



# The role of the level of intensification, productive orientation and self-reliance in extensive beef cattle farms



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## ABSTRACT

The identification of the livestock production systems (LPS) existing in a given area constitutes the first step to manage farms sustainably, since it improves the knowledge of its operation and subsequently allows for establishing the appropriate managerial strategies for each LPS. It is of great interest, as LPS are key for agro-ecosystem conservation and rural population in many areas. The present study was conducted in light of the importance of the beef cattle sector for one of the oldest and most heavily protected agroforestry systems ('dehesa', SW Spain and Portugal). A total of 63 beef cattle farms (including organic and conventional ones) were analysed from the structural and technical-economic points of view, aiming to: (i) improve the knowledge of the dehesa beef cattle sector; (ii) define specific managerial strategies tailored to each typology (LPS) in order to increase their sustainability as well as that of the dehesa ecosystem; (iii) clarify whether there is a relationship between the typologies obtained on the basis of technical-economic indicators and a previous classification of the farms based on their condition of being organic, and their productive and market orientation. For this purpose, the analysis paid special attention to the level of intensification, productive orientation (presence of a calf-finishing period) and self-reliance (related to their dependence on subsidies). The methodology yielded the following four typologies: (i) extensive farms selling at weaning with low productivity; (ii) extensive farms with low productivity and high dependence on subsidies; (iii) calf-finishing farms with average stocking rates and high profitability; (iv) irrigated farms with low presence of livestock, and high fixed capital and economic fluxes. In general terms, management and structure of dehesa beef cattle farms positioned them in a good place regarding CAP (Common Agricultural Policy) trends (mainly in terms of environmental protection). However, the farms studied must improve several aspects. Firstly, they need to increase their degree of self-reliance (reducing their dependence on external workforce and subsidies). Secondly, their productivity and economic performance must also be increased. The latter could be achieved by adding value to the products being sold, i.e. finishing more calves, developing new products and/or participating in marketing. Generally speaking, a close relationship between farm typologies and the previously established groups of farms (Conventional, Organic 1 and Organic 2) has not been observed. This was due to the similarities between organic and conventional farms in the context of the dehesas with regard to indicators used in the present study.

## 1. Introduction

Livestock farms constitute a key element for both agro-ecosystems conservation and rural population, due to their environmental (Bernués et al., 2011; Henkin et al., 2011) and socioeconomic role (Kristjanson et al., 2007).

In the Mediterranean area, these farms are characterized by their extensive nature and their dependence on grazing resources, as well as their diversity and complexity. Thus, there is a high degree of interdependence between ecosystems and farms. In this context, it is

noteworthy to mention the Spanish rangelands (SW Spain and Portugal) are also referred to as 'dehesas'. A dehesa is one of the oldest and most commonly used agroforestry systems in Europe (Eichhorn et al., 2006; Moreno and Pulido, 2009), and is characterized by the integration of livestock, woodland (holm oaks -*Quercus ilex* subsp. *Ballota*- and cork oak -*Q. suber*-) and pastures. Its agro-climatic conditions are complex, which, in combination with the scarcity and instability of its feed resources, the low profitability of its farms, and the narrow margin between under- and over-exploitation, have shaped unique LPS that are key to the conservation of dehesas. These LPS

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typically have low stocking rates, long productive cycles, low use of external agricultural inputs (extensiveness and self-reliance) and high business diversification (multipurpose: crops, livestock, wood, cork, coal, etc.). According to the study conducted by Ripoll-Bosch et al. (2013), the level of 'self-management', 'self-reliance' or 'self-sufficiency' is a fundamental aspect for the sustainability of pasture-based livestock systems located in the Mediterranean area. In the present study, dependence (the opposite of self-reliance) was associated to feed expenditure, workforce and subsidies, as they constitute the main production costs, limitations and sources of income in these LPS, respectively (Escribano et al., 2015).

From an environmental point of view, these diversified and complex agro-climatic conditions have positive externalities in relation to carbon sequestration, soil quality, pasture quality, prevention against fire risk, dependence on non-renewable energy and ground pollution (Jose, 2009; Henkin et al., 2011; Dumont et al., 2013; Sanderson et al., 2013). From the social point of view, they contribute to stabilizing rural population because, as many authors have stated (De Rancourt et al., 2006; Manos et al., 2013), few alternatives to the agricultural sector exist in European (and Mediterranean) rural areas.

However, various socio-economic factors (changes in market and agricultural policies) have led to specialization and intensification of their production systems in order to increase profitability (Bernués et al., 2011; Udo et al., 2011). Nevertheless, such adaptive changes did not increase dehesa livestock farms' profitability, but rather caused negative environmental and social externalities, which were eventually reflected in reductions in their cultural heritage and overall sustainability (Gaspar et al., 2009; Udo et al., 2011).

There is thus a need to identify units with similar patterns (LPS) in order to be able to understand the abovementioned complex scheme (Landais, 1998) and define measures adapted to each LPS. In this regard, several authors (Gaspar et al., 2011; Madry et al., 2013) have highlighted the importance of typifying farms by means of multivariate statistical methods, based upon their structural, managerial, economic and social aspects.

Given that organic ruminant production systems have been identified as potentially sustainable in the Mediterranean area by several authors (Bernués et al., 2011), and their census has increased significantly in recent years (MAGRAMA, 2013), the present study has been carried out with the aim of: (i) improving the knowledge of the dehesa beef cattle sector; (ii) defining specific managerial strategies tailored to each LPS in order to increase their chances of success (overall performance), as well as that of the dehesa ecosystem.

## 2. Material and methods

### 2.1. Area of study

The study area was the dehesa's surface located in Extremadura region (SW Spain), between lat. 37°56'32"–40°29'15" and long. 4°38'52"–7°32'35" (reference system: European Datum 1950). This is a deprived area with a low population density that provides a total of 2.2 million hectares of pasture. The rural economy is highly dependent on agricultural activity carried out in the pasture. Its climate is continental Mediterranean, presenting mean annual temperatures of around 16–17 °C. Summers are hot and dry (average temperature in July exceeds 26 °C and the maximum values exceed 40 °C). Rainfall is erratic during the year and between years, with values ranging between 300 mm and 800 mm (Hernández, 1998).

### 2.2. Selection of the farms

Due to a lack of official statistics on the dehesa beef cattle sector located in Extremadura, the sampling was non-probabilistic by quotas. Different criteria were taken into account in order to select an indicative sample of the area and sector studied:

- Predominant species and productive orientation: beef cattle.
- Herd size: over 25 adult cows, in order to avoid selecting non-commercial (family-run) farms.
- Geographical and forestry: the study includes farms located in different areas within the dehesa (geographical criteria) with different woodland density (forestry criteria).
- Organic farms: all organic farms had already finished their conversion period to the organic system.
- Balance between organic and conventional farms: similar sample sizes of organic and conventional farms, thus allowing an adequate comparative analysis of both production systems.
- Scientific literature on characterizing beef cattle farms: a sample size close to that of other studies characterizing livestock farms (around 65 farms) was reached (Serrano et al., 2004; Gaspar, 2007, 2009).

Finally, 63 farms (30 conventional and 33 organic) located in the dehesas of the Extremadura region were selected and analysed. This region is the core of such ecosystem and contains nearly 50% of the surface of it. Farms were selected thanks to the collaboration of local farmers' associations, cooperatives, and the Spanish Government. The selected farms were indicative of the situation and characteristics of the cattle sector of the region, and of the dehesa ecosystem. More detailed information regarding the selection of farms has been provided by Escribano et al. (2014a).

### 2.3. Selection of indicators

The selection and development of indicators was conducted based on scientific literature, current legislation and the experience of the research group. On the one hand, indicators of structure, technical management, labor, and productive results were defined on the basis of the scientific literature addressing such topics (Gaspar et al., 2007, 2009, 2011; Toro-Mújica et al., 2012; Ripoll-Bosch et al., 2013; Riveiro et al., 2013). On the other hand, economic indicators were selected according to scientific literature (Gaspar et al., 2007, 2011), European system of accounts (EAA, 2001) and current legislation (Regulation CE No 138/2004). Some of these were calculated directly from the information collected in the survey, while others were calculated at a later time following the methodology used by researchers (Gaspar et al., 2007; Toro-Mújica et al., 2012).

Finally, from the pool of indicators, 45 were selected (Table 1), as the research group considered that they had the greater discriminating power and relevance for dehesa beef LPS.

### 2.4. Questionnaire design and data collection

A questionnaire was designed covering different aspects: farms and herd structure, cattle management, workforce, capital (infrastructure, land, and animals), and economic flows.

Subsequently, the data collection was carried out. However, both the validity of the questionnaire and the ease to capture the answers in the database was tested thanks to trial surveys. After such trials, the final questionnaire was designed and data were collected by means of surveys to the main farm managers (following the methodology described by authors: Gaspar et al., 2011; Escribano et al., 2014a). The data used in this work were obtained in 2011 and are dated from the years 2010 and 2009.

### 2.5. Analysis of the information

In order to carry out the classification (typification) of the farms, authors followed the methodology previously used by a number of researchers (Milán et al., 2006; Gaspar et al., 2007, 2011; Toro-Mújica et al., 2012; Ripoll-Bosch et al., 2013; Riveiro et al., 2013). The mentioned methodology consists of three stages: review and selection of indicators (previously detailed), Principal Component Analysis

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