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Small ruminants in a High Nature Cultural Value agroforestry system. Case studies in sheep research

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Abstract. Sheep and goat systems in south west Spain are “suffering” the same as any other extensive ruminant systems the Mediterranean area. Specifically, sheep farms have been endangered in recent years due to various pressures derived from changes in the consumption patterns and public policy changes. These systems are extremely fragile, as well as having a key role in providing environmental services. In this paper two case studies are presented. The first one is dealing with dairy herds of Merino ewes producing under a PDO scheme. In this case we analyse the farmers’ perception of their relationship with the PDO “Torta del Casar”, one of the most well-known Cheese PDOs in Spain, focusing on the technical and economic benefits that they obtain from their membership. The second case is related to sheep for meat systems. A sample of 101 sheep farms belonging to a second degree cooperative has been analysed. From this case we can conclude that the integration of farms into cooperatives can improve farm structure and ensure their persistence, due to the provision of additional services to the farmer, the generation of added value and increased price stability. Both cases are examples of successful strategies to improve the level of competitiveness of the productive system and the viability of the farms.

Keywords. Dehesa – Extensive farming – Agroforestry systems – PDO – Cooperativism.

Petits ruminants dans un système d'agroforesterie à forte valeur culturelle. Études de cas en recherche de moutons

Résumé. Les systèmes de moutons et de chèvres dans le sud-ouest de l'Espagne « souffrent » de même que tous les autres systèmes de ruminants extensifs de la région méditerranéenne. Plus précisément, les exploitations de moutons ont été mises en danger ces dernières années en raison de diverses pressions découlant des changements dans les modes de consommation et les changements de politique publique. Ces systèmes sont extrêmement fragiles, tout en jouant un rôle clé dans la fourniture de services environnementaux. Dans cet article, deux études de cas sont présentées. Le premier concerne les élevages laitiers de brebis Merino produisant dans le cadre d'un programme PDO. Dans ce cas, nous analysons la perception par les agriculteurs de leur relation avec l'AOP “Torta del Casar”, l'une des PDO les plus connues du fromage en Espagne, axée sur les avantages techniques et économiques qu'elles obtiennent de leur adhésion. Le deuxième cas concerne les moutons pour les systèmes de viande. Un échantillon de 101 élevages de moutons appartenant à une coopérative de deuxième degré a été analysé. Dans ce cas, nous pouvons conclure que l'intégration des fermes dans les coopératives peut améliorer la structure des exploitations agricoles et assurer leur persistance, grâce à la fourniture de services supplémentaires à l'agriculteur, à la création de valeur ajoutée et à la stabilité des prix accrue. Les deux cas sont des exemples de stratégies réussies pour améliorer le niveau de compétitivité du système productif et la viabilité des fermes.

Mots-clés. Dehesa – Agriculture extensive – Systèmes agroforestiers – PDO – Coopérativisme.

I – Small ruminant systems in south west of Spain

In the southwest of the Iberian Peninsula, small ruminant production is based primarily on an extensive farm system, usually associated with beef cattle and pigs, and located frequently in agroforestry systems known as “Dehesas”. “Dehesas” are High Nature Cultural Value agroforestry system used for livestock range farming characterized by its mix of pasture and evergreen oak stands. It originated from the traditional Mediterranean forest, and indeed human intervention has been fundamental in maintaining the dehesa ecosystem as such, because the use of appropriate cultural practices has conserved the tree stratum, thus avoiding scrub invasion and increasing the system’s efficiency. Mixed-species grazing of beef cattle, sheep, goats and Iberian pigs is often practised to more efficiently utilize grazing resources. The ruminants can make use of the pasture, stubble, and fallow land, while the Iberian pigs in their final phase of fattening for market feed free-range on the pasture, and on mast from the holm oaks principally, but also from gall and cork oaks (Gaspar *et al.*, 2007). The main orientation of these systems is to meat production and the sale of animals for intensive fattening (Pulido *et al.*, 1999).

In Figure 1 one can see the distribution of agroforestry systems categorized by der Herder *et al.* (2017) in a recent work. As can be seen, throughout the southwest of the Iberian Peninsula there is a large expanse of territory occupied by these agroforestry systems.

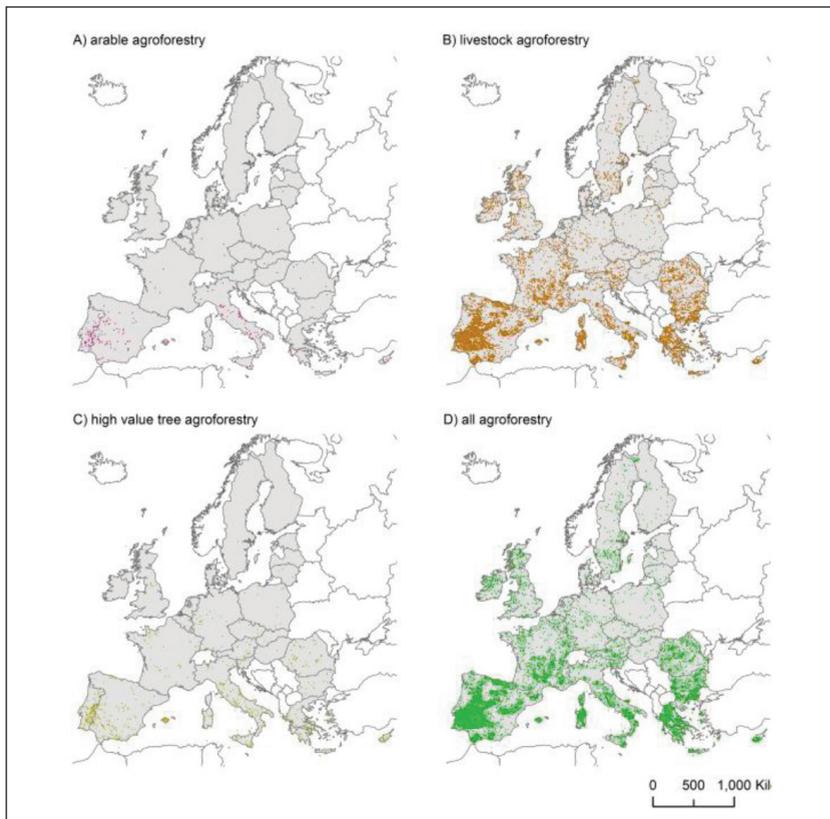


Fig. 1. Distribution of agroforestry in Europe. A) arable agroforestry, B) livestock agroforestry, C) high value tree agroforestry, and D) total extent of agroforestry.

Source: den Herder *et al.* (2017).

In Spain, major census of sheep, are concentrated in the autonomous communities of Extremadura, Castilla-Leon, Castilla-La Mancha, Andalusia and Aragon, representing 78.7 per cent of the national total altogether. In particular, the weight of the sheep in Extremadura is very significant, since it has a census of 3.4 million heads, representing 20.7% of the census at the national level (MAPAMA, 2014). Distribution of sheep and goat cattle in the different regions of Spain can be seen in figures 2 and 3. Largely, the areas with the highest density of small ruminants are also areas occupied by agroforestry systems.

In recent decades, the reduction in the number of farms and animals has been significant. The abandonment of this sheep activity has been of concern for institutions both at European, national or regional level. In particular, in Spain (second largest producer of sheepmeat in EU-28) is worth mentioning that since 2002 the production of lamb meat has been reduced approximately 50% (MAPAMA, 2014).

However, the successive reforms of the CAP and the continuous changes in the market have led to a decrease in the profitability of sheep and goat farms. As a result, there have been changes in the use of the soil, which have failed to materialize in some cases in a production intensification and in other cases in the abandonment of sheep farming activity (Gaspar *et al.*, 2008; Gaspar *et al.*, 2009; Ripoll-Bosch *et al.*, 2012).

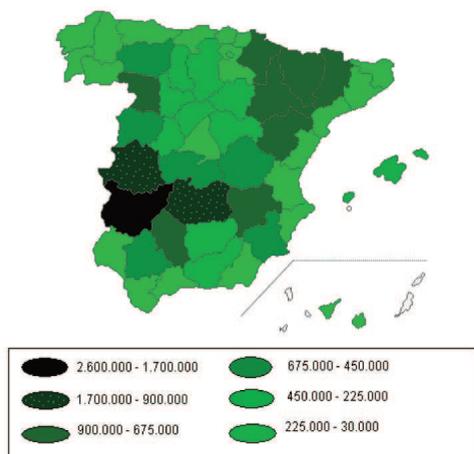


Fig. 2. Geographical distribution of sheep in Spain.

Source: <http://www.mapama.gob.es>

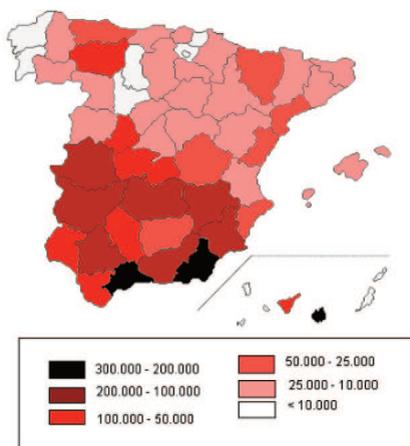


Fig. 3. Geographical distribution of goat in Spain.

Source: <http://www.mapama.gob.es>

In this sense, there is a certain consensus about the fragility of the sheep's meat systems located in Mediterranean regions (De Rancourt *et al.*, 2006), Despite the crucial role they play in maintaining environmental and socio-economic disadvantaged areas of Europe (Bernues *et al.*, 2011). An example of this role is the contribution of sheep grazing in the fight against climate change through protection against forest fires (Mena *et al.*, 2016).

The base of the sheep-farming systems in dehesa agroforestry is the Merino. Because of its hardiness and adaptation to the environment, it is the predominant breed. It has a high capacity to resist extremes of temperature and deficiencies of pasture in both quantity and quality. It also presents rapid bodily recovery when conditions turn favourable. Breeding selection to retain its hardiness, and the use of crosses with meat breeds to improve yields have been the common practice in the dehesas, just as has been the case with cattle.

Dehesa sheep are highly adapted to the energy supply characteristics of the system, so that supplements are minimal compared to other species. Sheep use the grazable pasture resources of autumn and spring, and the agricultural stubble in the summer months. Sheep farms in dehesa systems are basically devoted to meat production, but there are examples where other sheep products are also targeted. Meat production is lamb fattened on the farm, and slaughtered at 3 months and 23-25 kg live weight, depending on resource availability and market demand.

Traditionally, when the Merino sheep was directed towards the production of wool as a main objective, milk only was valued based on the ability of the ewe to grow their lamb. In this sense, the Merino sheep, exploited under grazing conditions with no feed supplement, milk production was very low. The milking was limited to a small number of farms, for a period of 15 - 20 days, after weaning the lambs, for the purpose of obtaining some cheese for family consumption. Yields of 200 gr. per sheep per day were considered to be acceptable (MERAGEM, 2011).

Nowadays, the milking has been extended to a large number of herds, sometimes of great dimensions, although they maintain certain familiar character but which in recent years has transformed into continued, industrial production milking animals throughout the year and applying mechanical milking. In general, the Merino sheep lactation period is divided into two phases; a, 60-day, which corresponds to the period of breeding of the Lamb, and, another, 50 - 70 days, milking-oriented. The average production of milk obtained per sheep per year can be estimated between 30 and 50 litres. The milk obtained by the Merina sheep milking is intended for the manufacture of cheese. In this sense, it has acquired great fame for its high quality, type cheeses: "Serena" "Casar" "Pedroches", among others, obtained from Merino ewes milk (MERAGEM, 2011).

These production models stand out for their high environmental and socio-economic value. Livestock activity, in this case that we carry out with the sheep, plays a very important role in their maintenance and upkeep. However, currently, the stability of the system is conditioned by the low profitability of the extensive sheep productions, the seasonality of the same and the difficulties of marketing.

II – Participatory research: Problems identified by stakeholders in Dehesa agroforestry systems

Within the framework of the European project called AGFORWARD (www.agforward.eu), whose main objective is to promote agroforestry systems in Europe, it is worked to find and test various innovations that can improve agroforestry systems existing at European level. To do this in the early stages of the project was conducted a participatory research process in which a first identified problems which had rangeland and animal systems that settle in it.

One hundred and sixty-nine individual stakeholders were invited for a first meeting. The meeting was envisaged as an open-door day for people interested in the development and conservation of the Iberian dehesa system. The meeting, hold on 30th May 2014 in the Forestry School (University of Extremadura). The degree of participation was very high (> 90 stakeholders) indicating the great awareness of farmers and society in relation to the conservation of the dehesa system. Among the attendees, there were farmers, breeders, foresters, landowners, representatives of their associations (regional and national level), agricultural services companies, extension services, nature-related NGOs, local action groups and policy makers.

Besides of the informative aims, the meeting was stimulated through different techniques of social participation (Ishikawa or fishbone diagrams), to allow joint discussion of the current difficulties and challenges of dehesa and other extensive silvopastoral systems and to compile proposals of innovation. From the discussions consistent proposals of participatory research to evaluate on-farm innovative practices emerged. Participants formed the first nucleus of a Participatory Research and Development Network for the dehesa of SW Spain.

The list of constraints listed in the Ishikawa diagram can be summarized under the following topics:

1. Lack of reliable evaluations of **dehesa profitability**.
2. The sanitary status of dehesa trees. Over-ageing of dehesa trees and lack of tree regeneration.
3. Poor quality of dehesa soils and pasture. **Low productivity and strong seasonality**. Mismatch among pasture resources and **stocking rate**.
4. Livestock health and continuous TB re-infestation through big game.
5. Payment for public **ecosystem services** that presumably are important in the dehesas but that are **not quantified and valued yet**.
6. Lack of governance and communication with **policy** agencies.
7. Lack of adapted policies to multipurpose and seminatural agrosystems such as **extensive wood pastures**.

As it can be seen, a large proportion of the problems identified were that affect animal systems since they are the fundamental pillar by the regime of extensive grazing that occurs there. Thereafter focused on innovations for those animal systems proposal, which though not focus only on the sheep.

A. Demand on innovation new research on animal production

1. The genetic of livestock races is important for selecting the races best adapted to pasture seasonality, docility, browsing behaviour (low preference for young trees) ...
2. Livestock diversification to optimize resources use and market opportunities:
3. Increase the fertility ratios. Semen quality evaluation and breeding males' illnesses.
4. Livestock health with special focus on the tuberculosis re-infestation by wild animal in drinking water points and areas of supplementary fodder provision.
5. Herding schemes
6. Matching stocking rates to forage resources availability and not to subsidies rules.
7. To recover some traditional practices as overnight livestock folding to improve soil and pasture quality.
8. Grazing under the Holistic Management rules (managed fast rotational grazing)
9. Precision grazing by designing calendars for location of facilities (complementary fodder supplementation, water for drink, salt mineral blocks).
10. GPS herding to assist precision grazing, protection of tree regeneration, control of livestock re-infestation by wild animals, monitoring livestock health. While the implementation of GPS to follow and analyse animal's activity is technically solved, the application of negative/positive stimuli to drive animal behaviour is still a big challenge.

III –Case studies in sheep systems research

1. The case of PDO cheese “Torta del Casar”

The sheep sector in Extremadura has been historically oriented towards the production of meat. Milk production has had a marginal importance until the last decade, which has developed a productive infrastructure in some areas of Extremadura region, with a base that is oriented towards the production of artisan cheeses. In this context, producing differentiated through quality marks or Protected Designations of Origin (PDO) could improve the situation of sheep farms, so to en-

sure its continuity and promote rural development in these areas. The PDO Torta del Casar is a case study that demonstrates the usefulness of this strategy. The Torta del Casar is a cheese made with raw milk from merino purebred and crossbred ewes. The geographical area of production and manufacturing is located in the province of Cáceres, in the autonomous community of Extremadura, and within the regions of Los Llanos de Cáceres, Sierra de Fuentes and Montánchez, occupying approximately 400.000 ha.

What is presented in this paper is part of a work that focuses on the analysis of the productive structure of holdings of the PDO "Torta de Casar", assessing the relationship of holdings with the PDO and its future prospects.

A. Methodological process

The research presented analyses sheep farms enrolled in the PDO "Torta de Casar", located in different municipalities of the province of Cáceres (Spain). The data were obtained directly through a survey of farms' managers during the months of March and April 2016 and corresponds to a total of 15 of 16 farms that are covered by the PDO "Torta de Casar".

The main purpose was to analyse how farmers valued their relationship with the PDO "Torta del Casar" and what benefits they got from a technical and economic point of view. So, farmers were asked to rank various aspects of their relationship with the PDO, such as the advice and assistance in management that the PDO provides to its members or the benefits perceived by farmers related to farming under the PDO scheme.

Questions were punctuated by farmers using a Likert scale of 1-5 where 1 value corresponds to "very in disagreement", "disagree" value 2, value 3 to "not in disagreement or agreement", the value 4 to "agree" and the value 5 to "very agree" regarding statements presented on the utilities provided by the PDO. Treatment and statistical analysis of data was carried out using SPSS v. 21 statistical package.

B. Assessment of the experience of belonging to the PDO

Figure 4 shows the most common benefits provided to farmers belonging to the PDO. It can be observed that farmers are quite satisfied with respect to the benefits of the PDO especially in aspects related to the breeding of animals, the increase in production and sales volume. We can see that other studies in sheep dairy scanned deeply breeding farms of sheep dairy in order to increase the milk yield of the animals (Ugarte *et al.*, 2002), as well as, the use of reproductive and genetic technologies in the La Mancha dairy sheep system (Rivas, 2014).

However, farmers are more neutral when value the benefit in the improvement of the infrastructures. The latter result is expected, since the improvement of facilities is resulting in greater investment in a farm, and for which the PDO cannot contribute, at least economically. Nevertheless, and in order to enhance the denominations and other figures of quality, the perception of certain Community aid, such as those included in the improvement of farm plans, membership could link to any of these quality figures. This could improve the image of them among its partners, encouraging interest in membership and remaining.

When farmers were asked about advice and assistance in management they receive for their membership of the PDO, it was found that some aspects has recieved the least ratings (Figure 5). Respondents are timidly highlight only an improvement in the milk marketing, sales and advice provided by the PDO in animals feeding. However, farmers complain the high price of feed supplied through the associated cooperative and that the POD has not generated support for improvement of farms, as well as veterinary and financial assesment is deficient.



Fig. 4. Benefits of a general nature that PDO Torta del Casar provides to its members.

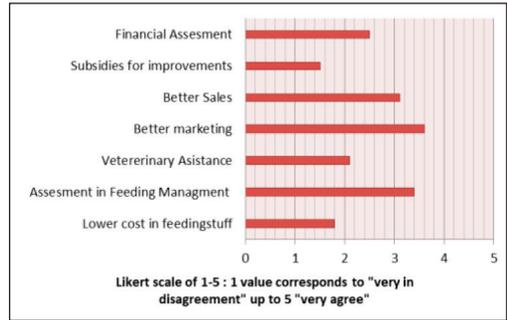


Fig. 5. Valuation of advice and assistance in management that the PDO Torta del Casar provides to its members.

All these aspects will be of extraordinary relevance in assessing the level of competitiveness of the productive system and the viability of their farms, such as in the study of Rivas (2014) in the case of Manchego sheep, or as García *et al.* (2012) who addressed the marketing of milk of sheep like productive alternative.

Finally, the incidence of the PDO on the technical management of farms is given in Figure 6. In terms of the ease of reaching the criteria imposed by the PDO, surveyed farmers are in general quite satisfied. They point to the seasonality of milk production is the main problem in the management of their farms. However, they are reluctant to establish the management of sheep in batches proposed by the PDO, hence they indicated a low level of satisfaction.

As a conclusion, there has been some degree of satisfaction for farmers due to their membership in the PDO, in which they acknowledge its role in the improvement of the general aspects of farms. Respondents are reluctant to establish certain changes in the management of animals involving an annual continuous milk supply for industries. It is clearly visible that they point out shortcomings in financial assessment to undertake reforms and the lack of adequate veterinary advice.

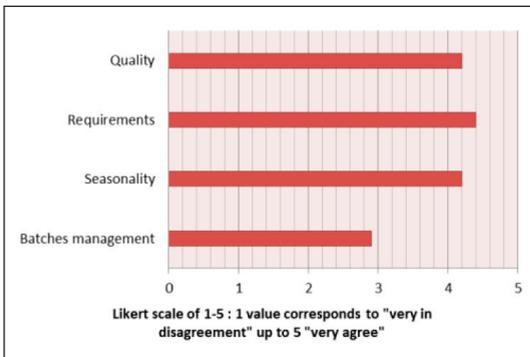


Fig. 6. Assessment of the technical advice provided by the PDO Torta del Casar to its partners.

2. Cooperativism in sheep for meat

In parallel the sheep meat sector is undergoing a transformation, both in the management of their production systems and marketing, to achieve stability of prices throughout the year and the development of new presentations or product formats making it more attractive to the consumer. The aim is that the producers can obtain higher economic returns by improving the management of their holdings and the commercialization of their products. Both levels can be addressed from the integration of farms in a cooperative system that can cope with the current situation and improve their competitiveness (Ruiz *et al.*, 2014), assuming that this integration is one of the key aspects for maintenance and viability of the extensive systems (Horrillo *et al.*, 2016).

So nowadays the sheep meat sector has been involved in recent years in a very important cooperative integration process. This phenomenon of cooperative concentration has affected heavily the Extremadura sheep sector and has led to now unite the 64.7% of the 2.3 million of sheep meat in cooperative structures, which has led to an increase in profitability (Pozo & Agudo, 2013).

In this context, it is of importance studying both technical and economic characteristics of integrated cooperative sheep farms. It has conducted a comparative analysis of three major cooperative partner for the cooperative of second-degree OVISO.

A. Methodological process

The data used in this study correspond to the analysis of 101 sheep farms of 3 of the most significant cooperative OVISO group (named in this paper Coop1, Coop 2 and Coop 3). OVISO group is a second-degree ' cooperative based in Villanueva de la Serena (Badajoz) integrated today in OVISUR, in what constitutes the largest cooperative group of sheep for meat at European level. OVISO encompasses 17 cooperatives whose members manage a total of 1.3 million sheep (Pozo & Agudo, 2013). OVISO group has experienced tremendous growth since the end of the 1990s to the present, not only in size (passed 3 cooperatives to 17) but also in regards to the introduction of improvements in the value chain, where it has been strengthened the training of farmers, investment in productive infrastructure and the creation of fattening facilities for lambs.

One of the strategies understood by the cooperative as key to future has been the pursuit of collaborations and agreements with other cooperatives in the sector to reach new markets. One example is Ovispain, which is a consortium for export, comprising Ovis, Pastores y Cordesur group. One of the strategies understood by the cooperative as key to future has been the pursuit of collaborations and agreements with other cooperatives in the sector to reach new markets. One example is Ovispain, which is a consortium for export, comprising Ovis, group shepherds and Cordesur. This collaboration has enabled that the exportation has been increased from 4.108 channels in 2005 (only Ovis) to more than 70,000 channels in 2012 (Ovispain). This collaboration is intended to look for alternatives in times of low domestic consumption.

Cooperative farmers have access to the services of the cooperative of second degree in the same conditions. Although technical advice at farm level is similar, technical personnel giving assistance depends on the cooperative's first grade. As for breeds mostly exploited, they are fundamentally Merina racial base females crossed mainly with Ile de France and Berrichon du Cher males.

From the primary information provided by cooperatives, a refined database was created and complemented with secondary sources of information and field work. Information provided by Ovis which mainly limited to technical data of the holdings of the year 2012, being necessary to directly contact each associated cooperative to obtain more specific information from the activity of farmers. It has been found that the availability and use of the information stored by first grade cooperatives is limited, requiring intense collaboration by the technicians for the final preparation of the data base. Treatment and analysis of the information contained in the final database was carried out with the statistical package SPSS, v.22.

B. Characteristics of the studied farms

Table 1 contains information relating to the structural indicators of the farms as well as relevant qualitative information. These parameters allow to identify structural differences based on the main characteristics of the studied farms, i.e. available land, sheep census, ownership of the land and the uses of the land for agricultural purposes. In addition are also reflected differences in predominant breeds in each cooperative.

Table 1. Basic characteristics of the analysed farms

	Coop 1	Coop 2	Coop 3	Total	
Number of farms surveyed	33	26	48	101	
Total farm land (ha)	360.39	326.56	420.83	379.28	
Owned land (ha)	73.09	274.39	219.16	187.53	
Agricultural land (ha)	52.45	63.93	112.13	82.01	
Number of ewes	779.76	1077.33	858.10	887.3	
Number of rams	25.24	43.27	30.44	31.95	
Sheep breed in the farm (%)	Merino	50	57.7	6.3	31
	Cross breed	38.5	38.5	91.6	64
	Meat breed	11.5	3.8	2.1	5

C. Analysis of technical parameters of cooperatives

Table 2 shows the mean values of these indicators for each of the analysed cooperatives. One of the most relevant sheep performance indicator is the sheep replacement rate. In this case the values presented three cooperatives seem to conform to the usual requirements of extensive sheep farms, around 15% sheep replacement rate, which covers needs of new breeding ewes. However, the 2 cooperative has significantly higher than mean values. The value of the percentage of replacement of sheep can be taken as a reference when deciding if the exploitation requires a more detailed inspection, since those farms with rates below 13% or above 20% out of the desirable parameters.

Another of the problems that sometimes can be found in an extensive sheep farm is the limited reproductive capacity due reduced number of males for mating in the farm (ratio ewes per ram). As can be seen in table 2, there are significant differences between the three cooperatives regarding this aspect; cooperative 2 has the best ratio 26.33 ewes per ram.

Also, the cooperative 2 shows a better reproductive management obtaining higher productivity of lambs (1.22 lambs born per ewe per year). However, when comparing all cooperatives with indicators of reproductive management of other sheep extensive systems, it is observed that these indicators are slightly higher than those observed by Gaspar *et al.* (2007) and Milán *et al.* (2003) which reflects that farms in the cooperative environment are more efficient in these aspects thanks to the technical assistance and advice specific reproductive issues.

In addition to the above, the stocking rate parameter is high for the type of sheep exploitation where recommended values are around 0.3 LU/ha. This greater intensity in the use of pastures resources is common in sheep systems of semi-arid areas and it has been for several decades now, since it has been the most common way to maximize the perception of subsidies during the periods in which they were linked to the number of heads.

Concerning the management of livestock feed, it should be noted that the variations that can be found are closely related to the previously analysed stocking rate parameter. Figure 7 shows average consumption of feedingstuff per adult sheep, which highlights that the cooperatives with lower stocking have lower consumption since they have more resources available to each animal. Fig-

Table 2. Technical indices. Mean, Standard error and significance level (ANOVA) in the farms according to cooperative membership

Technical and economic indicators	Coop 1	Coop 2	Coop 3	Total	SE ¹	Sig.
Stocking rate (LU/ha)	0.48 ^{ab}	0.49 ^a	0.39 ^b	0.47	0.02	**
Sheep replacement rate (%)	15.44 ^{ab}	19.63 ^a	14.42 ^b	16.02	0.75	*
Cull ewes (%)	7.71 ^a	10.99 ^b	9.55 ^{ab}	9.27	0.47	*
Lambs born per ewe per year	1.07	1.22	1.09	1.12	0.03	NS
Ratio ewes per ram	33.62 ^a	26.33 ^b	29.77 ^{ab}	30.12	0.83	**
Commercial productivity (lamb sold per ewe)	0.87	0.94	0.88	0.89	0.02	NS
Average lamb price (€/lamb sold)	66.58 ^{ab}	65.56 ^a	67.16 ^b	66.59	0.02	*
Average lamb price per kilogram (€/kg)	3.24	3.24	3.19	3.22	0.01	NS
Average price per cull ewe (€/ewe)	24.88 ^a	25.74 ^a	29.90 ^b	26.87	0.75	*
Wool sold per sheep (kg/ewe)	2.88 ^a	2.27 ^b	4.80 ^c	3.53	0.13	**
Average wool price (€/kg)	1.37 ^a	1.37 ^a	0.77 ^b	1.1	0.03	**
Labour expenses per ewe (€/ewe)	5.99 ^a	19.35 ^b	14.20 ^b	12.92	1.01	**
Veterinary expenses per ewe (€/ewe)	2.71 ^a	4.30 ^b	3.37 ^{ab}	3.39	0.21	*
Total expenses per ewe (€/ewe)	59.92	59.7	56.55	58.35	2.27	NS
Agricultural subcontracting expenses /total expenses	0.34 ^a	0.04 ^b	0.28 ^a	0.24	0.02	**
Animal feedstuffs expenses /total expenses	0.53 ^{ab}	0.61 ^a	0.47 ^b	0.52	0.01	*
Labour expenses / Total expenses	0.13 ^a	0.34 ^b	0.29 ^b	0.25	0.02	**
Subsidies perceived per ewe (€/ewe)	38.53	49.04	48.35	45.38	2.13	NS
Total income per ewe (€/ewe)	102.68	117.21	110.11	109.54	2.98	NS
Gross margin per ewe (€/ewe)	42.76 ^a	57.50 ^b	53.56 ^{ab}	51.19	2.96	*

*p <0.05 y **p<0.01; 1SE: standard sampling error.

Different subscripts in the same row indicate significant differences as *p <0.05 y **<0.01.

ure 8 shows the average consumption of concentrate per fattening lamb where can be seen that there are hardly any differences among cooperatives. This fact is expected because the fattening systems are very similar, all of them in intensive conditions where the second degree cooperative standardizes the live weights the lambs before slaughter.

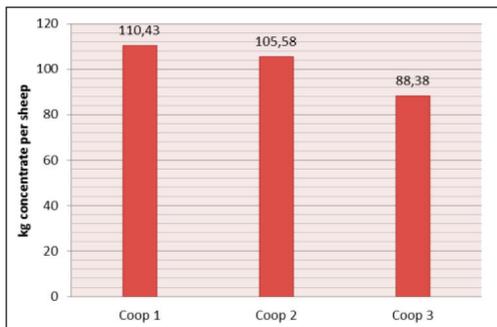


Fig. 7. Average yearly consumption of concentrate per sheep.

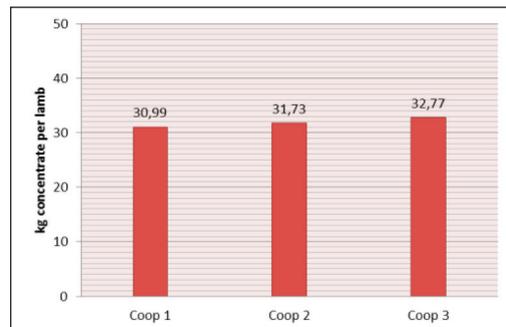


Fig. 8. Average consumption of concentrate per fattening lamb.

D. Analysis of the productive indicators

Regarding the results obtained on commercial productivity of the three analysed cooperatives (table 2), it is observed that the average price of lamb for each cooperative is at very close range. Although the differences are little significant (significant between the 2 and 3), it can be observed that cooperative 2 obtains the lowest price per sold lamb.

These indicators of sale of lambs, although interesting for analysis and comparison among three cooperatives, also serve to study one of the issues that matter most as managers in a farm: business productivity per sheep. The annual commercial productivity per ewe is a normalized variable that indicates the total number of lambs delivered to the cooperative per ewe per year. This is an indicator of great importance to the cooperative, since it expresses the relationship of production among associate and company. Once again the cooperative 2 presents the highest average value (0.94) which indicates that it is the cooperative whose members deliver a greater number of lambs.

If we analyse this indicator “commercial productivity” from the perspective of the cooperative, we can identify different performance of farmers towards the cooperative. This analysis should identify the farmers who are delivering below the standard delivery rate established by the cooperative considered as desirable for such holdings, and study the reasons underlying low rates in order to establish mechanisms to increase these levels.

E. Balance of expenses and income of farms

Indicators of expenses and income can be also observed in table 2. There are significant differences between cooperatives, such as labour expenses per ewe or agricultural subcontracting expenses, which is usually related to the percentage of family labour. Also noteworthy are the more purely economic indicators such as total income per ewe or gross margin per ewe, in which the cooperative 2 stands out with respect to the other two. An explanation for this behaviour may be in the structure of the cooperative 2 farms, which had the largest number of sheep, mostly Merino ewes, and had the highest rate of lambs born and lambs delivered per ewe. The largest stocking doesn't seem to be the main explanation of the profitability of farms, in the light of works such as that of Gaspar *et al.* (2008) who indicated that the factor that seemed to have more relevance was the exploitation of different breeds as a way to more efficiently use of environmental resources.

As a conclusion, it can be said that the comparative study of sheep farms belonging to three cooperatives, integrated into a single entity of second grade, has allowed to identify homogeneous aspects such as the average price per kg of live weight obtained by farmers in each delivered lamb. This fact was predictable since the commercialization of the lambs are made jointly. However aspects differentiated between cooperatives were also found, such as those related to reproductive management and that could be linked to the different technical assessment received from the first degree cooperative.

Although in all analysed cooperatives farms have shown stocking rates higher than those recommended for semi-arid environments, those with minor charges have reflected it in their lower dependence on purchased feedstuff, since they can make better use of the resources generated by the system.

Interesting differences regarding productivity, have appreciated since the cooperative 2 presents substantially higher values. The differences in an important aspect for the cooperative may show an aspect in which relevant improvements could be done. The study of differentiated entities within one cooperative business environment could serve both to establish benchmarking strategies (best holdings became farms for the rest of the cooperative model), as to correct deficiencies, to allow to detect abnormal values or inefficient behaviour.

References

- Bernués A., Ruiz R., Olaizola A., Villalba D. and Casasús I., 2011.** Sustainability of pasture-based livestock farming systems in the European Mediterranean context: Synergies and trade-offs, *Livestock Science*, 139, p. 44-57.
- De Rancourt M., Fois N., Lavín M.P., Tchakérián E. and Vallerand, F., 2006.** Mediterranean sheep and goats production: An uncertain future, *Small Ruminant Research*, 62, p. 167-179.
- Den Herder M., Moreno, G., Mosquera-Losada R.M., Palma J.H., Sidiropoulou A., Freijanes J.J.S. and Papanastasis V.P., 2017.** Current extent and stratification of agroforestry in the European Union, *Agriculture, Ecosystems & Environment*, 241, p. 121-132.
- García-Díaz L.K., Mantecón A., Sepúlveda W. and Maza M., 2012.** Producción de leche ovina como alternativa de negocio agropecuario: modelo de producción en Castilla y León (España), *Revista Mexicana Agro-negocio*, 16(31), p. 6-18.
- Gaspar P., Escribano M., Mesías F.J., de Ledesma A.R. and Pulido F., 2008.** Sheep farms in the Spanish rangelands (dehesas): Typologies according to livestock management and economic indicators, *Small Ruminant Research*, 74(1), p. 52-63.
- Gaspar P., Mesías F.J., Escribano M., De Ledesma A.R. and Pulido F., 2007.** Economic and management characterization of dehesa farms: implications for their sustainability, *Agroforestry Systems*, 71(3), p. 151-162.
- Gaspar P., Mesías F.J., Escribano M. and Pulido F., 2009.** Assessing the technical efficiency of extensive livestock farming systems in Extremadura, Spain, *Livestock Science*, 121, p. 7-14.
- Horrillo A., Escribano M., Mesías F.J., Elghannam A. and Gaspar P., 2016.** Is there a future for organic production in high ecological value ecosystems?, *Agricultural Systems*, 143, p.114-125.
- MAPAMA, 2014.** Caracterización del sector ovino y caprino en España año 2014. Subdirección general de productos ganaderos.
- Mena Y., Ruiz-Mirazo J., Ruiz F.A. and Castel J.M., 2016.** Characterization and typification of small ruminant farms providing fuelbreak grazing services for wildfire prevention in Andalusia (Spain), *Science Total Environment*, 544, p. 211-219.
- MERAGEM, 2011.** Programa de mejora de la raza ovina merina y merina (variedad negra).
- Milán M.J., Arnalte E. and Caja G., 2003.** Economic profitability and typology of Ripollesa breed sheep farms in Spain, *Small Ruminant Research*, 49, p. 97-105.
- Pozo, J.C. and Agudo B., 2013.** El ovino de carne cooperativo en Extremadura. In: *La Agricultura y Ganadería Extremeñas, Informe 2012*. Ed. Facultad de Ciencias Económicas y Empresariales, Escuela de Ingenierías Agrarias y Caja de Badajoz. España, pp. 121-133.
- Pulido F., Escribano M., Mesías F.J. and Rodríguez A., 1999.** Use of energetic resources in sheep farms in dehesas of south-west Extremadura, *Cahiers Options Méditerranéennes. Centre International de Hautes Etudes Agronomiques Méditerranéennes*, 39, p. 269-272.
- Ripoll-Bosch R., Díez-Unquera B., Ruiz R., Villalba D., Molina, E., Joy M., Olaizola A. and Bernues A., 2012.** An integrated sustainability assessment of Mediterranean sheep farms with different degrees of intensification, *Agricultural Systems*, 105, p. 46-56.
- Rivas Rangel J.H., 2014.** Nivel de competitividad del sistema productivo ovino lechero de la DOP “Queso manchego”: propuestas de mejoras de viabilidad de las explotaciones.
- Ruiz M.C., García E. and Hernández M.J., 2014.** Cómo responden a la crisis económica actual las sociedades cooperativas agrarias. El caso de las almazaras cooperativas andaluzas, *REVESCO: revista de estudios cooperativos*, 113, p. 120-149.
- Ugarte E., Serrano M., De la Fuente L.F., Pérez-Guzmán M.D., Alfonso L. and Gutiérrez J.P., 2002.** Situación actual de los programas de mejora genética en ovino de leche, *ITEA*, 98, p. 102-117.