

# Horse meat production in northern Spain: ecosystem services and sustainability in High Nature Value farmland

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## Implications

- Pasture-based, extensive livestock systems play an important role in the preservation of the rural landscape, and the many ecosystem services associated.
- Spain is the major horse meat producer at EU level, based on traditional extensive systems and a subsequent fattening outside the origin region.
- The movement of animals from raising to fattening areas entails a loss of added value in the regions of origin, which decreases farm profitability.
- The social recognition of the environmental role of extensive rearing systems based on native breeds and the local production and valorization of the horse meat are crucial objectives that need to be addressed and developed in the following years.

**Key words:** ecosystem services, extensive livestock systems, horse rearing, meat production, valorization and promotion strategies

## Introduction

The natural environment provides many benefits to humans, which are assessed in terms of ecosystem services. In most mountain regions of Europe, the rural exodus and the abandonment

of the traditional practices have led to deep changes in the landscape, decreasing the characteristic mosaicism and the diversity of inherited ecosystems (Martínez-Fernández et al., 2015; Muñoz-Ulecia et al., 2021). As a consequence, many ecosystem services are being affected, such as the biodiversity, the carbon sequestration, and the provisioning value of food for herbivores, among others (Durán et al., 2020; Oggioni et al., 2020). In addition, the current situation of climate change seriously aggravates the problem of land abandonment, especially in areas of high plant productivity. Forest expansion and shrub encroachment are leading to a loss of open spaces, a homogenization of the landscape and an accumulation of fuels that, in a situation of high temperatures and drought, entail high environmental risks.

Europe, as other regions of the world, has undergone in the last decades profound changes in their fire regime, and extreme wildfires are becoming increasingly frequent due to fuel accumulations and to drier and hotter climatic conditions than decades before (Krawchuk et al., 2009; Leys and Carcaillet, 2016). As a consequence, extreme wildfires are one of the most important threats Europeans face nowadays, due to its destructive capacity and its affliction on both human lives and the natural environment (San-Miguel-Ayán et al., 2013). Until recently, fire policies have mostly focused and invested on fire suppression and have assigned a minor role to fire prevention and to fuel management techniques. However, the high costs of preventing fuel buildups through periodic mechanical clearings of biomass cannot be accomplished with the limited budgets of the public administrations, and a social engagement and an active landscape management are necessary (Sande et al., 2010; Otero and Nielsen, 2017). It is in this context that the role of domestic herbivores and their associated extensive livestock systems become crucial. The capacity of herbivores to ingest high amounts of biomass may constitute an effective tool for reducing vegetation fuels in critical areas of the landscape (Canals, 2019).

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Equine farms play an important socioeconomical role in the sustainable development of mountain areas in many regions of southern Europe, and they play a key role as preservers of landscapes. Of the range of domestic herbivores suitable for environmental grazing, horses have several important advantages. Despite being monogastric, they can digest cellulose efficiently, the main organic component of plants, and their big frame size and rapid digestion process ensure a high intake capacity. Their digestive tract is designed to take in small and frequent meals of forage, and they exert a selective pressure on grasslands that results in a characteristic “lawn and rough” pattern according to their dietary preferences (Williams et al., 2020). Horses are estimated to spend about 75% of the daytime and 50% of the nighttime grazing (or a total of 60% of a 24-hr day, Fleurance et al., 2001). In addition, thanks to their size and heavy complexion, they can also gain a control on lignified vegetation through the trampling (personal observation).

Regarding the environment, equines adapt very satisfactorily to extreme climates (cold temperatures, high rainfall, snowfall events) and to rough landscapes, particularly when native breeds are used (Canals, 2019). In the current situation of climate change and the priority to reduce greenhouse gas emissions, horses also have an important advantage over ruminants due to their particular digestive physiology that reduces the production of methane. The emission factor for methane (kg CH<sub>4</sub> per head) coming from enteric fermentation is significantly much lower in equines than in ruminants (14 kg CH<sub>4</sub> per head of equine vs 48 kg CH<sub>4</sub> per head of cattle; FAO, 2020). Similarly, the energy losses in horses due to CH<sub>4</sub> production average 3.5% of the feed digestible energy compared to 10% to 13% in adult ruminants (Vermorel, 1997).

## Horse Meat Production in Spain

Worldwide, horse meat production (741,003 tonnes and 4,803,585 carcasses) is currently far below the rest of meat-producing species (0.25% of the total, even below goat and rabbit meats), whereas pork (36%), poultry (34%), and bovine (21%) are the most produced and consumed meats.

Spain stands out as the major horse meat producer in the EU (17%), followed closely by Italy (16%), Romania (14%), Poland (11%), and France (8.2%; FAO, 2020). According to

the national statistics, the current horse censuses account for 630,703 heads (MAPA, 2020a), distributed in 189,452 farms (Figure 1b), which are mostly concentrated in southern and western Spanish regions such as Andalusia (34%), Extremadura (6.4%), Castile and Leon (12%), Galicia (6.4%), and Asturias (6.2%) (Figure 1a).

Among the national registered horses, most animals are raised for leisure activities and only 6.1% are focused on meat production. The latter corresponds to 38,200 animals slaughtered in 2019, which means 0.4% of the total Spanish livestock production and a value worth of 78M€ (MAPA, 2020a). From the total registered equine farms, 15.3% horses are bred for meat production, and most of them (88%) are located in the north-western regions of Spain (Asturias, Castile and Leon, Galicia, Basque Country, and Cantabria; Figure 2a). In the last decade, horse meat production has increased in the country by 51%, and over 73% of the meat produced goes to European markets. National economical balance for international trade is positive for equine meat (MAPA, 2020b), with higher exports (27M€ and 7,074 tonnes) than imports (0.51M€ and 302 tonnes). The level of local consumption is low (average supply per capita below 0.10 kg, Belaunzarán et al., 2015), but it is increasing in the last years. All these data indicate the potential of this product for both exportation and local consumption.

The traditional meat production system is based on the raising of native breeds, which were used as draft animals in the past and that were reoriented for meat production after farm mechanization. For decades, equine breeding innovation depended on the weight, which established genetic improvement programs, artificial insemination, etc. When these activities were transferred to the regional governments, the development and promotion of the horse breeds displayed a high variability among regions. As a consequence, a great breed variability can be found nowadays, which is mainly linked to geographical areas: heavy horse breeds (mare live weight > 650 kg) such as Hispano-Bretón (Castile and Leon; Cantabria; and Huesca), Burguete (Navarre), Basque Mountain Horse (Basque Country), and Catalan Pyrenean Horse (Catalonia); medium-frame breeds (351–650 kg) such as Jaca Navarra (Navarre) and crossbred animals; and small-frame breeds (<350 kg) such as Galician Mountain Horse (Galicia), Asturcón (Asturias),

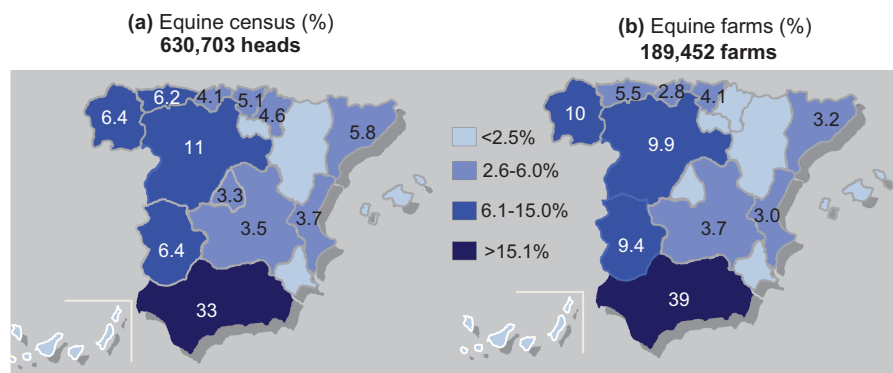
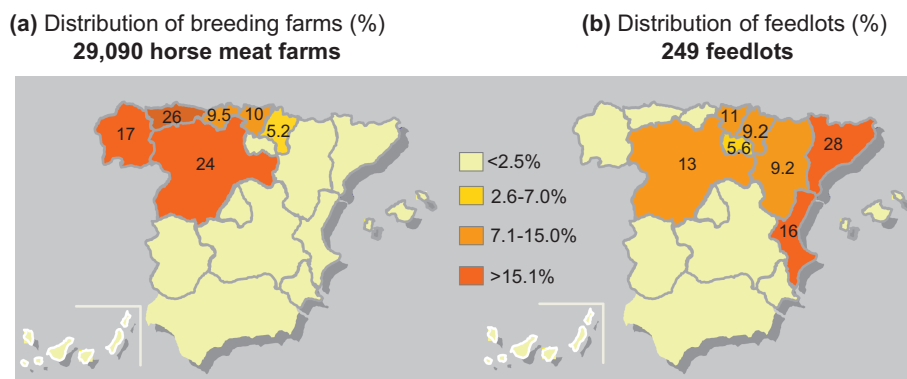


Figure 1. Spanish animal census (a) and equine farms (b) distribution. Source: MAPA (2020a).



**Figure 2.** Distribution of horse meat farms: (a) breeding farms and (b) feedlots. Source: MAPA (2020a).

Losino (Castile and Leon), Monchino (Cantabria), and Pottoka (Basque Country) (MAPAMA, 2015).

Due to the high rusticity and adaptation of the local breeds, the breeding systems mostly rely on the extensive grazing of the natural resources provided by mountain areas and on the feeding with preserved forages in the most extreme winter months (Figure 3). Animals are capable to adapt to harsh conditions making an effective use of mountain and valley grasslands, shrublands, and open forests (of communal use in some cases). Only occasionally, under adverse climatological conditions, animals are supplemented or remain stabled during short periods. In most of the production areas, animals freely graze in high-altitude pastures from spring until autumn. Then, foals are weaned, and animals move to valley pastures before the first snowfalls of the year, closer to villages but without housing. This is the common production system in small family farm units in which horse farming provides an additional income to the regular cattle farming or even as an alternative when the livestock activity (or main activity) has been left. In some regions such as Galicia, equine production is performed under total free grazing conditions. This traditional system in which herds are kept wild in communal pastures constitutes a tourist attraction of the region when, once a year, horses are collected (“Rapa das Bestas”).

Until the second half of the 20th century, horse meat available in the markets came from old animals that were not properly finished. Nowadays, a high-quality horse meat derived from fattened foals is produced. After weaning, foals are usually moved to other regions for fattening and slaughter. In Spain, 249 farms are classified as feedlots, focused on foals fattening and representing 0.13% of the total equine farms in the country. Those are primarily located in the east of Spain (Figure 2b). Catalonia (28%) and Valencia (16%), together with Castile and Leon (13%), Basque Country (11%), Navarre (9.2%), Aragon (9.2%), and La Rioja (5.6%) regions, concentrate 92% of the Spanish horse feedlots (MAPA, 2020c).

In the primary production areas, fattening facilities are normally small-size family farms or farms directly owned by local butchers. In these units, 20–25 native animals are reared, and after weaning and a short adaptation period, foals are fed on concentrates and forage until slaughter. Commonly, animals

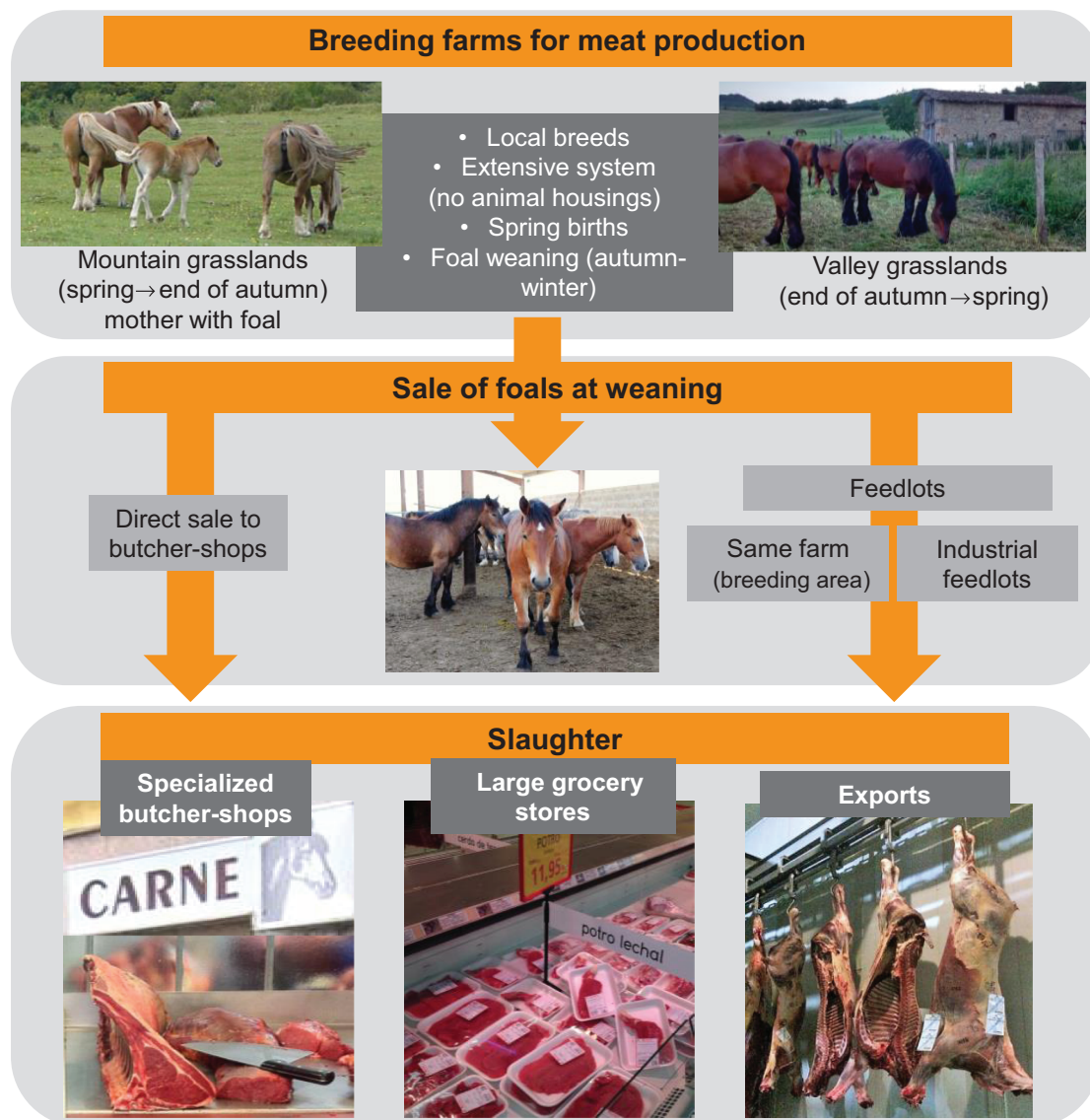
are slaughtered at the age of 12 mo, but depending on marbling and butchers’ requests, meat from 6-mo-old foals is also commercialized. On the other hand, bigger industrial feedlots with capacity for 100–800 animals can be found, which are exclusively dedicated to fattening and meat trading. In these feedlots, a high breed variability is usually found, depending on the region from which suckling foals are purchased (Trasega, 2003). Foals are generally fattened until 12–15 mo or up to 24 mo of age, and they are intended for bigger consumption areas and/or international exports.

As a result of the current animal management and movements, 81% of the horse meat produced in Spain (9,527 tonnes) is concentrated in four regions: Navarre, 38%; Aragón, 21%; Valencia, 14%; and Catalonia, 7.6% (Figure 4a; MAPA, 2020b), despite these regions accounting for only 8.2% of the breeding farms. The average carcass weight is 261 kg, but significantly heavier carcasses are produced in the fattening regions compared to the extensive production regions (Figure 4b). In the latter, local breeds are usually small sized, and foals are slaughtered at younger ages with carcass weights averaging 150 kg.

The movement of foals from the north-western to the fattening and slaughtering areas in the north-eastern regions involves a loss of added value in their regions of origin. The finishing of foals in their original regions, besides an opportunity gain for the rural economy, will also ensure an optimal and complete use of the natural resources, and the traceability and highest quality for the final product, the meat. As a consequence, any action that helps and gives support to the local production and valorization of the final product would be beneficial for the producers and for the rural economy.

## Nutritional Composition of Horse Meat

Horse meat, as any other meat, is a nutritionally valuable foodstuff. It constitutes a significant source of high-value proteins, iron, zinc, B type vitamins, and selenium with a greater bioavailability compared with that found in other foods (Lorenzo et al., 2014). However, in contrast to other more consumed meat species (i.e., bovine, poultry, or pig), few scientific studies have focused on horse meat quality although it has been recognized as a healthy meat (Lorenzo, 2013; Belaunzaran et al., 2015).



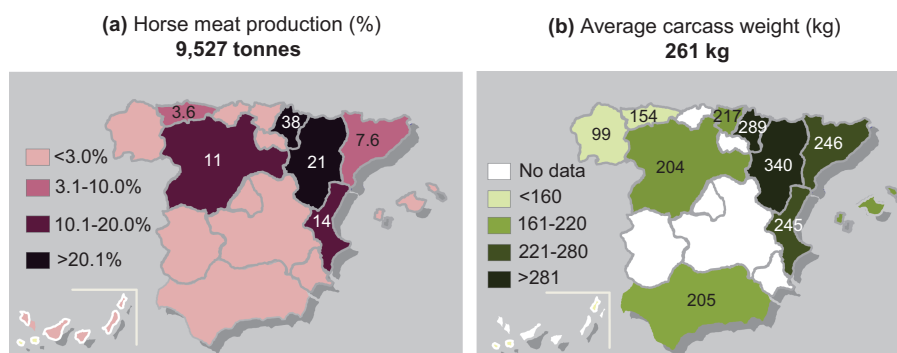
**Figure 3.** Scheme of the Spanish horse meat production system.

Horse meat has a low-fat content and a significant proportion of n-3 polyunsaturated fatty acids (PUFA), such as linolenic (18:3n-3) and other long-chain n-3 fatty acids (FA), that have been reported to have beneficial properties for preventing chronic diseases (Weylandt, 2016). In horses, considering their digestive track, dietary FA are absorbed before the anaerobic microbial hydrogenation occurring in the hindgut (cecum and colon). Thus, the postgastric localization of digestive chambers allows them for an efficient absorption and deposition of n-3 PUFAs coming primarily from pastures. In addition, even though the horse is a nonruminant herbivore, due to a light microbial fermentation taking place in the hindgut, the formation and accumulation of several *trans*-18:1 and conjugated linoleic acid isomers have been reported (Clauss et al., 2009). The low *trans*-FA level in horse tissues is not surprising since the formation of nonindustrial *trans*-FA normally occurs in ruminant

species through biohydrogenation processes in the rumen (see review by Aldai et al., 2013).

The aforementioned considerable n-3 PUFA transfer efficiency from pasture to muscle tissue in horses was described in the 1950s (Gupta and Hilditch, 1951), and more recently, several studies have brought up new peculiarities of these animals. Even though horses do not have a gall bladder, the continuous secretion of biliary salts, together with lipase-rich pancreatic juices, provides them the ability to efficiently digest high amounts of dietary lipids in the small intestine. In this regard, a specific pancreatic lipase (pancreatic lipase related to protein 2) that is absent in pigs, turkeys, or ruminants has been described in horses, and has been linked to its capacity to hydrolyze the linolenic acid (18:3n-3) esterified in galactolipids of plants (see recent review by Sahaka et al., 2020). In this line, several studies have pointed out that horse tissues constituted





**Figure 4.** Distribution of the horse meat production (a) and average carcass weights (b) in Spain. Source: MAPA (2020b).

a valuable source of energy and PUFA in the diet of humans in the Paleolithic and the Neolithic, when plants and marine foods were scarce due to recurrent glaciations (Guil-Guerrero et al., 2013), and this could be directly related to the preferential deposition of 18:3n-3 in neutral compared to polar lipids (i.e., subcutaneous fat; Belaunzarán et al., 2017).

### Valorization of Horse Meat Production Systems

The concept of High Nature Value (HNV) farming in Europe constitutes a recognition of the fact that the conservation of biodiversity depends on the continuation of low-intensity farming systems and the environmental services and positive externalities they provide. But, for its maintenance, these systems need to be profitable to farmers and rural development is necessary (González-Díaz et al., 2019). Existing support mechanisms such as the agri-environment measures have helped to slow down the loss of these systems, but they are insufficient to make HNV farms commercially viable and ensure its survival in the rural economic structure (Rodríguez-Ortega et al., 2018).

The recognition and valuation of the ecosystem services provided by extensive farming systems is necessary to raise social awareness and design effective communication strategies that contribute to improve the market value of the animal-derived products (Faccioni et al., 2019). That is why new efforts are being carried out to valorize and promote the extensive production system itself, as well as the final product (horse meat), based on its important role in the sustainable development of mountain areas at economic, environmental, and social levels (i.e., the European project Open2preserve, <https://open2preserve.eu/en/>). Anyway, giving a monetary value to these externalities is a challenge, and many attempts of measurable criteria for the valuation of the ecosystem services provided by pasture-based farming systems are being developed in the last years to that purpose (Bernués et al., 2014; Rodríguez-Ortega et al., 2014; Maldonado et al., 2019; Durán et al., 2020).

In the same line, the Payments for Environmental Services can be a suitable arrangement to remunerate producers for the positive externalities associated to the environmental grazing and to compensate farmers for the complexity of the

management and/or the potential decrease in productivity (Sattler et al., 2013; Varela et al., 2018). In the south of Spain, there is a long-lived and successful example of the implementation of payments to shepherds for practicing an extensive and targeted grazing for the maintenance of firebreaks areas. The Red de Áreas Pasto-Cortafuegos de Andalucía (RAPCA) program rewards extensive breeders for their biomass control services in fuel breaks located in public forests. The payments received depend on the size, location, and difficulty of grazing of the area assigned to each shepherd, as well as the degree of accomplishment of the task. The political will, the stable commitment from the public administrations, and the well-designed system of biomass monitoring have been crucial for the success of the program (Varela et al., 2018).

### Conclusions

In a scenario of climate change, the preservation of resilient landscapes that encompass as many ecosystem services as possible is necessary, and low-intensity farming systems are to play a key role in them. Pasture-based, extensive equine breeding produces a traceable and remarkable high-quality meat, while offering many positive externalities such as the preservation of mosaic landscapes and its associated biodiversity, the reduction of fuels for wildfire prevention, the recovery of endangered breeds, the maintenance of a primary activity that fixes population, and the low-water and -carbon footprint linked to pasture-based livestock productions with a low-methane emission. From now on, an important work to promote the local production of horse meat and the investment in effective diffusion and communication tools that raise social awareness and contribute to improve the consumption and the market value of these animal-derived products is necessary.

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