EXTENSIVE LIVESTOCK FARMING IN DEVELOPED COUNTRIES: A GLOBAL PERSPECTIVE (A SYSTEMATIC LITERATURE REVIEW FOR FUTURE RESEARCH)

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Abstract

In the context of economic development, countries have adapted production models to become more intensive. However, a substantial proportion of livestock production is still conducted under extensive farming systems. The objective of this study is to explore the situation of extensive livestock farming in highly developed countries, as are perceptions of the sector, benefits and disadvantages it presents, and what challenges it faces. This systematic literature review analyses the state of the art regarding the situation of extensive livestock farming in several contexts: its sectorial dynamics, future expectations and services provided, paying special attention to its implications and needs. To establish a clear definition of the term "developed country", a boundary was determined using the Human Development Index (HDI). Among countries with a very high HDI (>83%), three major trends in the circumstances of extensive livestock farming were identified. These three trends correspond to European countries (France, Germany, Spain, Italy, among others), countries with Anglo-Saxon heritage (USA, Australia, and New Zealand), and Latin American countries (Argentina, Chile, and Uruguay). A critical examination reveals notable distinctions among these three trends. The results demonstrate the disappearance of extensive livestock farming in Europe, with policies aimed at promoting its recovery; a concern for sustainability and resilience to climate change in the Anglo-Saxon world; and the challenge of overstocking and soil pollution in Latin America.

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Highlights

Extensive livestock farming is gaining academic interest.

Literature reviews have revealed the advantages, problems, and challenges associated with extensive livestock farming.

Despite its benefits, traditional extensive livestock farming faces difficulties and is at risk of extinction due to its transformation and disadvantage compared to intensive production.

The ecological paradigm shift involves a return to traditional livestock farming.

This response is driven by concerns such as animal welfare, product quality, and the ecosystem services provided by extensive livestock farming (e.g. fire prevention, soil fertilization, landscape care, etc.).

This review aims to identify research gaps, propose new studies, and establish knowledge for future public policies based on verifiable scientific foundations.

Introduction

The agricultural sector is fundamental for any territory. It supplies food and other raw materials for further processing. Within the agricultural sector, extensive livestock farming (ELF) has numerous implications. There could be defined ELF as "*that which takes advantage of the natural resources of the territory, with a low use of external inputs and mainly through grazing. In general, it is characterized by the use of species and breeds of livestock adapted to the territory, the use of diverse pastures adjusting to their spatial and temporal availability, and respect for the environment in which they are sustained"* (Ruiz Mirazo et al., 2017).

Historically, ELF has generated wealth for many societies, especially in the rural world. In cultural terms, a thousand-year-old idiosyncrasy has developed around this activity, which has shaped much of what societies do and how they behave. Finally, in the economic context, it has constituted a strategic economic sector until the irruption of industrial activity.

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Ecosystem services are the benefits that ELF provides to the environment. Among these services there could be found a greater rooting of the population, defense against abandonment and depreciation of the land, belonging to the cultural heritage, fire prevention or increasing of biodiversity (Cocca et al., 2012; Lenormand, 2012; Garbarino et al., 2014; Álvarez Martinez et al., 2016; Lasanta et al., 2016; Perea et al., 2016; Honrado et al., 2017; Lasanta, 2019; Díaz Gaona et al., 2019; Zaratiegui, Gurrutxaga, 2021; Lasanta et al., 2022; Celaya et al., 2022; Salachna et al., 2022; Varela et al., 2022; Madau et al., 2022). These benefits have led in recent years to raise ELF as a clear opportunity for sustainable rural development and nature protection (Farinella et al., 2017), and therefore an ally against the depopulation of rural areas (Quaranta et al., 2020; Rodríguez Soler et al., 2020). Despite these benefits, ELF has experienced a significant decline in all European countries (García Ruiz, Lasanta Martinez, 1990; Pardo Abad, 1996; Martín, 2001; Pardini, Nori, 2011; Bento Gon Çalves, 2012; Ríos Núñez et al., 2013; Ríos Núñez, Coq Huelva, 2015; Portús, Rosario Mateo Pérez, 2020; Dinis, Simões, 2021; Sa Rego et al., 2022; Pinto et al., 2023).

The idea of improving production using returns to scale has been very popular throughout the 20th century, shaping policies that penalized less scalable modes of production. However, in recent decades, it has been approached from a new perspective, according to externalities that operate in the intensive and ELF model. Today, in Europe, the discussion is not whether or not ELF is more sustainable, but rather what mechanisms make it so sustainable. However, pastoralism faces a complex situation with a consolidated trend towards disappearance or replacement by more intensive livestock farming models. Other contexts where ELF proliferates, such as the Anglo-Saxon environment (i.e. United States, Canada, Australia, and New Zealand), reflect this sector's resilience, as well as the effects livestock stocking can have on ecosystem quality. Similarly, the perspective of countries with ELF in an economic regime between the developed and underdeveloped world, such as Argentina, Uruguay, or Chile, may be helpful.

In short, this article aims to answer the following questions: i) what are the dynamics of ELF in developed countries? and ii) which are the main topics of discussion in the academy on ELF?

For this purpose, there have been analyzed the relevant literature on ELF, traditional livestock farming and pastoralism in the context of economically developed countries. The proposed review uses the Systematic Literature Review (SLR) methodology to address the subject matter. According to current knowledge, this is probably the first research that holistically review the body literature of traditional livestock farming in developed countries, as it is usually presented as fragmented in different areas (e.g. sustainability, economic efficiency, reforestation, etc.).

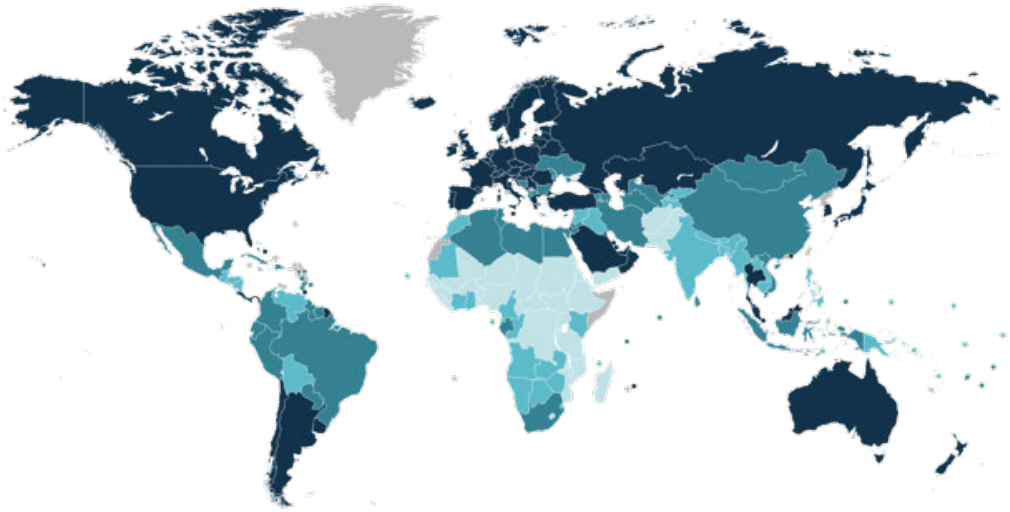
Materials and Methods

SLR is a methodological approach to literature review that synthesizes knowledge, addresses and identifies problems in primary research, and generates and evaluates theories. To be treated as such, it must be transparent and complete, including the review method and what was found (Page et al., 2021). In our case, we have followed the PRISMA protocol (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) in its 2020 declaration, which provides standardization of the SLR, so that the review will result in a comparable and revisable document for future reviews.

The approach to the review contains three phases:

Choice of search criteria - This research aims to present all available works on ELF in an orderly way in a developed economic environment. Therefore, there were considered synonyms for the following terms: extensive livestock farming, extensive husbandry and extensive cattle. There are also other expressions related to these definitions, as are grazing systems and pastoralism.

Figure 1. Countries by HDI in 2022



Source: UNDP, 2022.

There are offered two necessary views to determine what is understood as a developed economic environment. Firstly, it is not traditional livestock farming related to indigenous ethnic groups as part of their cultural heritage (such as the Sapmi, Aborigines, nomadic Steppe peoples, or the Mapuche). Secondly, it must be in countries with a high HDI (Human Development Index). According to United Nations Development Programme (UNDP), for 2022 (UNDP, 2022), there were 51

countries that exceeded 83% (Figure 1.). Of these, 34 were European countries, 4 belonged to the English heritage overseas, and 3 were Latin American countries. The other belonged to Eastern Asia (three, Japan, South Korea, and Singapore), Arabia (four, Saudi Arabia, Qatar, Bahrein, and Kuwait) and other regions (Turkey, Israel and Saint Cristopher, and Nevis).

Search in databases - The bibliographic databases Scopus and Web of Science were a starting point for identifying the relevant literature. The use of these databases responds to practical reasons. These databases are freely accessible to researchers, since they are provided by the University of Castilla-La Mancha (Spain). This fact implies a bias that the reader must consider. The analysis period was delimited from 1988 (the date of the first relevant record for the analysis) to May 2023, when the review was carried out.

In the search strategy, the terms for the identification of resources were the following:

TS = (Livestock) AND TS = (Extensive)

TS = (Extensive husbandry) OR TS = (Extensive cattle) OR TS = (Grazing systems) - Added in Scopus: *AND NOT TS = (Africa) NOR TS = (Brazil) NOR TS = (China) NOR TS = (Pakistan)*

TS = (Pastoralism) - Added in Scopus: *AND NOT TS = (Africa) NOR TS = (Brazil) NOR TS = (China) NOR TS = (Pakistan) NOR TS = (History) NOR TS = (Archaeology)*

The searches yielded 2,484 publications (Figure 2.), of which 233 were retained and the remainder excluded. The reasons for exclusion were as follows:

Repetition. The repeated appearance in searches for different items, and in different databases.

Unrelated subjects. Study topic focused on unrelated issues (e.g. pastoralism in ancient times).

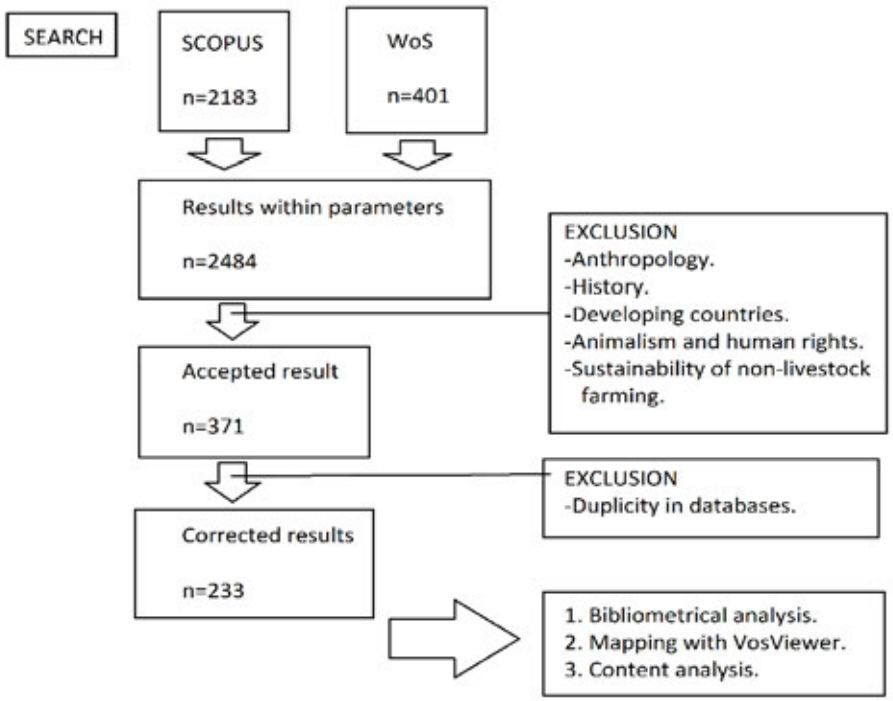
Contexts other than those for which the research is proposed. These are not assessed in this work (e.g. tribal and nomadic pastoralism, whether or not it occurs in developed countries).

Issues unrelated to those proposed in this research. Publications where the emphasis is placed on aspects that are not the object of performed study (e.g. animal rights or ecology of fertilizers and chemical products).

Low level of development. To limit the scope of this review, there have been considered the criterion of a high HDI, settling this limit at 83%. At the same time, there have been established three main regions.

Specifically, the systematic review took the form presented in Figure 2.

Figure 2. Research outline



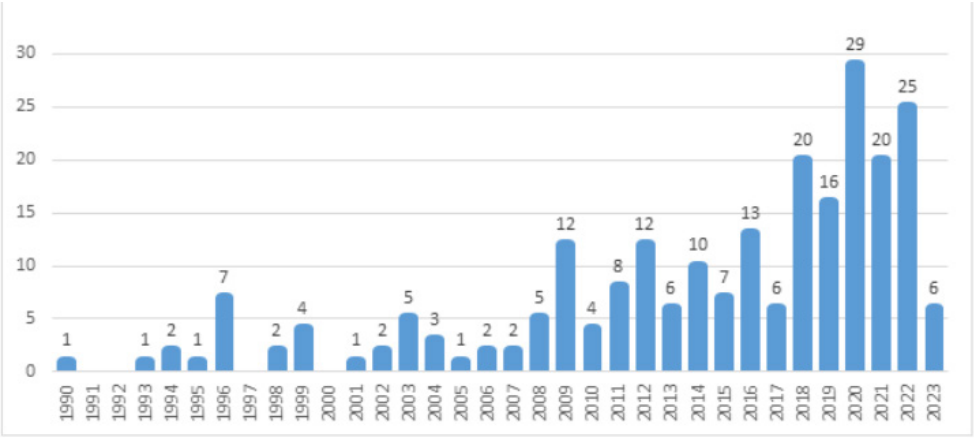
Source: According to authors research.

Method of analysis - Once the definitive bibliographic base has been obtained, a bibliometric study is carried out. To classify the publications analyzed, we used the VOSviewer programme to map the keywords and facilitate the content analysis.

Bibliometric Study

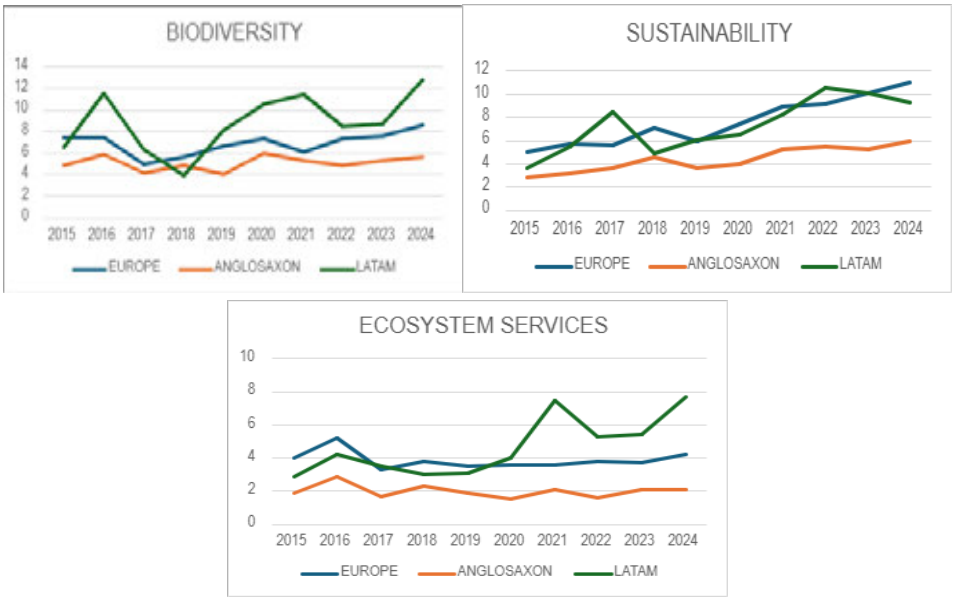
The number of publications on ELF in a developed country has increased in recent years, demonstrating a growing interest of the academic community in this field. Graph 1. shows the absolute increase of publications. Graph 2., 3. and 4. show the relative increase inside livestock farming publications where keywords as "biodiversity", "sustainability" and "ecosystem services" are included. The graphs point out the three main contexts analyzed: Europe (publications in France, United Kingdom, Spain, Italy, and Germany), Latin America (Chile, Uruguay, and Argentina), and Anglo-Saxon Area (United States, Australia, Canada, and New Zealand).

Graph 1. Number of publications per year



Source: Author's elaboration based on WoS and Scopus data.

Graph 2., 3. and 4. Percentage of livestock farming publications addressing following keywords, by region



Source: Author's elaboration based on Scopus.

The Graphs 2-4. shows an increase in publications starting in the second decade of current century, with a rapid acceleration in the last five years. This increase in interest coincides with a growing concern about the environment among policymakers and consumers.

Firstly, it is important to differentiate, as it is pointed out in the introduction, various socio-economic contexts existing in the publications, which could be classify into three groups:

- Europe, including the EU and neighboring countries (e.g. Norway). In this context, ELF has declined considerably. New territorial and sustainable development strategies in Europe seek to benefit a sector that has suffered the consequences of the previous decades of the de-structuring of agricultural activity and intensification, giving it an essential role in new policies.
- Anglo-Saxon context, mainly represented by the countries such as Australia, New Zealand, or the United States. These countries are characterized by having historically significant livestock populations. The greater availability of land has allowed livestock farming to be mainly extensive. However, in recent times certain attempts have been made to combine livestock farming and sustainability. Effect of both livestock pressures on the soil and its practices is being studied, seeking productivity, additional ecosystem services and resilience to climate change.
- Southern Latin American countries, including Argentina, Chile, and Uruguay. These countries form a microsystem separate from other South American countries, as they have higher per capita income and human development rates, and can be considered to have their own particularities. In these countries, ELF is a reality and the study of their livestock farming is based on seeking to optimize economic and ecological sustainability, profitability, quality and productivity.

This socio-economic disparity is relevant because the increase in academic interest has been evenly distributed across regions, resulting in differences in the quantity and content of academic publications. Thus, it was found that publications from the Anglo-Saxon context have been present since the beginning of the analysis. However, sustainability and ecological services issues have only recently been gaining ground.

In the European context the increase of publications occurs less progressively. Publications emerged mainly from France and spread through the other Mediterranean countries (Spain, Portugal, Italy, and, to a lesser extent, Greece), while it includes, in the last decade, different countries of Central and Eastern Europe (Germany, Poland, Romania, Czech Republic, Hungary, etc.). The growth of this interest can only be understood with the European Union's commitment, at least formally, to territorial development, cohesion and environmental protection, related to the role played by ELF in these issues.

Finally, in the case of Latin America, there has been an increase due to global quality demands, the need for productivity and competitiveness in a star product of the region's trade and, to a lesser extent, the weak international commitment to curb climate change.

The publications that have had the greatest impact on the scientific community are mainly on landscape management and land use. Table 1. can help in establishing the main topics of academic on ELF.

Table 1. Most cited publications

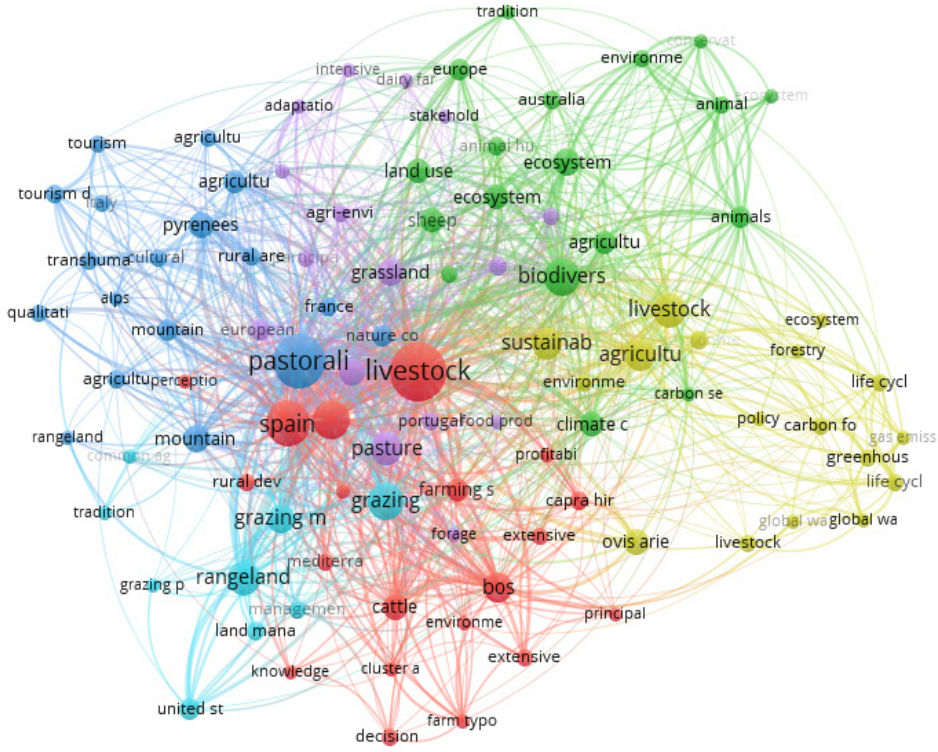
Title of the work	Times cited
Monitoring Animal Behavior and Environmental Interactions Using Wireless Sensor Networks, GPS Collars and Satellite Remote Sensing	202
Diversity and change in Australia's rangelands: A post-productivist transition with a difference?	153
Managing abandoned farmland to control the impact of re-vegetation on the environment. The state of the art in Europe	136
Is abandoning traditional livestock farming systems the primary driver of mountain landscape change in Alpine areas?	130
The Impact of Heavy Grazing on Soil Quality and Pasture Production in Rangelands of SW Spain	126
Land-use changes in the Spanish Pyrenees	116
Grazing studies: What we've learned	112
Rotational grazing effects on rangeland vegetation at a farm scale	104
Multifunctional agriculture in policy and practice? A comparative analysis of Norway and Australia	102

Source: Author's elaboration based on Scopus.

VOSviewer Mapping

Using co-occurrence analysis, there could be identified the relationships between the keywords in the selected articles. Some of the words used in the search are relevant terms in the map, obviously. However, there are some curiosities, such as the recurrence of the keywords "Spain", "Pyrenees", or "Mediterranean environment", which shows a precise geographical location of the interest of the works, or "sustainable development" and "climate change", which allude to a thematic concentration.

Figure 3. Keyword co-occurrence map



Source: Prepared by the authors using VOSviewer from the selected database.

The analysis tool generates six large clusters of keywords. In next image (Figure 3.), these clusters are identified as violet, red, light blue, dark blue, green, and yellow:

- Violet: This group relates concepts related to types of grasslands and soil management. As there could be seen on the map, it is a transversal and generic group that is closely related and interconnected with the others.
- Red: There was found terms related to the typology of livestock farming, such are extensiveness, decisions, knowledge, Mediterranean environment (countries), rural development, types of livestock (cattle, goats), etc.
- Light blue: This color groups together issues related to management of grazing systems. It is common in countries where ELF is widespread (Anglo-Saxon and Latin American world, characterized by pastures at "ranches").
- Dark blue: In this group, the concepts are directly related to pastoralism, associated with an essentially traditional model and mountainous territories, and a qualitative perspective of study, which focuses on the practices and models of

ELF in less favored territories. Positive and negative impact of tourism in these areas is also mentioned.

- Green: This section is characterized by integrating characteristics of the eco-systemic impact of livestock farming, the benefits and damages on the land, and its relationship with local fauna and flora. There could be seen a preponderance of biodiversity, ecosystem services and sheep.
- Yellow: It considers the link to the eco-systemic impact of ELF at a more global level. It could be called as environmental impact. It analyses the carbon footprint, its relationship with climate change, and its prospects for scenarios of this type.

Content Analysis

The literature mapping helps to organize the content analysis and discussion of the results, which will be carried out according to the classification of the clusters obtained by the VOSviewer mapping.

Potential of land use through pastures management

In the literature related to pastures management, the typology of pastures appears as grassland, forage lands (green crops for subsequent haymaking or silage), or forestry systems. There have been given some general concepts that appear recurrently in the literature, which are necessary to introduce in order to understand content analysis: 1) Forage lands are associated with a certain level of farming intensiveness, as its consumption implies a dependence on external feed. Livestock farms may own rangelands and belong to the farmer through farms or ranches. 2) Grasslands may also be part of communal or public lands and therefore run the risk of increased livestock load, overgrazing and "tragedy of the commons". 3) Forest systems differ from communal or public grasslands in that they are not used for livestock as a primary activity, but are wild lands where the cattle naturally find their food. Two cases should be noted: first, unbalanced forest systems (undergrowth and shrubbery from abandoned agricultural land) can be converted into communal grazing land; and second, the territory is usually affected by another economic activity.

Unbalanced forest systems open the door to state intervention and, therefore, the implementation of policies. Landscape management as such a policy is studied with increased interest in Europe, where rural depopulation leads to revegetation: recovery of previously agricultural areas by nature. This phenomenon increases carbon sequestration but, at the same time, it leads to a rise in undergrowth and shrubbery, and to a rapid spread of fires (Penniston, Lundberg, 2014; Vlami et al., 2019; Harkoma, Forbes, 2020; Mastronardi et al., 2021). Revegetation seems to be

closely linked to the subsidies to extensive farms (Hardaker, 2018). There has been noted the lack of studies showing such results for the European Union.

There is no doubt that these lands are or can be recovered by traditional livestock sectors through active land use policies (Cocca et al., 2012; Garbarino et al., 2014; Álvarez Martinez et al., 2016; Lasanta et al., 2016; Perea et al., 2016; Honrado et al., 2017; Lasanta, 2019; Díaz Gaona et al., 2019; Lasanta et al., 2022; Celaya et al., 2022; Salachna et al., 2022), also allowing the use of remote pastures (Schmitz, Isselstein, 2018). The effects of this inactivity in decision-making and the lack of maintenance result in problems of floods, fires, landslides, which represent a cost that has been calculated for certain areas (Durán et al., 2020). However, determining these climatic services is complex (Wardropper et al., 2021). Even the burning of shrubland allows the ashes to give rise to higher-quality grasslands (Nadal Romero et al., 2018).

Extensive livestock farming: Between intensification and abandonment

The trend towards ELF in most developed countries implies a move away from extensiveness. Although greater flexibility and survivability (Kardulias, 2015) and greater sustainability (Schiere, Gregorini, 2023) are observed in pastoral human societies, there was not seen an evolution that corresponds to this. On the contrary, the trend is towards intensification and unsustainability (Godde et al., 2018).

In studies carried out in Austria (Steinweider et al., 2010), Germany (Luick, 1998), New Zealand (Luo, Ledgard, 2021), Hungary (Varga, 2017), France (Berriet Solliec et al., 2018), Australia (Schapper, 1996; Holmes, 2002; Colley et al., 2020) or Argentina (Faverin, Machado, 2019), there are observed three fundamental trends. There is an intensification or disappearance in Europe, a confrontation with environmental regulation in the Anglo-Saxon world and attacks due to low productivity in Latin America. In the Spanish case, there was observed the gradual disappearance of traditional livestock practices such as transhumance – seasonal movement of livestock between fixed summer and winter pastures (García Ruiz, Lasanta Martinez, 1990; Pardo Abad, 1996; Martín, 2001; Ríos Núñez et al., 2013; Ríos Núñez, Coq Huelva, 2015; Portús, Rosario Mateo Pérez, 2020), analogous to the Portuguese case (Bento Gon Çalves, 2012; Dinis, Simões, 2021; Sa Rego et al., 2022; Pinto et al., 2023), or the Italian case (Pardini, Nori, 2011).

At a global level, these dynamics are observed in pastoral production (Gertel, Le Heron, 2011; Dong, 2016; Easdale et al., 2020), where the capitalist economic system in which livestock production is circumscribed plays an essential role (Sayre, 2009), and, linked to it, the conservation and tenure of land as a pillar of agrarian policy (Mitchell et al., 2005). The idea of continued economic growth also has an impact on the viability of pastures (Czech et al., 2008).

According to literature, the most traditional livestock farming has escaped the general trend towards intensification (Europe) and the privatization of land in an extensive environment (Anglo-Saxon's and Latin America). The main argument is that traditional livestock farming could be more economically efficient (Nastic et al., 2017). Yet, these studies rarely analyze the non-market benefits and externalities, especially in areas of economic decline (Scoones, 2023), that would motivate a payment to finance ELF as a key to allow economic sustainability in those regions (Krajcovic et al., 2003). Some activities, such are tourism, or technology are proposed to change intensiveness trend (Liechti, Biber, 2016). Some other studies wonder why the farmers decide to change, and what incentives guides them to convert their farm into an intensive farm (Baskaran et al., 2009; Greiner, 2016; Czajkowski et al., 2021; Santiago et al., 2022), but there is no consensus on the reasons. About the practical reasons, ELF is linked to the abundance of land, which implies a low-cost and profitable alternative to external feeding based on supply and demand, and to marginal areas with no other land use, too. The link between traditional native breeds and the marginality of regions (Bertaglia et al., 2007) reveals that this type of livestock farming has been maintained in neglected areas, thus escaping the trend. In fact, the factors of intensive use in Australia were determined by population, inequality and access to markets, and climatic conditions (Marcos Martinez et al., 2017). Moreover, livestock farming is affected in efficiency by the economy (Holechek et al., 1994) and by other practices such as the spatial heterogeneity of pastures, scale effects or random events (Laca, 2009). These random events are significant since cases such as drought imply an important cost (Thomasz et al., 2020), in addition to producing imperfect information for farmers that is difficult to overcome (Gregg, Rolfe, 2016).

However, in terms of economic sustainability, ELF can be more independent of the market and its price volatility. Some authors point to the use of economic instruments to reduce the uncertainty of feed costs (Pérez Franco, 2022), while other studies show that greater independence from markets through grazing implies greater economic sustainability by reducing dependence on supplementation (Leithold, 2011; Franco et al., 2012), and therefore reducing energy consumption (Bossis, 2012). This is something that intensive livestock farming cannot afford. In a modelled environment, it could be seen that an increase in external feed prices leads to a greater proliferation of transhumant herds (Ragkos et al., 2020). Indigenous breeds, existing on traditional livestock farming, present numerous advantages: biodiversity (Tampaki et al., 2022); reduced dependence on subsidies (Gaspar et al., 2009; Lasanta, 2010); and an increase in biological efficiency (Dos Reis et al., 2021). In addition, there is significant support for the resilience of ELF to climate change (Lodge et al., 2009; Macleod et al., 2013; Teague et al., 2015; Deléglise et al., 2019; Barron et al., 2021), and to drought (Nettier et al., 2010). This resilience would be based on modifying the livestock load on soils

with greater or lesser presence of grass (Bailey, Brown, 2011; Rodríguez Ledesma et al., 2021).

According to this picture, what has been the public intervention on the matter? In the European Union, there is a direct link between the survival of the sector and the Common Agrarian Policy (CAP), (Luick, Böcker, 1999; Vicente, Azqueta, 2019; Stankov, 2020), for example, by making the livestock-agriculture symbiosis incompatible, which provides the former with food (stubble) and the latter with fertilizer (manure), (Caballero, 2003; Hughes, 2011; Farah, Gomez Ramos, 2014; López et al., 2018). Regulation seems essential for the survival or abandonment of the sector (Morgan Davies et al., 2014). Within the surveillance of the food chain and consumer protection by the authorities, there are incompatibilities between legal requirements and grazing (Gardin, 2013; Aubron et al., 2014). Faced with this problem, some authors propose exceptional legal regimes for this activity (Pérez Barbería et al., 2023), or to focus attention on local consumption (Bjørkhaug, Richards, 2008). New technologies applicable to livestock farming are emerging to reduce the problem of reconciling traditional extensive production with consumer protection. Although intensive livestock farming has a much higher level of food traceability (Wang et al., 2019), traceability has been improved in ELF (Tonsot, Schroeder, 2006).

However, public intervention is now moving to a weak attempt at recovery. Some studies are optimistic about the role of the CAP in pastoralism and sustainable development (Nori, Gemini, 2011; Chereji et al., 2016). The role of these financing and investment policies is crucial and should be adapted to sustainable development (Ouedraogo, Davies, 2016).

The trend of resurgence of livestock farming as added value and the agricultural practices and incentives that farmers or potential farmers have had to act in this direction have been evaluated. A comparison has been made of the livestock structure according to type of farm (Easdale et al., 2009), or organic direction in production (Horrillo, 2020). An ELF model inevitably depends on public aid (Roeder et al., 2010; Lienard, 2014). But there is also a certain consensus on the economic and ecological unsustainability of intensive livestock farming (Von Boberfeld et al., 2002; Ares, 2007; Mena et al., 2017; Díaz Gaona et al., 2021). Within ELF, for some authors success seems to reside in small herds with large tracts of land (Jocum, Groenewald, 1993). Others complement it with the pasture species, the physical environment and the management of the farm (Simpson, Langford, 1996), where has to be include an economic advantage if they are transhumant (Fernández Giménez, Ritten, 2020). There could also be added that ELF is independent of the psychic character - essentially random - of the animals, an issue that does affect intensive livestock farming and generates livestock management problems (Reeves, Derner, 2015).

It is also true that in recent times an attempt has been made to reverse the technological gap between extensive and intensive livestock farming. Thus, new "virtual fence" systems are being developed to improve grazing in the territory (Anderson et al., 2014), the detection of births in free-ranging animals is being analyzed (González Sánchez et al., 2021) or the inclusion of the Internet of Things in ELF is being analyzed to study important livestock parameters (Keates, 2019; Mishra, Sharma, 2023).

Grazing systems: An unresolved debate

The impact on the soil and the profitability of different grazing systems are discussed here. This research refers mainly to Anglo-Saxon's and Latin America, and refer to the use of private or public-private pastures to the extent that they are significant extensions of land where livestock co-exist with wild species. The literature has sought to optimize grazing according to continuous or rotational grazing, with defenders and detractors of both (Guevara et al., 1996; Welsh, 1996; Holechek et al., 1999; Jacobo et al., 2006), or even a commitment to a strategic or alternative type of grazing (Dahal et al., 2020; Bertolozzi Caredio et al., 2021). These can improve the profile of plants, their biodiversity and their photosynthesis capacity (Barnes, Hild, 2013) and advance greenhouse gas optimization for the rotational system (Anderson, Vandehey, 2004).

Pastoralism: An activity unjustly neglected

Pastoralism is not just a grazing practice, but a budget of historical, cultural, economic and environmental practices supported by the knowledge (Maroto Molina et al., 2018) and the life of the transhumant shepherd (Agulló, 2009; Osamu, 2016; Archer, 2018).

A significant problem in preserving mentioned active pastoralism is spatial competition. Tourism, in conjunction with ELF, has often been considered a winning bet in sustainable territorial development (Montrasio et al., 2020; Belliggiano et al., 2021; Ghirardello et al., 2022;) and as the spearhead of public policies to curb the problem of revegetation of abandoned agricultural areas (Lasanta et al., 2015; Tulla, 2019; Potthoff et al., 2020). However, these sectors do not coexist peacefully, as the proliferation of tourism causes a decline in livestock farming (Laguna, Lesanta, 2003; Jiménez et al., 2019). It is also worth mentioning that ELF not only competes with tourism, there are also existing conflict between local farmers and "foreign" farmers who opt for profitable grazing (Eychenne, 2008).

Finally, for some authors, the transformation or abandonment of traditional livestock farming in Europe is also due to the lack of social cohesion (Caballero,

Gil, 2009), the lack of voice in regional governments, weak cooperation between farmers (Fernández, Estaque, 2012), the difficulty to access the pastures (Schils et al., 2019), the lack of generational change and labor (Ruiz et al., 2020; Sendyka, Makovycki, 2018), or the requirements of the meat industry (Morsel, Garambois, 2022). The loss of land and common goods has also affected ELF (Galán et al., 2022). Among mentioned problems, there could be observed a great cohesion between the shepherds at international level (Sánchez, Gallar, 2016), the study of the causes that lead to generational change (Bertolozzi Caredio et al., 2020; Pérez et al., 2020), the questionable compensation of labor with immigration (Nori, 2021), the incorporation of women into the sector (Fernández Gimenez et al., 2021), or the opportunity to convert traditional penalized livestock farming to organic livestock farming, which is legally protected (Horrillo, 2020). Some authors have examined the possibility of analyzing the sector as a whole within this legal framework (Mena et al., 2012; López i Gelats, Filella, 2020). This is not a trivial issue, since greater productivity has also been detected in organic livestock pastures (Sauer et al., 2015), as well as a better energy consumption profile (Neira et al., 2014; Pérez Neira et al., 2018).

Prevention of natural disasters by shepherds is well known (Pateiro et al., 2020), both by them and by forest owners in case of fires (Varela et al., 2022). Prevention plans have started to be implemented on the ground, as in the case of Catalonia (Spain), and some qualitative studies allow better understanding of good results and failures (Nuss Girona et al., 2022). Some studies indicate that grazing does not reduce the risk of fires (Jones et al., 2016), but they are focused on closed farms with permanent pastures rather than transhumant and itinerant livestock. Finally, the degradation of the landscape conditions, or the choice of the type of livestock, which will tend to be native in responding to environment to which it is genetically adapted (Delattre et al., 2020), and in fact, a re-adaptation of livestock farming to mountain territories is proposed (Castro et al., 2021).

To the ecosystem services provided by traditional ELF, there could be added sociocultural services (Zaratiegui, Gurrutxaga, 2021; Madau et al., 2022), animal welfare (Bade, 1996; Dwyer, 2022), or territorial development (Lenormand, 2012). The question arises as to whether this development can be combined with population decline, land abandonment and the absence of generational change (Nori, Farinella, 2020).

However, there is a resurgence of pastoralism with traditional roots but under new paradigms (De Larrinoa, 2009), as a form of entrepreneurship (Allan Degen, 2011) with an important environmental component (Granjou, Mauz, 2012). This trend, which is still a minority, seems to be focused on a market differentiated products, with a seal of superior quality, animal welfare and growing population support

(Resano, Sanjuan, 2018; Varela, Kallas, 2022; Kitano et al., 2022; Stampa, Zander, 2022). Although these products do not report sensory benefits in double-blind studies (Zamuz et al., 2021), nutritional improvements are observed (Lorenz et al., 2019; De la Torre Santos et al., 2020; López Pedrouso et al., 2020). Paradoxically, the legal creation of denomination of origin labels (geographical labels), that are linked to traditional livestock management, affects the intensification of activity (García Hernández et al., 2022).

Some authors envision a future of urban pastoralism (Grădinaru et al., 2018; Herrington, Zielnicki, 2019) or even a future of viable small cities with forests and ELF as a solution to polarized demographic situation of developed countries (Gómez Villarino, Gómez Orea, 2021). This analysis of the role of pastoralism can reveal new benefits, such as the care of semi-natural spaces in cities and their surroundings, and the contribution of resilience and sustainability through the diversification of economic sectors.

The ecological impact of livestock farming

Ecosystem impacts have been studied on a recurring basis due to the interest in successive environmental policies. Penalties increase environmental protection (Pringle, 1995; Fitch, Adams, 1998) and the production of ecosystem services (Morales Jerrett et al., 2020). This improvement in biodiversity has been studied and confirmed in macrofauna (Rodríguez et al., 2002), micro fauna (Garde et al., 2014), and flora (Pavlu et al., 2003; Pinho et al., 2012).

It is argued that better environmental management can be achieved by linking the traditional knowledge of pastoralists about their environment with scientific knowledge (Morales Reyes et al., 2019), especially of wild species (Artano Garmendia et al., 2022). This is important if sustainability sometimes requires land policies (Azevedo et al., 2021). Grassland management (permanent and transhumant grazing) ensures coexistence with wild habitats (Anderson, McCuistion, 2008; Schmitz, Isselstein, 2020). It was found some specific studies on elk in the United States on ranch lands (Krausman et al., 2009; Tolleson et al., 2012) or carrion birds on transhumance (Aguilera Alcala et al., 2022). This coexistence, however, is difficult when it comes to carnivorous animals that use livestock as a food source (Boronyak et al., 2020), as is the case of the wolf in Switzerland, where the number of attacks on herds has increased and which imposes new livestock practices (Mink et al., 2023). At the flora level, a better impact of grazing is observed when grasslands come from the abandonment of agricultural land (Psyllos et al., 2022).

Extensive livestock farming: Global warming or carbon sequestration?

This category encompasses the generic impact on the planet as a whole. Progress has been made in quantification of carbon footprint, such as the Agro-Environmental Footprint Index (Louwagie et al., 2012), as well as technical proposals for livestock farming due to monitoring and minimizing the environmental impact (Handcock et al., 2009; León et al., 2020; Atzori et al., 2022). The dependence on external feed can be considerable, while some studies assess the environmental impact of silage versus haymaking, as two ways of storing fodder for later animal consumption (Opitz Von Boberfeld, Sterzenbach, 1999).

Greenhouse gas (GHG) emissions of ELF have been quantified with better profile than intensive one (Eldesouky et al., 2018; Morais et al., 2018; Escribano et al., 2022). Some studies show a better global warming profile of intensive livestock farming (Bragaglio et al., 2018), but they do not consider the carbon absorption of pastures, which must necessarily be maintained as a source of feed and tend to be permanent (grasslands, forests), while forage comes from temporary herbaceous crops. Studies of the life cycle of agricultural products indicate that ELF is better in terms of pollution than intensive livestock farming (Audsley, Wilkinson, 2014; Borsato et al., 2018). Management changes are also being made to reduce GHG emissions and make livestock farming economically viable (Howden et al., 1996). It is not uncommon, therefore, for sustainability to be linked to extensivity in the opinion of future livestock farmers (Damico et al., 2022).

Modelling shows that ELF, when oriented towards commercial grazing in a market system, leads to overgrazing and desertification (Andrade, 2012; Noll et al., 2020), also due to a comparatively larger water footprint than intensive livestock farming (Ran et al., 2013). Thus, some authors have established a conflict between ELF and environmental protection (Ngugi et al., 2013), not without reason if there is analyzed a market failure that looks at lake pollution (Abell et al., 2011). This would imply a degradation of natural resources and soil due to the increase in livestock farming (Pulido et al., 2018), but they do not seem mutually exclusive (Pérez Suárez et al., 2018). Modelling is also used to define better pastoral management in grasslands (Higgins et al., 2007; Pulina et al., 2018; Vallés et al., 2021).

Conclusions

The Systematic Literature Review has provided us with some revealing findings for further research focusing on the field of ELF. Using SCOPUS and Web of Science as databases, there are analyzed 233 publications. The requirements were that they dealt with ELF in developed countries, and for this purpose there are selected a series

of countries with a high Human Development Index (>83%). These countries were grouped, according to their geographical and cultural context, into three categories: Europe, the Anglo-Saxon world, and Latin America. The publications found have been more numerous in recent years, with a real growth in studies relating to Europe, due to the growing interest in the subject. Using the VOSviewer program, it is possible to divide the main themes addressed in these publications into six categories. These categories have been the basis for analyzing the content of the publications. There are summarized the main ideas of the content analysis below (Table 2.).

Table 2. Summarize of content analysis

Cluster	Main ideas
Potential of land use through pastures management	Inactivity in landscape management leads to problems as floods, fires or landslides, which represent an unnecessary cost. Revegetation is a problem because of rapid fire spread. These lands can be recovered by traditional livestock farming.
Extensive livestock farming: between intensification and abandonment	The trend towards ELF in most developed countries implies intensification and, therefore, unsustainability (economically and ecologically). There is an intensification or disappearance in Europe, a confrontation with environmental regulation in the Anglo-Saxon world, and attacks due to low productivity in Latin America. There are several reasons for this trend: economic system (market-oriented production, tenure of land, idea of constant economic growth); psychological reasons (there is no consensus about them); land abundance and competition of uses; geographical and climatic conditions (spatial heterogeneity of pastures, random events as droughts, natural disasters, population); and economic reasons (scale effects, uncertainty, access to markets). The most traditional livestock farming has escaped the general trend towards intensification (Europe) and the privatization of land in an extensive environment (Anglo-Saxon's and Latin America). Indigenous breeds, existing on traditional livestock farming, present numerous advantages: biodiversity, reduced dependence on subsidies, and an increase in biological efficiency. Public intervention is decisive for ELF: agrarian policies, sectoral regulations, etc. Some authors propose a special regime for extensive farming. Public intervention has damaged the sector, but now there is a weak attempt for recovering it. Success of extensive exploitations is related to small herds with large tracts of land, pasture species, physical environment and the management of the farm and transhumance. New researches and technologies have been developed lastly in terms of ELF ("virtual fence" systems, the detection of births in free-ranging animals, the inclusion of the Internet of Things, etc.).
Grazing systems: an unresolved debate	Literature proposes three types of grazing management: continuous, rotational or an alternate management using both. Rotational management optimize GHG emissions. Alternate management improve biodiversity and photosynthesis ability.

Cluster	Main ideas
Pastoralism: an activity unjustly neglected	Pastoralism is a budget of historical, cultural, economic and environmental practices supported by the knowledge and the life of the transhumant shepherd. Literature see rural tourism as an opportunity for sustainable development, and as a spatial competitor to ELF. Process to intensiveness or abandonment, in Europe, is due to: lack of social cohesion, or lack of sectorial cohesion, lack of voice in regional governments, difficulty of access to pastures, lack of generational change and labor, requirements of the meat industry, and loss of land and common goods. Solutions have been proposed for these problems: greater cohesion between shepherds at an international level, the study of the causes that lead to generational change, compensation of labor with immigration, the incorporation of women into the sector, or the change from traditional livestock farming to "organic" livestock farming (organic farms shows better productivity and better energy consumption). Services provided by pastoralism are: prevention of natural disasters, animal welfare, sociocultural services, or territorial development. There is a resurgence of pastoralism with traditional roots but under new paradigm, where entrepreneurship, environment and superior quality products (with better nutritional profile) are main components. But it is still a minority. Some authors envision urban pastoralism as a demographic solution to developed countries.
The ecological impact of livestock farming	Environmental policies affect environmental protection and production of ecosystem services (among them, there could be noted the biodiversity). Grassland management ensures coexistence with wild habitats, except when carnivorous animals that can feed from cattle are involved. Better environmental management can be achieved by linking the traditional knowledge with scientific knowledge.
Extensive livestock farming: global warming or carbon sequestration	Progress in monitoring and minimizing environmental impact. Better pollution profile in GHG emissions and life cycle analysis. Worse pollution profile in water consumption. Extensive farming leads to overgrazing and desertification Modelling is also used to define better pastoral management in grasslands.

Source: Author's elaboration.

The aims of this review were following: i) what are the dynamics of ELF in developed countries? and ii) which are the main topics of discussion within the academic community on ELF? The findings that have been presented in Table 2., provide satisfactory answers to these questions.

The practical implications of the findings seem to link a series of positive effects of ELF on the environment and the economy. Regarding the environment, there were found certain ecosystem services such as increased biodiversity, prevention of natural disasters, or monitoring of natural environment. Regarding the economy, there have been underlined more resilient sector, independent of volatile feed markets, and in line with sustainable development aspirations. However, overgrazing leads to soil deterioration and aquifer contamination. These findings can provide policy-makers with sufficient information to implement policies that reach a "break-even point" that optimizes livestock loading. How can such a policy affect the extensive livestock

sector? The same review offers some explanations for the abandonment of ELF: population, economic system, regulations, provisions on hygiene and traceability, development of other elements in competition for land (tourism), low investment in R&D, etc.

For future research, there have been identified interesting niches such are: monitoring the effective conversion of wild areas into pastures; labor issues that concern livestock farmers (may be important factor in the sector abandonment); or other ecosystem services of shepherds such as pest prevention or surveillance against poaching.

This study has several limiting factors. As regards the methodology, databases are limited to Scopus and Web of Science. Countries with high HDI as Japan, South Korea, or Saudi Arabia have been rejected from study due to the little research done in these countries regarding ELF. Other countries with high HDI according to United Nations standards have also been rejected for showing if their HDI was lower than 83%. As regards the literature, there was found the need for greater consensus on some recurring issues, as well as conflicting views that seem to have a certain bias. The authors have been studying certain phenomena and suggesting extensive or intensive livestock farming as a plausible solution in some cases, but some of the claims need empirical verification.

ELF is a topic of growing interest in the academic community. In Europe, there could be seen an interest in initiating active policy on this issue, linked to the abandonment of rural areas and depopulation. ELF is becoming a spearhead of sustainable development. Meanwhile, in the Anglo-Saxon world and in Latin America, other aspects stand out. In these countries, with large territories and low population density, ELF is usually the most profitable, since there is no competition for the use of land. The issue, in these two contexts, has to do with achieving greater efficiency and productivity, analyzing the environmental impact and resilience to climate change.

This review aims to establish a frame of references for future research that has to give broader view of ELF, as well as providing relevant knowledge to policy-makers. There is no doubt that ELF is a topic that arouses increasing interest, both in academia and among the general public, while hoping that it can be a key sector in a world where climate change requires the development of a more sustainable economy.

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