Do Organic Livestock Farms Differ From Low-Input Conventional Ones? Insights Based on Beef Cattle in Southern Europe

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Additional information is available at the end of the chapter

Abstract

The objective of this study is to determine whether there are clear differences between conventional (but low-input) and organic beef cattle farms located in the Southwest of Spain. Thirty-three conventional and 30 organic farms were compared in terms of structure, technical management, and performance. The results showed that organic farms ('All Organic') mainly focus on the production of calves at weaning age, which are fattened in conventional holdings ('Organic 1'; $n = 22$). The remaining organic farms ('Organic 2'; $n = 11$) showed to participate in almost all stages of the agri-value chain. 'Conventional' farms were mainly dedicated to producing calves at weaning age (similarly to Organic 1). Organic 1 had the smallest herd size (80.18 livestock units (LU), $p < 0.05$). Organic 2 showed greater presence of indigenous breeds (62.08%, $p < 0.05$). Conventional farms proved to bear higher feed and veterinary costs per area (161.59 and 17.87 €/ha; $p < 0.01$ and $p < 0.05$, respectively), but Organic 2 had higher feed costs per LU. Therefore, Conventional and All Organic were quite similar, and differences depended mainly on farm structure. Hence, being either conventional or organic does not seem to be a valid criterion for drawing conclusions regarding the benefits or characteristics of each system.

Keywords: semiarid, production systems, sustainability, sustainable agriculture, mediterranean, drylands

1. Introduction

Organic livestock farm numbers have sharply increased in recent years [1] as an adaptive response for increasing farm profitability (through subsidies and price premiums). However,

before implementing any production systems, an analysis of the similarities and differences between both the current and the potential new farm configurations should be carried out, since it will provide a wider view of the chances of success after the change.

For this purpose, the methodological process of farm characterisation is essential as it allows in-depth understanding of the operation of livestock production systems, which is key to improving their management, economic performance and overall sustainability. Thus, Rodríguez et al. [2] stated that farm viability relies on specific management practices that are suitable for the specific socioeconomic and environmental context of the farm, and this should be based on the knowledge of the characteristics and performance of the production systems.

Subsequently, several researchers have conducted studies for characterising farms according to various parameters. Some authors have focused on livestock species reared on the farms. Thus, different authors [3–10] have studied and characterised beef cattle farms by means of descriptive and/or cluster analysis on the basis of technical, structural, economic and/or social indicator. However, to our knowledge, there are no available studies that comparatively characterise organic and pasture-based or low-input conventional beef cattle farms, contextualizing such analysis within the evolution of the production systems under study. We therefore believe that this is a particularly appropriate time to conduct the present study. This would be of even more interest if the farms studied were located in complex agro-ecosystems with great value and externalities from the socio-economic and environmental points of view.

The present study was carried out with the following aims: (i) to shed light on the gap of knowledge existing due to the lack of studies that compare the characteristics of conventional and organic beef cattle farms and (ii) to find similarities and differences between organic and low-input conventional beef cattle farms. For this purpose, a characterisation (technical management, structure and economic performance) of the farms located in the '*dehesa*' was carried out.
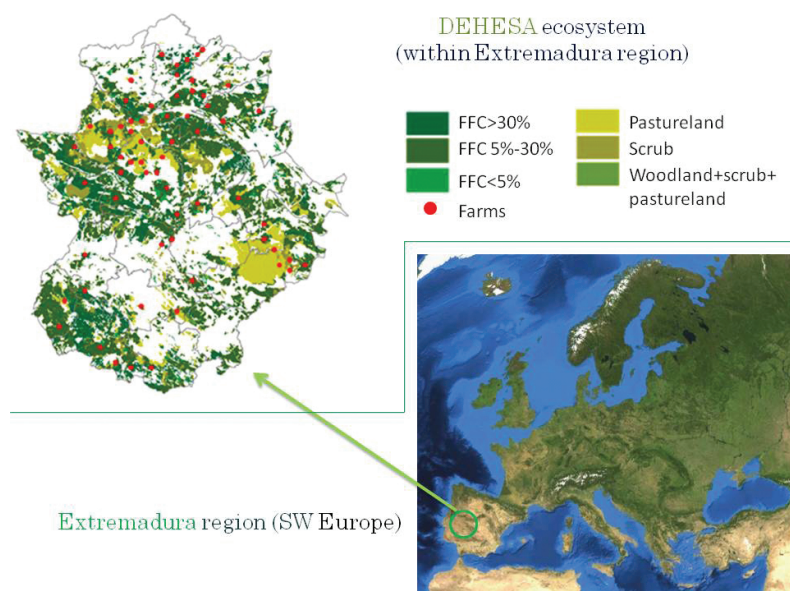
2. Material and methods

2.1. Study area

The study area was the *dehesa* located in the region of Extremadura (Southwest of Spain). From a climatic point of view, it enjoys annual average temperatures of 16–17°C, with mild winters (average temperature of 7.5°C) and hot and dry summers (the average mean temperature is greater than 26°C, exceeding 40°C in the hottest months, which correspond to a Mediterranean continental semiarid climate. Its rainfall pattern is irregular (300–800 mm). Soils are shallow, acidic and of low fertility. Due to these characteristics, the availability of grazing resources is reduced and unstable [11–13].

2.2. Sample selection

A sample of farms in the beef cattle sector located in the *dehesa* of Extremadura was selected. Due to a lack of official statistics on figures and locations of *dehesa* farms in Extremadura, the

sampling was non-probabilistic by quotas. The number of farms surveyed was 63, in line with other studies analysing livestock production systems [4, 14–17]. Apart from the number of farms, various criteria (already explained by Escribano et al. [17,18]) were used to select the farms with the aim of obtaining an indicative sample of the various beef cattle production systems located in *dehesas*. The criteria used are summarised below:

- Predominant species and productive orientation: beef cattle.

- Herd size: over 25 adult cows, in order to differentiate between small and commercial farms.

- Geographical and forest-related aspects: the study includes farms located in different areas within the *dehesa* (geographical criteria) with different woodland densities (forest criteria similar to that followed in previous studies in the area [14]). **Figure 1** shows farms' spatial distribution and type of *dehesa* in which they were based on.

Figure 1. Dehesa location and different land cover characteristics. Forest fractional cover (FFC): Fraction of the land covered by the vertical projection of the tops of trees.

- Organic farms: all organic farms had already finished their conversion period to the organic system.

Finally, 63 farms (30 Conventional and 33 Organic farms were selected, thus achieving: a sample size similar to that of other studies characterising livestock farms [4,5,10,14]; similar sample sizes of organic and conventional farms, thus allowing an adequate comparative analysis of both sectors.

2.3. Selection of parameters

In order to select the most appropriate indicators to analyse the farms under study, two main steps were followed. Firstly, the scientific literature addressing the structural and technical-economic points of view was reviewed. The selection of consistent and similar indicators allowed carrying out comparisons with studies on the topic. Moreover, economic parameters were created following the economic accounts for agriculture in the community [19] and the adaptation to dehesa livestock farms already carried out in previous studies [14,15,20]. As a consequence, the discussion of the results was consistent and the achievement of the aims of the present study was possible.

Finally, the selected set of indicators were confirmed to be in agreement with the recommendations of Lebacq et al. [21]: relevance, representativeness of the system, measurable, value to the end user, no ambiguity, no redundancy, and predictive.

2.4. Data collection

Data were collected from farms by means of a questionnaire in the year 2010. The questionnaire was developed according to selected indicators. These included information on structure (farms and herd characteristics: sizes, infrastructure, etc.), technical management, production results, economic data and social aspects. Subsequently, data were collected by the first author directly at the farms, followed by structured and semiclosed interviews with farm managers. Farmers' answers were the sources of information for all indicators. All these processes were carried out in accordance with the methodology used by several authors who analysed similar aspects of livestock farms [2,6,8,10,14,15,17,22–27].

2.5. Analysis

The statistical analyses included descriptive statistics for the full sample of farms. Subsequently, an ANOVA test was applied to all parameters, as all of them are quantitative ones. This allowed comparing all farms following two approaches. First, conventional farms were compared to organic farms in order to compare the two production systems as a whole (Conventional vs. All Organic). Secondly, farms were compared based on three classifications that are explained in the next section: (i) Conventional farms; (ii) Organic 1 farms; (iii) Organic 2 farms. This approach offered insight into each of them, so that more valuable and precise conclusions about the organic beef cattle sector could be made. Statistical analyses were performed using SPSS v. 20.

3. Results

3.1. Farm types

After collecting data and creating the database, it was noted that, based on the aspects studied, organic farms could clearly be subdivided into two production systems, so it was decided that a classification of the farms selected needed to be made, with the resulting following groups:

- Conventional; found as "Conv." in the tables ($n = 30$): This grouped conventional farms. With regards to the situation of the beef cattle sector in the *dehesa*, these farms were mostly focused on calf rearing (calf fattening was almost nonexistent, so these farms mainly sold their calves at weaning age (5–6 months old and 160–220 kg of live weight; see **Table 1**).

Parameters	Conv.	Org. 1	Org. 2	Sig. 1[4]	Sample	SD	All Organic	Sig. 2[5]
	($n = 30$)	($n = 22$)	($n = 11$)		($n = 63$)		($n = 33$)	
UAA[1]	275.80	223.72	337.84	0.378	268.44	223.34	261.76	0.806
Owned area/UAA	0.64	0.54	0.55	0.541	0.59	0.44	0.55	0.390
Wooded land/UAA	0.46	0.47	0.77	0.101	0.52	0.43	0.57	0.336
Crop area/UAA	0.00	0.00	0.00	0.576	0.00	0.01	0.00	0.334
Bovine LU[2]	104.92ab	74.33a	124.83b	0.016*	97.72	52.14	91.16	0.299
Ovine LU	6.78	5.36	15.37	0.496	7.78	30.38	8.69	0.805
Swine LU	0.00	0.50	0.77	0.445	0.31	1.55	0.58	0.138
Total LU	111.70ab	80.18a	140.95b	0.024*	105.80	63.33	100.44	0.485
Bovine LU/Total LU	0.98	0.96	0.92	0.452	0.96	0.13	0.85	0.369
Total stocking rate[3]	0.73	0.50	0.44	0.312	0.60	0.64	0.48	0.131

a, b, c Mean values with different letters in the same row are significantly different. * $p<0.05$, ** $p<0.01$, *** $p<0.001$. SD: standard deviation. [1]UAA: Utilized Agricultural Area. [2]LU: Livestock Units. 1 cow = 1 LU; 1 sheep = 0.12 LU; 1 sow = 0.37 LU. [3]Total Stocking rate = LU/ha UAA. [4]Analysis of Variance of the groups Conventional, Organic 1 and Organic 2. [5]Analysis of Variance of the groups Conventional vs. All Organic.

Table 1. Herd and farm structure. Mean values, standard deviation and level of significance

- Organic 1; found as "Org. 1" in the tables ($n = 22$): These farms were producing under the organic system, but none of them fattened their calves. On the contrary, they were marketed with almost the same characteristics (age and live weight) and price as the conventional ones (check **Table 1** to observe the similarity with conventional farms).

- Organic 2; found as "Org. 2" in the tables ($n = 11$): Organic farms that fattened and sold their calves under the organic system.

Furthermore, organic farms were also analysed as a whole in a group called "All Organic" ($n = 33$).

3.2. Farm structure and management

3.2.1. Farm and herd characteristics

The average size of farms was 268.44 ha utilized agricultural area (UAA) (**Table 2**). Organic 2 farms were larger than 'All Organic', but the high variability within the sample did not allow identifying significant differences between this group and Organic 1. With regard to herd size, All Organic farms were also similar to Conventional farms, and an important variation within

farms was identified in relation to the mean cattle herd size (140.95 livestock units (LU) in Organic 2 vs. 80.18 in Organic 1, $p < 0.05$).

Parameters	Conv. (n = 30)	Org. 1 (n = 22)	Org. 2 (n = 11)	Sig. 1[6]	Sample (n = 63)	SD	All Organic (n = 33)	Sig. 2[7]
Replacement rate (%)[1]	11.98	11.92	13.29	0.922	12.19	1.23	12.38	0.875
Cows/bull (N°)	31.01	30.67	28.29	0.844	30.42	1.68	29.88	0.740
Estrous synchronisation (%)[2]	6.70	0.00	0.00	0.321	3.20	–	0.00	0.132
Artificial insemination (%)[3]	6.70	4.50	0.00	0.592	4.80	–	3.00	0.658
Length of mating period (months)	10.40	10.70	10.14	0.922	10.46	0.29	10.52	0.846
Fertility rate (%)[4]	85.15	77.70	81.49	0.187	81.91	1.82	78.97	0.091
Age at first calving (month)	30.68	33.45	33.68	0.197	32.17	0.79	33.53	0.074
Calving interval (days)[5]	346.50	33500	343.64	0.165	341.98	2.74	337.88	0.117
Calves born/cow/year (N°)	0.85	0.78	0.81	0.187	0.82	0.02	0.78	0.091
Weaned calves/cow/year (N°)	0.81	0.71	0.65	0.061	0.75	0.03	0.69	0.025*
Age at weaning (months)	5.86	5.82	6.00	0.886	5.87	0.13	5.88	0.944
Live weight at calving (kg)	202.33a	190.91b	193.18ab	0.037*	196.75	2.12	191.67	0.011*
Calves sold at weaning age/cow/year (N°)	0.63a	0.66a	0.27b	0.000***	0.58	0.03	0.53	0.000***
Fattened calves sold/cow/year (N°)	0.07a	0.00a	0.45b	0.000***	0.11	0.03	0.15	0.000***
Fattened calves/total calves sold	0.09a	0.00a	0.64b	0.000***	0.15	0.30	0.21	0.119

a, b, c Mean values with different letters in the same row are significantly different. * p<0.05, ** p<0.01, *** p<0.001. [1]Calculated as the annual average proportion of heifers bred for reproduction/number adult. [2]Annual average proportion of cows synchronized/total adult cows in the farm. [3]Average annual proportion of inseminated cows/total adult serviced cows in the farm. [4]Annual average proportion of: live births/serviced cows. [5]Annual average number of days from calving to calving in the adult cows of the farms. [6]Analysis of Variance of the groups Conventional, Organic 1 and Organic 2. [7]Analysis of Variance of the groups Conventional vs. All Organic.

Table 2. Reproductive management and performance, and productive orientation. Mean values, standard deviation and level of significance

In relation to the various land uses and the type of ownership, it was seen that 59% of land was in property (owned area/UAA in percentages). Fifty-two percent of UAAs had tree presence. Moreover, crop areas were almost inexistent.

3.2.2. Reproductive management and performance, and production results

Estrous synchronisation was only carried out in the 3.20% of farms held. This practice was only observed in conventional farms, since it is not permitted in organic farming. Accordingly, only 4.80% of farms opted for artificial insemination, with all of them also carrying out natural mating, such that the use of either one or another technique was not exclusive. This scarce use of these reproductive techniques is typical in low-input beef cattle farms.

Calves weaned in All Organic had lower weights than those belonging to the conventional group, and Organic 2 farms sold less weaned calves per cow in total, thus showing a lower

productivity in this regard. However, Organic 2 and All Organic sold more fattened calves per cow and also sold a higher proportion of fattened calves/total calves sold. These differences were due to the fact that the Organic 2 group was composed entirely of fattening farms, while all Organic 1 farms solely marketed calves at the age of weaning. Similarly to the Organic 1 group, 83.33% of the farms belonging to the conventional group did not carry out the fattening of any of the calves that they produced. These facts about the composition of the groups also influenced the differences between these indicators for yearlings sold per cow and calf weight at weaning.

3.2.3. Breeds

The breed distribution of organic farms is also an important issue, as autochthonous breeds are preferable for this production model, as indicated by Regulation 834/2007 [28]. **Table 3** shows the composition by breed of the farms.

Parameters	Conv. (*n* = 30)	Org. 1 (*n* = 22)	Org. 2 (*n* = 11)	Sig. 1[1]	Sample (*n* = 63)	SD	All Organic (*n* = 33)	Sig. 2[2]
Purebred autochthonous cows (%)	20.11a	30.76ab	62.08b	0.015*	41.83	31.16	41.20	0.045*
Purebred foreign cows (%)	8.86	11.25	6.74	0.854	22.31	9.33	9.75	0.877
Purebred cows (%)	28.97a	42.01ab	68.82b	0.027*	42.85	40.48	50.95	0.041*
Purebred autochthonous bulls (%)	13.02	15.91	31.36	0.264	32.06	17.23	21.06	0.324
Purebred foreign bulls (%)	86.98	76.82	68.64	0.254	33.94	80.23	74.09	0.133

a, b Mean values with different letters in the same row are significantly different. * $p < 0.05$. [1]Analysis of Variance of the groups Conventional, Organic 1 and Organic 2. [2]Analysis of Variance of the groups Conventional vs. All Organic.

Table 3. Farm breed structure. Mean percentage values, standard deviation and level of significance

The percentage of purebred autochthonous cows reached 41.83%, with this percentage being higher in All Organic and Organic 2 than in the conventional group. Also, All Organic and Organic 2 showed a higher presence of these purebred cows; either autochthonous or foreign ones. The main reason for this is that Organic 2 farmers were market oriented (they had contracts with supermarkets) so that they knew that more productive breeds that allow them to produce carcass of better conformation, mainly Limousine.

3.3. Economic parameters

3.3.1. Analysis of fixed capital

This analysis allowed identification of similarities between organic and conventional systems (**Table 4**), with regard to infrastructure, land and animals. It is worth highlighting the high average value of land fixed capital 5489.42 €/ha that accounted for the 81% of total fixed capital (**Table 5**).

Parameters	Conv. (n = 30)	Org. 1 (n = 22)	Org. 2 (n = 11)	Sig. 1[5]	Sample (n = 63)	SD	All Organic (n = 33)	Sig. 2[6]
Land fixed capital[1]	5,630.07	5,194.52	5,695.62	0.788	5,489.42	310.43	5,361.56	0.669
Buildings fixed capital[2]	660.75	606.48	546.10	0.935	621.78	114.32	586.35	0.748
Machinery fixed capital[3]	215.51	138.79	107.77	0.449	169.91	35.00	128.45	0.217
Livestock fixed capital[4]	624.81	416.66	329.10	0.217	500.49	69.69	387.47	0.089
Total fixed capital	7,131.14	6,356.45	6,678.59	0.443	6,781.59	430.59	6,463.83	0.443

Note: all these indicators were measured in terms of €/ha. [1]Value of the land at market prices. This depended on the quality of the plots (grazing resources, location and tree density, among other parameters). [2]Value of infrastructure at market prices. Years of use and level of conservation/maintenance were taken into account. [3]Value of machinery (cars, trucks, etc.) at market prices. Years of use and level of conservation/maintenance were taken into account. [4]Value of all livestock present at market prices. [5]Analysis of Variance of the groups Conventional, Organic 1 and Organic 2. [6]Analysis of Variance of the groups Conventional vs. All Organic.

Table 4. Fixed capital according to farm groups.

Parameters	Conv. (n = 30)	Org. 1 (n = 22)	Org. 2 (n = 11)	Sample (n = 63)	SD	Sig. 1[13]	All Organic (n = 33)	Sig. 2[14]
Feed/ha UAA[1]	109.69a	17.55b	96.63ab	75.24	112.18	0.009**	43.91	0.019*
Feed/LU[2]	161.59a	38.27b	220.54a	128.82	165.70	0.003**	99.03	0.136
Seeds and fertilisers[3]	7.51	3.10	1.00	4.84	12.61	0.252	2.40	0.108
Veterinary and medicines/ha UAA[4]	17.87a	4.51b	4.84b	10.93	21.16	0.043*	4.62	0.012*
Veterinary and medicines /LU[5]	20.32a	7.45b	11.64ab	14.31	15.14	0.006**	8.84	0.002**
Maintenance of fixed capital[6]	15.74	18.95	22.60	18.06	22.68	0.681.	20.17	0.444
Energy[7]	24.24	22.44	18.27	22.57	22.84	0.765	21.05	0.584
Other expenditure[8]	24.32	20.87	21.88	22.69	33.67	0.934	21.20	0.717
Intermediate consumption[9]	199.38	87.42	165.22	154.32	177.86	0.077	113.36	0.054
Remuneration of employees[10]	60.29	42.48	61.24	54.24	100.69	0.799	48.73	0.653
Fixed capital consumption[11]	54.59	44.20	38.08	48.08	66.62	0.744	42.16	0.464
Land rented[12]	30.56	30.96	23.25	29.42	38.47	0.846	28.39	0.825

a, b Mean values with different letters in the same row are significantly different. * p<0.05, ** p<0.01. [1]Expenditures (purchases) made in external feedstuffs/hectare of UAA (€/ha). [2]Expenditures (purchases) made in external feedstuffs/LU (€/LU). [3]Expenditure in seeds and fertilisers/hectare of UAA (€/ha). [4]Expenditures made in veterinary and medicines/ha UAA (€/ha). [5]Expenditures made in veterinary and medicines /LU (€/LU). [6]Expenditures made in maintenance of fixed capital/ha of UAA (€/ha). [7]Expenditures made in energy/ha UAA (petrol and electricity) (€/ha). [8]Expenditures/ha UAA made in farmers' associations, lawyers, etc. (€/ha). [9]Sum of the following costs (€/ha of UAA: External feedstuffs + Veterinary services and medicines + Energy + Maintenance of machinery and infrastructure + Other goods and Services (lawyers, farmers' associations, etc.). [10]Expenditures made in salaries/ha of UAA (€/ha). [11]Amortization of machinery and infrastructure = Sum of (((1/20 years amortization) × Value of infrastructures) + ((1/10 years) × Value of machinery)). [12]Cost of the land rented (€/ha). [13]Analysis of Variance of the groups Conventional, Organic 1 and Organic 2. [14]Analysis of Variance of the groups Conventional vs. All Organic.

Table 5. Intermediate consumption and other costs.

Parameters (€/ha)	Conv. (n = 30)	Org. 1 (n = 22)	Org. 2 (n = 11)	Sample (n = 63)	SD	Sig.[6]	All Organic (n = 33)	Sig.[7]
Livestock sales	291.23	151.90	215.92	229.43	223.45	0.081	173.24	0.035*
Other sales	1.49	11.34	9.75	6.37	23.05	0.276	10.81	0.110
Gross output[1]	635.24	464.09	578.52	565.57	406.81	0.328	502.24	0.197
Subsidies for livestock	158.54	153.75	185.72	161.61	118.93	0.759	164.41	0.847
Total subsidies	165.70	159.91	193.85	168.59	123.39	0.752	171.22	0.861
Total income	458.41	323.15	419.52	404.39	316.03	0.313	355.27	0.198
Total subsidies/total income (%)	0.39	0.45	0.47	0.42	0.18	0.353	0.45	0.160
Net value added[2]	388.43	338.63	383.35	370.15	249.94	0.769	353.53	0.584
Net operating surplus[3]	320.98	289.98	313.99	308.94	223.74	0.886	297.98	0.687
Net entrepreneurial income[4]	290.43	259.02	290.74	279.52	214.31	0.861	269.60	0.703
Profitability rate (%)[5]	4.39	4.18	4.35	4.31	2.69	0.961	4.24	0.819

Note: Those parameters whose unit is not showed in the table are measured per ha of UAA ((€/ha). [1]Value of all the products of agricultural activities. All agricultural output was recorded except that which was solely produced by units for their own consumption. [2]It measures the value created by all agricultural output after the consumption of fixed capital. That output is valued at basic prices and intermediate consumption is valued at purchase prices. It was calculated as follows: (Gross output – Intermediate consumption – Amortisation) + (Those subsidies not related to livestock farming). [3]It measures the yield from land, capital and unpaid labour. It is the balance of the generation of income account which indicates the distribution of income between the factors of production and the general government sector. [4]Obtained by adding the interest received and then deducting rent (i.e., farm and land rents) and interest payments, measuring compensation of unpaid labour, remuneration from land belonging to units and the yield arising from the use of capital. [5]Ratio between net surplus and average capital assets, estimated from the value of total fixed capital and the value of capital. [6]Analysis of Variance of the groups Conventional, Organic 1 and Organic 2. [7]Analysis of Variance of the groups Conventional vs. All Organic.

Table 6. Economic and productive performance and subsidies.

Table 6 shows the economic and productive performance of the farm groups, as well as aspects related to subsidies, where the Organic 1 group can be seen to have lower livestock sales per hectare of UAA and lower gross production.

Conventional farms proved to sell more calves per hectare and year, which is due to their shorter productive cycle and the low productivity of Organic 1. No differences were found for the remaining indicators, but some interesting results were found and therefore comments are necessary. Organic farms (especially Organic 2) revealed higher numerical values for other sales, which reflect a higher level of business diversification, something that is key in the farms' flexibility and adaptability to the changing market environment. Moreover, organic farms (especially Organic 2) tended to be more dependent on subsidies.

4. Discussion

4.1. Structure

4.1.1. Farm and herd characteristics

All Organic farms were much smaller than the average farm size found by Perea et al. [10] in organic cattle farms located in seven regions of Spain (261.76 vs. 425 ha UAA). With regard to

herd size, All Organic farms were also quite similar to Conventional farms and again smaller than the farms studied by [10], with 100.44 vs. 154 livestock units (LU).

The scarce association between land and animals continues to be an unsolved concern [6,10]. Similarly, the integration of different livestock species is beneficial. In the farms analyzed, the proportion of cattle has been really high – 96%, in line with the findings of Perea et al. [9,10]. This situation responds to the trend of specialisation and intensification already described [15,17,18], with increasing total stocking rates in beef cattle farms from 0.40 to 0.43 LU/ha ([6] —conventional farms; and [9,10]—organic farms) to the current 0.60 LU/ha. The higher mean values observed in this study came from conventional farms (0.70). Both Organic 1 and Organic 2 farms complied with the regional organic rules [29] setting a maximum stocking rate allowed of 0.5 LU/ha.

4.1.2. Reproductive management and performance, and production results

No major differences were found between farm's groups regarding the reproductive management among groups, since most of arms followed the typical technical reproductive management in extensive ruminants production systems located in semiarid areas, where the low fertility rates compared to other breeds and systems. This is due to the fact that heats are not detected by farmers, there is no heat synchronization, and natural service is the predominant technique used for conception. Only some organic farms showed to apply artificial insemination. Average replacement rate of the sample was close to 12%, similar to that found in *dehesa* beef cattle farms, either conventional: with values ranging from 10 to 12.4% in Extremadura [30–32] or organic: 10.65% in Andalusia [9]. However, values found in the study of Milán et al. [6] were higher: 19.2%. The number of cows per bull was 30.42, lower than the 38.4 found by Milán et al. [6] and similar to the 27 found by López de Torre et al. [31] in conventional cattle farms in the *dehesas* of Extremadura. The implementation of reproductive techniques, such as artificial insemination, was even lower than that found by Milán et al. [6]: 8.5 vs. 4.80%. This divergence in results is due to the fact that they analysed farms rearing autochthonous purebred beef cattle cows. In these cases, livestock is usually registered in the Stud Book of the breeds, and the use of artificial insemination is more widespread, with the aim of rearing offspring of more appreciated genetic potential, and thus obtaining higher incomes through both selling animals as breeding animals and public subsidies.

Despite the lack of significant differences among groups, it is necessary to discuss some topics such as the reproductive calendar due to its importance in the context of uncertain availability of pastures in pasture-based systems, such as those of the Mediterranean basin. In this sense, it is recommended to avoid continuous mating and make it coincide with spring and autumn, the seasons where the availability of local feed resources allows fulfilling an important percentage of animals' nutritional needs at more affordable prices, due to a lower dependence on external feedstuff, whose prices are high and subjected to great volatility. However, also positive externalities can be found from this organization: reduced seasonality in marketing their products, thus obtaining better prices for them at certain times. Many of the farms analysed showed a distribution of mating throughout a year. Thus, the average duration of mating was 10.46 months.

Calves weaned in organic farms had lower weights than those belonging to the Conventional group. This could be due to the following aspects: Firstly, in some of the studies discussed, farms reared only local breeds, whose growing rates are lower. However, in the farms analysed in this study, many cows were either crossed or more efficient breeds, mainly the Limousine breed. Secondly, increased livestock pressure led to intensification and guidance to higher productivity which, among other adaptations, led to the inclusion of more efficient breeds. Thirdly, the rising prices of feed led to the weaning of animals at a younger age (therefore at lower weights), in order to use less feedstuff and thus reduce production costs. Finally, the next link in the food chain prefers younger animals because of their better conversion rates in feedlots. Moreover, less time grazing is usually associated with meat tenderness and lighter colour, which is in line with butchers' preferences. Thus, Organic 2 farms were those that sold more fattened calves per cow, and the age of weaning of these was lower. The latter was due to the fact that calves in Organic 2 farms were weaned before starting the fattening period, which shortened the length of the production cycle at the farm level (period between weaning and sale).

The results relating to calves weaned and sold per cow clearly show how the production of beef cattle in Southwest Europe and in semiarid areas, such as the Mediterranean basin, is mainly focused on the sale of calves at weaning. As a result, the percentage of fattened calves sold has been reduced. This is due to both the lack of infrastructure and the traditions of finishing and slaughtering animals in the Extremadura region [33]. Currently, this fact might have increased due to high feed prices and low farm profitability.

The existence of organic farms without organic products (Organic 1 in the present study) has been reported for more authors in dairy cattle [34], in a mixture of livestock and crop farms [35] and beef cattle [10,18]. Specifically, Perea et al. [10] reported that only 40.6% of the surveyed organic beef cattle farms marketed calves as organically certified, and to the organic market. Thus, they also noticed that in different areas of Europe (from Norway to the Mediterranean area) the marketing of organic livestock is focused on the sale to conventional feedlots, and their organic stamp does not have market implications (there is a scarce market for these weaned organic animals, and they are not sold at a higher price; see [27]).

4.1.3. Breeds

The use of autochthonous breeds is a contemporary issue and usually promoted in organic farming. However, the low productivity of the rustic local cows makes it necessary to make use of other breeds that, despite not being autochthonous, are both well adapted to the local conditions and more productive. Thus, in the case of males, the racial distribution was mainly based on Limousine and Charolais breeds. This is a growing trend that responds to the need for productivity and competitiveness that requires specialisation [36]. In the *dehesas* of Extremadura, there has also been a change from Charolais towards Limousine, probably aimed at avoiding problems related to dystocia and the ability of calves to suckle, since farmers perceive that these problems are more frequent when the Charolais breed of animals are reared.

4.2. Economic parameters

4.2.1. Analysis of fixed capital

No significant differences were found between the groups of farms studied.

4.2.2. Costs, production and incomes

It is important to note that expenditure on feedstuff was lower in Organic 1 than in Conventional group when studied per hectare, while differences were found between Organic 1 and the rest of groups when these expenditures were measured per livestock unit. The expenditure on veterinary services and veterinary drugs were also lower in Organic 1 group both per area of land and per livestock unit. However, these differences only were found between Organic 1 and the Conventional group. All Organic group showed to also rely less on these external resources (feedstuff, veterinary services and drugs). However, the expenditure on feed per livestock unit was not statistically different between All Organic and the Conventional group. In general terms, these higher reliance on external resources, and in particular feed and veterinary services and drugs, is consistent with the organic production method, since the use of inputs such as feed must come from the farm itself (or the immediate surroundings), and veterinary drugs are limited to two treatments per adult cow per year, according to [28] and subsequent amendments.

When comparing Conventional and All Organic farms, one can observe very low feed costs in Organic 1 and very high feed costs in Organic 2 farms. This is due to the fact that Organic 2 farms fattened all their calves, and Organic 1, none of theirs. This increases the organic feedstuff purchased, whose price is high: around 30% above the conventional one.

The cost related to veterinary services and medicines shows that in extensive livestock systems of semiarid areas and conditions it is possible to reduce reliance on drugs with no major problems. In fact, conventional low-input farms in this area do not rely significantly on these products due to low stocking rates and dry climate. Also, as the prevalence of infectious diseases is low, it must be mentioned that the health management of organic beef cattle farms in this area is very similar to that carried out in Conventional farms, and it is not based on alternative medicine. In fact organic beef cattle farms also used some veterinary drugs as a preventive measure [17]. Organic 2 farms had higher veterinary costs than Organic 1 farms due to the fact that the transition to the fattening period usually provokes some respiratory and/or intestinal disorders.

Regarding incomes, it is necessary to increase the market orientation of Organic 1 farms, as they are not providing organic goods to the market, which influences their low economic results. Conversely, the longer productive cycle in Organic 2 farms did not allow them to clearly stand out in terms of income. Finally, the dependence on agricultural subsidies must be addressed as it is a key point for both the organic sector and the extensive beef cattle farms of Mediterranean Europe. The high dependence of this aspect makes it unstable and fragile. In the case of the organic sector, the contribution of the agro-environment subsidies makes

them numerically more dependent, which is in contrast with other studies, regardless whether or not they were receiving agricultural subsidies [35,37,38].

The lower livestock sales per hectare of UAA and lower gross production in the Organic 1 group can be due to the fact that farms belonging to this group only sold calves at weaning age, and their prices were lower than those of fattened calves. Despite the price of organic fattened calves (marketed by the Organic farms 2 group) being greater, income from the sale of livestock per hectare of UAA was higher in Conventional farms. This was probably due to an extension of the productive cycles in Organic 2 compared to Conventional farms which, in turn, led to a reduction in the number of calves sold per cow per year. On the other hand, organic farms (especially the Organic 1 group) had higher incomes in relation to other sales (those not related to livestock). This could be a consequence of the greater degree of diversification in organic farming over conventional.

4.2.3. Other aspects worthy of discussion: workforce, agro-environmental management and marketing strategies

In addition, other aspects came up from the interviews with farmers during the farm visits which point to additional interesting aspects and open up perspectives which would be interesting to research. In this sense, Escribano et al. [17,18] carried out a comparative sustainability assessment which showed that organic farms did not carry out so many agroecological practices as would be desirable to increase farm environmental protection, nutrient cycling and self-sufficiency. Moreover, these authors found that in terms of workforce both production systems are also very similar. Additionally, short marketing channels, which are commonly associated with organic production, were noted to also be very similar in various studies [17,18,27,39,40]. Profound discussion and review about these aspects can be found in other studies [40].

5. Conclusions and future perspectives

The present study integrated structure, technical, productive and economic parameters that allowed for a deep understanding of the organic beef cattle farms of Southern Europe, as well as their similarities and differences with conventional ones. Organic farms have proved to be very similar to Conventional farms (but pasture-based or low-input). Accordingly, the differences were based on the structure of the farms, more than the condition of their being organic.

According to the results discussed, it is worth mentioning that there was little orientation towards a different concept of farming, namely, environmental sustainability and self-sufficiency. However, the organic farm has been defined as a production system based on the principles of Health, Ecology, Fairness and Care. In this sense, consumers expect organic products to be based on these principles, and citizens support this system through taxes. All these aforementioned aspects shape the necessity to increase the implementation of sustainable agricultural practices, self-sufficiency and sales of organic products. Otherwise, the current

production systems will hinder their sustainability due to high global competition, the increasing cost of agricultural inputs and reduced grazing resources in the Mediterranean area due to global warming. To do so, the education level of farmers, public support and farmer cooperation are essential. Moreover, further research is needed to study different production systems and strategies in order to improve the situation of the sector and the differential externalities of the organic livestock sector above the conventional one.

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References

[1] FiBL, IFOAM. The world of organic agriculture. Statistics & Emerging Trends 2015. 2015; http://www.organic-world.net/yearbook-2015.html. Accessed 04 August 2015.

[2] Rodríguez L, Bartolomé DJ, Tabernero de Paz MJ, Posado R, García JJ, Bodas R, Garrido C, Vázquez JM, Mazariegos V, Vicente M, Olmedo S. Características técnico-económicas de las explotaciones de ovino lechero con reproducción asistida de Castilla y León: Sistemas y tipos de explotación. ITEA. 2013;109:201-214.

[3] Olaizola AM, Manrique E, Maza MT. Tipos de sistemas de producción y rendimientos económicos en las explotaciones de vacuno de montaña. ITEA Producción Animal. 1995;91:47-58.

[4] Serrano EP, Lavín P, Giradles FJ, Bernués A, Ruiz A. Classification variables of cattle farms in the mountains of León, Spain. Spanish Journal of Agricultural Research. 2004;2:504–511.

[5] Serrano E, Lavín P, Giradles FJ, Bernués A, Ruiz A. The identification of homogeneous groups of cattle farms in the mountains of León, Spain. Spanish Journal of Agricultural Research. 2004;2:512-523.

[6] Milán MJ, Arnalte E, Caja G. Economic profitability and typology of Ripollesa breed sheep farms in Spain. Small Ruminant Research. 2003;49:97-105.

[7] Nieto MI, Olaizola AM, Manrique E. Los sistemas de vacuno de carne de las sierras de La Rioja: I Caracterización de las explotaciones. ITEA Producción Animal. 2005;26:183-185.

[8] Ruiz R, Igarzabal A, Mandaluniz N, Amenazar M, Oregui LM. Caracterización de los principales sistemas de producción de ganado vacuno en el País Vasco. ITEA. 2005;26:195-197.

[9] Perea J, García A, Acero R, Valerio D, Rodríguez V. Caracterización productiva del vacuno ecológico en Andalucía. Archivos de Zootecnia. 2007;56:517-521.

[10] Perea J, Blanco–Penedo I, Barba C, Angón E, García A. Organic beef farming in Spain: Typology according to livestock management and economic variables. (Producción ecológica bovina de carne en España: tipología de acuerdo a variables técnicas y económicas). Revista Científica, FCV-LUZ. 2014;XXIV:347-354.

[11] Granda M, Moreno V, Prieto M, (Eds.) Pastos naturales en la dehesa extremeña. SIA-Junta de Extremadura. 1991.

[12] Hernández CG, (Ed.) La dehesa, aprovechamiento sostenible de los recursos naturales. Editorial Agrícola Española. 1998.

[13] Espejo M, Espejo AM. Los sistemas tradicionales de explotación y la aplicación de innovaciones tecnológicas de la dehesa. In: Espejo M, Martín M, Matos C, Mesías FJ, (Eds.) Gestión ambiental y económica del ecosistema dehesa en la Península Ibérica. Junta de Extremadura, Consejería de Infraestructuras y D.T. 2006.

[14] Gaspar P, Mesías FJ, Escribano M, Rodríguez De Ledesma A, Pulido F. Economic and management characterization of dehesa farms: Implications for their sustainability. Agroforestry Systems. 2007;71:151-162.

[15] Gaspar P, Mesías FJ, Escribano M, Pulido F. Sustainability in Spanish extensive farms (Dehesas): An economic and management indicator-based evaluation. Rangeland Ecology and Management. 2009;62:153-162.

[16] Franco JA, Gaspar P, Mesías FJ. Economic analysis of scenarios for the sustainability of extensive livestock farming in Spain under the CAP. Ecological Economics. 2012;74:120-129.

[17] Escribano AJ, Gaspar P, Mesías FJ, Escribano M, Pulido F. Comparative sustainability assessment of extensive beef cattle farms in a high nature value agroforestry system. In: Squires VR, (Ed.) Rangeland Ecology, Management and Conservation Benefits. Nova Science Publishers. 2015.

[18] Escribano AJ, Gaspar P, Mesías FJ, Pulido AF, Escribano M. A sustainability assessment of organic and conventional beef cattle farms in agroforestry systems: The case of the dehesa rangelands. ITEA Información Técnica Económica Agraria. 2014;110:343-367.

[19] Regulation (EC) No 138/2004 of the European Parliament and of the Council of 5 December 2003 on the economic accounts for agriculture in the Community.

[20] Gaspar P, Escribano M, Mesías FJ, Ledesma AR, Pulido F. Sheep farms in the Spanish rangelands (dehesas): Typologies according to livestock management and economic indicators. Small Ruminant Research. 2008;74:52-63.

[21] Lebacq T, Baret PV, Stilmant D. Sustainability indicators for livestock farming. A review. Agronomy for Sustainable Development. 2013;33:311-327.

[22] Nieto MI, Olaizola AM, Manrique E. Los sistemas de vacuno de carne de las sierras de La Rioja: I Caracterización de las explotaciones. ITEA. 2005;26:183-185.

[23] García A, Perea J, Acero R, Angón E, Toro P, Rodríguez V, Gómez Castro AG. Structural characterization of extensive farms in andalusian dehesas. Archivos de Zootecnia. 2010;59:577-588.

[24] Gaspar P, Escribano AJ, Mesías FJ, Escribano M, Pulido AF. Goat systems of Villuercas-Ibores area in SW Spain: Problems and perspectives of traditional farming systems. Small Ruminant Research. 2011;97:1-11.

[25] Toro-Mújica P, García A, Gómez-Castro AG, Acero R, Perea J, Rodríguez-Estévez V, Aguilar C, Vera R. Organic dairy sheep farms in south-central Spain: Typologies according to livestock management and economic variables. Small Ruminant Research. 2012;100:89-95.

[26] Riveiro JA, Mantecón AR, Álvarez CJ, Lavín P. A typological characterization of dairy Assaf breed sheep farms at NW of Spain based on structural factor. Agricultural Systems. 2013;120:27-37.

[27] Escribano AJ. Beef cattle farms' conversion to the organic system. Recommendations for success in the face of future changes in a global context. Sustainability. 2016;8:572.

[28] Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092/91.

[29] DECRETO 9/2016, de 26 de enero, por el que se regula el régimen de ayudas agroambientales y climáticas y agricultura ecológica para prácticas agrícolas compatibles con la protección y mejora del medio ambiente en la Comunidad Autónoma de Extremadura. DOE Numero 18. Jueves, 28 de enero de 2016.

[30] López de Torre G.. Metodología y esquema de selección de razas maternales de vacuno de carne: Aplicación a la raza Retinta. Especial Vacuno de Carne. Exclusivas ONE. 1986:75-93.

[31] López de Torre G, García Barreto L, López Márquez JA. Encuesta sobre la explotación y mejora del ganado vacuno en la Dehesa extremeña. In: Campos P, Martín M, (Eds.) Conservación y Desarrollo de las Dehesas Portuguesas y Española. Ministerio de Agricultura, Pesca y Alimentación. 1987.

[32] Martín M, Escribano M, Mesías FJ, Rodríguez de Ledesma A, Pulido F. Sistemas extensivos de producción animal. Archivos de Zootecnia. 2001;50:465-489.

[33] Mateos A. 2008. Caracterización del cebo de bovino en Extremadura. Doctoral thesis. Departamento de Producción Animal, Universidad de Extremadura.

[34] Flaten O, Lien G, Ebbesvik M, Koesling M, Valle PS. Do the new organic producers differ from the 'old guard'? Empirical results from Norwegian dairy farming. Renewable Agriculture & Food Systems. 2006;21:174-182.

[35] Argyropoulos C, Tsiafouli MA, Sgardelis SP, Pantis JD. Organic farming without organic products. Land Use Policy. 2013;32:324-328.

[36] Ligios S, Revilla R, Nardona A, Casu S. Cattle husbandry systems in Mediterranean mountains: Situation and prospects. In: Georgoudis A, Rosati A, Mosconi C, (Eds.) Animal Production and Natural Resources Utilisation in the Mediterranean Mountain Areas EAAP. 2005.

[37] Hrabalová A, Zander K. Organic beef farming in the Czech Republic: Structure, development and economic performance. Agricultural Economics UZPI. 2006;52:89-100.

[38] Gillespie J, Nehring R. Comparing economic performance of organic and conventional U.S. beef farms using matching examples. Australian Journal of Agricultural and Resource Economics. 2013;57:178-192.

[39] Lobley M, Butler A, Winter M. Local organic food for local people? Organic marketing strategies in England and Wales. Regional Studies. 2013;47:216-228.

[40] Escribano AJ. Organic livestock farming: Challenges, perspectives, and strategies to increase its contribution to the agrifood system's sustainability – A review. In: Konvalina P, (Ed.) Organic Farming – A Promising Way of Food Production, InTech. 2016.