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Which Factors Determine the Distribution of Low-Impact Horse Logging in the Hungarian State-Owned Forests?

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Abstract: Nowadays, forest management focuses on nature- and environmentally-friendly methods in Europe with less fossil fuel use; however, animal-powered logging is rarely covered by scientific papers despite the fact that it is considered to be less harmful to topsoil, wood stands, saplings, and natural values than heavy machines. The main goal of this study is to determine its characteristics, advantages, and disadvantages based on structured and semi-structured interviews with loggers and foresters in every Hungarian state-owned forest area. Our results show that while 39 out of the total 116 Hungarian forest districts hired teams that applied horses for logging in 2013, their number fell to 24 in 2021. Despite this negative tendency, 34 out of the 44 forest districts that operate in hilly and mountainous areas still find horses to be useful for timber extraction. Five forest districts own horses, but none of them use animal power for logging (only for touristic and hunting activities). The productivity of a logging team depends on the timber extraction distance, terrain slope, number of workers, and cut timber volume per turn. The average logging capacity of a brigade with horses is 0.78 m^3 per load, 15 m^3 per day, and 2413 m^3 per year. The average terrain slope angle is 15°, situated 350–450 m above sea level. The average timber extraction distance is 185 m, and the width of a track made by a horse is 96 cm. The average distance from the barn to the cut-block area is 11 km. Lower impact of horse logging on the affected area is more important than the amount of the harvested wood. Therefore, from a nature conservation aspect, it is essential to maintain animal logging and promote it with training and financial incentives.

Keywords: animal logging; forestry; horse; interview; nature conservation; small-scale harvesting system

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1. Introduction

Forest management practices differ in their intensity and impacts on forest ecosystem health [1]. The small-scale and environmentally friendly methods represent a key interest in Europe. Of the several operations of forest management, logging is probably the most harmful to the forest environment [2]. The damages that occur during logging are more frequent in the skidding operation compared to the felling and processing operation [3]. Removal of the harvested wood logs from the forests affects the soil, the remaining trees, the forest floor vegetation, and the saplings everywhere in forested areas under management [4–8]. This operation of forest management can be carried out with heavy machines, cable yarders, or animals, and it requires attention to avoid soil erosion and minimize harm to the vegetation.

Several authors state that logging with draft horses or mules imply lower impact on the forest environment [9] than the use of heavy machines, causing significantly less harm to the wood stand, the saplings, and the topsoil (less compaction and disturbance) as the horses move slower and maneuver better [10–19]. Even if some ecological damage can be traced to the skidding of wood by horses, such as abraded trunks of standing trees, or erosive furrows in the soil, this method is much cheaper than the even more environmentally friendly cable yarders. Due to the weight of logs, animal power is applied basically for transporting smaller amounts [20] in hygienic cuttings, thinning cuttings, and selective felling with small volumes of the medium size trees, and in dense stands, where machines would cause more harm [21,22]. In addition, horse keeping needs a smaller investment than purchasing machines [23,24].

Despite its several advantages mentioned above, animal-powered logging is rarely covered by scientific studies everywhere in the world (see e.g., [25,26]). Before the mechanization of timber harvesting, animal power had been extensively used, and several authors agree that it still has its place even nowadays [27–29]. Although most studies report a limited use of horse logging and a low frequency of loggers who work with horses, Ref. [30] found some enterprises that use animal traction for 20%–100% of their volume in large-scale industrial community forests in Chihuahua, Mexico.

In Hungary, the total number of horses that have been used for forest work was 5918 in 1955, falling to 1747 in 1981, and 950 in 1991 [31]. Since the 1990s, their numbers have drastically reduced. The frequency and characteristics of animal-powered logging for timber harvesting have been reported from Hungary by [32], showing results from the year 2013 with evidence of its need in Hungary. Our main aim with the current study is to explore the occurrences and tendency of horse logging in Hungarian state-owned forests in 2021, as well as to present its characteristics, advantages, and difficulties. We intend to show alternatives for mechanized logging in favor of effective nature conservation in forested areas and reduction in fossil fuel use, both being of utmost importance all over Europe in the time of energy and biodiversity crisis.

More than half of Hungary's forested area (55%) is owned by the state [33]. About 84% of the state-owned forests are managed by 22 state forestry companies, which are divided into 116 operational divisions (further mentioned as forest districts) throughout the country. They hire private contractors for several forest works.

The rate of forests that are in a natural state is negligible (353 ha). The next naturalness category covers those forests that are in a close-to-natural condition. Almost 70% of them are state-owned and managed by the mentioned forest districts. The majority of forests under private or community ownership is less natural [33]. Based on international literature, the greatest value of horse logging is its low impact on natural assets. As the state-owned forests have greater naturalness value in Hungary, we focused on these areas.

2. Materials and Methods

Our main target group was the foresters and the loggers who use horses for log skidding. We conducted structured and semi-structured interviews [34,35] with them in every Hungarian state-owned forest district (n = 116) in 2013 and 2021 (Table 1). Compared to the interviews prepared in 2013, we collected more details on the factors that make animal-powered logging to be low-impact on natural values and considered more aspects in 2021.

In the first research phase (in 2013 and 2021) a telephone interview was made with every Hungarian forest district (n = 116). The relevant colleague was interviewed at each company, usually the director or the deputy director general, because they have the widest knowledge and information on this topic. The most important question during these 116 telephone interviews was whether horse logging is present in their operational area. Based on the answers, the number of forest districts that apply horse logging was determined.

The next step (in 2013 and 2021) was to prepare a face-to-face, semi-structured interview with those people who use horses for timber extraction. The main topics were the personal information, the workload, the equipment for and process of horse logging, advantages and disadvantages, and the main natural backgrounds of the affected areas.

Table 1. Main characteristics of the interviews.

Period	Main Target Groups (Number of Interviews/Whole Population)	Main Topics	Duration of Interviews; Min–Max. (Average)	Interview Type
Feb–April 2013	forest districts (116/116)	use or no use of horse logging and the reasons	5–20 min. (12 min.)	telephone, structured
March–May 2013	horse loggers (16/30)	advantages, disadvantages, efficiency, characteristics	50–120 min. (90 min.)	face-to-face, semi-structured
Feb–March 2021	forest districts (116/116)	absence or presence of horse loggers and the reasons	5–20 min. (12 min.)	telephone, structured
March–May 2021	horse loggers (23/23)	the method of horse logging, horses used, characteristics, personal reasons	60–120 min. (100 min.)	face-to-face, semi-structured
Feb–March 2021	forest districts in hilly areas without horse logging (44/44)	the reason for not applying horse logging, consequences	20–30 min. (25 min.)	telephone, structured
Feb–March 2021	forest districts with their own horse stock (5/5)	main tasks of the horses and their ownership	5–15 min. (10 min.)	telephone, structured
Feb–March 2021	forest districts using horses but not for logging (9/9)	main tasks of the horses, frequency, ownership	5–15 min. (10 min.)	telephone, structured

The next group of interviews (in 2021) was conducted with those forest districts that are situated in hilly areas but do not apply horse logging at all. In their case, using horses for forest work would be necessary due to the steep terrain. This is why we made a short-structured interview with all of them in order to explore the reasons for the lack of horse logging.

Approximately two-thirds of the interviews were recorded using a Dictaphone, with the permission of the respondent. Then we prepared summaries based on the interviews and analyzed them via qualitative content analysis based on predetermined (a priori) codes [35], that are connected to our main topics. Results are illustrated with quotations, indicating the code of the interviewee. Those questions that were answered by mentioning numbers were evaluated with basic statistical methods, i.e., frequency, distribution percentage, minimum and maximum value, mean, and standard deviation [34].

We followed the ethical principles that are required for social studies. The interviewees contributed to our research on a voluntary basis after they were acquainted with the aims of the study. We ensured anonymity during the elaboration and publication of the interviews [34,35].

Description of the Forest Areas

The most detailed description of a forested area can be found on the relevant standard data form in the office of the forest district. In order to gain a thorough view of the characteristics of the forests where horse logging is applied, we analyzed these forms and collected the forest management method, harvesting method, primary and secondary purpose, elevation, forest stand type, area, terrain slope, registered protected species, and the amount of harvested wood.

3. Results and Discussion

We publish detailed data in the Appendix A (Table A1).

3.1. The Trend of Horse Loggers in Hungary between 2013 and 2021

Altogether 39 forest districts applied horses for logging in 2013, while this number fell to 24 by 2021 (Table 2). The number of horse loggers contracted regularly decreased by 53.3%.

The number of horse loggers showed a massive decrease between 2013 and 2021, but there was still a high demand for their work. Several interviewees at forest districts mentioned that they tried to hire horse loggers, but they failed, usually due to non-proper skills and lack of practice, or "*was not willing to do it (H3)*". More than three-quarters (34) of the forest districts that are situated in hilly areas but do not apply horse logging at all (44) indicated that they really prefer horse logging as a gentle mode of timber transport. The main reasons for the decline in Italy according to [13] were emerging costs, low productivity, and fewer skilled workers. Contrary to the European trends, [30] reported from Chihuahua, Mexico that thousands of skilled horse logger brigades are prepared to teach newer ones. Despite the negative tendency, there are some newly established horse logger enterprises in Hungary as well.

Table 2. Forest districts that applied horse logging in Hungary in 2013 and 2021 (n = 116).

Frequency of Horse Logging	Number of Forest Districts in 2013	Number of Forest Districts in 2021	Rate of Forest Districts in 2013 (%)	Rate of Forest Districts in 2021 (%)
Regular	30	14	28.04	12.07
Occasional	9	10	8.41	8.62
Sum	39	24	36.45	20.69

The majority of horse loggers were ageing men, and there was no one to share their knowledge and experience with, except for three enterprises where the sons worked as well. This tendency is similar to the case in Alabama, the United States, where the mean age of the interviewed horse loggers was 54 years, i.e., most of them would retire within 10–15 years, while only 6 new enterprises were founded during the past 10 years [27].

3.2. Horses Used in Forests, but Not for Logging (n = 11)

Only five forest districts owned a horse stock in 2021 (each of them two horses), and still, they did not use the horses for logging, but instead, for hunting, transporting forage for the games (winter feeding), or waste collection from tourist places. This number was six in 2013 and half of them used their own horses for logging. The only site where state-owned horses worked in logging in 2021 was a hygienic cutting in a botanical garden operated by the forest district.

Six private enterprises that previously used horses (two on average) for logging served other roles, such as transporting hunters and tourists in wains or carriages, or winter forage for the games at the time of the study. These mean only a couple of occasions annually, showing a decreasing tendency.

3.3. Characteristics of the Forested Areas Where Horse Logging Is Still Applied

Horse loggers who worked regularly basically used their animals for thinning and selection works, because the horses moved more easily in the dense stand of young trees than the machines without causing harm and the harvested wood volume is smaller, i.e., not too heavy for the animals. Moreover, using harvester machines was not profitable from an economic point of view due to the small wood volume. Moreover, horses occasionally worked in selective thinning of the continuous cover forestry (CCF) areas, and in hygienic cuttings, or residential collection, but clearcutting also occurred. The forest districts usually designated those areas for horse logging that were heavily accessible with machines, such as steep rocky slopes.

According to the relevant standard data forms of the forest patches, thinning and selection were the most frequent harvesting methods in those forest areas where horse logging occurred. The average size of the areas logged with horses was 10.28 ha based on 14 sample sites, but the directly affected areas might have been smaller. The smallest site where horse logging occurred was 4.32 ha, while the greatest one was 16.91 ha.

The standard data forms determine the primary and sometimes also secondary purpose for every forest patch all over Hungary. The primary purpose of every forest site where horse logging occurred in 2021 was nature conservation function, except for one site, where it was wood production and the greatest wood volume logged by horses was registered there. The secondary purpose of two sites was Natura 2000 function (this is the ecological network of the European Union, connecting the sites that are protected at the national level), and soil protection in one case.

About 43 per cent of the Hungarian forested area is declared as a nature conservation area by national laws and/or part of the Natura 2000 network of the European Union [33]. Most forest sites where horse logging was used were protected areas, one site was under strict protection and one site was not protected. Two of the forest districts that applied horse logging managed mainly protected forests characterized by steep, rocky hillsides, and both hired two horse logger brigades.

The dominant forest stand varied among the forest districts that applied horse logging, i.e., the dominant tree species did not determine the use of horses, except for one special case where manna ash (*Fraxinus ornus*) was aimed to overgrow a previous European black pine (*Pinus nigra*) stand and this process should have been harmless for the seedlings of the indigenous species and the topsoil.

The average elevation of the areas where horse logging occurred was 387.5 m, the lowest lying between 250 and 350 m, and the highest between 450 and 550 m. The most frequent value was 350–450 m. Their relief was categorized as "hillside, slope" in the standard data forms.

The average slope angle of the Hungarian areas where horse logging occurred was 24.67% (i.e., 13.86°) and these data are close to the average 20% (i.e., 11.31°) which is calculated based on data from international literature [14,17,19,29] (Table 3); the steepest being 36.4%–46.63% (i.e., 20–25°), and the gentlest incline 17.63%–26.79% (i.e., 10–15°). The most frequent value was 27%–36% (15–20°) in Hungary, which is quite similar to the data published by [36] (40%), [19] (40%), [28] (30%), and [37] (30%). The greatest value where animal power was applied (75%) was measured in Iran [38], followed by a Romanian site (45%) [21].

Table 3. Factors that determine the work productivity of horse logging. Track means the route where the horse drags the log from its harvesting place to the location for transport.

	Slope (%)		Track Length (m)		Track Width (m)
	Literature	Own	Literature	Own	Own
min.	4	10	25	45	0.5
max.	75	25	375	550	2
average	20	24.67	135.8	185	0.96

3.4. The Work Productivity of Horse Logging and Its Determining Factors

An average brigade for horse logging consisted of three people (the highest number was five). The contractors claimed more workers in order to increase the work productivity (i.e., the volume of logged timber within a certain time frame), but usually did not find reliable and skilled workers. The contractor usually performed tree felling, another worker performed tree processing, and a third one was engaged with leading the horse (Figure 1). Two horses were applied, and they often worked in parallel, with the exception of two contractors (one of them owns only one horse, while another uses three). The horses usually did not work together, because it requires special skills from the worker (see Figure 2). The average daily working time was 7 h, not counting the resting periods and the time needed for accessing the site.

The average distance from the stable to the working place, either on foot or with a wain, was 11 km, the longest being 15 km, meaning another 4 h every day; this decreased the work productivity, since only 2 contractors out of 15 owned a wagon for transporting the horses. The latter ones were able to undertake more harvesting places that were even 45 km far away, not exhausting their horses with accessing the site. One of the contractors ensured accommodation for his workers and horses in the forest during the whole year in a trailer and a mobile stable. Another contractor ensured accommodation in the closest village, but this was more and more difficult due to the disappearing stables and homesteads.

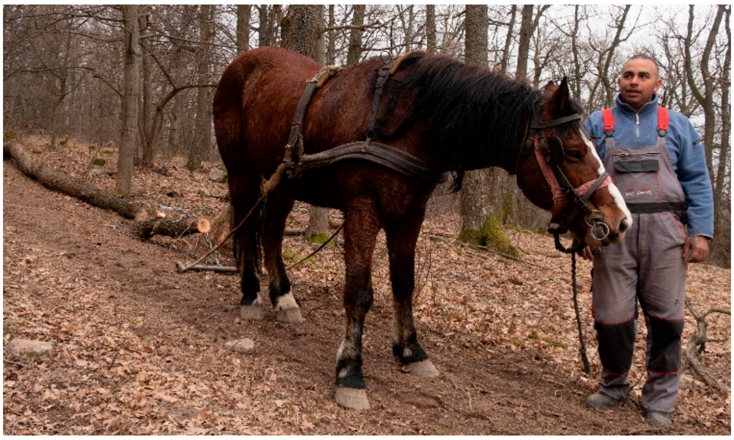

Figure 1. One horse in work with a chain, led from the front (area of the Tállya Forest District, 2021).

Figure 2. Horses working in pair with a chain, led from the back (area of the Királyrét Forest District, 2021).

The work productivity of animal logging was further determined by the length of the skidding track, the slope angle, the size of the log, and the weather conditions [21,22,30,39] (Table 3). These factors were considered in the price as well that the Hungarian forest district paid for the hired loggers.

The length of the track, i.e., the route where the horse drags the log from its harvesting place to the location for transport, is rarely covered by scientific studies. Based on the experience of Hungarian horse loggers, its average length in Hungary was 185 m, while the longest published track was 375 m [24] and 300 m [21]. Refs. [12,37] mentioned an average of 100 m, while distances of Ref. [17] 82 m, Ref. [40] 61 m, and Ref. [41] 25 m have also been recorded. The average width of the track in Hungary was 0.96 m based on our interviews. No international data were found for this factor.

The mean quantity of timber a horse (or mule in some publications) could pull in one turn varied between 0.212 m^3 and 0.684 m^3 in foreign areas, with an average of 0.46 m^3 [14,21,22,27,40,42]. Our interviewees reported a greater average, 0.78 m^3 (varying from 0.3 m^3 to 1 m^3, Table 4). The average volume logged by a horse per hour varied between 0.15 m^3 and 3.13 m^3, with an average of 1.73 m^3 [11,17,21,27,29,37–40,43]. Ref. [27] reported a daily volume of 16.095 m^3, which was close to our data of 15 m^3. The total annual volume per horse was 2413 m^3 for one brigade, which usually worked with two horses. We did not find any relevant literature data.

Table 4. The work productivity of horse logging.

	Work Productivity per Turn (m^3)		Work Productivity per Day (m^3)		Work Productivity per Site (m^3)
	Literature	Own	Literature	Own	Own
min.	0.212	0.3	10	8.5	133
max.	0.684	1	16.095	22.5	627
average	0.46	0.78	12.67	15	296

3.5. Personal Circumstances in Horse Logging

Our interviewees have been logging with horses in forested areas for 17 years on average, varying between 3 and 35 years. Almost half of them acquired the knowledge and special practical skills from their father. They like the horses and the unique lifestyle: "*bad feeling to see an empty stable (Á4)*", and "*I could not endure for a half year without horses (Á9)*". Further mentioned reasons for working with horses in forests were the smaller investment compared to buying machines, and the lack of job opportunities in their village. They did not have another job in parallel with logging, with one exception (night watch).

Seven contractors owned a machine for logging beside the horses and usually worked with them in parallel, as they complemented each other well. The horses worked in the denser stands where the machine could not maneuver.

3.6. Advantages and Disadvantages of the Horse Logging

3.6.1. Advantages of Horse Logging Compared to Using Machines

Despite the fact that the majority of the forest districts that operate in hilly areas (n = 44) did not apply horse logging, more than half of them (n = 25) considered this method to be less harmful to the forests than the machines. There were several forest sites within their operational area that needed much less harmful management, and they would have hired contractors for horse logging if they found them. The main reason for not applying horses for logging was the lack of skilled workers (Figure 3). Several interviewees emphasized that there were no more people with the necessary skills in their surroundings. Some previous horse loggers have died and could not be substituted. Half of the interviewees mentioned that the main barrier was that they cannot pay a higher wage for the horse loggers. One-quarter of the interviewees considered the hard work with horses and the special lifestyle as the main barrier: "*Horses need you to feed them every day, while the tractor only needs to be stopped. (H5)*". A quarter of them answered that the reason for the lack of horse logging in their area was its low work productivity. Others mentioned the low number of horses kept in their vicinity, or the difficulty to find another job during the vegetation period (see above).

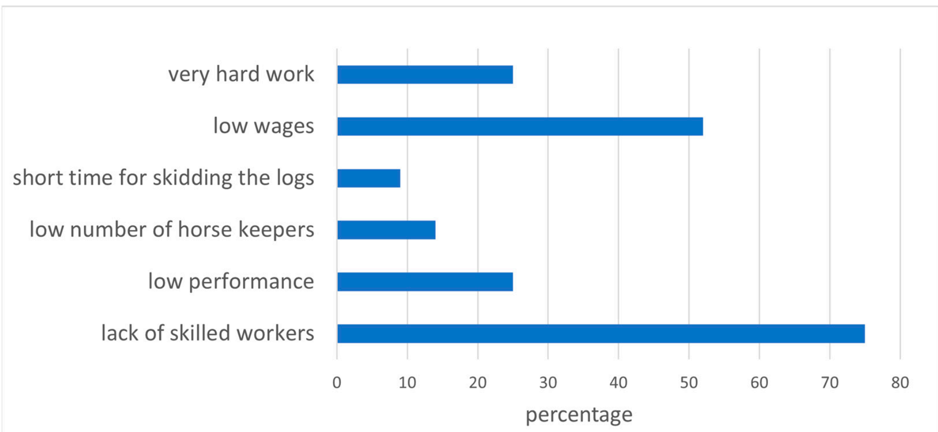

Figure 3. Reasons for not applying horse loggers in those Hungarian hilly forest districts where no horse logging occurs in 2021.

3.6.2. Advantages of Animal Power in the Logging

Based on the interviews we can summarize the advantages and disadvantages of horse logging (Table 5).

Table 5. Advantages and disadvantages of horse logging.

Advantages of Horse Logging Compared to Using Machines	Disadvantages of Horse Logging
Environmental: • less noise • no oil spill • less soil compaction • less harm to wood stands, saplings, and natural assets • disturbance is concentrated on a smaller area Economic: • requires smaller investment • not exposed to fluctuations in oil prices • can be applied when the use of machines is difficult or not profitable (e.g., steep slopes, scattered trees, sensitive areas) Social-cultural: • an old tradition • loggers enjoy the work and life with horses	labor-intensive hard work shortage of skilled workers lower wages periodic work that needs to be supplemented

The environmentally friendly aspect of animal logging, causing less soil compaction and less harm to wood stands, saplings, and natural assets than heavy machines, were emphasized in several interviews, similarly to previous authors [12,16,19,29].

Horses were applied basically for skidding smaller amount of log in thinning cuttings and selection works, and in dense stands in Hungary, showing the same result as [11,21,27] reported. According to the interviewees, using horses required smaller investments, and it was not exposed to the fluctuations in fuel prices. They also answered that the use of horses seemed economically more viable especially in the case of short skidding routes as reported by [15,18,30] as well, and within those areas where the machines would produce very small profit shown also by [28], such as after wind fallings, where the logs are scattered in a bigger area. Horses were also more beneficial for logging on steep slopes similar to [20]. Some forest districts hired horse loggers for those areas that could not be maneuvered by machines. Refs. [10,23] mentioned similar cases. Horses might work in the most sensitive and most frequently visited forest habitats as well, such as arboretums and botanical gardens, or nature conservation areas, as reported also by [13] because the logging process caused less noise pollution when using horses reinforcing the results of [44]. We found several cases when horses logged in rocky slopes with shallow soil layers, belonging to the most sensitive forest habitats (reported also by [36]), and only one among our fourteen studied areas was not declared as a nature conservation area. The authors of Ref. [45] add that horse logging was more accepted by society and local stakeholders than machines. Our interviewees mentioned it as preserving an old tradition as heritage.

It was mentioned as another advantage that fewer trees needed to be cut from the remaining stand in order to create the skidding track for horses than for machines as also shown by [24]. In addition, smaller area was converted for storing the logs before their transportation by truck, as well as less log processing waste remained in the forest, and thus, the decrease in the aesthetic value was smaller. Several interviewees reported severe habitat disturbance in these storing sites for many years after skidding with machines, while this disturbance was more concentrated on a smaller area in the case of horse logging.

Both the representatives of forest districts and the horse loggers considered this activity to be labor-intensive and physically exhausting. These results strengthened the statements of [11,21,23]. Our interviewees considered the shortage of skilled workers to be the greatest limiting factor, in line with [24,30]. Our interviewees also emphasized that the number of workers was unpredictable; several of them gave up the hard forest work after a couple of days and it was not easy to substitute them from the small villages with a declining population. In addition, this method was often applied in nature conservation areas, where logging was prohibited by the Forest Act during the vegetation period and, thus, they had to find another job. Despite the hard work, the total work productivity still lagged behind the volume logged by machines, leading to lower wages. Other studies also showed that horses worked slower and skidded smaller logs [45]; this is why they were usually applied in thinning cuttings and selection works. Moreover, they were more sensitive to weather extremes than the machines similar to [15] and could not drag the logs upwards on slopes with a great distance.

4. Conclusions

In our study we examined the state of horse logging in state-owned forests and also compared it with the situation in 2013. Several logging brigades and contractors whom we met during our field studies in 2013 gave up working with horses by 2021, either due to their age, health condition, or lack of suitable skilled young loggers. This is why we consider our compilation of horse loggers' experience and knowledge to be important. The presence of horse logging in privately owned forests should be explored in the near future as well.

In Hungary, the use of horse teams has a historical legacy. This is the case in Mexico as well, where it has persisted due to its apparent ongoing advantages [30], showing a good example for the European countries. Nowadays, fewer horses are used for log skidding and instead, they remain for serving touristic and hunting purposes. Horse skidding is considered as a reasonable alternative for mechanized logging in areas of nature conservation and on forested surfaces that are highly vulnerable, and it should receive much greater attention in the time of energy and biodiversity crisis all over Europe as an effective solution for fossil fuel use reduction. In steep terrain conditions (harvesters are not used above 45% in Hungary), cable yarders represent an alternative to animal logging, causing even less damage, but their cost is extremely high compared to the application of horses. They need skilled operators as well as very good organization of work, while skidding fewer logs within the same time frame [46].

In most cases, horse loggers were hired for skidding in steep rocky slopes of hilly areas that could hardly be approached by a machine, or it would have caused significant harm. This statement was supported by the majority of forest districts that operate in hilly areas and considered the horses to be less harmful to the forest habitats; and by the standard data forms of forest patches that witness nature conservation areas in almost every studied case. We collected and presented many arguments and data on horse logging as being environmentally friendly and suitable for protected areas, which should lead to the revival of this century-old tradition. The emphasis was on being less harmful to the affected area rather than on the amount of harvested wood. In order to preserve this method, the wages should be adapted to the new challenges, and the extreme situations that surround the people who work with horses in the forests, to ensure stable subsistence for them. Based on a few positive examples, we recommend ensuring the transport of horses by motorized vehicles over a longer distance in order to increase efficiency. Showing the positive perspective is inevitable to lure in young, devoted people to learn the essential knowledge and practical skills from experienced workers before they retire.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Summary of the interviews.

Name of Forest District and Code of Interview	Quantity Logged by 1 Horse during 1 Day (m^3)	Quantity Logged by 1 Horse in 1 Turn (m^3)	Number of Workhorses	Number of Workers	Owner of a Machine	Max. Distance from the Stable (km)	Horse Logger for How Many Years	Reaching the Area	Driving Horses from
Hegyaljai; Á1	12.5	0.75	2	4–5	no	10	12	On foot	front
Hegyaljai; Á2	17.5	0.75	2	5–6	yes	15	30	On foot	front
Tállyai; Á3	15	0.5	2	3–4	no	12	9	On foot	front
Tállyai; Á4	12	0.5	2	4–5	yes	10	15	On foot	front
Pétervásárai; Á5	12.5	0.75	2	4–5	yes	15	35	Motor-horsebox	back
Királyréti; Á6	22.5	1	2	5	no	12	15	On foot	back
Diósjenői, Kemencei; Á7	9.5	0.5	2	3	no	15	3–4	Motor-horsebox	front
Telkibánya; Á8	15	1	2	3	yes	8	10	On foot	front
Zselic; Á9	12	0.75	1	3	yes	10	10	On foot	front
Pilisszentkereszt; Á10	15	1	2	3	no	15	20	On foot	front
Bakonybél; Á11	8.5	1	2	1	yes	12	19	On foot	front
Keszthelyi; Á12	17.5	1.5	2	4	no	5	35	On foot	front
Bódvavölgyi; Á13	20	0.5	2	3	no	10	10	On foot	front
Nyugat-Cserhát; Á14	22.5	1	3	4	yes	6	25	Local accommodation	front
Lenti; Á15	12	0.3	2	5	no	15	10	On foot	front

References

1. Moreaux, C.; Martin, P.; Hereş, A.M.; Yuste, J.C. Effects of forestry practices on the conservation of soil and forest ecosystem health and functioning: An umbrella review protocol. *OSF Prepr.* **2022**. [CrossRef]
2. Cudzik, A. Damage to Soil and Residual Trees Caused by Different Logging Systems Applied to Late Thinning. *Croat. J. For. Eng.* **2017**, *1*, 83–95.
3. Knežević, J.; Gurda, S.; Musić, J.; Halilović, V.; Soković, D.; Bajrić, M. The Impact of Animal Logging on Residual Trees in Mixed Fir and Spruce Stands. *South-East Eur. For.* **2018**, *2*, 107–114. [CrossRef]
4. Lucas-Borja, M.E.; Heydari, M.; Miralles, I.; Zema, D.A.; Manso, R. Effects of Skidding Operations after Tree Harvesting and Soil Scarification by Felled Trees on Initial Seedling Emergence of Spanish Black Pine (*Pinus nigra* Arn. ssp. *salzmannii*). *Forests* **2020**, *11*, 767. [CrossRef]
5. Naghdi, R.; Solgi, A.; Labelle, E.R.; Zenner, E.K. Influence of ground-based skidding on physical and chemical properties of forest soils and their effects on maple seedling growth. *Eur. J. For. Res.* **2016**, *135*, 949–962. [CrossRef]
6. Pitta-Osses, N.; Centeri, C.; Fehér, Á.; Katona, K. Effect of Wild Boar (*Sus scrofa*) Rooting on Soil Characteristics in a Deciduous Forest Affected by Sedimentation. *Forests* **2022**, *13*, 1234. [CrossRef]
7. Tavankar, F.; Picchio, R.; Nikooy, M.; Jourgholami, M.; Naghdi, R.; Latterini, F.; Venanzi, R. Soil Natural Recovery Process and *Fagus orientalis* Lipsky Seedling Growth after Timber Extraction by Wheeled Skidder. *Land* **2021**, *10*, 113. [CrossRef]
8. Zenner, E.K.; Berger, A.L. Influence of skidder traffic and canopy removal intensities on the ground flora in a clearcut-with-reserves northern hardwood stand in Minnesota, USA. *For. Ecol. Manag.* **2008**, *10*, 1785–1794. [CrossRef]
9. Picchio, R.; Mederski, P.S.; Tavankar, F. How and How Much, Do Harvesting Activities Affect Forest Soil, Regeneration and Stands? *Curr. For. Rep.* **2020**, *6*, 115–128. [CrossRef]
10. Engel, A.M.; Wegener, J.; Lange, M. Greenhouse gas emissions of two mechanised wood harvesting methods in comparison with the use of draft horses for logging. *Eur. J. For. Res.* **2012**, *4*, 1139–1149. [CrossRef]
11. Jourgholami, M. Small-Scale Timber Harvesting: Mule Logging in Hyrcanian Forest. *Small Scale For.* **2012**, *2*, 255–262. [CrossRef]

12. McNamara, D.; Kaufman, A. Can horses compete with tractors? *Calif. For. Note* **1985**, *95*, 1–7.
13. Spinelli, R.; Lombardini, C.; Magagnotti, N. Salvaging windthrown trees with animal and machine systems in protected areas. *Ecol. Eng.* **2012**, *53*, 61–67. [CrossRef]
14. Wang, L. Assessment of animal skidding and ground machine skidding under mountain condition. *J. For. Eng.* **1997**, *2*, 57–64.
15. Wang, L. Environmentally sound timber extracting techniques for small tree harvesting. *J. For. Res.* **2000**, *4*, 269–270.
16. Dudáková, Z.; Allman, M.; Merganič, J.; Merganičová, K. Machinery-Induced Damage to Soil and Remaining Forest Stands—Case Study from Slovakia. *Forests* **2020**, *11*, 1289. [CrossRef]
17. Ghaffariyan, M.R.; Durston, T.; Sobhani, H.; Mohajer, M.R. Mule logging in northern forests of Iran: A study of productivity, cost and damage to soil and seedlings. *Croat. J. For. Eng.* **2009**, *30*, 67–75.
18. Jamshidi, R.; Jaeger, D.; Raafatnia, N.; Tabari, M. Influence of Two Ground-Based Skidding Systems on Soil Compaction Under Different Slope and Gradient Conditions. *Int. J. For. Eng.* **2008**, *1*, 9–16. [CrossRef]
19. Naghdi, R.; Lotfalian, M.; Bagheri, I.; Jalali, A.M. Damages of skidder and animal logging to forest soils and natural regeneration. *Croat. J. For. Eng.* **2009**, *30*, 141–149.
20. Ezzati, S.; Najafi, A.; Durston, T. Impact of animal logging on soil physical properties in mule trail in Hyrcanian forests. *Transp. Res. Part D* **2011**, *16*, 316–320. [CrossRef]
21. Borz, S.A.; Ciobanu, V. Efficiency of motor-manual felling and horse logging in small-scale firewood production. *Afr. J. Agricult. Res.* **2013**, *24*, 3126–3135.
22. Timofte, A.I.; Enescu, C.M. Economic aspects regarding the extraction of wood using horses: A case study. *Sci. Pap. Ser. Manag. Econ. Eng. Agric. Rural Dev.* **2019**, *3*, 599–604.
23. Heinrich, R. *Medium Technology in Wood Harvesting. Logging and Transport in Steep Terrain*; FAO: Rome, Italy, 1985.
24. McNamara, D. Horse logging at Latour. *Calif. For. Note* **1983**, *88*, 1–10.
25. Shrestha, S.P.; Lanford, B.L.; Rummer, R.B.; Dubois, M. Utilization and cost of log production from animal logging operations. *Int. J. For. Eng.* **2005**, *16*, 167–180. [CrossRef]
26. Lobo, J.; Barrantes, G.; Castillo, M.; Quesada, R.; Maldonado, T.; Fuchs, E.J.; Solís, S.; Quesada, M. Effects of selective logging on the abundance, regeneration and short-term survival of *Caryocar costaricense* (Caryocaceae) and *Peltogyne purpurea* (*Caesalpinaceae*), two endemic timber species of southern Central America. *For. Ecol. Manag.* **2007**, *245*, 88–95. [CrossRef]
27. Toms, C.W.; Dubois, M.R.; Bliss, J.C.; Wilhoit, J.H.; Rummer, R.B. Survey of animal-powered logging in Alabama. *South J. Appl. For.* **2001**, *1*, 17–24. [CrossRef]
28. Akay, A.E. Determining cost and productivity of using animals in forest harvesting operations. *J. Appl. Sci. Res.* **2005**, *2*, 190–195.
29. Badraghi, A.; Erler, J.; Hosseini, S.A.O.; Lang, R. Evaluation of animal logging in the mixed broadleaved mountain forest: Economic and environmental impacts. *J. For. Sci.* **2018**, *64*, 251–259.
30. Bray, D.B.; Duran, E.; Hernández-Salas, J.; Luján-Alvarez, C.; Olivas-García, M.; Grijalva-Martínez, I. Back to the Future: The Persistence of Horse Skidding in Large Scale Industrial Community Forests in Chihuahua, Mexico. *Forests* **2016**, *7*, 283. [CrossRef]
31. Gólya, J. Fakitermelési Munkarendszerek Gyérítésekben. Ph.D. Thesis, University of West-Hungary, Sopron, Hungary, 2003; 171p.
32. Malatinszky, Á.; Ficsor, C. Frequency and Advantages of Animal-Powered Logging for Timber Harvesting in Hungarian Nature Conservation Areas. *Croat. J. For. Eng.* **2016**, *2*, 279–286.
33. NFK. Magyarország Erdeinek Összefoglaló Adatai. Data on Hungary's forests. In *Hungarian*; Nemzeti Földügyi Központ Erdészeti Főosztály: Budapest, Hungary, 2021; 2p.
34. Babbie, E. *The Practice of Social Research*, 13th ed.; Wadsworth Cengage Learning: Boston, MA, USA, 2013; 579p.
35. Patton, M.Q. *Qualitative Research and Evaluation Methods*; Sage: London, UK, 2002.
36. Rockwell, C.; Kainer, K.; Marcondes, N.; Baraloto, C. Ecological limitations of reduced-impact logging at the smallholder scale. *For. Ecol. Manag.* **2007**, *223*, 365–374. [CrossRef]
37. Melemez, K.; Tunay, M.; Emir, T. A comparison of productivity in five small-scale harvesting systems. *Small-Scale For.* **2014**, *1*, 35–45. [CrossRef]
38. Ghaffariyan, M.R. Selecting the best skidding system using AHP: A case study in Northern Iran. *For. Sci.* **2008**, *44*, 77–86.
39. Mousavi Mirkala, S.R.; Nikooy, M.; Naghdi, R.; Ghaznavi, N.; Karamzade, S. Productivity and cost study of mule logging in Astara watershed forests. *J. Wood For. Sci. Technol.* **2015**, *21*, 161–174.
40. Szakálosné Mátyás, K.; Fekete, G.; Horváth, A.L. Lovak alkalmazása és jövője a hazai fahasználatokban. In *Soproni Egyetem Erdőmérnöki Kar: Tudományos közlemények*; University of Sopron: Sopron, Hungary, 2020; pp. 273–277.
41. Jelves, C.M. Rendimientos y Costos Para Diferentes Metodos de Raleos de Pino Insigne, *Pinus radiata* D. Don. Master's Thesis, Universidad de Chile, Valdivia, Chile, 1977.
42. Magagnotti, N.; Spinelli, R. Integrating animal and mechanical operations on protected areas. *Croat. J. For. Eng.* **2011**, *2*, 489–499.
43. Magagnotti, N.; Spinelli, R. Financial and energy cost of low-impact wood extraction in environmentally sensitive areas. *Ecol. Eng.* **2011**, *37*, 601–606. [CrossRef]
44. Shrestha, S.P. Animal logging applications in urban forestry. In Proceedings of the Emerging Issues along Urban/Rural Interfaces: Linking Science and Society Conference, Atlanta, GA, USA, 13–16 March 2005; pp. 281–286.

45. Russell, F.; Mortimer, D. *A Review of Small-Scale Harvesting Systems in Use Worldwide and Their Potential Application in Irish Forestry*; COFORD: Dublin, Ireland, 2005; Available online: http://www.energyineducation.ie/Renewables/Bioenergy/Review_of_small_scale_harvesting_systems.pdf (accessed on 8 September 2022).
46. Szakálosné Mátyás, K.; Gimesi, K.S.; Major, T.; Horváth, A.L. Kötélpályás közelítés Vizsgálata a Soproni Hegyvidéken. In *Soproni Egyetem Erdőmérnöki Kar Tudományos Közlemények*; University of Sopron: Sopron, Magyarország, 2020; pp. 278–283. ISBN 9789633343760.