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in

Mena Y. (ed.), Castel J.M. (ed.), Morand-Fehr P. (ed.).
Analyse technico-économique des systèmes de production ovine et caprine : méthodologie et valorisation pour le développement et la prospective.

Zaragoza : CIHEAM / FAO / Universidad de Sevilla
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 70

2006
pages 101-109

Sheep production systems in the north of Granada province. Case studies

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SUMMARY – We studied the characteristics of 21 conventional and two organic sheep enterprises in the north of Granada Province. Most of the herds were mixed sheep and goat farms, with emphasis on sheep production. We considered aspects related to management systems, productive behaviour and technological and economic characteristics of the herds. All these may indicate barriers and potential for the expansion of sustainable organic sheep systems in this area. Information was obtained through semi-structured interviews to farmers in 2003.

Keywords: Sheep, system, organic, sustainability.

RESUME – *"Système de production ovine dans le nord de la province de Grenade. Études de cas". Dans ce travail on analyse les caractéristiques de 23 exploitations d´élevage de l'Altiplano de la province de Grenade, 21 en élevage conventionnel et deux en biologique. La plupart font de l'élevage de moutons et l'on décrit les pratiques utilisées, les systèmes de production, les caractéristiques technologiques et économiques afin d'étudier les potentialités qui existent pour l'extension de l'élevage biologique dans la région. L'information a éte obtenue en 2003 en réalisant des entretiens semi-structurés avec les éleveurs.*

Mots-clés : *Moutons, élevage, biologique, durabilité.*

Introduction

Granada Province has more than half a million head of sheep (DPAPG, 2004). The High Plateau, Baza-Huescar (N.E. of Granada), is characterized by low rainfall and large oscillation of temperatures. Dry region cereals and almond and olive trees complement the pastoral economy. The Segureña is the most important sheep breed in the region and is characterised by a high level of rusticity and presents some good production characteristics (Fálagan and Hernández Egea, 1992). The breed is early maturing, with the first lambing at twelve months of age (Cruz and Cruz, 1992). It produces meat of good quality and has high potential for lamb production per year due to its high prolificacy. The breed has a reputation for good maternal instinct and good capability of milk production. The Segureña sheep production could be an important added value resource for the local farmers, if the present marketing situation improves.

Generally sheep flocks graze in communal, natural pastures and browse on Mediterranean forests that are abundant in these regions. They used many crop residues of the region and are supplemented with cereals, hay and straw.

Organic production has potential for sustainable development of autochthonous sheep production in the area and adds value to potential products. Organic production may also help the efficient use of natural resources, the maintenance of family farms and the diversification of the farming enterprises in the area. The current work explores the logic of farm management systems and management strategies used by farmers in the region, in order to develop advice for sustainable organic sheep production systems in the area.

Case studies

Characterization of conventional enterprises was carried out with semi-structured interviews with

21 conventional producers from the Huescar's District and two organic producers from the Baza's District (the only organic farms within the two regions), with the aim of understanding their systems of management, production and the technological and economic characteristics in detail. The enterprises, apart from the organic ones, were selected according to the flock size and number of goat and sheep in each herd obtained by clustering of different farm types in the region based on census (OCA Huéscar [Huéscar Agrarian Regional Office], 2003). Only farms with pedigree Segureña sheep were included, although goats were of varied breeds.

Producers

The age of the conventional producers averaged 47 years (standard deviation [SD] 12.9). Thirty three percent of them were less than 40 years old, 52% were 40-60 years old and 14% over 60 years old. Their experience in livestock production averaged 30 years (SD = 15.6). Most producers (57%) had 25-50 years of experience, 33% had less than 25 years and 10% had over 50 years of experience. The two organic producers were both 32 years old and had each 20 years of experience in the activity.

Flocks/herds

Of the conventional enterprises seventeen were mixed flocks/herd (sheep-goats) and the rest (4) only had sheep. In the sample, the average number of breeding female sheep per flock was 449 (SD = 350). The average number of male sheep per flock was 13 (SD = 8), resulting in an average of 43 (SD = 11) reproductive females/male per flock. Replacement animal numbers per flock averaged 101 (SD = 36). The great variation observed resulted from the difference in the farm sizes in the sample.

The role of the goats in the systems was mainly to drive the sheep flock in difficult situations and even to help sucking lambs. Nevertheless, the sale of kids and goat milk in some cases complemented the economy of the sheep systems markedly. The number of breeding goats per herd averaged 50 (SD = 74). The two organic enterprises only kept sheep. The number of breeding females in the organic flocks was 500 and 480, with 16 and 12 males, respectively.

Production systems

We classified the sheep systems in different ways as conventional or organic, and by the different production activities developed on the farm (main source of pasture, forage production, cereal production, other crop production, products for market, etc.) and according to the degree of intensification of the rearing system. For these purposes, we used variables like stocking rate and level of grain supplementation.

In relation to production activities, we found two main types of farmers; livestock-crop farmers and livestock farmers. In the first group, we found high diversity of crops combined with livestock (Table 1). The principal crops cultivated by livestock-crop farmers were cereals (82% of cases). 38% of the producers produced both cereals and forages. Olive tree cultivation was less representative, appearing only on 16% of the farms. Communal areas were used by 53% of the livestock-crop farmers, most of them producing cereals as well (Table 1). Intensification of the sheep systems studied was mainly related to the increase of food supplementation rather than to stocking rate (Fig. 1). In most of the flocks, the stocking density was less than two sheep per hectare.

Despite the low number of organic enterprises in the sample, we used their figures in order to compare the most extreme strategies we found and to achieve the specific target of this work: to develop advice for organic producers. The two organic producers from the Baza's Natural Park used only communal areas (800 and 750 ha respectively), as they have limitation in the use of non-certified crop areas. Of the conventional producers, 83% grew crops for animal feed, while the rest (17%) used communal areas as the main source and purchased cereals and forages to supplement livestock with. The average surface area of own cropping land per farm was 178 ha (SD = 309) and of rented land 369 ha (SD = 453).

We analysed the relationship between some principal management factors and sheep productive behaviour using regression analysis, and the differences between mainly intensification groups by ANOVA analysis made by SPSS 10 by Windows (Joariste, 1998).

Table 1. Different resources used in the study farms production systems (conventional + organic)

Basic System	Complement system	Farms	%
Pasture + browse	Without crops	5	21.7
Pasture + browse	Cereal[†]	7	30.4
Pasture + browse	Cereal + Olive	2	8.6
Pasture + browse	Cereal + Fruits	1	4.3
Pasture + browse	Cereal + Forage[††]	3	13.0
Pasture + browse	Cereal + Forage + Olive	1	4.3
Pasture + browse	Cereal + Fruits + Vegetables	2	8.6
Pasture + browse	Cereal + Forage + Fruits + Vegetables	1	4.3
Pasture + browse	Forage + Fruits	1	4.3

[†]For feeding animals and to sell.
[††]For feeding animals.

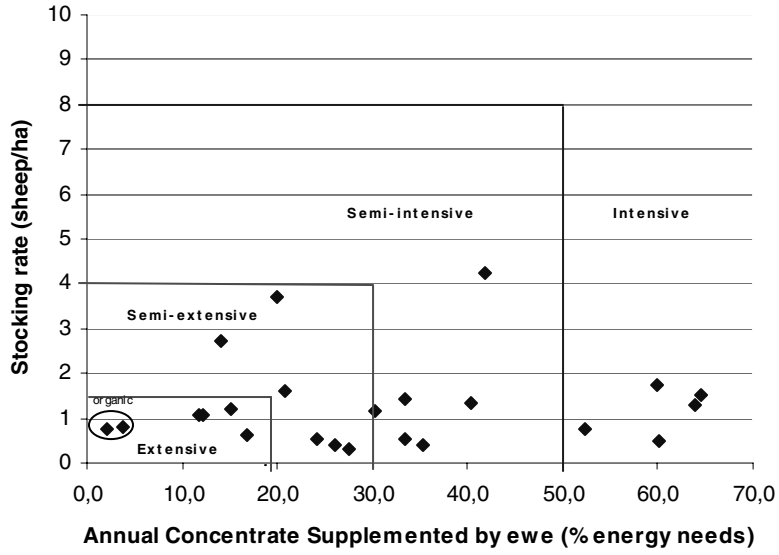

Fig. 1. Intensification degree in sheep systems studied, based on concentrates supplements and stoking rate level.

Feeding

The sheep and goat feeding was based mainly on existing natural resources obtained directly by grazing, the supplements (grain and forages) produced by the farmers themselves and those supplements that they buy to cover feed deficits. The strategies of supplementation came from two fundamental factors: the physiological state at the end of gestation and during lactation and during the months of low pasture and forage production. Feeding patterns were diverse, depending on the habitual practices of each producer. As a general rule, the sheep were housed between 15 to 25 days before lambing. Some producers may increase the housing period to 1-2 months, while others may house the ewes the day before lambing. In one case, the ewes were not housed at all. Housing of ewes generally initiated supplementary feeding. The quantities of each supplement and combination

of them were variable. The quantities for different feeds were: barley (0.25-1 kg/animal/day), lucerne pellets (250-500 g/animal/day), lucerne hay (250 g/animal/day - to *ad libitum* access) and cereal straw. Barley was used by 77% of the farmers, lucerne by 85% and cereal straw by 54%.

After lambing, ewes were loose housed for varying periods, depending on the farm, extending from 15 to 90 days. Nutrition involved varying the proportions of supplements during pregnancy and lactation. In some case, grain and lucerne feeding was increased, in others, the opposite pattern was used, while in some cases, the feeding was maintained throughout the pregnancy.

The nutrition of the lambs from weaning to sale was uniform. Generally, granulated fodder, straw, salt and correcting minerals *ad libitum* were offered. Nevertheless, some producers provided other types of foods to lambs like oats, wheat, lucerne and barley when the lambs were larger.

Organic producers fed their animals differently. Farmer 1 penned in pregnant ewes between 7 and 15 days before lambing. He supplemented them in the evening with 400 g of oat hay, 500 g of oat grain and 200 g of cereal straw per ewe. The day after lambing, the ewes returned to pastures with the rest of the flock and the supplementation remained the same as before lambing. Farmer 2, however, did not pen in nor supplement his ewes before lambing. After lambing he fed the ewes as Farmer 1.

Some estimated feeding and nutritional figures from conventional and organic flocks are shown in Table 2. The contribution of supplements over the energy requirements of animals was 39% and 3% for conventional and organic flocks, respectively. This indicated that organic herds obtain their needs from natural resources, mainly pastures and shrub.

Table 2. Some data about feed production, feeding and animals requirements in conventional and organic farms

	Conventional herds		Organic herds
	Average	SD (±)	Average
Supplements produced by the farm (%)	56.3	31.7	0
Food supplemented (kg DM/animal/year)	164.5	76.7	11.9
Cereal supply (kg/animal/year)	127.7	66.2	11.6
Energy supply (Mcal ME/animal/year)	388.1	186.8	28.6
PDIN supply (kg/animal/year)	11.4	6.09	0.8
PDIE supply (kg/animal/year)	12.7	6.18	0.9
Energy requirement (Mcal ME/animal/year)	997.3	31.6	995.6
PDI requirement (kg/animal/year)	32.1	0.70	32.3
Energy requirements cover with supplementation (%)	38.7	18.1	2.86
PDI requirements covered with PDIN supplementation (%)	35.4	18.5	2.39
PDI requirements covered with PDIE supplementation (%)	39.5	18.9	2.85

The energy and protein values of foods and the animals' requirements have been calculated from the INRA's recommendations (1989).

Reproduction

But for a few organic herds we can take the reproductive behaviour as an indication of the results of the organic strategy. As can be observed in Table 3, the average number of lambs born per breeding female was 1.7 and 1.2 for conventional and organic flocks, respectively. Nevertheless, lamb survival at weaning was moderately superior in the organic flocks. The proportion of ewes lambing every year was similar in both systems, but the proportion of twin births and ewes with two lambings per year was twice as high in the conventional as in organic flocks. This phenomenon can be related to the nutritional differences between the different farm types. In general, the variability in these indicators was high between flocks.

Table 3. Reproductive behaviour

	Conventional herds		Organic herds
	Average	SD (±)	Average
Reproductive female/male	43.1	11.1	47.5
Animals that lamb annually (%)	92.2	7.88	90.0
Ewes with two lambs/birth (%)	30.7	15.8	11.0
Animals with two birth/year (%)	38.9	19.7	17.5
Lambs born/ewe	1.70	0.22	1.20
Survival at weaning (%)	79.1	14.6	81.1
Lambs weaned/ewe	1.30	0.29	0.96
Rate of ewe replacement	0.24	0.17	0.16

Survival at weaning shows higher values in the organic flocks than in the conventional flocks, reducing the difference in lambs weaned per ewe between the systems. Rate of ewe replacement was lowest in the organic flocks.

There was no significant difference in reproductive behaviour between systems as shown in Fig. 1, although, when we grouped the farms in extensive and intensive, we found significant differences ($P<0.05$) in the number of lambs born alive between them. The figures were 1.5 (SD = 0.3) and 1.7 (SD = 0.2) for extensive and intensive systems, respectively. In the case of the number of weaned lambs per ewe, we only found differences at 10% between intensive systems (1.4; SD = 0.2) and two extensive systems (1.2; SD = 0.3). Annual energy supplement per ewe (Mcal of ME) explained significantly 28% of the variation of weaned lambs per ewe, expressed by equation:

$$y = 1.445\ \mathrm{Ln}(x) + 0.471$$

Generally, we observed three important lambing seasons: spring, summer-autumn and December-January. Summer-autumn lambing aims to sell for Christmas, when lamb price is at its best. Lambing in December-January is achieved by ewes that did not get pregnant between March to May, months of low sexual activity. These ewes give rise to lambing in summer-autumn of the following year. Late spring, summer and early autumn lambing is characterised by low lamb mortality, but winter lambing has higher mortality.

Disease and mortality

Average mortality in adult sheep was 5.4% (SD = 6.5%) in the conventional flocks and 1.8% in the two organic flocks. The principal mortality causes in adult sheep in the conventional flocks were clostridial diseases (mentioned by 33% of the producers), followed by mastitis (21%) and brucellosis (17%). Weight loss, paratuberculosis, oral abscesses, poisoning and respiratory illness were other mortality causes mentioned by the producers. It is interesting to note that the producers mentioned weight loss as fatal in adult sheep. They attributed the illness to the consumption of pesticides and herbicides when grazing in crop production areas. According to the producers, the stock loose appetite and become progressively malnourished until they die. In organic flocks, the principal mortality causes reported were brucellosis and lambing related causes.

Average lamb mortality in conventional flocks was 22.0% (SD = 14.1), while in the two organic flocks the lamb mortality was 18.9% on average. There was no significant difference between the systems in lamb mortality, but there was a tendency of decreased mortality when ewe annual energy supplement increased to around 350-500 Mcal of ME/ewe in unpenned systems.

The principal mortality cause in conventional lambs was diarrhoea that covered 39% of the fatal causes mentioned by the producers, followed by white muscle disease (selenium/vitamin E deficiency; called the “drunken lamb” syndrome by the producers) and trampling of lambs at birth by ewes (both 21%). Trampling appeared to be common in lambs penned in winter time, especially

during very cold nights in sheds with poor temperature control. In the two organic flocks, the principal causes of death were diarrhoea and deaths at lambing.

De-worming was practiced twice a year by 69% of the producers (15% carried out this once a year). Two of the conventional producers with extensive systems did not de-worm sheep at all.

Production

The principal animal products on all farms were weaned lambs. The other products for sale were adult sheep for slaughter (74% of farms), kids for slaughter (65%), manure (35%), adult sheep for breeding (5%) and goat milk (one farm). No farmers sold wool, due to the low quality of Segureña breed wool (Romagosa, 1970). For this reason, sheep shearing is an unavoidable expense, carried out for welfare and hygiene reasons. Some sale prices of different farm products are shown in Table 4.

Table 4. Selling price of different animal products

Products	Conventional		Organic
	Average	SD (±)	Average
Lambs (€/lamb)	55.9	7.33	42.1
Young goats (€/kid)	54.4	4.70	37.6
Sheep for slaughter (€/sheep)	7.90	3.82	8.00
Goat for slaughter (€/goat)	6.4	1.57	10.0
Sheep for breed (€/sheep)	60.1		
Goat milk (€/litre)	0.42		

Economy

The economic analysis shows important differences between conventional and organic systems. While conventional farms sold 43% more products than organic ones, they received 61% less subsidies, and the production costs were 50% higher (Table 5). This resulted in higher gross income on the organic farms (by 24%), with favourable net family income. It is necessary to point out that organic lambs in the study farms were sold at a lower price than conventional, due to non developed organic meat market in the region. On conventional farms, the size of the flock influenced net income markedly. The study of the different systems classified in Fig. 1 showed that the annual cost of extensive systems was significantly lower (62 €/ewe; SD = 29) than in the rest of the systems, that averaged between 104-124 €/ewe without difference between them. We found no significant difference in net income or net family income between the studied systems, but the best result was found in the extreme systems (intensive and extensive) with regard to the net income.

In some small or medium size farms, net income may be negative but net family income is generally positive. In these cases, generally the animal components complement the rent of farmers or animal production income is complemented by other products (see Table 1). These explain the survival, over time, of many small farms.

Sustainability indicators

Indicators were used for a general evaluation of the systems. We selected a group of strong indicators in different areas of evaluation like technological (weaning and mortality rates), economic (young animal sales and net family income), social (continuity of exploitation for 25 years and provision of efficient rural work in work unit) and system sustainability (self-sufficiency of exploitation and use of natural resources). The average values of each indicator found in both systems as well as general desirable goals are show in Table 6 .

Table 5. Economic analysis in conventional and organic farms (€/ewe + goat)

	Conventional		Organic	
	Average	% of totals	Average	% of totals
Products				
Lambs	53.50	91.5	32.50	96.7
Young goats	3.65	6.24	0.32	0.95
Adult sheep and goat for slaughter	0.48	0.82	0.79	2.35
Manure	0.91	1.56		
Total production sales	58.50	100	33.60	100
Subsidies				
Sheep	27.40	81.1	34.7	39.8
Goat	2.11	6.24	–	
Organic cattle raising	–	–	48.5	55.6
Disadvantaged zone	4.24	12.5	3.97	4.55
Total subsidies	33.80	100	87.2	100
Gross income	92.3		120.8	
Expenses				
Feeding	33.7	33.2	4.98	9.86
Amortizations	9.42	9.27	0.93	1.84
Various expenses	24.4	24.0	18.80	37.20
Salaries	34.1	33.6	25.80	51.10
Total expenses	101.6		50.50	100
Net income	-9.3		70.3	
Net family income (family salaries + income)	15.0		87.5	

Table 6. Indicators used to evaluate systems

Indicator	Conventional Average	Organic Average	SD (±)	Goal value
Animals weaned/reproductive female	1.3	1	0.29	1.79
Young animals mortality (%)	22	18	0.13	8
Adult mortality (%)	5	2	0.06	2
Young animals sale/reproductive female	1.05	0.79	0.35	1.83
Net family income/ reproductive female	34	68	35.8	99
Continuity of exploitation for 25 years†	0.78	1.00	0.31	1
Work units/100 reproductive female	0.91	0.49	0.46	0.4
Self-sufficiency of exploitation (%)††	84	97	10.8	90
Use of natural resources (%)†††	61	97	20.1	98

†Estimated by a system including the age of the farm owner and if there is another family member to continue farming after him.
††Energy from purchase feeds/animal energy requirements.
†††Feed energy coming from natural resources (pasture, browse)/animal energy requirements.

With the data from Table 6, an AMEBA figure following MESMIS methodology (Masera *et al.,* 1999) was constructed (Fig. 2). This graphic shows the behaviour of each indicator according to systems expressed as percentage of desirable value selected by us.

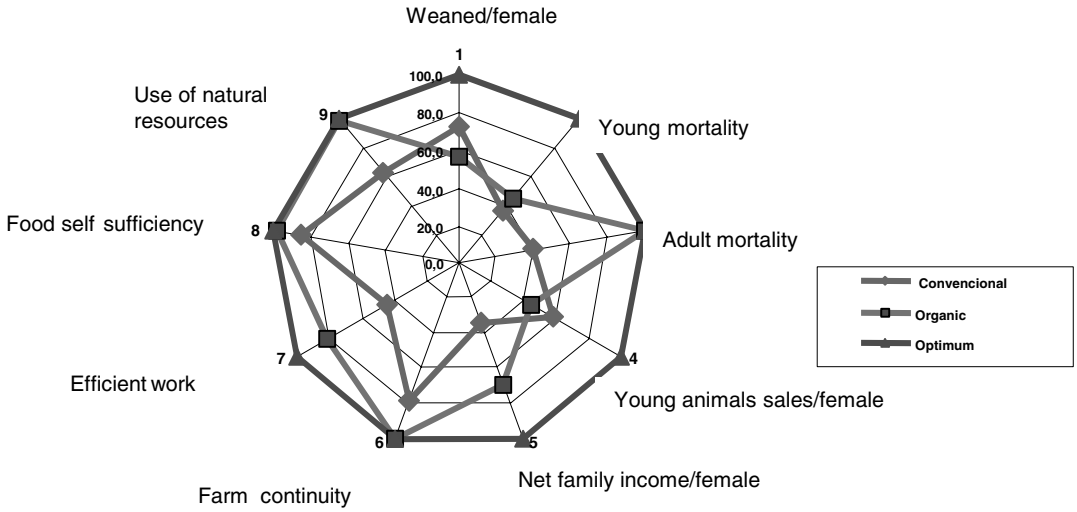

Fig. 2. AMIBA representation of strong indicators to evaluate the study systems.

The two organic systems were, on average, superior in seven out of the nine indicators evaluated. Conventional systems were superior for animals weaned and sales per reproductive female. These differences between organic and conventional systems depend on the basic systems or the resources available for each enterprise. A symmetric general indicator of sustainability gives values of 77% and 57% for organic and conventional systems, respectively.

Conclusions

The analysis of 23 farms shows evidence of great diversity in production systems, although animal husbandry was predominately integrated with some crop cultivation. In addition, the principal natural resources for sheep and goat production in the studied zone were browsing and grazing from hill areas and pasturelands, both from communal areas and stubble fields.

Intensification did not produce, on average, better economic results than extensive systems. Organic flocks, despite the few data available, showed a good production strategy to develop sustainable sheep production systems in areas with availability of natural pastures. The principal problem detected in organic flocks was the difficulty of increasing reproductive performance. It may be important to explore strategic management of feed supplements and use of the ram. For other indicators, such as health and operational costs, organic management shows some interesting strategies that need further studies. The lower production costs and the organic subsidy permits better economic balance in organic systems despite not receiving premium prices for organic products, as we observed in others studies (García Trujillo *et al.*, 2003). In general, the organic systems present a higher level of sustainability expressed by the level of feed self-sufficiency and use of natural resources in combination with good flock health, financial performance and social impact.

The principal barrier for the expansion of organic sheep production in the study zone is the shortage of pasture land, mountains and cultivations qualified as organic. At present, the farms that have the best potential for organic conversion are the ones with large areas of semi-natural land, abundant in the zone. The veterinary issues or availability of organic feed does not appear to be a real problem for organic conversion of sheep and goat flocks. Poor organic market development is a barrier that also limits the expansion of organic animal production in Andalusia.

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