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Organic Dairy Sheep Production Management

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Abstract

Organic production systems are based on natural processes, the use of local feed resources, and the maintenance of biodiversity in all senses. Several studies have noted the positive effects of organic sheep milk production systems on animal welfare, animal health, product quality, and environmental impact. On the other hand, it has been reported that dairy sheep organic farms show lower milk yields and increase the susceptibility to environmental impacts compared with conventional farms. The standards that regulate feeding management in organic systems are one of the most critical factors that influence milk production performance. Lower milk production is also associated with poor ability to adapt specialized dairy breeds to organic management, low genetic potential for milk production in native and local breeds, and elevated dependence on environmental conditions. However, the aim of organic dairy production is not to reach maximum dairy productivity but rather to integrate animal and crop production and to develop a symbiotic relationship between recyclable and renewable resources; furthermore, organic production positively affects the employment rate and quality of life in rural communities. Organic dairy sheep production is one means of improving the balance between society's demand for food and the ecological impact of the agro-alimentary industry.

Keywords: Sheep, milk production, organic system, sustainability

1. Introduction: A brief overview of organic farming

Society's demand for foodstuffs is growing at a higher rate than current levels of production due to population growth and the rise in average income. According to the FAO, "food security exists when all the people, at all times, have physical, social and economic access to sufficient, safe and nutritious food." Over the last few years, some consumers have expressed increasing

concern regarding the origins of their food, its social and ecological impacts, and the fairness of its production. These customers prefer organic products, based on their perception that organic farming generates benefits associated with animal welfare, food quality, food safety, environmental concerns, and community development [1].

Due to its agro-ecological and holistic approaches and the competitive prices for organic products in the market, organic farming has developed into a small but important sector in agricultural production [2]. In 2012 alone, the “organic market” was worth approximately 50 billion euros. The International Federation of Organic Agriculture Movements (INFOAM) [3] reported that in 2012 some 37.5 million hectares of land were dedicated to organic agriculture, which represented 0.87% of total agricultural land. Australia is the country with the largest area used in organic agriculture, with 12 million hectares, followed by Argentina (3.19 million ha) and the USA (2.2 million ha) (Figure 1).

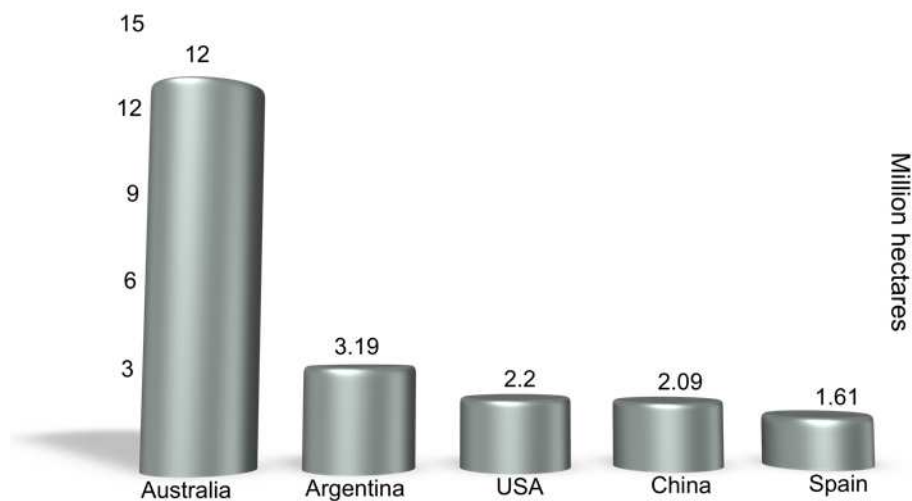


Figure 1. Countries with the largest areas of land dedicated to organic agriculture [4].

The quantity of land dedicated to organic agriculture appears to be small; however, at the local level in several countries, the impact of organic systems is very important. Although smallholder farms grow 70% of the world’s food, 50% of those without food security are small-scale farmers from underdeveloped and developing countries [5]. Smallholder organic farmers from developing countries account for 73% of land certified for organic production [3]. These producers use organic techniques in soil and water and holistic management, practices that allow them to be productive, achieve food security, and increase their incomes. Ayuya et al. [6] note that organic certified smallholders are less likely to suffer multidimensional poverty compared with conventional producers.

There are an estimated two million certified organic farmers worldwide; of this total, producers in developing countries account for 80%: 34% in Africa, 29% in Asia, and 17% in Latin America [7]. The countries with the highest numbers of organic producers are India (650,000 producers), Uganda (189,610 producers), and Mexico (169,703 producers) [5] (Figure 2). Some countries, such as India, Ethiopia, Mexico, and Uganda, have promoted the participation of smallholder

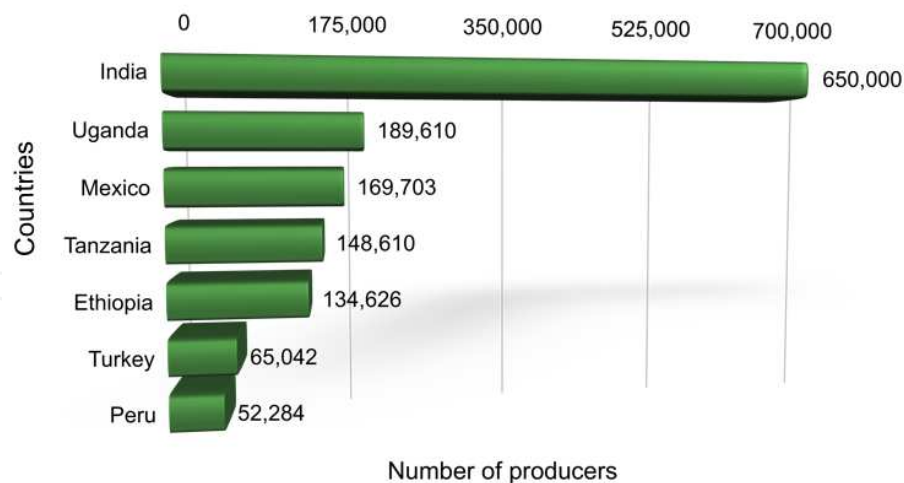


Figure 2. Countries with the largest number of certificated organic producers (adapted from [4]).

farmers in the organic market, through certification schemes such as “group certifications” and the so-called participatory guarantee systems, which link organic producers to international and domestic markets. Organic agriculture, therefore, represents an option to improve agro-ecological, social, and economic conditions in developing countries and emerging markets.

The cycle of production–consumption of certified organic products can be observed mainly in regions with high purchasing power, where consumers are able to pay the price premium of such products. In this sense, the main consuming countries of organic products are industrialized countries; the leader in organic food retail sales is the USA, with 22,590 million euros annually, followed by Germany (€7,040 million/year), France (€4,004 million/year), Canada (€2,136 million/year), and the UK (€1,950 million/year). Developed countries also have the highest consumption per capita of organic products, led by Switzerland (€189.1/year), Denmark (€165.8/year), and Luxembourg (€143.0/year) [4].

1.1. Organic livestock production

Organic livestock production is a holistic system aimed at the integration of animal and crop production and the development of a symbiotic relationship of recyclable and renewable resources [8–10]. The grassland and grazing areas used by organic livestock activity represent two-thirds (27 million hectares) of agricultural organic land; this reflects the importance of animal production within the organic production industry [4].

Organic livestock farming involves radical changes in production processes related with major attention to health and animal welfare, environmental conservation, quality, and food safety [10]. The diversity of organic livestock farms relies not only on natural local resources, animals used, climatic conditions, products manufactured, and commercialization but also on the production and farming strategies of each organic farmer.

Verhoog et al. [11] distinguish three types of organic farmers. In the “non-chemical approach,” the producers are pragmatic organic farmers who formally follow organic farming standards but continue to have a conventional problem-solving approach with economic motives to conversion. The second type of producers follow the so-called “agro-ecological approach,” with a more systematic approach and closed cycles; they focus on efficient production without causing damage to ecosystems. Finally, the “integrity approach” farmers develop farms where soil, plants, animals, and the farm as a whole are regarded as an organism with an intrinsic value. Each organic farming approach will determine different feed, breeding, reproduction, and health requirements.

Some of the positive effects of organic livestock practices are promoting sustainable land use, improving animal welfare and increasing product quality. The methods used exert a positive effect on biodiversity and ecological balance. Furthermore, organic management may contribute to the safeguarding of agricultural functions, with positive effects on the employment rate and the quality of life in rural communities [12, 13]. For these reasons, organic livestock farming can improve the balance between the demand for human food and the ecological impact of the agro-alimentary industry.

2. Organic dairy sheep production

Milk and dairy products constitute a high share of all organic products sales, positioned in second place behind only fruits and vegetables, and in first place for animal products, with 15% of total organic sales [14]. Sheep milk production has an important economic role in industrial countries due to high prices for dairy products, mainly cheese. Additionally, sheep milk represents a source of high quality protein and calcium in arid areas, especially for hungry or malnourished people [15].

Organic dairy sheep farms represent a system focused on producing high-quality nutritious milk, by implementing production methods that reject the use of agrochemical products, artificial compounds, pesticides, growth promoters, and forage additives and that utilize crop rotation and the reuse of organic residues. In some countries, such as Spain or Greece, organic dairy sheep systems are an essential factor for rural development for three reasons: their low environmental impact, their use of autochthonous breeds, and the diversity of transformation of milk and manufacturing processes [16].

According to Perez et al. [17], milk production is one of the most complex systems in organic production, which complicates the conversion from conventional to organic production. This is due to the large quantity of technological innovations that have been developed within the industry. However, several other authors claim that conversion from conventional to organic production systems in small ruminants appears to be less complicated in terms of management when compared with other farm species. This situation may be mainly because the management of sheep feeding does not differ dramatically between organic and conventional production systems [18–20].

Sheep have several characteristics that promote the transition process, such as easy management, effective adaptation to diverse environmental, geographic and climatic conditions, and

high efficiency in the use of available sources of grazing [19, 20]. These characteristics conform with the management practices suggested by organic standards, which dictate that feeding must be based on extensive grazing and that supplementary feed should come from organic farms (certified feed industry) [21].

Organic dairy sheep farms are generally located in harsh environments, where dairy cattle production is not feasible. Organic dairy sheep nutrition is based on grazing in natural pastures and using winter fodder crops; therefore, the seasonal effects on milk sheep production are strong. The grazing system of organic dairy sheep farms promotes the continuity of traditional pastoral systems, which is the key to the sustainability of rural areas, the conservation of traditional systems of production, and the preservation of cultural heritage [22].

Location	Name of regulation		Date of publication	References
Global or regional				
FAO-WHO	The Guidelines for the Production, Processing, Labeling and Marketing of Organically Produced Foods (Codex Guidelines)		1999	[23]
INFOAM	Standard for Organic Production and Processing		August 12, 2012	[3]
EAC ¹	East African Organic Products Standard, EAS 456:2007		April, 2007	[24]
EU ²	Council Regulation (EC) No 834/2007 on organic production and labeling of organic products with regard to organic production, labeling and control		June 28, 2007	[25]
Continent	Country			
America	Argentina	National Law 25.127. Ecological, Biological and Organic Production	September 8, 1999	[26]
	Brazil	Law No. 10.831 and decree No. 6.323 (2007)	December 23, 2003	[27]
	Chile	Law 20.089 from National System of Organic Products Certification	December 12, 2005	[28]
	Costa Rica	Law of Development, Promotion and Foment of the Organic Agricultural activity. No. 8591	August 14, 2007	[29]
	Mexico	Law of Organic Products	February 7, 2006	[30]
	United States	National Organic Program	December 21, 2000	[31]
Africa	Tunisia	Law on Organic Agriculture No. 99-30	April 5, 1999	[32]
	Uganda	Uganda Organic Standard (UOS) East African Organic Products Standards	2004 April, 2007	[24, 33]
Asia	Japan	Japanese Agricultural Standards for Organic Livestock Products	October 27, 2005	[34]
	India	National Programme for Organic Production (NPOP)	May, 2001	[35]
Oceania	Australia	National Standard for Organic and Bio-Dynamic Produce. Edition 3.4	July 1, 2009	[36]
	New Zealand	Technical Rules for Organic Production. MAF Standard OP3,	June, 2011	[37]

¹EAC, East African Community, ²EU, Europe Union

Table 1. Organic production standards.

The technical challenges faced by organic dairy sheep producers are regulated by international and regional standards, such as EU regulation No. 834/2007 [25], IFOAM standard for organic production and processing [3], Basic Standards and Codex Guidelines [23], and local regulations in each country (Table 1). Sheep milk production under organic management within defined standards entails challenges in feed, reproductive management, breeding, health, and welfare practices.

2.1. Feed management in organic dairy sheep farming

Organic dairy sheep systems involve extensive management, with high levels of nutrient self-sufficiency and efficient nutrient utilization. This livestock system requires management strategies with highly complex crop rotation to produce both forage and concentrate feed. Regardless of production system type (conventional or organic), the lactation process in dairy sheep requires feed rations with high levels of nutrients during mammogenesis, lactogenesis, and lactation [38]. Bencini and Pulina [39] have estimated that to produce a liter of sheep’s milk with 7% fat content requires 7.1 mega joules of metabolizable energy (MJ of ME).

Country	Breed	DMY (kg/ day)	Fat %	Protein %	SNF%	TS%	References
Organic management							
Italy	Sardinian	1.23(l)	6.74	5.7	-	-	[42]
Italy	Sardinian	1.44	6.46	5.61	10.65	17.11	[43]
Czech Republic	¹ Crossbred	0.82(l)	7.94	6.49	12.25	20.19	[44]
Greece	Karagouniko	1.1	6.8	5.7	11.6	18.5	[45]
USA	² Crossbred	-	8.69	6.33	12.19	20.88	[46]
Czech Republic	East Friesian	1.03	6.65	5.30	11.1	17.75	[47]
Mexico	East Friesian (EF)	0.56	6.63	5.14	10.2	16.85	[48]
	EFxPelibuey	0.39	8.03	5.33	10.6	18.71	
	EFxSuffolk	0.55	6.98	5.29	10.4	17.42	
Conventional management							
Spain	Churra	1.0(l)	6.54	5.7	12.03	18.57	[49]
Israel	Awassi Assaf	2.77	4.68	5.13	-	-	[50]
Italy	Valle del Belice	1.58	7.32	5.69	-	-	[41]
Czech Republic	East Friesian	0.87	8.0	5.71	11.59	17.86	[51]
Spain	Lacaune	1.04	6.14	4.89	9.85	15.99	[52]

TMY, total milk yield; DMY, daily milk yield. SNF, Solids non-fatty; TS, Total solids, ¹First lambing crossbred ewes, Lacaune (50%), East Friesian (37.5%) and Improved Wallachian (12.5%). ²Crossbred ewes Lacaune X East Friesian.

Table 2. Milk production and composition of dairy sheep in organic and conventional production systems.

The energy and protein content in dairy sheep rations must be adequate and sufficient to support maintenance requirements as well as milk production [40]. Pulina et al. [41] note that energy intake is the most important factor that influences milk production and composition, followed by protein and fiber content of the diet. An adequate amount of energy in dairy sheep diets increases glucose content in the blood, which promotes the synthesis of lactose, the activation of mammary and systemic regulators (insulin, IGF, thyroid and neurohormones, etc.), and the increased uptake of milk precursors (glucose, acetate, butyrate, amino acids, NEFA, vitamins, and minerals) [41].

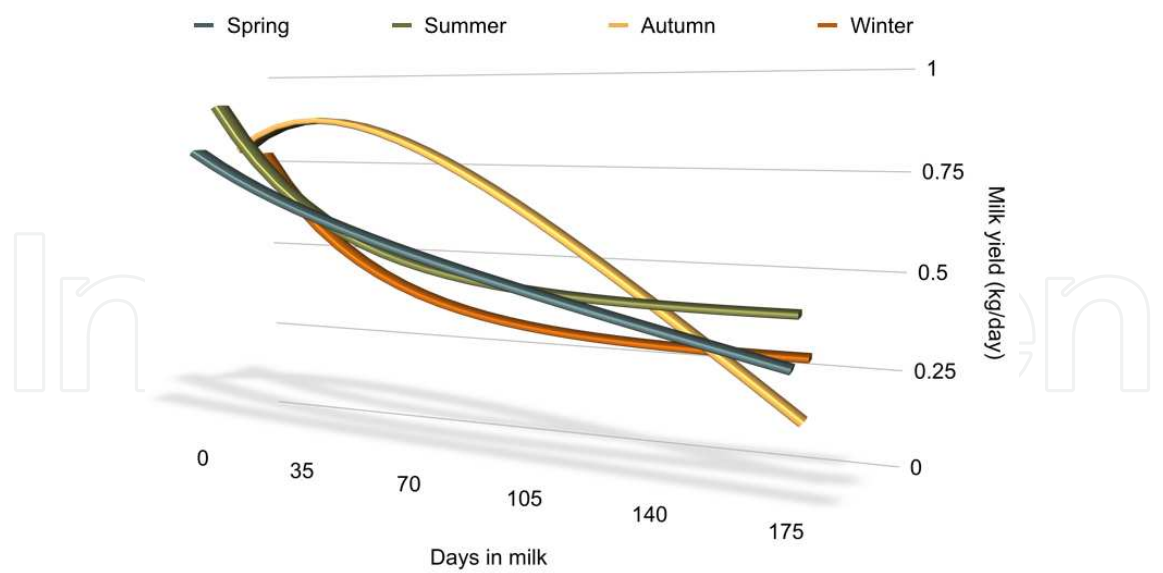
The standards that regulate feeding management in organic systems are one of the most critical factors that influence milk production performance and quality of milk (Table 2). Organic regulations limit the use of concentrate and reduce the range of ingredients that can be included in organic rations. This situation may cause deficiencies of energy, protein, and minerals (zinc, molybdenum, selenium, copper, and iodine), which increases the risk of nutrient imbalances [53, 54]; it has been reported that underfeeding ewes in early lactation, when nutritional requirements are highest, results in lower milk yields [55].

European organic standards require feed rations based on forage (minimum 60% of daily dry matter inclusion) and primarily homegrown ingredients [25]. One of the major challenges in organic management is to formulate high forage diets with an adequate energy concentration due to the low energy value of most forages (<11 MJ of ME per kg DM) when compared to concentrate feeds (>13 MJ of ME per kg DM) [56]. The stage of lactation determines the percentage of forage in the total ration, which can comprise up to 100% of the total ration. Organic dairy sheep can graze in natural or cultivated pastures, and different strategies of feeding can be used to follow organic standards.

The feed management on most organic dairy sheep farms is based on grazing. Grazing is the interaction between animals using the pasture and the pasture itself [57]. Systems based on natural pasture grazing utilize less fertilizer and are considered more ecological. However, the high level of pasture in diet, the availability and quality of forage, and the change from grazing fresh herbage to consuming conserved forage are associated with lower milk yields for sheep under organic management compared with milk yields on conventional farms [58, 59].

The availability and quality of pastures and conserved forage change significantly throughout the year, producing a seasonality effect on milk production. Angeles-Hernandez et al. [60] analyze the effect of lambing season on milk production in sheep under organic management; they conclude that sheep with autumn lambing showed significantly ($P = 0.002$) higher milk yields (Figure 3). This may be due to the sheep having been pregnant during the summer, when the availability of forage reaches its maximum, producing a positive effect on the differentiation of mammary secretory cells as well as on the buildup of the animal's physical condition.

Zervas et al. [58] analyze the milk production and live-weight changes in ewes in both conventional and organic systems. Ewes under organic management were fed with grass hay plus barley grain, and ewes under conventional management were fed with grass hay plus balanced concentrate feed. Milk yields of ewes fed organically were significantly lower ($P <$



Lactation curve adjusted using the Wilmink model [61] ($Y = a + be^{kt} + ct$.)

Figure 3. Lactation curves per lambing season of dairy sheep under organic management (adapted from [60]).

0.001) when compared with conventional-fed ewes (134 vs. 180 kg/year, respectively). Also, ewes in conventional management showed higher values of live-weight gain ($P < 0.01$) in the period between lambing and weaning (organic 67 vs. conventional 79 g/day).

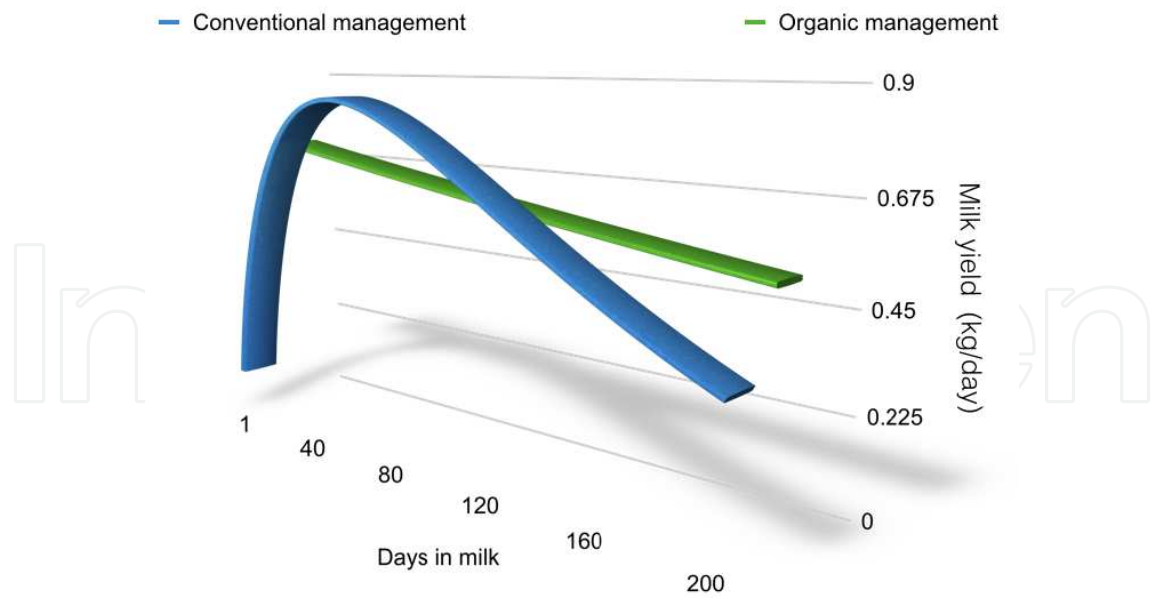


Figure 4. Lactation curves of conventional and organic dairy sheep farms (adapted from [62]).

Some studies note that milk yields of dairy sheep under organic management can be similar or higher than conventional dairy farms, which can be explained in part by lower stocking

rates and high availability of forage per animal [43, 63]. Angeles-Hernandez and Gonzalez-Ronquillo [62] compared the milk production and lactation curves of conventional and organic dairy sheep farms; these authors used the Wood model [64] to analyze a total of 7,501 weekly test-day milk yield records from crossbred dairy ewes. There were no differences in milk yields between organic and conventional dairy sheep farms (97 vs. 103 kg, respectively), but there were significant differences ($P < 0.05$) in the shape of the lactation curve (Figure 4), traits that defined the shape of lactation curve (peak yield and time of peak yield), and parameters of the Wood model (Table 3). Sheep in organic systems showed a higher percentage of lactation curves with atypical shape (without peak of lactation) (Table 3), which could be beneficial in this system, as the risk of negative energy balance and metabolic disturbances in early lactation is lower (Figure 4).

Type of farming	Traits of lactation curve			Parameters of Wood model			Proportion of atypical shapes
	TMY(kg) ¹	PY(kg)	PT(kg)	<i>a</i>	<i>b</i>	<i>c</i>	(%)
Organic	97.3	0.79 ^b	20.9 ^b	0.51 ^a	0.43 ^b	0.011 ^a	52.6
Conventional	103.0	0.85 ^a	86.9 ^a	0.25 ^b	1.89 ^a	0.002 ^b	10.5
P-value	0.06	0.05	0.001	0.01	0.001	0.001	

¹ TMY, total milk yield adjusted to 200 days in milk; PY, peak yield; PT, time to peak yield; *a* is the production of milk at beginning of the lactation (kg), *b* and *c* are parameters of inclining and declining slopes of lactation curve before and after the PY, respectively.

Table 3. Characteristics of lactation curve and parameters of Wood model from lactation of organic and conventional dairy sheep farming (Adapted from [62]).

Pasture farming systems result in milk characterized by a chemical composition that has beneficial properties for human health. Organic sheep milk has a high fat content (Table 2) due to rations rich in fiber [15]. Several studies report that milk and dairy products from certified organic production systems contain higher concentrations of protein, cis-9, trans-11 CLA, α -linolenic (α -LNA), transvaccenic acid, docosapentanoic acid, eicosapentanoic acid, total n-3 fatty acids, α -tocopherol, and β -carotene than those from conventional production systems [65–67]. Tsiplakou et al. [45] conclude that sheep milk produced under organic farming conditions has higher nutritive values, with elevated contents of MUFA, PUFA, α -LNA, cis-9, trans-11 CLA, and ω -3 FA compared with that from conventional systems.

2.2. Effect of genetic factors in organic dairy sheep farming

The breed or genotype of dairy sheep is one of the main factors that affects milk yields and chemical composition. The choice of breed in organic systems must be considered, with an emphasis on animal characteristics that ensure their welfare and health, such as adaptation to local environmental conditions, vitality and resistance to disease, and absence of specific health problems associated with certain breeds [23, 25].

According to Nauta et al. [2], the different production and marketing strategies of organic farmers demand different breeds. Current dairy breeds have been modified through selective breeding programs to produce high levels of milk, which may make them unsuitable for a traditional and more natural production system. However, the “non-chemical approach” organic farmers use specialized dairy sheep breeds to reach economically viable milk yields, and organic farmers with other production approaches use specialized dairy sheep breeds during the conversion process, usually with moderate milk production performance (Table 2).

The main strategies of animal breeding in organic dairy systems are selection (within and among breeds) and crossbreeding. Selection in organic farming should be used to reinforce, in a sustainable manner, the relationship between the animal and the environment in which it is produced [21]. There are differences in the characteristics and magnitude of genotype due to external factors (i.e., environmental interaction between conventional and organic systems) [68]; the specific approximation to environmental conditions of organic management determines different selection traits for both production systems (Table 4).

The program of selection on organic dairy sheep farms can be applied to specialized, local, or native breeds to improve dairy production traits, but it mainly promotes the selection of vital traits that improve animal well-being, sustainability, health, and flock efficiency [69] (Table 4). Nauta et al. [2] noted that 43% of organic farmers were seeking functional traits as a breeding goal, 32% productive traits, and 25% conformation traits.

Trait	Heritability
General disease resistance	0.05-0.80
Resistance to parasite infection	0.25-0.40
Somatic cell count	0.12-0.13
Longevity	0.05-0.13
Female fertility	0.07-0.20
Mature size	0.47
Feeding characteristics	0.10
Udder shape	0.20-0.24
Teat size	0.18-0.39
Milking ease	0.01
Milk production and composition	
Milk production	0.28-0.32
Fat content	0.41-0.62
Protein content	0.51-0.53
Fat yield	0.17-0.29
Protein yield	0.18-0.27

Data from: [21, 70-77].

Table 4. Important traits in organic dairy sheep breeding.

Organic dairy production can benefit from using native or local breeds genetically adapted to their environment; these breeds are more resilient to climatic stress and are resistant to local parasites and diseases, enabling them to utilize a lower quality of feed [78]. Organic farming may contribute to the maintenance and improvement of the variability of dairy sheep breeds. The use of native breeds can also help support food, agricultural, and cultural diversity, in that the milk and cheese produced from sheep are an expression of a regional cultural tradition. Native breeds also promote local food security and represent a valuable genetic source for improving health and performance traits in the future [12, 78]. However, under organic management, the use of local sheep breeds that are not specialized in milk production may hinder the achievement of sufficient milk yields to reach economic viability. In these situations, crossbreeding can be an option as an improved genetic strategy [79].

Crossbreeding of native breeds with specialized dairy breeds is a viable option to improve dairy production parameters and promote adaptation to feed sources, climate, and the management and market conditions of organic milk production systems, through heterosis and the combined attributes of different breeds [48]. When animals are genetically adapted to specific/extreme environmental conditions, they will be more productive and production costs will be lower. Furthermore, genetic groups adapted to organic dairy management help to safeguard animal health and welfare [78].

Angeles-Hernandez et al. [48] carried out an evaluation of the effect of genetic group on milk production and composition on an organic dairy sheep farm; they compared three genetic groups: East Friesian (EF), EFxPelibuey (local hair breed) (EFxPL), and EFxSuffolk (EFxSF). They found significant differences among genetic groups in milk yield and milk composition (Figure 5). EFxPL sheep showed a lower milk yield (59.8 kg), protein yield (20.8 g/day), and fat yield (31.3 g/day) compared to the other groups. EF and EFxSF showed similar values of milk yield ($76.1 \cong 75.8$ kg), protein yield ($28.8 \cong 29.1$ g/day), and fat yield ($37.2 \cong 38.4$ g/day, respectively).

The EFxSF group showed appropriate milk yield and chemical composition; these contribute not only to an increased cheese yield but also to a differentiation of cheese flavor. However, crossbreeding presents challenges in terms of maintaining a correct proportion of purebred–crossbred populations; furthermore, in systems with inadequate management, biodiversity may be jeopardized by the elimination of certain purebreds (specialized and native breeds) [21].

The goals of organic dairy production farms are more than maximum milk productivity; their objectives are directed to favoring animal health and welfare and to improving the quality of their products with minimum environmental impact. In this sense, genetic improvement strategies must be individually selected and designed for each farm according to resource availability, local market conditions, and management approach.

2.3. Economic implications of organic dairy sheep farming

Organic dairy sheep farming provides income to thousands of families and contributes to regional development, especially in isolated and less favored areas. It also generates employ-

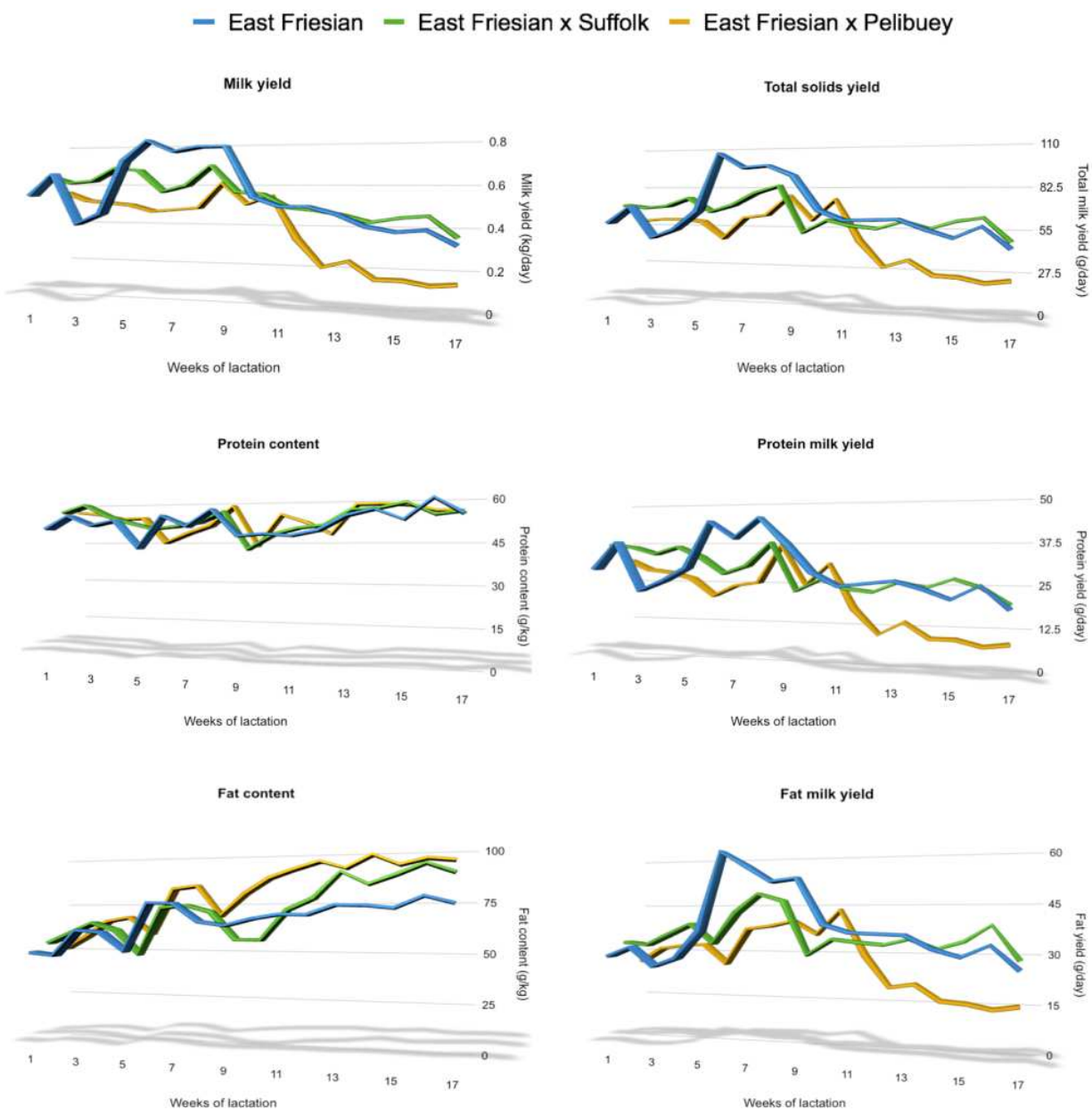


Figure 5. Effect of genetic group on milk production and composition in sheep under organic management (adapted from [48]).

ment, promotes closer links with local markets, restores connections between farmers and customers, and increases incomes in the local economy through exports [13].

The specific productive approach of organic dairy sheep farms determines its economic stability and profitability. The main factors that affect the expected returns of dairy sheep farming are milk yield and price of dairy products [80]. The competitive prices of organic products has played an important role in the expansion of interest in organic systems. Frequently, organic products obtain a premium price when compared to products from conventional farms. The magnitude of the premium depends on product availability and market demand.

The premium in price for organic sheep milk over conventional milk ranges from 8% to 36% within European market [81], 51% in New Zealand [82], from 47% to 79% in the USA [83], and a price difference of approximately 20% to 30% in Mexico [79]. In the case of the gross production value of meat and lambs, the variation arises mainly from fluctuations in price. Gross production value for ewe meat (non-productive ewes) contributes less to the total gross production value of the farm.

Gerrard et al. [84] have noted that organic dairy sheep farms show lower investments in items such as acquisition of animals, equipment depreciation, and agronomic management (less use of fertilizers and chemical compounds). However, it should be taken into account that in the case of organic farming, the value of animal capital is lower due to the fact that the flock consists mainly of crossbred dairy ewes [79]. It has also been reported that organic dairy sheep farms employ more people in comparison with conventional farms. Padel and Lampink [85] noted the higher number of working hours on organic farms (10–50% greater), and they considered salaries to be an expense with a higher impact on the total cost of organic milk sheep production.

The initial investment for establishing an organic farm, as for a conventional farm, includes investments in buildings (stables and barns), equipment (milking machine, feeders), animal capital, pasture area, and grain supplements for feeding throughout the year. An added investment that needs to be considered for organic farms is the certification process, as well as the fact that during the conversion process the commercialization of dairy products with a premium price is not yet possible.

The questions that we have to ask when comparing conventional systems vs. organic systems in general terms are as follow: How will sustainable intensification work in practice? How can farmers and other producers improve their production systems to produce food in more sustainable ways? Being less susceptible to volatile food prices, how can niche-level innovations and consumer interpretations and social practices be better integrated into the mainstream food security discourse? For example, organic systems offer the security of avoiding chemical fertilizers, antibiotics, hormones, and synthetic growth promoters, all of which involve human risk through the increase in allergies and antimicrobial resistance. How will the transformations of the food system play out in terms of geographical area, food security and animal welfare?

From the economic perspective, the dominant message is the importance of the profit motive, which drives the production system. However, the cost to the environment must also be taken into account. For this reason, we have to analyze the “economic sustainability” based not only on economic profitability but also on the relationship of farmers to their land environment and the sustainability of their activity [86]. There may also be hidden costs of production not only from agricultural intensification [87] but also from organic production [88].

3. Conclusion

Organic production is not a method of production that can solve all the problems of the dairy sheep industry; it is mainly an approach to production focused on satisfying the current

demand for dairy products, but without the adverse effects of intensified livestock production. Moreover, organic farming is a production method with a specific market focus on products of premium quality and high standards of production. Organic sheep milk production can provide a balance between society's demand for food and the ecological impact of the agro-alimentary industry, through the comprehensive implementation of conservation practices and the ecological utilization of natural resources.

The production of organic sheep's milk requires research along specific lines, aimed at developing better methods of production, distribution, and marketing of their products. These must be focused mainly on genetic improvement, preventive medicine, welfare, nutrition management, and promotion of nutritional characteristics, in accordance with defined production approaches and regulations.

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