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Animal traction in developed countries: the reappropriation of a past practice through agroecological transition.

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Abstract:

As part of the current agroecological transition, animal traction in agriculture is benefiting from an increased focus in developed countries. However, the practice is struggling to gain recognition from research, institutions and the agricultural profession. This article aims to analyze how animal traction is treated in developed countries, and to assess the extent to which it could be considered an agroecological practice. We analyse animal traction as a scientific object and a socio-professional movement. Our methodology is based on a review of scientific literature and an analysis of the French general press. The various studies show that animal traction has advantages in terms of energy, economics and agronomy. It tends to be developed by alternative movements and farmers motivated by a desire to redesign our food systems. Both scientific and press reviews show a renewed positive interest in animal traction. Although these reviews highlight its agroecological potential, the practice is facing difficulties in gaining recognition. The findings of this article are of obvious interest to rural development researchers and policy makers. They help the former to explore new issues in the return of animal traction, and the latter to better understand the development factors of this practice.

Keywords: Animal traction, draft animal, agroecology, alternative agriculture, repeasantization, literature review, press analysis

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33 1. Introduction

34 In a context of debate about agriculture's dependence on fossil fuels and growing concern for the
35 environment and the challenges of climate change, animal traction has seen an increasing interest in
36 recent years in developed countries (i.e. Western Europe, North America and Australia). Animal
37 traction was almost extinct in high-income countries by the middle of the 20th century, but equine
38 traction is experiencing a revival among farmers interested in agroecological and peasant methods
39 (Duriez and Fouquet, 2012; Jez *et al.*, 2012; Almeida *et al.*, 2017; Rodrigues *et al.*, 2017). Cerutti *et*
40 *al.* (2013) note that many thousands of farms use draft horses in the USA, and about 100 farms use
41 them in Germany. In France, 299 vineyards use or have used draft horses in recent years (IFCE and
42 IFV, 2021). Since the 2000s, there has been a new dynamic in the use of equine traction for different
43 types of agricultural work in France. In 2016, 1,600 horses were purchased for work in France,
44 compared to 1,100 in 2010 (IFCE, 2019). The potential to develop the practice of equine traction
45 therefore seems to be there, and the Institut Français du Cheval et de l'Equitation (IFCE) has made it
46 one of its objectives between 2018 and 2022 (IFCE, 2018).

47 In the developed countries, animal traction is used in different contexts and in relation to specific
48 issues. It is used in mountainous and hilly regions where constraints to tractor use are common
49 (Rodrigues *et al.*, 2017). Beyond the constraints of mountainous regions, some farmers continue to
50 use draught animals, particularly horses and to a lesser extent donkeys. The most prominent example
51 is Amish agriculture (Parker *et al.*, 2016; Holly *et al.*, 2019), a community that has continued to use
52 animal traction, thereby preserving its knowledge, tools and heritage. However, modern use of animal
53 traction is observed amongst organic farmers (Herold *et al.*, 2014; IFCE and IFV, 2021) and, more
54 broadly, among farmers experimenting with alternative farming practices to conventional agriculture.
55 In this case, the use of animal traction can complement motorized traction. The growing importance
56 of animal traction as an alternative or complementary option to mechanical traction has led to the
57 simultaneous emergence of several NGOs across Europe, some of which have joined together in
58 FECTU (European Draught Horse Federation - www.fectu.org).

59 The modern use of animal traction is driven by several motivations, identified as environmental,
60 such as those related to product quality and image or breed conservation (Rzekęć *et al.*, 2020; IFCE
61 and IFV, 2021; EFA *et al.*, 2022). Faced with the challenge of reducing the use of chemical inputs
62 and improving the sustainability of their farms, farmers are experimenting with new agroecological
63 practices (Catalogna *et al.* 2022). The use of animal traction is in line with the principles of
64 agroecology, in particular the following two (Altieri, 2002): (i) to reduce the use of chemicals by
65 relying on the ecosystem services provided by the conservation of biodiversity, and (ii) to ensure soil
66 conditions favorable to plant growth by improving soil organic matter and biotic activity. In France,
67 horse-drawn tillage is one of the most widespread uses of animal traction by farmers. The adoption
68 of this practice by farmers is motivated by, among others, the reduction of fossil fuel use (Rydberg

69 and Jansén 2002), by the fact that tilling the soil with a horse limits soil compaction (García-Tomillo
70 *et al.* 2017) and therefore avoids erosion and the disappearance of living organisms in the soil.

71 However, despite the renewed interest and its promising potential as a practice in line with
72 agroecological principles, animal traction faces difficulties in gaining recognition at various levels:
73 scientific, institutional and civil society (Rodrigues *et al.*, 2017). In terms of scientific research,
74 animal traction seems to be rarely studied by research in developed countries, as evidenced by the
75 review from Mota-Rojas *et al.*, (2021) on the use of draft animals, where these countries have few
76 citations. Similarly, the review by Wezel *et al.*, (2013) on agroecological practices does not mention
77 animal traction as one of these practices. At the policy level, the use of draft animals is deemed
78 unviable in the face of the energy transition challenge by the French government (Journal officiel de
79 la République française, 2020). These observations of difficulties in gaining recognition, despite a
80 renewed interest, leads us to focus on analyzing the treatment of animal traction in developed
81 countries. We go further by analyzing some of the research on animal traction in developed countries:
82 what discipline, what topics and what results. This will help to assess the extent to which it can be
83 considered an agroecological practice.

84 Agroecology is a polysemic, multi-dimensional concept. Broadly speaking, agroecology is
85 defined as a practice, a science and a social movement (Wezel and Soldat, 2009). Based on this vision
86 of agroecology, we propose to approach animal traction through these three dimensions.
87 Consequently, our study will approach the world of research through an analysis of scientific articles
88 dealing with animal traction in developed countries. We will combine this review with an analysis of
89 the French general press in order to gain an insight into the socio-professional dynamics surrounding
90 this practice.

91 The aim of this study is to highlight the main features of the recent development of animal traction
92 in developed countries, against the backdrop of the agroecological potential of this practice. First, the
93 methodology used will be detailed. Next, we will present the results of our study. Thirdly, we will
94 discuss these results in order to draw conclusions about animal traction in countries with motorized
95 agriculture.

96

97 **2. Material and Method**

98 In our literature review on animal traction in developed countries, we have sought to cover a
99 number of disciplines in order to provide a broad overview. To do so, we mobilized a frequently used
100 resource in bibliometrics: Web of Science, from Thomson-Reuters. This database has a
101 multidisciplinary coverage, from arts to applied sciences, including social sciences. Web of Science
102 contains 12,000 journals, but it is far from exhaustive, as there are more than 42,000 peer-reviewed
103 scientific journals (Johnson, 2018). Web of Science was used because its meta-data is more complete

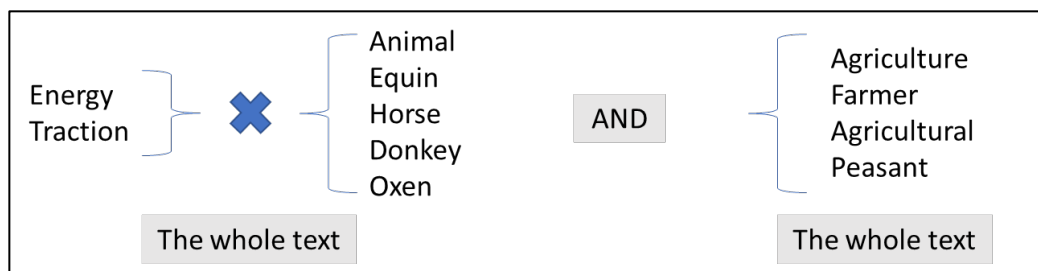
104 and it was supplemented with Scopus, which has broader coverage with more than 21,000 journals.

105 The first step of the bibliographic search consisted in the extraction of articles related to
106 animal traction based on the exclusive selection of agricultural topics. The search was carried out on
107 03/02/2022, without setting a publication date, which makes it possible to obtain all the scientific
108 publications related to animal traction listed in Web of Science. Animal traction refers to a variety of
109 practices, so we specified keywords to make our research more specific. We used the following
110 keywords in the category's "title", "abstract" and "key-words" for our search: "Animal traction",
111 "Horse traction", "Donkey traction", "Oxen traction", "Buffalo traction", "Draft/draught animal",
112 "Draft/draught Horse", "Draft/draught Donkey", "Draft/draught buffalo" and "Draft/draught Oxen".
113 Only articles published in journals are retained, books, conference proceedings and the like are
114 excluded in order to compare identical materials.

115 We performed the same search in Scopus, but only on titles and keywords, since some articles
116 in Scopus do not have abstracts. By combining the results of these two searches, deleting duplicates
117 and articles not related to agriculture (mainly veterinary, history and archaeology), we obtained 235
118 articles related to animal traction. Finally, we performed a geographical sorting in order to keep only
119 articles from developed countries, allowing us to keep 16 documents, representing 7% of the corpus.
120 These 16 articles were analysed in order to extract the main themes and results, with the aim of
121 highlighting the characteristics of animal traction and objectifying its treatment by research.

122 Given the small number of scientific articles identified, and in order to approach the socio-
123 professional dynamics of animal traction, we conducted an analysis of the French general press. The
124 database chosen to constitute the corpus is Europresse, a full-text press database published by Cision.
125 It's a French-speaking reference with more than 10,000 sources of information, ranging from local
126 newspapers to international titles, this press database allows the creation of corpora in different
127 formats. It does not cover the entire press, but it is an adequate corpus. We tried to build the most
128 exhaustive query according to the criteria described in Figure 1. Because articles do not have
129 keywords or abstracts, we decided to perform the search in the full text.

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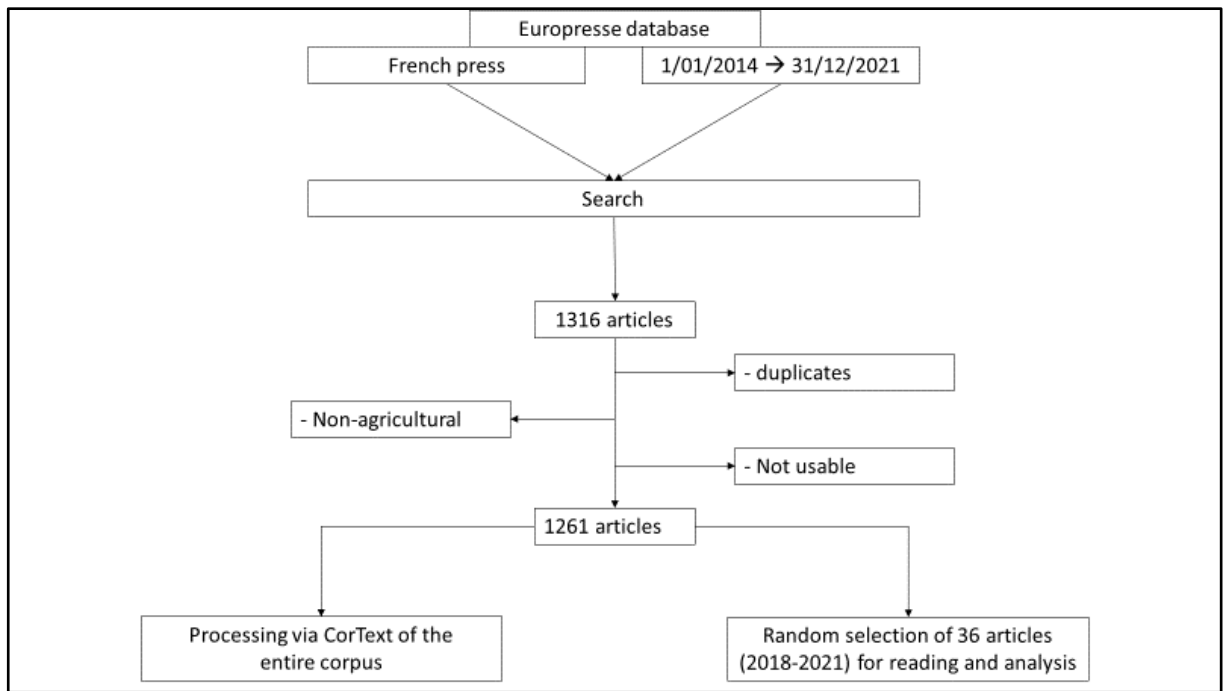
Figure 1. Request to Europresse (translated)

133 We conducted a study of the French press, from 1/01/2014 to 31/12/2021, in order to cover a
134 recent period that is long enough to provide a substantial number of articles. We chose France because
135 it's one of the countries in Europe where animal traction is developing rapidly, with numerous schools
136 and historical working breeds such as Percheron or Trait Breton. We also focus our analysis from
137 2014 because in France many changes have been made in the equine sector after the disappearance
138 of the National Studs in 2011. The aim was to begin our analysis a few years after this event so that
139 it would not predominate in our corpus, since it is not the subject of our study.

140 After this research, a sorting process was performed to remove duplicates, non-agricultural
141 items, and non-exploitable items. Articles related to logging and the use of animal power in cities
142 were intentionally excluded. We focus only on agricultural animal traction, although these uses also
143 contribute to the dynamics around animal traction in general. In total, our corpus consists of 1261
144 articles. Our approach mobilizes lexicometrics (Lebart & Salem 1994), i.e. the quantitative study of
145 the lexicon using statistical tools. This quantitative study is possible thanks to the CorTexT software
146 developed by L'Institut Francilien Recherche, Innovation et Société (IFRIS). This software performs
147 a lexical extraction to obtain a list of standardized nominal groups composed of terms and multiterms
148 (Tancoigne *et al.*, 2014). Beyond this word extraction, CorTexT manager normalizes the occurrences
149 and co-occurrences of the terms in our corpus using the chi-2 measure, and identifies coherent
150 subgroups of terms thanks to the Louvain algorithm (Blondel *et al.*, 2008). We extracted the 100 most
151 frequent multiterms in our corpus. We sorted these 100 multiterms in order to exclude incoherent
152 terms (such as "in the"). We then performed a co-occurrence analysis between these 75 multi-terms.

153 We also mobilize a qualitative analysis of our corpus of press articles, analyzing 36 articles,
154 published recently (between 2018 and 2021) and randomly selected. This qualitative approach
155 consists of an in-depth reading of these articles in order to highlight their main themes and content.

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Figure 2. Methodology used to build a corpus and analyze it via Europresse.

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161 3. Results

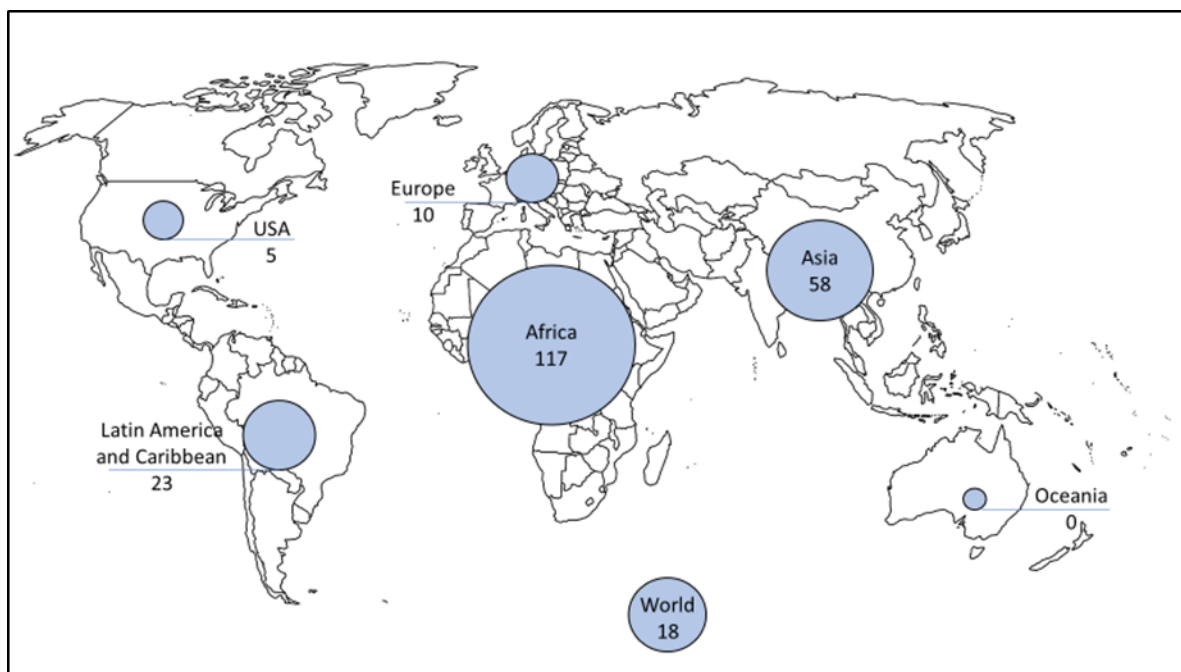
162 3.1 A practice that receives little research attention and is approached from a technical- 163 economic perspective

164

165 3.1.1 A growing number of scientific articles

166 Most of the papers are published in the following major journals: Agricultural Systems (18
167 publications), Agricultural Mechanization in Asia, Africa and Latin America - AMA - (20
168 publications) and Soil and Tillage Research (15 publications). Research on animal traction seems to
169 be concentrated in countries with predominantly non-motorized agriculture, as evidenced by the large
170 number of publications in AMA. The main authors publishing on this topic are Thierfelder C. (7
171 publications), Pearson A. (5 publications) or Gebresenbet G. (5 publications). Figure 3 thus shows
172 which regions are mainly studied by the research community.

173



174

175 **Figure 3.** Number of published articles on animal traction in agriculture by geographic region

176

177 Of the 16 articles studied (Table 1), 5 deal with animal traction in the United States, 2 in France, 2
 178 in Denmark, 2 in Spain, 2 in Sweden, 1 in Portugal, 1 in Italy and 1 in developed country context. The
 179 higher number of articles in North America can be explained by both the size of the country and by the
 180 presence of Amish agriculture. As we can notice in Table 1, the number of publications increases over
 181 the decades, as no articles were published before the 2000s, 5 were published before 2010, and 11
 182 between 2010 and 2019.

183

184

185

Year	Author	Title	Main results	Country
2001	Bender	An economic comparison of traditional and conventional agricultural systems at a country level	All animal traction is possible. It would take 23 million horses, which would occupy 6 to 7% of the UAA, to feed the USA.	USA
2002	Rydberg and Jansén	Comparison of horse and tractor traction using energy analysis	The tractor is more energy efficient, but is much less renewable.	Sweden
2006	Rydberg and Haden	Emergy evaluations of Denmark and Danish agriculture: Assessing the influence of changing resource availability on the organization of agriculture and society	The increase in energy mobilized by our societies is linked to agricultural mechanization and the abandonment of the horse. However, agriculture is a way to capture renewable energies.	Denmark
2009	Conner and Rangarajan	Production costs of organic vegetable farms: Two case studies from Pennsylvania	The cost of horses for a farm of 2.5 ha in market gardening is 9000 euros. The variable costs, especially labor, are quite important.	USA

2009	Griffin-Kremer	Dynamics of Informal Networking: Two Studies of Cattle Draft in the Perspective of Deeper Time	Important informal networks link animal traction practitioners	France and Ireland
2013	Spugnolli and Dainelli	Environmental comparison of draught animal and tractor power	For a farm in a developed country, switching to an Indonesian-style animal traction system increases the impact on global warming by a factor of 17.	Developed countries (among others)
2013	Johansson <i>et al.</i>	Impact on food productivity by fossil fuel independence - A case study of a Swedish small-scale integrated organic farm	Animal traction is a little less productive, but combined with the tractor, good results are obtained.	Sweden
2013	Cerutti <i>et al.</i>	Comparison of the environmental performance of light mechanization and animal traction using a modular LCA approach	96% reduction in global warming impact with animal traction compared to tractors for seeding	Italy
2014	Johansson <i>et al.</i>	How the choice of biofuel system in a small-scale Swedish organic farm affects food production and NPK balance	By combining animal traction and biofuel tractors, farm production is reduced by 6% compared with a farm using fossil fuel tractors	Sweden
2014	Dube and Mulder	Energetic analysis of draught animal hay harvest	The energy efficiency of animal traction is similar to bio-energy, and renewable.	USA
2014	Mulder and Dube	Long-Term Ecological Assessment of Farming Systems (LEAFS)	Animal traction is economically viable, provided that products are sold directly (higher prices)	USA
2017	Quijano <i>et al.</i>	Modelling the effect of land management changes on soil organic carbon stocks in a Mediterranean cultivated field	More stable soil C levels during the horse work period	Spain
2017	García-Tomillo <i>et al.</i> ,	Effect on soil hydraulic properties of tillage operations with animal traction: results of an experiment in NE Portugal	Improvement of soil hydraulic properties with animal traction	Portugal
2018	Harchaoui and Chatzimpiros	Energy Nitrogen, and Farm Surplus Transitions in Agriculture from Historical Data Modeling.	Eroi doubled, so did traction efficiency. From 90% energy self-sufficiency in 1940 to 5% in 1980.	France
2019	Holly <i>et al.</i>	Management characteristics of Pennsylvania dairy farms	Amish dairy farms, using animal traction, are more productive than their neighbors with motorized traction.	USA
2019	Aguilera <i>et al.</i>	From animals to machines. The impact of mechanization on the carbon footprint of traction in Spanish agriculture: 1900-2014	Traction emissions more than doubled between 1900 and 2014.	Spain

Table 1. List of articles from our literature review on animal traction in agriculture in Europe and North America

186
187
188

189 The 16 articles identified in the literature review can be bundled into three categories: soil,
190 energy/climate and economy. Of these, only the article by Griffin Kremer (2009) stands out, which
191 deals with the networks and dynamics around bovine animal traction using a history of techniques and
192 anthropological approach. This article offers a social analysis of animal traction, rather than a

193 technical-economic one. Based on events that took place in France in the late 2000s, the author presents
194 the informal dynamics that formed a network around animal traction. Although these dynamics are
195 fragile, they do exist and preserve a heritage.

196 **3.1.2 A growing interest in energy and economic issues and a new consideration of soil**
197 **sciences**

198 Seven articles in our review deal with the subject of greenhouse gases. The methodologies used
199 are different, but the results presented are in favor of animal traction. Aguilera *et al.* (2019), who
200 conducted an analysis of the carbon footprint of traction in Spain between 1900 and 2014, showed
201 that traction was responsible for 3.1 teragrams equivalent (tg eq) of CO₂ emissions in 1900, during
202 the era of animal and manual traction, and that it is now 7-8 tg eq CO₂. The switch from animal power
203 to tractors has led to a significant increase (by a factor of 2.5) in greenhouse gas emissions. Cerutti
204 and colleagues (2013) further demonstrated a 96% reduction in global warming impact with animal
205 traction compared to tractors for sowing. Nevertheless, animal traction has lower energy efficiency
206 (energy efficiency can be defined as the ratio between the amount of energy produced and the amount
207 of energy consumed) than the tractor, as demonstrated by Rydberg and Jansen (2002), and some 15
208 years later Harchaoui and Chatzimpiros (2018). But if the tractor is more efficient, these two articles
209 also insist on the switch in energy source from horse to tractor: from a renewable resource to a fossil
210 resource. Thus, traction in France went from 90% energy self-sufficiency to 5% between 1940 and
211 1980. Moreover, even if the energy efficiency of animal traction is lower than that of the tractor, Dube
212 and Mulder (2014) showed that animal energy is comparable to renewable energies and bio-fuels on
213 a haying operation. Rydberg and Haden (2006) carry out a study on energy in Denmark from 1936 to
214 1990, relying in particular on the concept of emergy, i.e. a methodology characterizing all products
215 and services in solar energy equivalent (Odum, 1996). The authors demonstrate both the increase in
216 the amount of energy invested in agriculture, compared to 1936 levels, and the strong link between
217 motorization and this increase in energy use, and conclude that agriculture can be an effective way to
218 capture renewable energy. However, Spugnoli and Dainelli (2013) obtain results that are not in favor
219 of animal traction. In the case of a developed country using tractors and switching to animal traction,
220 the energy used for production would triple, and the impact on global warming impact would increase
221 by a factor of 17. These results can be explained by the traction model chosen: the Indonesian model
222 based on the Peranakan Ongole cattle, which the authors themselves consider inappropriate to
223 represent animal traction in developed countries.

224 The majority (4 out of 6) of the articles in our literature review dealing with economics are
225 from the United States. Described in particular by Holly (2019), in the United States context, the
226 Amish model of dairy farming results in a smaller farm on average, but has a higher yield per hectare
227 than the other categories in the study (organic, semi-confined, confined, intensive grazing).
228 Economically, Amish farms are more profitable per liter than semi-confined or confined farms.

229 However, this system also has the most unpaid hours for farmers, which may call into question the
230 measures of economic performance. Conner and Rangarajan (2009) also conducted an economic
231 study of an Amish farm, but in vegetable production. They estimated the cost of using working horses
232 on a 2.5 ha farm to be €9,000 and found that fixed costs were lower in the Amish model, while variable
233 costs were higher. Bender (2001) has estimated that horse-based agriculture is feasible in the United
234 States with 23 million horses. This would require using 6-7% of the U.S. UAA to feed the horses. To
235 the author, this is more efficient than biofuels. Apart from the Amish model, other American authors
236 support the economic viability of systems mobilizing animal traction, provided that the products are
237 sold directly, guaranteeing higher prices (Mulder and Dube, 2014). Regarding productivity in Europe,
238 a study was carried out on a dairy farm in Sweden. By simulating different farm scenarios under
239 different modalities (increase in the number of cows, change of breed, arrival of sheep), the authors
240 were able to compare animal traction, mixed traction and motorized traction. According to their
241 results, the performance of the farm in terms of productivity decreases slightly with animal traction,
242 but remains within orders of magnitude of motorized traction (Johansson *et al.*, 2013). In addition,
243 these authors have explored the possibility of combining animal traction and biofuel and have
244 demonstrated the possibility of obtaining relatively similar production (-6%) as with conventional
245 motorized traction, while improving energy autonomy (Johansson *et al.*, 2014).

246 The effect of animal traction on agricultural soils is an important area of research. In our
247 literature review, two articles address this issue, and were recently conducted. Quijano *et al.*, (2017),
248 published a study in 2017 in *Land Degradation & Development* that looked at soil organic carbon.
249 They used a computer model to simulate changes in practices within a wheat plot typical of
250 Mediterranean agroecosystems, specifically northeastern Spain. Based on the actual practices of a
251 defined plot, the authors simulated 100 years of ploughing with animal traction, then 35 years of
252 conventional ploughing, followed by 15 years of reduced tillage. The authors show that erosion was
253 greater in the plot during the conventional tillage period. They also show that the switch from horse
254 to tractor resulted in a less stable soil organic carbon stock (Quijano *et al.*, 2017). In the same year,
255 García-Tomillo *et al.*, (2017) published a study in the journal *Open Agriculture*. This work compares
256 the effects of plowing with motorized and animal traction (donkey and cow) on soil hydraulic
257 properties, including compaction effects. The authors chose bulk density and hydraulic conductivity
258 (m.s-1) as indicators. Bulk density increased by 15% with the tractor, while it increased by only 8%
259 with the animals. In addition, hydraulic conductivity was reduced by 3 after tractor plowing, while it
260 was reduced by only 2 after donkey plowing (García-Tomillo *et al.*, 2017).

261 Thus, research questions animal traction mainly from a techno-economic perspective. The
262 number of articles is small, but growing, and new topics are appearing, such as pedology. The articles
263 are limited to showing the effects and consequences of the practice, whether on the environment or
264 on the farm; the social dynamics and the users are not mentioned, except for the article by Griffin-

265 Kremer (2009).

266

267 3.2 In France, an alternative practice viewed positively

268 3.2.1 Animal traction: an alternative and peasant form of farming

269 To complete our analysis, which consisted in questioning the perceptions associated with the
270 practice and its characteristics, general press articles were analyzed using lexicometric tools on 1261
271 general press articles. We have identified the most frequently used multi-terms in our corpus of press
272 articles. The frequency represents the total number of occurrences of the word in the corpus (Table
273 2).

274

Multi-terms	Frequency		
Animal traction	1463	Organic vegetables	35
Draft horses	386	Professional bac	34
Agricultural school	120	Farmers market	31
Peasant agriculture	85	Harnessed horses	29
Short supply chain	84	Local producers	29
Trait de vie	77	Breton horse	28
Young farmers	70	practice of animal traction	28
Agricultural equipment	70	XXe century	28
Direct Selling	67	maintenance of a peasant agriculture	27
Trait Breton	60	Wetland	27
Animal traction demonstration	55	Peasant market	25
Agricultural machinery	55	Rural area	25
Haras national	49	XIXe century	25
Open doors	49	ploughing competition	24
Draft animals	48	Small surface	24
Chambre d'agriculture	42	World War II	24
Local products	39	Regional products	22
Organic agriculture	38	Sustainable farming	21
AMAP	38	Agriculture and environment	21
Equine traction	36	Renewable energy	21

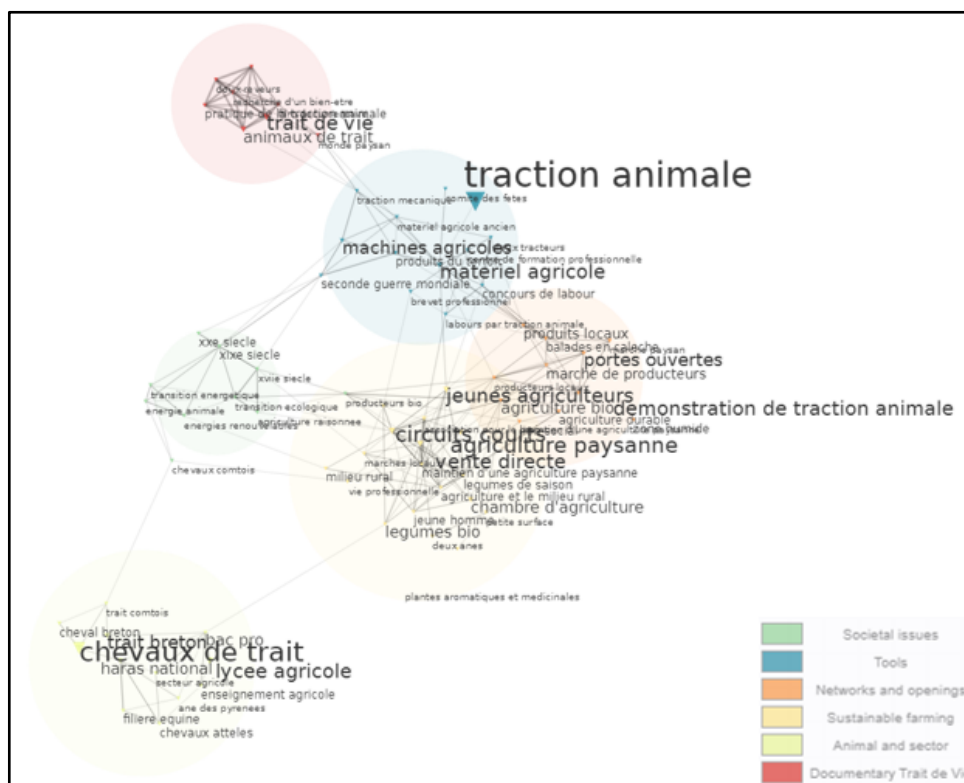
275 **Table 2.** 50 most frequent multi-terms in the corpus of press articles analyzed according to the output
276 of CorText Manager (n=1261)

277

278 Many frequently cited multi-terms are related to the animal, in particular its breed (“Breton
279 horse” (Cited 28 times), “Trait Breton” (Cited 60 times)) or the institutions (“Haras National” (49)).
280 There are also multiple references to learning and the transmission of knowledge (“agricultural
281 schools” (120), “open days” (49),” animal traction demonstration” (55)). An important theme within
282 this corpus is the notion of peasant agriculture (85), a term that comes in fourth place, and is also cited
283 through the "AMAP" (38)- associations for the maintenance of peasant agriculture - or "peasant
284 markets" (25). Markets also take an important place, as does localism in general, with "local products"

285 (22), "local producers" (29) and "regional products" (22) or "short supply chain" (84) and "farmers
 286 markets" (31). Sustainability is also a recurring theme, through "sustainable agriculture" (21),
 287 "renewable energies" (21), "organic farming" (38) and "organic vegetables" (35). Many terms are
 288 more technical, more related to the act of farming, such as "agricultural machinery" (55) or
 289 "agricultural equipment" (70). There are terms that evoke the past, such as previous centuries (28 and
 290 25 occurrences) or the "Second World War" (24), illustrating that this practice is still struggling to
 291 get rid of its image of an outdated traditional practice. Finally, the documentary "Trait de Vie" (77)
 292 appears in sixth position. Directed by Sophie Arlot in 2017, this documentary has generated a
 293 significant number of articles. This film follows the lives of animal traction users in France over the
 294 course of several months. The use of a co-occurrence map created with Cortext Manager allows us to
 295 refine the main elements that emerge from our corpus analysis (Figure 4).

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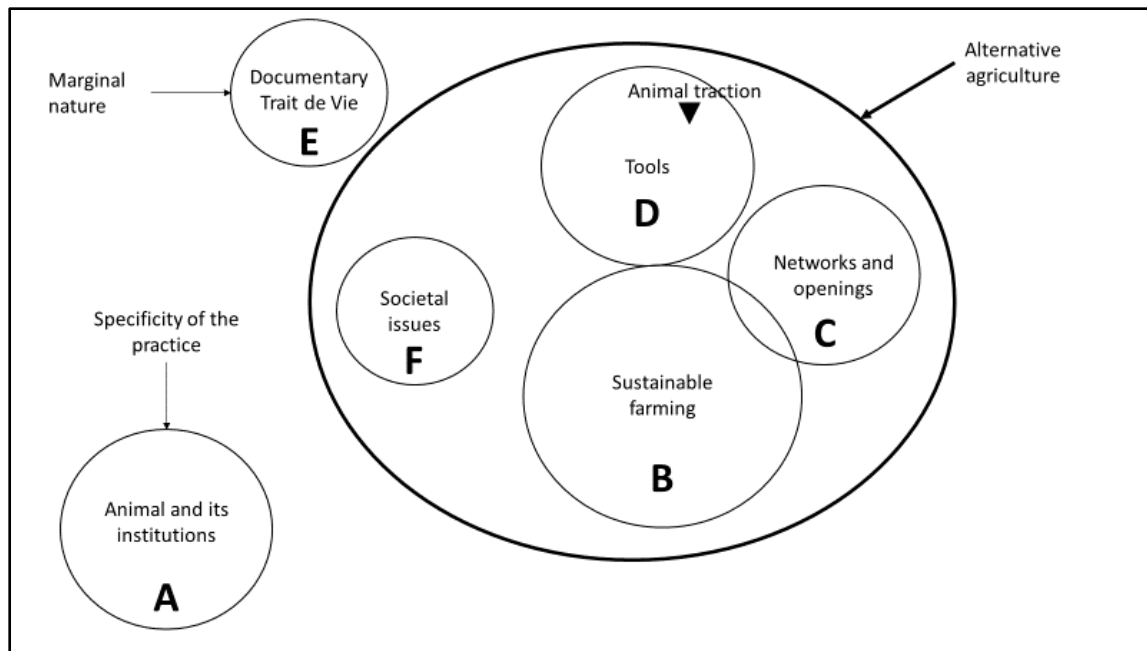
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Figure 4. Co-occurrence map of the 75 multi-terms resulting from the lexical extraction of the corpus of French generalist press articles dealing with animal traction in agriculture (Output from CorText Manager software; n=1261).



302
 303 **Figure 5.** Simplification of the co-occurrence map of the multi-terms resulting from the lexical extraction of
 304 the corpus of French generalist press articles (2014-2021) dealing with animal traction in agriculture (Output
 305 from CorTexT Manager software; n=1261). Each cluster represents a group of words aggregated together.
 306 Agricultural animal traction in France is perceived as marginal (cluster E) and alternative (clusters B, C, D
 307 and F), while retaining a specific feature: the presence of animals (cluster A).
 308

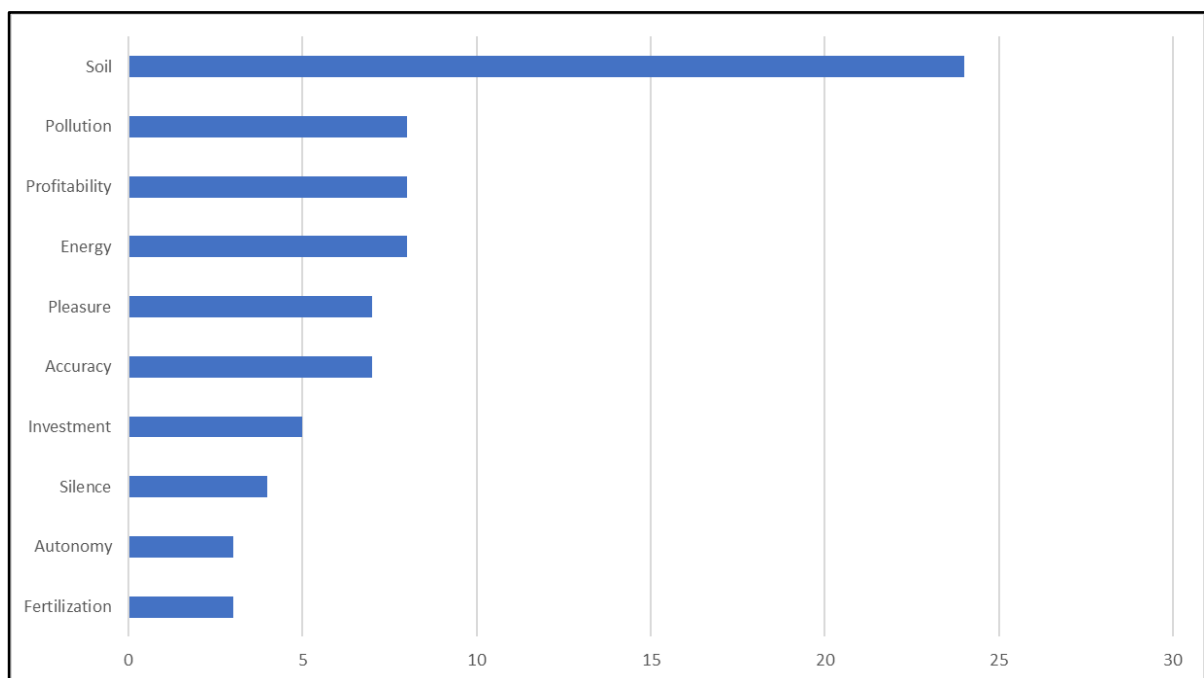
309 This co-occurrence map shows the frequency of multi-terms within the corpus via the relative
 310 size of the words. Then, we aggregated the words into clusters. Cluster A is related to the animal and
 311 its sector, constituting the specificity of the practice, with draft horses, national studs or different
 312 breeds, and to the networks and learning inherent to the animals and the practice. Pole B is linked to
 313 the type of agriculture, oriented towards sustainability, peasant agriculture and direct sales. This pole
 314 is strongly linked to cluster C on social relations, with multi-terms testifying to the openness of animal
 315 traction farms such as open doors or animal traction demonstrations. Cluster D is associated with
 316 animal traction as a tool and is therefore linked to this notion of equipment, which is common to the
 317 scientific approach that constantly compares animal traction farms with motorized traction farms. The
 318 last two poles represent less frequent multi-terms. One of these clusters, E, is related to the Trait de
 319 Vie multi-terms. Finally, pole F deals with agricultural and societal issues, with the term energy and
 320 ecological transition. Thus, animal traction is presented as an alternative, peasant practice,
 321 sustainable, based on localism and integrated in several networks.
 322

323 **3.2.2 Positive appraisals of animal traction which aims to be sustainable**

324 The qualitative analysis mobilized on 36 articles randomly selected allowed us to identify first
 325 trends on the practice of animal traction in France today. The articles are divided into four themes:
 326 stories, installations, training, events. The content of the articles studied is largely positive and
 327 benevolent, and the practice enjoys a particularly favorable image in the French general press.

328 However, many articles choose the angle of a return to a past practice in order to situate the current
 329 practice, limiting animal traction to an ancient practice. They speak of "an ancestral technique that is
 330 coming back into fashion in Corsica" or of "ploughing of vines by horses that is coming back into
 331 fashion". These statements tend to present animal traction as an outdated traditional practice. This
 332 contrasts with the desire to promote modern animal traction on the part of some actors quoted in these
 333 articles, such as Prommata (Association for the Promotion of Modern Agriculture with Animal
 334 Traction). In fact, these actors promote a modern use of animal traction and a reappropriation of this
 335 practice, rather than a return to the practice of the last century. In almost all the articles, the use of
 336 animals is compared to that of motorized tools, and the actors are given the opportunity to justify their
 337 choice to mobilize this practice. As in the case of the research articles, many agro-economic concepts
 338 (soil, energy, economy...) are included in the selected angles.

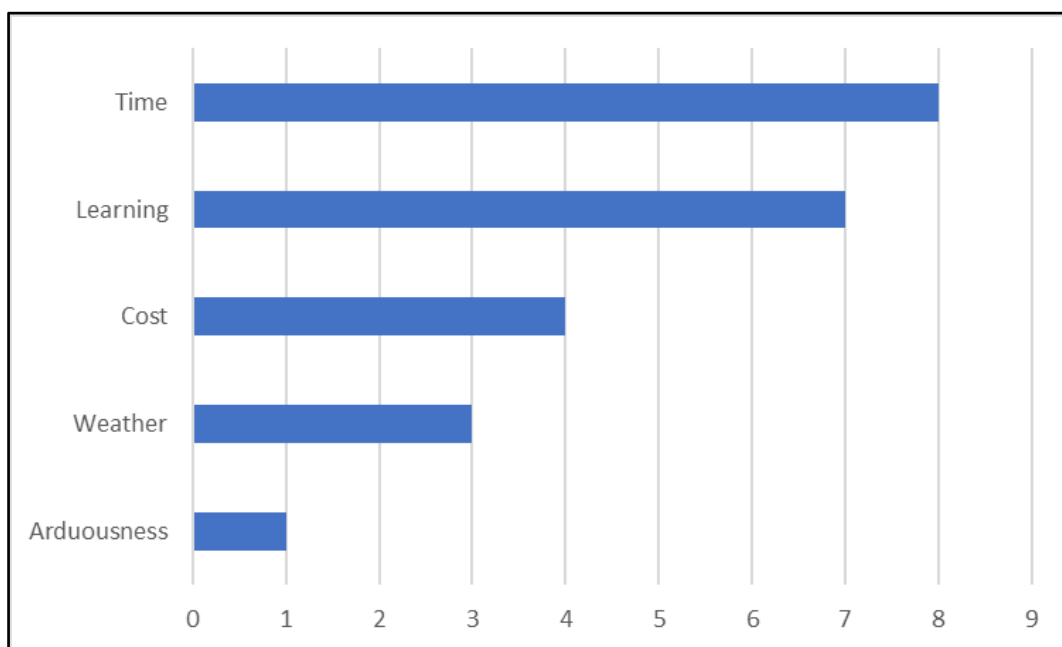
339 According to our analysis, the most important and unanimous benefit of animal traction is the
 340 improvement of soil health (Figure 6). In this category, the reduction of compaction is mainly cited,
 341 but soil biodiversity and soil structure are also mentioned. With more than 60% of occurrences, soil
 342 improvement thus seems to be the main benefit of animal traction. This confirms the studies carried
 343 out on the subject (García-Tomillo *et al.*, 2017). In addition to soil benefits, other agronomic benefits
 344 are cited, such as precision and fertilization. The precision argument is particularly used by market
 345 gardeners, especially when working on weed control. Another result that stands out is the economic
 346 argument. The investments are lower, and the farms mention a profitable practice. Overall, the articles
 347 highlight the sustainable and agroecological nature of the practice, through titles and content that
 348 specifically mention this dimension: "Ariège: Guillaume relies on agroecology and animal traction to
 349 support his farm" or "Agroecological awards 2019-2020: cereal meadows on the farm at Naroques".



350

351 **Figure 6.** Occurrence of benefits of animal traction cited in randomly selected general press articles (n=36)
352

353 Although the articles are all positive, the qualitative analysis of our corpus of 36 articles
354 reveals difficulties in practicing animal traction (Figure 7). Here, the difficulties are mainly socio-
355 economic: the time required, the additional costs or the difficulty of learning. Some statements from
356 our press corpus underline that animal traction can be unprofitable. Learning difficulties are also seen
357 as a potential obstacle to the development of the practice. Finally, disadvantages more specific to the
358 farmer's condition are mentioned, such as weather constraints or the occurrence of pain related to the
359 difficulty of the task. However, the number of inconveniences in the press articles is very low
360 compared to the number of benefits. The inconveniences are not often mentioned. This gives a
361 positive image of the practice.



362
363 **Figure 7.** Occurrence of inconvenient of animal traction cited in randomly selected general press articles (n=36)
364

365 To summarize this press analysis, animal traction is presented as a peasant practice supported
366 by alternative movements with the goal of sustainability. Thus, animal traction has the characteristics
367 of an agroecological practice and its stakeholders present it as such. The effects of this practice appear
368 to be positive. It is enjoying a renewed interest and a positive image in the media. However, some
369 press articles associate animal traction with an outdated image, which would hinder its adoption by
370 agricultural stakeholders as an agroecological practice.

371
372 **4. Discussion**

373 We will now detail the main points that emerge from our study. First, users of animal traction
374 are part of alternative agricultural movements. Second, animal traction users are demanding an
375 improvement in the sustainability of their farms and a place in the agroecological transition.

376 **4.1 A peasant practice supported by alternative movements struggling to get rid of its image** 377 **of an outdated practice**

378 For a long time, animal labor predominated, but it quickly declined and was maintained
379 sporadically and occasionally, on the fringes of conventional agriculture. However, as early as the
380 1980s, researchers were calling for this practice to remain part of the French agricultural landscape
381 (Pousset, 1982; Rossier, 1984). Some users have continued to use animals on their farms. If the
382 practice has survived, it is mainly due to the presence of these few farmers and communities (Lizet *et*
383 *al.*, 2015). As a result, many initiatives such as Prommata have developed on the margins of traditional
384 institutions. Prommata is a French association frequently found in our corpus of press articles, that
385 promotes modern animal traction through exchanges, training, free access documents, etc.

386 Today, the practice benefits from the dynamism of alternative and peasant movements and spreads
387 through these networks. The precise definition of alternative agriculture has been debated for decades
388 (Vandermeer, 1995). According to the National Research Council (1989, p. 8), alternative agriculture
389 is based on "a range of technological and management options used on farms to reduce costs, protect
390 health and environmental quality, and enhance beneficial biological interactions and natural
391 processes". Deleage (2011) includes a more general dimension, defining alternative agriculture as "a
392 mode of agricultural production that opposes the purely technical project of intensive agriculture"
393 (Deleage, 2011). Alternative agriculture is based on a set of practices related to agroecology, among
394 others (Coolsaet, 2016). The movements that support and develop alternative agriculture are based on
395 the values of sustainability and localism (Bruce, 2019), values that are also cited in our press articles.
396 This alternativity can be found in the movements in which farmers practicing traction take part, such
397 as the "associations pour le maintien d'une agriculture paysanne" (AMAP), cited in the multi-terms of
398 our analysis. The principle of AMAPs is to create a link between producers and consumers, with the
399 consumers buying the produce of the producers at a fair price and paying in advance. In France, these
400 movements are led by alternative farmers who claim to be part of the peasant movement. The
401 predominance of environmental issues, especially energy (Harchaoui and Chatzimpiros, 2018) and soil
402 issues (García-Tomillo, 2017), also points in the direction of an alternative aspect. As a reminder,
403 alternative agricultural movements were forged around environmental concerns, particularly in the
404 United States, and built their theoretical foundations on a challenge to the dominant paradigm (Dunlap
405 and Van Liere, 1978).

406 Beyond this opposition, users of animal traction see themselves as peasants and are part of related
407 movements. Peasant agriculture is one of the most frequently cited multi-terms in our press corpus.

408 According to Van der Ploeg (2008), the peasant condition is characterized by a “struggle for autonomy
409 and progress”, the aim of which is “the creation and development of a self-controlled and self-
410 managed resource base” through an 'interaction between man and living nature'. The author identifies
411 three main characteristics of peasant agriculture: (i) interconnection between actors, (ii) the quest for
412 autonomy and (iii) the search for added value. In our study, interconnection is illustrated by the article
413 by Griffin-Kremer (2009), which highlights the links and networks that exist between practitioners of
414 animal traction. In the world of research, there is the Fédération Européenne du Cheval de Trait pour
415 la promotion de son Utilisation (Fectu), which brings together researchers and players in the world of
416 animal power in Europe. Its president is Joao Brandao Rodrigues, author of numerous articles on
417 animal traction (García-Tomillo *et al.*, 2017; Rodrigues *et al.*, 2017). Beyond the world of research,
418 networks exist through the communities of animal traction users, such as Prommata. In terms of
419 autonomy, this seems to be a constant quest for animal energy practitioners. On the one hand, financial
420 autonomy is widely discussed, both in scientific articles and in the press. We find terms like direct
421 sales, short circuits, farmers' markets, etc. Practitioners look for direct marketing, where prices are
422 under control and thus allow for added value (Mulder and Dube, 2014). What's more, self-sufficiency
423 is also about energy. By moving from the horse to the motor, we have moved from a society based
424 on renewable energy and the local market to one based on fossil fuels and the global market (Rydberg
425 and Jansen, 2002). Finally, added value is very high in the main animal-drawn production sectors,
426 such as market gardening and viticulture. In fact, this is a condition for animal traction to be
427 sustainable (Mulder and Dube, 2014). In addition, added value is not necessarily linked to the
428 economy, and the notions of pleasure associated with working with an animal can be found in the
429 press corpus.

430 Thus, this practice is perceived and described by the press as a peasant and alternative movement,
431 and takes on its characteristics in the light of the various research articles on the subject. The dynamics
432 surrounding peasant and alternative agricultural practices are part of a repeasantization movement.
433 This concept, developed by Van der Ploeg (2008), can be defined as a process of increasing the
434 number of people defending the peasant condition. Animal traction is therefore an alternative peasant
435 practice that is spreading, but remains marginal.

436 In the French press, one article was published every 2.3 days between 2014 and 2021. Using
437 Chartier's (2003) classification of article themes, journalists write about animal traction because of its
438 unusual local character. In other words, the articles focus on the "small local farmer", and the angle
439 of the article revolves around his installation, his training and his life story. The majority of the press
440 articles approach animal traction in this way, the unusual nature reinforcing the marginal aspect of
441 the practice. As far as the research world is concerned, less than one article per year was recorded.
442 Van der Ploeg (2018) calls this phenomenon "black holes", which can be interpreted as areas left
443 untouched by research and interest, "zones of ignorance". These black holes imply that this field has

444 not been invested in by science, especially during the period of intense modernisation of agriculture.
445 This is particularly true for our literature review, as no articles were published before 2001. The
446 number of farmers practicing animal traction in countries with motorized agriculture is very limited,
447 although there are no studies enabling us to state the figures for each country with any precision. The
448 process of agricultural modernisation combined with the rural exodus has made the tractor
449 hegemonic, and the actors of the agricultural world have abandoned this subject. Today, animal
450 traction is still compared to tractors and is entrenched in its past, struggling for recognition.

451

452 **4.2 A practice that is spreading as part of the agroecological transition in developed countries**

453 Those involved in animal traction claim to be farmers and alternative farmers. Beyond these
454 characteristics, some users of animal traction claim to be part of the agroecological transition. The
455 motivations associated with agroecology include a critique of the dominant agronomic model. Thus,
456 agroecology is at the root of many processes of repeasantization (Petersen, 2014). Autonomy,
457 localism and sustainability are key concepts in this practice and in agroecology. In a closer reading of
458 the articles in our scientific corpus and by looking at the social representations of press articles, we
459 can see that agroecology is mentioned, either directly or through its principles. The agroecological
460 transition is based on increasing the sustainability of farms. In fact, innovative and alternative
461 practices in line with sustainability and sustainable development occupy an important place in the
462 concept of agroecology (Costabeber and Moyano, 2000). This increase in the sustainability of farms
463 is also an effect of animal traction, according to Gantner (2014). Given our results and the literature,
464 it seems likely that animal traction will find a place in future agricultural transformations, whether for
465 its technical (Quijano *et al.*, 2017; García-Tomillo *et al.*, 2017), economic (Mulder and Dube, 2014;
466 Johansson *et al.*, 2013) or environmental (Rydberg and Jansén, 2002; Cerutti *et al.*, 2013; Aguilera *et al.*,
467 2019) performance. But it's a project for life and society. In this sense, the notions of pleasure in
468 work, silence, and the Amish motivation to practice animal traction illustrate the global nature of
469 these alternative projects. This practice cannot be reduced to its technical and economic
470 characteristics. Animal traction farms are part of a process of redesigning agricultural and food
471 systems (Hill and MacRae, 1995). This process of redesign is not only about agricultural practices. It
472 is also about lifestyles. Moreover, one of the difficulties frequently encountered on agroecological
473 and alternative farms concerns working conditions (Dumont and Baret, 2017). These difficulties are
474 also mentioned by users of animal traction in our press articles. In high-income countries, this practice
475 is therefore part of fast-growing movements, in particular agroecology. Indeed, agroecology is now
476 widely institutionalised, and there are many injunctions to make this transition (Bellon *et al.*, 2017).

477 However, animal traction suffers from a paradoxical treatment that is not recognized by
478 agroecology (Wezel *et al.*, 2013). This may be related to the stage of development of animal traction
479 in which we find ourselves. Having survived thanks to a few pioneers since the 1980s, the practice is

480 gradually spreading and beginning to find its place within alternative and peasant movements. For the
481 moment, the sector is not very professionalized, and it still seems difficult to train in the practice.
482 Nevertheless, young farmers are turning to animal traction. In viticulture, the users are 7 years
483 younger than other farmers (IFCE and IFV, 2021). What's more, nearly 40% do not come from a
484 farming background (IFCE and IFV, 2021). These statistics are reminiscent of the neo-rural
485 movements established in agriculture, which are often close to alternative and peasant movements, as
486 shown by a study conducted in Italy by Milone and Ventura (2019). Animal traction is developing in
487 small structures, particularly because of the economic relevance of this model (Mulder and Dube,
488 2014).

489 This study also gives us an idea of the scientific momentum around animal traction in high-
490 income countries. Although the number of published articles is not large enough to draw general
491 conclusions, we can see an increase in publications on these topics. But beyond the scientific
492 community, it is the farmers themselves who seem to be driving this momentum (Rodrigues., 2017).
493 Through networking, exchange, sharing and discovery, farmers are setting up with animal power,
494 mainly horse power, as can be seen from the press articles in our corpus.

495 Finally, our results must be seen in the light of some limitations. First of all, we used non-
496 exhaustive databases (Web of Science, Scopus or Europresse), which did not allow us to collect all
497 the academic publications and press articles dealing with the practice. If animal traction is still
498 marginal, the publications promoting or discussing it may also be marginal or not included in the
499 databases selected here. Furthermore, our findings on the press need to be qualified by the sociological
500 make-up of journalists. Journalists' norms, values, interests and goals influence their articles (Gans,
501 1979). Finally, while the characteristics of the practice make it part of agroecology, some articles,
502 such as Spugnolli and Dainelli (2013), tend to mitigate the positive effects identified. By accepting
503 the hypothesis of an agroecological practice, it seems important to carry out more in-depth
504 assessments of the sustainability of animal-drawn farms. Since the main objective of agroecology is
505 to increase the sustainability of farms, it would be interesting to confirm whether animal-drawn farms
506 are sustainable. Another in-depth perspective deals with the analysis of the social dynamics
507 underlying animal traction initiatives. Press and academic articles have addressed technical, economic
508 and energy considerations. On the other hand, they have not addressed the social dynamics associated
509 with this reappropriation of the practice. It is therefore important to treat the reappropriation of animal
510 traction as a social movement.

511

512 **5. Conclusion**

513 Using a methodology based on the analysis of scientific articles and the general press, our study

514 has identified the main characteristics of animal traction in developed countries in the 21st century.
515 Although animal traction almost disappeared in developed countries at the end of the 20th century, it
516 is now attracting renewed interest and is reappropriated by the new peasantry. This is reflected in the
517 press and in the growing number of scientific publications on the subject. Animal traction offers
518 agronomic, economic and energetic advantages that meet the objectives of transition and
519 sustainability of our agricultural model. The results show that the modern use of animal traction is
520 part of the agroecological transition. The modern use of animal traction is developing within the
521 alternative movements and is part of a more global dynamic of repeasantization and the search for
522 autonomy in these regions. Farmers using animal traction are adopting a method of production that
523 they consider appropriate to contemporary issues, with high sustainability goals, as part of a drive to
524 redesign farming and food systems. Despite the positive image it enjoys and the agroecological
525 potential it claims, animal traction appears to lack recognition. We need to take a closer look at the
526 actors involved and the dynamics at play in order to gain a better understanding of these new emerging
527 practices within agroecology.

528

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