]	4791[a]	6014[b]	4554[a]	6040[b]
Feed unit/day from concentrate	2.6[a]	5.3[b]	2.4[a]	5.1[b]	2.4[a]	5.3[b]

Observations on 29 dairy farms organically managed compared to 87 conventionally managed for three successive years.

[a] Significant differences between systems.

[b] Significant differences within year.

often related to local conditions. Nevertheless, interesting data on the effect of organic farming for reproductive traits are showed by Table 8, detailing 3 years of records in Norway (Reksen et al., 1999). The calving interval is similar for organic and conventional management, while milk yield is statistically larger in farms having conventional management than in those with an organic system. The impact of different management systems seems to be effective on production traits but is not on reproductive traits.

Reksen et al. (1999) also produced more detailed descriptive data (Table 9) showing that days open is always statistically larger for conventional than for organic dairy farms. It is difficult to explain the reasons, since it could be affected by a voluntary management procedure. The possible effects to explain the different days open are too numerous: larger milk production for cows in conventional dairy herds could intensify the metabolic stress so that reproductive performances can be negatively influenced. Conventional farm data are those typical of an intensive dairy herds: high production level, high level of used concentrate, and low reproductive performance. Organic management causes less metabolic stress for the more “natural” management, but for the same reason, the milk yield is always smaller and the reproductive performance is often better. The larger percentage of natural and summer breeding in organic management again shows the closeness to natural condition of organic farming systems.

Before 2005, the level of roughage in the feed ration must reach at least 60%; therefore, it is useful to understand the effect of different levels of concentrates, below 40%, in cows of high genetic merit. Table 10 illustrates the effect of different levels of concentrates on reproductive traits (Sehested et al., 2003). This research examined the effect of three different concentrate levels on high productive dairy cows. Each feed ration has less than 40% concentrates but on different levels (0%, 19%, and 38%). There is a significant decrease of number of days to first insemination with increasing concentrate level. The tendency is to increase lactation length and, therefore, calving interval for feed ration with low level of concentrate. Sehested et al. (2003) also reported that the concentrate level did not influence the proportion of live-born calves.

9. Image of organic farming: the dairy cow on pasture

Experience shows that the relative low cost of extensive farms, as observed for example in dairy cows in Ireland where land is available and there is increasing demand for organic milk, encourages dairy farmers to shift to using an organic farming system.

Table 9

Mean calving interval, mean days open, mean interval from calving to first AI, mean interval from calving to last AI, mean AI per cow, mean energy-adjusted 305-day milk yield (EA_{305}), mean feed units (FEM) per day from concentrate, FEM from concentrate/100 kg of energy-adjusted (EA) milk, mean multiparity percentage, mean percentage of cows in the second lactation, mean percentage of cows bred during summer, and mean percentage of cows bred by natural service, distributed by class of husbandry systems and year (after Reksen et al., 1999)

	1994		1995		1996	
	Organic	Conventional	Organic	Conventional	Organic	Conventional
Calving interval	378.4	377.8	376.4	375.1	369.0*	374.1*
Days open	115.3*	130.5*	111.2*	126.5*	112.8*	130.5*
Calving to first AI interval	77.7	80.0	82.2*	76.3*	78.7	80.9
Calving to last AI interval	95.6	99.7	100.3	96.9	98.7	98.4
AI per cow	1.6	1.7	1.6	1.7	1.6	1.6
EA_{305} (kg)	4854*	6212*	4791*	6014*	4554*	6040*
FEM/day from concentrate	2.6*	5.*	2.4*	5.1*	2.4*	5.3*
FEM from concentrate/100 kg of energy-adjusted milk	16.2*	26.1*	14.9*	26*	18.1*	27.1*
Multiparity (%)	70*	60*	71*	58*	68*	62*
Second parity (%)	22*	27*	24*	26*	23*	30*
Breeding in summer (%)	58*	38*	59*	42*	52*	36*
Natural breeding (%)	25	3	27	5	19	4

* Significant within-year difference between organic and conventional husbandry systems ($P<0.05$).

Table 10
Days to first insemination, calving interval, length of lactation, and dry period in cows given different amounts of concentrate mixtures (least square means and standard errors; after Sehested et al., 2003)

	Group				*P* value	
	All	L	N	L^+	Group	Parity
Days to first insemination						
After first calving	80±5	95±10[a]	68±9[b]	78±7[b]	0.007	0.76
After later calving	77±5	89±10[a]	60±8[b]	81±6[a]		
Calving interval (days)						
First to second calving	391±8	415±14[a]	370±14[b]	389±11[ab]	0.14	0.012
Later calving	364±7	364±14[a]	356±13[a]	371±9[a]		
P value for 1=2	0.008	0.013	0.44	0.20		
Dry period						
First to second calving	36±3	36±5	30±5	43±4	0.160	0.250
Later calving	41±3	39±5	42±5	45±3		
Days in lactation						
First to second calving	345±7	362±13	329±13	343±9	0.234	0.109
Later calving	325±10	327±21	322±17	326±12		

L=0% concentrate; L^+=19% concentrate; N=38% concentrate.
Different letters in superscript indicate significant differences between the groups. Calculation of days in lactation was based only on full lactations, which was terminated due to dryoff before expected calving.

Moreover, when EU regulations for organic farming system are applied in an extensive environment, dairy animals should not reduce production performance like for intensive cases. This was demonstrated for dairy sheep by Goulas et al. (2002) in a mountainous environment in Greece.

For many extensive dairy farms in Europe, the shift to an organic farming system can be achieved with little difficulty. However, this requires a full conversion of plant production and the availability of land generally must increase to maintain a herd of the same size. The closeness of most extensive farms to organic standards could facilitate the certification of those as organic.

Yet some limit still exists to the high number of specifications in the EU regulation 1084/99. The regulation contains about 60 derogations, creating many difficulties to apply the requirements and successive control. In addition, there is flexibility in the interpretations of the regulation, especially in some situations in which there are still existing old national legislation. Nowadays, two dairy farms having both organic certification can commonly produce in different manner and with products having different characteristics, thus creating uncertainty among the consumers and unfair disequilibrium of production costs between farmers. In the case of dairy cows, the feeding system or feeding level is not strictly fixed (case of concentrate level).

10. Environmental aspects

The issue of environmental impact is highly emotive in Europe. The last EU agricultural policy is largely devoted to environmental sustainability of farming. Organic farm management is considered by the consumers as having a low environmental impact. This can be regarded as a reduction in the number of dairy cows per hectare. The same reduction cannot be considered when comparing a similar volume of milk produced. This very important issue stimulates studies to estimate the comparison between the level of environment impact of organic and conventional dairy herds. Research by De Boer (2003) established the acidification and eutrophication potential as a measure of the environment-friendly system for conventional and intensive, conventional and extensive, and organic dairy farm management. Acidification can be caused by surplus of nitrogen in the soil (De Boer,

Table 11
Acidification and eutrophication potential for several milk production systems (after De Boer, 2003)

Case	Production system	Acidification (SO_2 equivalents/FU)					Eutrophication potential (NO_3^{-a} or PO_4^{-b} equivalents/FU)					
		FU		Contribution (%)			FU		Contribution (%)			
		t of milk	ha	SO_2	NO_3	NH_2	t of milk	ha	NO_2	NH^3	NO_3^-	PO_4
Swedish[a]	Conventional	18	131	3	7	90	58	433	4	53	41	2
	Organic	16	52	1.5	9.5	89	66	218	5	41	52	2
Dutch[a]	Conventional	10	116	12	10	78	69	820	3	21	15	61
	Environment-friendly	6	82	11	9	80	20	271	5	47	48	0
	Organic	10	115	9	12	79	34	396	7	44	24	25
German[b]	Conventional–intensive	19	136	1	4	95	7.5	54	–	–	–	–
	Conventional–extensive	17	119	1	4	95	4.5	31	–	–	–	–
	Organic	22	107	0.5	2.5	97	2.8	14	–	–	–	–

[a] Eutrophication potential expressed in NO equivalents per functional unit (FU).
[b] Eutrophication potential expressed in PO equivalents per FU. The contribution of NO, NH, N^-, and PO, therefore, is not available.

2003), while overuse of artificial fertilisers increases eutrophication potential. Table 11 shows that no differences can be seen for the relative impact on soil acidity between organic and conventional dairy management. On the contrary, organic farming seems to reduce the eutrophication potential when compared to conventional system, although in the Swedish case studied by de Boer, this difference was not present. This can be further explained by local specificity.

Another important aspect is the ecological sustainability of organic dairy farming. The public perception of organic farming could be hardly affected by negative ecological characteristics of organic farming. Production of milk from organic dairy farming has a lower ecological impact as proved by a recent research conducted in The Netherlands (Oosting and de Boer, 2002). The research showed that acidification potential, measured as grams of SO_2 equivalents per litre of organic milk, was 40% less for milk produced in conventional dairy farming. Moreover, the emission of greenhouse gases from organic farming is 14% less than from conventional farming systems. But the same research showed that to produce the same amount of milk, the organic system needs 42% more land. This difference is mainly due to land requirements for concentrates. Therefore, this issue is still debatable.

Table 11 also shows the important environmental aspect of nitrogen balance in favour of organic productions. Excess nitrogen per hectare per year is almost double in conventional intensive dairy farms than for organic farms, reinforcing the opinion of more environmental sustainability of organic farming.

11. Conclusion

Considering organic systems as a whole is not an easy option. The driving forces for European farmers to change from conventional to organic management systems are mainly economic. For some farmers, especially those already using pastures as feed source, the change was easier than for others. For farms located in marginal areas, organic market seems to be often the only possibility to survive, especially in the new scenario where increased limitation of subsidies is forecast. Food safety, more than animal welfare, quality of the products, and other relatively important subjects, is the most important issue for free European farms to change from conventional to organic dairy systems. The organic market will also powerfully protect European farmers from the global competition.

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