

**PROXIMITY TO THE ECOLOGICAL MODEL OF DAIRY GOAT SYSTEMS IN THE ANDALUSIAN  
MOUNTAINS (SPAIN)**

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**ABSTRACT**

Interest is growing in promoting sustainable animal production systems because of their healthy relation to the natural environment. Ecological systems stand out, as they pay special attention to preserving natural resources, promoting biodiversity, guaranteeing animal well-being, and obtaining healthy products from raw materials and natural processes. The objective of this study is to evaluate proximity to the ecological model of dairy goat systems in mountainous areas of Andalusia, Spain. Furthermore, those aspects which could be improved in order to convert these farms into ecological systems were analyzed. A questionnaire was designed for the farms, including 53 variables integrated into 10 indicators. Twenty three farms were surveyed (5 meat farms and 18 milk farms), of which 6 (2 meat and 4 milk) are certified in ecological production. The ecological farms show an 81% fit with the agroecological model for animal production, and the conventional farms show a 55% fit. Principal actions which should be carried out in order to adapt conventional Andalusia mountain systems to the ecological model are: (i) diminishing outside dependence on concentrated feed, (ii) improving quality of natural grasses and optimizing their use by the animals, (iii) adapting animal productive level to environmental carrying capacity, (iv) observing strict sanitary conditions of the facility and equipment, using products permitted by ecological goat farm regulations, (v) improving farmer training, particularly in relation to management, and (vi) promoting direct marketing channels and farmer participation in value added of processed goat products.

**KEYWORDS:** goat system, organic farming, management.

## **1. INTRODUCTION**

Ecological production has grown rapidly in the European Union in the past few years, with Spain in second place in terms of ecologically cultivated surface (SOEL-FiBL, 2007). The two species which have increased most greatly, in terms of number of farms as well as number of animals, are beef cattle and sheep raised for meat, while goat production has grown more moderately, or very little in the case of dairy goats. In Spain, a total of 168 ecological goat farms exist, of which 134 produce meat, and 34 milk. In Andalusia, the region of Spain taking first place in terms of surface and ecological farms, 74 ecological goat farms have been certified: 64 for meat, and 10 for milk (MAPA, 2007). Nevertheless, initiatives exist in several countries in the Mediterranean Basin (Kyriazakis and Zervas Ed. 2002; Hardy, 2008), allowing us to affirm that ecological goat production, using sustainable production and management techniques, is viable.

An ecological production system should comply with the following requirements: contribute to the equilibrium of agricultural systems integrated with the natural environment, contribute to sustainable agriculture development, minimize all types of contamination, respect animal well-being, avoid systematic use of chemically synthesized substances, and renounce the use of genetically modified organisms (Reglamento (CEE) nº 2092/91). According to these requirements, mountain goat systems, in which feeding is largely based on grazing (Ruiz et al. 2008), could already be functioning close to the ecological model.

The objective of this study is to evaluate approximation to the ecological model of dairy goat systems in mountainous areas of Andalusia (Spain). Furthermore, those aspects which should be improved in order to increase sustainability are analyzed in the light of sustainable animal production and management techniques.

## **2. MATERIAL AND METHODS**

Through meetings with experts in agroecology and ecological production, and based on specifications of the European Union Directives 2092/91 on "Crop Products" and 1804/99 on "Livestock Products",

criteria for organic production of agricultural products were defined, from which a questionnaire for goat farmers was designed, including 53 binominal variables (yes = 1 or no = 0). Variables were grouped into ten multi-criteria indicators, as shown in Table 1. Each indicator was assigned a value based on the proportion of positive responses of this indicator's variables, with 100% as the optimum for each indicator. Later, an organic conversion index (OCI) was elaborated using the sum of the values pondered for each indicator (Table 1), in relation to the difficulty and time required to comply with the norm.

Table 1. Indicators of level of ecological conversion: number of variables integrating the indicators (NV) and ponderation value (PV) for use in calculating the organic conversion index

Indicator	NV	PV (%)	Indicator	NV	PV (%)
Feeding management	7	14	Prevention and treatments	6	12
Sustainable grassland management	7	14	Breeds and reproduction	4	6
Soil fertilization	5	6	Animal well-being	9	6
Weed control	4	6	Product innocuity	4	14
Pest control	3	6	Ecological management	4	16

Twenty three goat farmers were interviewed in 2006 (5 meat farmers of the Huelva mountains and 18 milk farmers of the Cadiz mountains). Of these, 6 (2 meat and 4 milk) are certified as ecological and comply with the ecological norms. However, the indicators do not necessarily reach a value of 100% of the OCI, since some questions have been included in order to evaluate sustainability of agroecological techniques and management carried out without being contemplated in the norms. Statistical analyses were carried out using the program SPSS (2005).

### 3. RESULTS Y DISCUSSION

#### 3.1. Analysis and diagnostic

Table 2 groups the results (average and standard error) obtained for the ecological and conventional farms with respect to level of approximation to the agroecological production model. It may be observed

that all indicators except for Pest control and Animal well-being show significant differences between the two production models, with an OCI value of 80.6 for the ecological farms and 54.9 for conventional farms.

Table 2. Average and standard error for each indicator in the two productive models

Indicator	Sig.	Organic (6 farms)		Conventional (17 farms)	
		Average (%)	SE	Average (%)	SE
Feeding management	p<0.01	76.2	6.0	49.6	5.1
Sustainable grassland management	p<0.05	52.4	4.8	29.4	5.3
Soil fertilization	p<0.001	44.7	3.3	20.5	2.6
Weed control in pastures and crops	p<0.05	100.0	0,0	76.5	10.6
Pest control in pastures and crops	NS	100.0	0.0	82.4	9.5
Prevention and treatments	p<0.001	94.4	3.5	38.2	4.7
Breeds and reproduction	p<0.01	95.8	4.2	77.9	2.9
Animal well-being	NS	79.6	5.3	76.5	3.6
Innocuity	p<0.05	95.8	4.2	66.2	6.0
Ecological management	p<0.001	79.2	4.2	5.9	2.7
Organic conversion index (OCI)	p<0.001	80.6	1.9	54.9	3.6

Indicators for the conventional systems show a value less than or equal to 50%, and therefore require more attention in order to be transformed into ecological systems. These indicators are: Feeding management, Sustainable grassland management, Soil fertilization, Veterinary prevention and care, and Ecological management.

With respect to Feeding management, the situation of the conventional systems is acceptable, mainly due to the fact that the animals pasture daily. Given that animal stocking rate is adequate, 0.82 goats/ha (Mena et al, in press), in the majority of the farms, pasturing is an important source of feed, including fiber, and offers a high level of animal well-being. The farms' main deficiencies related to feeding management are failing to produce their own goat feed, as well as lack of planning of feed supplements according to quantity and quality of grass available during each season. Only 6% of conventional farms analyzed

produce their own grain; as they are located in mountainous zones, cultivable surface is minimal or nonexistent, and cost of harvesting the crop is very high. Nevertheless, 56% grow their own fiber crops, although average cultivable surface of Cadiz mountain farms is only 0.1 ha/goat (Ruiz et al. 2008). A lack of feed autonomy is one of the main limits to ecological conversion. On average, conventional mountain farms purchase 290 kg of concentrate per goat per year (Mena, in press) due to scarcity and high price of balanced ecological concentrates.

The indicators Sustainable grassland management and Soil fertilization are the farthest from what would constitute adequate agroecological management in the case of conventional farms as well as those certified as ecological, although the latter comply with the ecological norms. With respect to Sustainable grassland management, the three aspects in which a large number of farms are deficient are: (i) presence of leguminous crops, alone or associated with other species, (ii) regeneration of woody species, and (iii) natural grass improvement. In relation to Soil fertilization, all farms use animal manure as fertilizer, but this proves insufficient in the majority of the cases, and no other type of fertilization indicated by the norms (green manure, organic fertilizers, etc) is used. Furthermore, hardly any of the farmers carry out periodic soil fertility analysis.

Although sanitary level is similar in conventional and ecological farms, as demonstrated by Mena et al. (in press) in relation to goat mortality in the zone (4.4 % vs 4.3 %, for conventional and ecological farms respectively), some aspects related to Veterinary care and prevention should be substantially improved in conventional farms in order to convert them to ecological. These aspects include: use of plant based natural medicine, use of cleaning products permitted by organic norms, and systematic analysis of water quality.

The indicator whose value is farthest from the ecological model in the conventional farms is Ecological management, which includes: (i) data recording and technical-economic management, essential to obtaining and maintaining organic certification, (ii) direct product marketing in order to make products available to consumers who value them, and (iii) farmer efforts toward ecological conversion. All farmers surveyed (including ecological growers) currently sell their milk to large milk processing industries, none of which have an ecological product line.

### 3.2. Proposals for fomenting ecological transformation

With respect to Feeding management, transition to the ecological model could be favored by two types of actions: (i) optimizing grassland and cultivated surface use in order to obtain the maximum feed autonomy possible, and (ii) reducing consumption of concentrated feed, even if this causes reduced milk productivity. Table 3 shows that a reduction in concentrates is accompanied by reduced productivity, but this does not lead to a lower final income. In situations in which increase in price of concentrates is much greater than increase in milk prices (as is currently the case: 57% vs. 18%), income could be higher if dependence on concentrates is reduced.

Table 3. Evolution of economic changes in relation to reduction of concentrate used in goat feeding in an ecological mountainous farm (Ruiz et al., 2006).

Indicators	Year		
	2003	2004	2005
Purchased concentrate (kg/goat/year)	297	316	198
Milk sold (l/ goat/year)	243	269	206
Income from milk sales (€/goat/year)	108	114	92
Feed costs (€/goat/year)	82	84	54
Difference between income from milk and feed cost (€/goat/year)	26	30	38

In order to optimize use of pasture surface, it is advisable to adjust reproductive management to seasonality of grasses; the seasons of highest goat milk production (and therefore of greater nutritive needs of the animals) should coincide with the season of greater feed production on the farm (Table 4). Furthermore, an improvement in management and use of natural grasslands as well as cultivated surfaces is necessary. Toward this end, we propose: (i) growing grasses with associated species, focusing on leguminous species, (ii) improving natural grasses, planting, if possible, leguminous species, using organic fertilizers such as compost, (iii) producing forage crops for use during seasons when natural grasses are scarce, and (iv) taking advantage of crop residues.

Table 4. Seasonal evolution of milk production and feeding in goats milked in a mountain farm (Mena, 2007).

	2005			
	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
% Milk sold in relation to annual total	14	42	30	14
% Energy from concentrate	57.7	46.0	42.6	42.5
% Energy from forage	6.5	3.4	3.8	1.9

<sup>1</sup>Both supplied in the stall, calculated in UFL and referring to daily needs. Other needs are covered by pasturing.

In order to avoid problems related to animal health, it is very important to continue using autochthonous goat breeds adapted to the environment, such as Payoya in the Cadiz mountains and the Blanca Andaluza in the Huelva mountains, taking into account that the animals' productive level must be adapted to environmental carrying capacity. This should be accompanied by appropriate supplementation in the stall. Strict sanitary conditions of the facilities and milking are essential to avoiding illnesses. Use of medicinal plants could be an alternative for prevention as well as cure of illnesses (Labre, 2008).

In order to improve Ecological management, improvement in training and advisory of technical advisors and farmers is necessary in the areas of sustainable production techniques, recording of information, and ecological farm management. Also, direct marketing channels and artisanal processing of milk into cheese must be fomented, so that ecological farmers may be compensated for their effort as well as for greater production costs due to increase in value added of their products.

#### 4. CONCLUSION

Conventional farms of mountainous areas of Andalusia (Spain) could fairly easily be transformed into organic production. The indicators Sustainable grassland management and Soil fertilization are the farthest from adequate agroecological management in the case of conventional as well as certified ecological farms.

Feeding management and Ecological management are the two indicators most in need of improvement in the conventional farms in order to be converted to organic. It is necessary to assure a high level of autonomous feed, improvement in recording data and technical-economic management, as well as improvement in marketing, if possible previously processing milk into products highly esteemed by consumers.

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