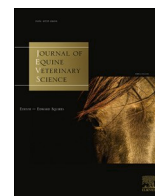




Contents lists available at ScienceDirect

## Journal of Equine Veterinary Science

journal homepage: [www.elsevier.com/locate/jevs](http://www.elsevier.com/locate/jevs)

Short Communication

## Preliminary examination of the perceptions of sustainable horse feeding practices in the Netherlands

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## ARTICLE INFO

## Keywords:

Nutrition

Equine

Sustainability

Willingness

Survey

## ABSTRACT

The purpose of this study was to determine the perception of sustainability among horse owners in the Netherlands and their willingness to switch to more sustainable feeding practices. A survey was distributed to a target group of horse owners in the Netherlands via social media channels. Data (n = 338 valid responses) were stratified based on yard type and size (small (<20), medium (20-50), and large (>50 horses)). Most of the yards were livery yards (68 %) and they were small in size (66 %). The term most commonly associated with sustainability was low environmental impact (61.8 %). All participants (338/338) indicated that they were willing to switch to more sustainable feeding practices. Of the six options offered, the most popular was the use of plastic-free packaging products (60.5 %). This study identified that numerically the greatest change in behavior for the Dutch equestrian community would be achieved by small livery yards (P < 0.001). The potential to modify certain practices might be limited by the size of the equestrian operation, such as the available land for altering pasture management, and the financial aspects of the enterprise. Future research should investigate how the scale and economic considerations of the equestrian business influence its capacity and willingness to adopt more sustainable feeding practices.

## 1. Introduction

The United Nations defined sustainability as “meeting the needs of the present without compromising the ability of future generations to meet their own needs.” [1]. The feeding and management of horses is heavily imbedded within the agriculture sector and this highlights the need for the equine industry to align practices with the wider agriculture sector and identify Sustainable Development Goals (SDGs) and agricultural practices, emphasizing sustainable approaches [2].

Within Europe it is estimated that there are approximately 6.5 million equines, used for sport and to a lesser extent agriculture [3]. Given the large number of equines, and in some parts of Europe areas of high horse density, the impacts of horse feeding on sustainability can be significant. “Sustainable horse Feeding” represents a comprehensive holistic approach, and focuses on strategies and techniques aimed at generating feed to provide optimal nutrition for horses while concurrently minimizing adverse environmental impacts. This encompasses both the feed supply chain (production process generating the horse

feed, often off-farm) and the management of the feed intake and grazing environment on-farm. Thus a range of variables require consideration such as adoption of sustainable agricultural techniques to minimize water consumption and greenhouse gas emissions, the utilization of recyclable or biodegradable materials to reduce of waste and pollution, the protection and restoration of natural habitats and the promotion of biodiversity. This concept of sustainable horse feeding and the principles requiring consideration have been previously covered in a recent review [4].

Within many aspects of the agriculture sector the production process has been well described, the negative impacts within the process identified and proposals for change proposed (2,4,5,9). In some sectors this transition to change has progressed to the point where they have obtained metrics on participants willingness to change and identified barriers (either physical, process or sociological) to the implementation of sustainability practices [5]. In comparison to the wider agriculture sector the equine industry has been relatively slow to recognize the need to consider sustainability. Recent publications have indicated an

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Received 14 September 2023; Received in revised form 2 November 2023; Accepted 17 November 2023

Available online 24 November 2023

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increased consideration by the equestrian community for sustainable practices, though many of these have focused around issue of management on perceptions of horse welfare, rather than impact on the environment via husbandry, feeding practices or the horse feed supply chain [6]. Thus there is a paucity of data describing sustainable horse feeding practices, the willingness of participant to adopt sustainable horse feeding practices and what processes could be changed to improve sustainable horse feeding practices. The purpose of this study was to determine horse keepers' in the Netherlands perceptions of sustainability, their level of concern around sustainability and their willingness to change to more sustainable feeding practices.

## 2. Materials and methods

### 2.1. Sample frame and survey

The target population for this survey were horse owner/managers within the Netherlands. Data were obtained via a cross-sectional online survey (Survey Monkey, 2022) of a convenience sample of horse owners/managers within the Netherlands collected between March 1st and June 1st, 2022. Pre-testing via a pilot survey was carried out as recommended by Robson [7]. Pilot study feedback inferred only minor modifications to question phrasing, aimed at making sure questions were interpreted correctly. Participants were recruited using a snowball sampling technique with the initial seeding social media posts (Instagram and Facebook) by Pavo Horse Feed Company and Royal Dutch Equestrian Sports Federation (KNHS). The survey consisted of six topics broadly divided into demographics of participants, demographics of horses and use of the horses, feeding, land and pasture management, manure management and the respondents' willingness to change feeding practices. The questions were predominantly multiple-choice. Awareness and consideration of horse sustainable feeding issues were evaluated using a 4-point Likert scale with 0 indicating no concern, 1 indicating minimal concern, 2 indicating moderate concern, and 3 indicating strong concern.

Respondents were asked to select their top three perceptions of sustainability within the equine industry from a list of nine options including; low environmental impact of horse feeding, avoiding the use of pesticides and herbicides, using plastic-free packaged products, using minimally processed horse feed or traditional horse feed, and high animal welfare standards, use of products from the local supply chain, economic growth in the agri-food sector, feeding horses only hay and feeding horses healthy products.

Respondents were asked to select their preferences for switching to sustainable equine feeding from a list of six choices (including using plastic free packaging products, feeding with organic muesli, organic roughage, stop feeding soy products, feeding with hay rather than haylage, and using rotational grazing).

A single iteration of pre-testing via a pilot survey was carried out. A copy of the survey can be obtained from the corresponding author.

### 2.2. Data analysis

Data were stratified and examined based on horse keeping activity and size of the equine operation (small (<20), medium (20-50), and large (>50 horses). Quantitative data were analyzed using descriptive statistics and Chi-square test (Systat 26, SPSS, Chicago, IL). Data were analyzed using descriptive statistics: frequency, percentage, mean, and standard deviation. Normally distributed data are presented as mean  $\pm$  standard deviation, whereas skewed data are presented as medians and interquartile range (IQR). A value of  $P < 0.05$  was considered statistically significant for all analyses.

## 3. Results

### 3.1. Demographics of respondents and horses

There were 400 surveys submitted, 62 participants failed to complete the section on horse demographics providing 338 valid responses. The respondents were predominantly female ( $n = 276$ , 66.7 %) in the 31-40 years age group (34.8 %) or 41-50 years age group (26.8 %). These respondents managed 5,765 of the 450,000 horses in the Netherlands (estimated response rate of 1.2 %). The horses were distributed among the four regions of the Netherlands. The majority of the yards were livery yards (230/338, 68 %) followed by sport horse yards (68/338, 20.1 %), riding school yards (35/338, 10.4 %) and few breeding yards (5/338, 1.5 %). The majority of the yards surveyed were small in size (223/338, 65.9 %) with few large (12/338, 3.6 %) yards represented.

The majority of the horses were identified as belonging to the 4 to 14-year-old age category (62 %,  $11.9 \pm 11.3$ ). There was no difference between yard type, or size, with the age distribution of the horses. Across all responses there was an even distribution between geldings (43.1 %, median 5, IQR 2-12) and mares (41.5 %, median 5, IQR, 2-10). An even sex distribution was observed in livery yards (for geldings; 45%, median 4, IQR 2-9 and for mares; 42%, median 4, IQR, 2-8). The majority of the horses in the breeding stables were mares (64 %, median 16.5, IQR 10 – 30), though these also had some geldings (28 %, median 7.5, IQR 3-14).

### 3.2. Understanding of sustainable equine feeding and concern

Participants ( $n = 262$ ) selected three of nine sustainable equine feeding options that they perceived as best describing sustainability within the equine context. The low environmental impact of horse feeding (61.8 %) was the most frequent choice, followed by avoiding the use of pesticides and herbicides (52.7 %), and using plastic-free packaged products (51.1 %). The remaining choices in descending order were using minimally processed horse feed or traditional horse feed (29 %), high animal welfare standards (20.6 %), feeding horses healthy products (20.6 %), use of products from the local supply chain (18.3 %), economic growth in agri-food sector (17.2 %), and feeding horses only hay (12.6 %) was the least frequent choice. The three most frequent terms associated with 'sustainability' (89.3 %) were; low environmental impact, pesticide and herbicide avoidance, and the use of plastic-free packaging products.

Most respondents (304/338, 90%) reported consideration of sustainability within the sector with a median score of 2 (moderate concern).

### 3.3. Willingness to change to more sustainable feeding practices

All participants (338/338) indicated their willingness to change to a more sustainable feeding practices for at least one of the sustainable parameters listed. The most popular options from the six sustainable feeding practices were using plastic free packaging products (60.5 %), feeding with organic muesli (56.5 %), organic roughage (53.3 %), stop feeding soy products (50 %), feeding with sustainable hay rather than haylage (49.7 %), and using rotational grazing (42 %).

Numerically the greatest responses for each option were from livery yards, and for most options small yards were numerically greatest responses (Tables 1 and 2). Relative to yard category riding schools and sport horse yards were more willing to switch to the suggested more sustainable practices than livery yards or breeding yards ( $P < 0.001$ ). A high percentage of the respondents in the medium size yards category were willing to change feeding practices (77–93 %, of respondents in this yard size, depending on choice). Compared to small yards, as the reference category, medium size yards were 1.9 [95 %CI 1.7–2.5] to 2.7 [95 %CI 2.2–3.5] times more likely to be willing to change feeding practices ( $P < 0.001$ ). There was no difference between small and large

**Table 1**  
Sustainability options respondents were willing to consider with responses categorized by type of horse yards (n=338).

Sustainability options	Responses All yards (n=338)	Livery yard (68%, n=230) (ref)	Riding school (10.4%, n=35)	Breeding yard (1.5%, n=5)	Sport horses yard (20.1%, n=68)
Providing horses rotational grazing system	(n= 142, 42%)	72 (50.7%)	24 (16.9%)	3 (2.1%)	43 (30.3%)
Using organically produced roughage to feed horses	(n=180, 53%)	64 (35.6%)	28 (15.6%)	2 (1.1%)	26 (14.4%)
Feeding horses with organic grains or muesli	(n=191, 57%)	106 (55.5%)	27 (14.1%)	1 (0.5%)	57 (30%)
Feeding horses hay rather than haylage	(n=168, 50%)	86 (51.2%)	27 (16.1%)	2 (1.2%)	53 (31.5%)
Stop supplying unsustainable soy products to horses	(n=169, 50%)	88 (52.1%)	24 (14.2%)	1 (0.6%)	56 (33.1%)
Feeding horses with corn oil or safflower oil	(n=143, 42%)	69 (48.3%)	23 (16.1%)	1 (0.0%)	50 (3.5%)
Choosing horse feed items that come in recycled paper or plastic packaging	(n=203, 60%)	117 (57.6%)	27 (13.3%)	1 (0.0%)	58 (28.6%)

\* Within a parameters in same column mean significantly different than ref ( $P < 0.001$ )

**Table 2**  
Sustainability options respondents were willing to consider with responses categorized by size of horse yards (n=338).

Sustainability options	Responses All yards (n=338)	Small yard (65.9%, n=223) (ref)	Medium yard (30.5%, n=103)	Large yards (3.6%, n=12)
Providing horses rotational grazing system	(n= 142, 42%)	66 (29%)	72 (70%)*	4 (33%)
Using organically produced roughage to feed horses	(n=180, 53%)	94 (42%)	82 (80%)*	4 (33%)
Feeding horses with organic grains or muesli	(n=191, 57%)	107 (48% <sup>a</sup> )	80 (78%)*	4 (33%)
Feeding horses hay rather than haylage	(n=168, 50%)	82 (37%)	83 (81%)*	3 (33%)
Stop supplying unsustainable soy products to horses	(n=169, 50%)	112 (50%)	87 (85%)*	4 (33%)
Feeding horses with corn oil or safflower oil	(n=143, 42%)	72 (32%)	68 (66%)*	3(25%)
Choosing horse feed items that come in recycled paper or plastic packaging	(n=203, 60%)	112 (50%)	87 (85%)*	4 (33%)

\* Within a parameters in same row mean significantly different than ref ( $P < 0.001$ )

sized yards.

#### 4. Discussion

The majority of participants within the Dutch equestrian sector reported some consideration and concern for sustainability within their equine enterprise, which reflects anecdotal observations and contemporary surveys of other agriculture sectors (8). The choice of low environmental impact as the most frequently identified theme for sustainability indicates that for the majority of respondents, sustainability represents a holistic overarching consideration of many aspects of horse feeding and management. A holistic environmental frame of reference for sustainability is often the context utilized within the media which may have influenced this result. For industry participants environmental impact, particularly with respect to the immediate actions involving horse husbandry may be easier to conceptualize and potentially moderate than aspects of the feed supply and production, which many are not directly involved in as these are often sourced through a third party.

The popular choices for practices that participants were willing to change such as plastic packaging and organic feed supply may reflect criteria or variables that are easily quantified, already have viable options within the marketplace and thus can be implemented without major changes in management of the horse(s). In contrast, rotational grazing systems consistently ranked low, or lowest, possibly reflecting limited capacity for change due to footprint of the yard (limited grazing area relative to horse numbers), which may be influenced by yard size and activity. Small and large facilities may face difficulties in implementing various systems for pasture turnout and pasture rotation. The high percentage of medium-sized yards willing to investigate changes in pasture system was surprising, though the survey did not reveal what the scope of these changes would or could be.

In conclusion, improving the horse owner's level of knowledge and education are essential because horse feeding has an impact on both the horse's health and the environment. With many feedstuffs (forage and concentrates) sourced from outside the yard, horse keepers in the Netherlands have limited opportunity to directly influence the production process of many feedstuffs. This limits much of the change in the sustainability of the equine industry to the "green dollar." To be effective, clear information and metrics for a variety of forages and feedstuffs must be provided so that horse owners can make informed decisions while feeding their horses a balanced diet.

It is often difficult to elucidate the true motivations for why some categories were more willing to change certain feeding practices in surveys. Prior to policy implementation, economic and operational constraints that may limit or be barriers to a yards' ability to change should be examined.

#### Ethical statement

There are no human/animal subjects in the article and informed consent is not applicable.

#### Funding

This work was supported by The SIA Directorate, the Netherlands Organization for Scientific Research (NWO), Taskforce for Applied Research between January 2022-2024.

#### Declaration of Competing Interest

The authors whose names are listed immediately below certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony

or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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