

Rearing goat kids away from their dams 2. Understanding farmers' views on changing management practices

Article

Published Version

Creative Commons: Attribution 4.0 (CC-BY)

Open Access

Vickery, H. M. ORCID: <https://orcid.org/0000-0001-7533-1136>,
Neal, R. A. ORCID: <https://orcid.org/0000-0001-5017-7283>
and Meagher, R. K. (2022) Rearing goat kids away from their
dams 2. Understanding farmers' views on changing
management practices. *Animal*, 16 (6). 100548. ISSN 1751-
7311 doi: 10.1016/j.animal.2022.100548 Available at
<https://centaur.reading.ac.uk/105518/>

It is advisable to refer to the publisher's version if you intend to cite from the work. See [Guidance on citing](#).

To link to this article DOI: <http://dx.doi.org/10.1016/j.animal.2022.100548>

Publisher: Elsevier

All outputs in CentAUR are protected by Intellectual Property Rights law, including copyright law. Copyright and IPR is retained by the creators or other copyright holders. Terms and conditions for use of this material are defined in the [End User Agreement](#).

www.reading.ac.uk/centaur

CentAUR

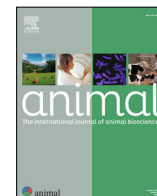
Central Archive at the University of Reading

Reading's research outputs online



Animal

The international journal of animal biosciences



Rearing goat kids away from their dams 2. Understanding farmers' views on changing management practices

H.M. Vickery^{a,*}, R.A. Neal^a, R.K. Meagher^b

^a Department of Animal Sciences, University of Reading, Reading, UK

^b Department of Animal Science and Aquaculture, University of Dalhousie, Truro, Nova Scotia, Canada



ARTICLE INFO

Article history:

Received 29 December 2021

Revised 22 April 2022

Accepted 25 April 2022

Keywords:

Attitudes

Behaviour change

Enrichment

Weaning

Welfare

ABSTRACT

Improving animal welfare is an important aim of livestock industries and is dependent on human management. Understanding attitudes to change and perceived barriers is therefore a key consideration for welfare scientists. A survey that aimed to investigate farmers' attitudes towards changing goat kid-rearing practices was distributed. Likert scales examined willingness to change and the importance of factors in decision-making alongside open-text responses for further explanation. A total of 242 farmers (United States of America (USA) 72; United Kingdom (UK) 71; Australia 33; Canada 23; New Zealand 20; European Union 14; Other 9) rearing goat kids away from their dams responded. All respondents rated from one (highly unwilling) to seven (highly willing), how willing they would be to supply three enrichment types. Willingness to provide enrichments differed ($\chi^2(2) = 190.114$, $P < 0.001$), with farmers most likely to provide climbing or loose items rather than swinging items. The most common reasons cited for unwillingness to provide enrichment were related to safety (101 responses/76.5%). Those currently abruptly weaning were asked how willing they would be to use gradual weaning methods. Those abruptly weaning from *ad libitum* milk systems ($n = 47$) showed no difference in willingness to change to different gradual weaning methods; the median (Interquartile Range (IQR)) for the willingness to change to removing teats was 2 (1–4), reducing milk temperature 3 (1–5) and diluting milk 2 (1–5), with most concerns relating to feasibility. Those abruptly weaning from bottle feeding ($n = 18$) also showed no difference in willingness to change to gradual weaning methods. Median (IQR) score for willingness to change to reduced number of bottle feeds was 4 (1–7), reducing milk quantity 3 (1–6.25), and diluting milk 1 (1–5), respectively. Health concerns were the most common reason for not being willing to change. All 242 respondents were asked to rate how important different factors are when deciding to implement a new management practice. There was a significant difference in importance between factors ($\chi^2(2) = 34.779$, $P < 0.001$). Median (IQR) importance of the factors was labour/time 5 (4–7), cost 5 (4–7), evidence beneficial to welfare 6 (5–7), evidence beneficial to health 6 (5–7), and evidence beneficial to growth 6 (4–7). To our knowledge, this is the first study to examine goat farmers' attitudes towards changing management practices and could help ensure that future research addresses farmer concerns and therefore has the best opportunity to be implemented on-farm.

© 2022 The Authors. Published by Elsevier B.V. on behalf of The Animal Consortium. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

Implications

This survey provides new insight into farmers' willingness to adopt, and concerns regarding, new management practices. Farmers were most willing to supply loose items as enrichment and safety was a key concern when it came to supplying enrichment. Willingness to use gradual weaning methods was low, with concerns related to feasibility and kid health; research is needed to address these. Practical considerations influenced decision-

making, and the authors suggest that this be factored into research aiming to be disseminated for use on-farm. This information can help ensure research aimed at improving goat welfare is relevant and impactful.

Introduction

Whilst the improvement of animal welfare involves many stakeholders within the agricultural and food industries, farmers, as the caregivers responsible for day-to-day husbandry of animals, have a large influence over animal welfare, health, and productivity (Boivin et al., 2003; Hemsworth, 2003). Implementing change

* Corresponding author.

E-mail address: h.m.vickery@reading.ac.uk (H.M. Vickery).

relies on best-practice research being adopted on-farm, and whilst farmers perceive actions to improve welfare as important, they often find them difficult to implement (Kauppinen et al., 2010). Therefore, to have the largest impact, it is essential that research is targeted and feasible for application. As farmers implement husbandry and management practices daily, understanding their willingness to change current management and their reasoning could help ensure this.

Consumer concern is often directed towards separating young animals from their dams and the subsequent artificial rearing period (Hötzel et al., 2017); a common practice in the dairy goat industry (Anzuino et al., 2019). Kids can be reared artificially in other systems for multiple reasons, including low milk yield caused by mastitis, dam rejection, and litter size greater than two. The milk-feeding stage and weaning transition are a high-risk period for young ruminants (Todd et al., 2019), yet despite the global popularity of goats, there is little information about the systems used to rear goat kids away from their dams.

The early-life environment is particularly important to future development, evidence suggests that animals reared in constant, non-demanding environments can later show reduced behavioural flexibility (Price, 1999), whereas providing species-appropriate enrichment can promote behavioural flexibility (Clemenson et al., 2015). As many goat kid-rearing environments can be constant and barren for reasons of hygiene and practicality, providing species-appropriate enrichment seems an important consideration. Zobel and Nawroth (2020) suggest that enriched environments resulting in increased behavioural flexibility could help individuals better cope with management-related stressors. This appears relevant during the weaning transition when kids are expected to cope with large changes to their feeding regimes, often alongside changes to their social and physical environment.

Under natural conditions, goat kids are weaned from milk between 84 and 168 days of age (Collias, 1956). However, in commercial situations, they are weaned from milk younger (20/29 farmers aiming for 42–56 days of age in the United Kingdom (UK); Anzuino et al., 2019) and over a reduced timeframe without dam cues that cause a gradual reduction in milk intake alongside increased solid feed intake. This weaning transition is a stressful experience for goat kids, evidenced by reduced growth rates (Newberry and Swanson, 2008) and development of oral stereotypies (Atasoglu et al., 2008). Many calf studies evidence how gradual weaning (the stepwise removal of milk) has benefits over abrupt weaning (the sudden and complete removal of milk) including earlier solid feed intake (Scoley et al., 2019), higher growth rates (Weary et al., 2008), and increased gastrointestinal tract adaptation (Steele et al., 2017). Whilst gradual weaning research is extensive for calves, this literature focuses on individualised methods that rely on technology (such as computerised feeders that step-down individual milk allowance) not currently utilised on goat farms, and therefore, currently has limited applicability. The gradual weaning strategies proposed within this survey were designed to be possible in low-tech systems.

This paper presents information collected by the second part of a survey, where the first part detailed existing management practices used to rear goat kids away from their dams (Vickery et al., 2022). This survey was designed to obtain open-text discussion of Likert-scale answers so a greater degree of detail on farmers' opinions could be collected to enable an informed approach to future research. The overall aim was to investigate farmers' attitudes towards changing their current kid-rearing practices, in order to identify common reasons underlying their views and ascertain the importance of factors to the uptake of new strategies and what barriers may prevent this.

Material and methods

Ethical approval was granted by the University of Reading, School of Agriculture, Policy and Development (reference number 001095) and Dalhousie University (reference number 2019-4934).

Questionnaire

A two-section anonymous questionnaire was designed. The first section collected information on farm characteristics and current management practices which are presented in Vickery et al. (2022). The second section is the focus of this paper and investigated farmers' attitudes towards changing management practices. Seven-point Likert scales asked farmers to indicate their willingness to change to new weaning methods, provide environmental enrichment, and the importance of various factors to their decisions to implement new strategies (Supplementary material S1). Optional open-text responses allowed farmers the opportunity to elaborate on their score.

The entire two-section survey was designed to be completed from memory within 10 min; routing directed respondents to sections specific to their current management practices. For example, the Likert-scale questions on changing to gradual weaning strategies were only answered by those currently abruptly weaning, and respondents were directed to separate questions; one for those using *ad libitum* milk-feeding systems and one for those bottle feeding. After piloting the survey on five farmers, minor changes were made to question format. Dutch and French translations were created and checked for accuracy by back translation and discussion with native speakers.

Participation criteria and recruitment

To participate, respondents had to be raising goat kids away from their dams and only submit one response per farm. Due to the primary researcher being based in the UK, paper copies were distributed at the Milking Goat Association open day (September 2019), Goat Veterinary Society conference (October 2019), and the Dairy, Sheep and Goat Conference (January 2020). Further in-person distribution was not possible during the remaining recruitment period due to Covid-19. An electronic version (translations available in French and Dutch) was distributed via the researchers' social media accounts and emailed to relevant organisations (including the International Goat Association, regional goat societies and veterinary services) for further distribution from September 2019 to June 2020. No promotions were paid for, and no incentive (financial or otherwise) was offered to participants.

The survey expected to receive the highest proportion from the UK and the United States of America (USA) as these areas are predominantly English speaking and have a greater level of organisation into associations/groups, and the researchers' social networks were based predominantly in the UK and North America, which could have impacted responses received. However, the survey welcomed a wide range of participants from geographical areas with commercial farms in order to identify common themes across goat keepers. The translations were created to assist in receiving more responses across North America and Europe.

Thematic analysis

All responses were collated and coded in Microsoft Excel. The thematic qualitative analysis of open-text responses (Braun and Clarke, 2006) was used to group the responses based on their content in order to identify patterns of meaning. If a response fit into more than one theme, it was counted within both categories. The

number of comments within each theme was presented to allow for quantitative comparisons of the frequency of that opinion. Direct quotes presented were lightly edited for spelling and grammar.

Statistical analysis

Statistical analysis was conducted in IBM SPSS (version 25; SPSS Inc., Chicago, IL, USA). Most results are presented as simple summary statistics. The Friedman test procedure was used to look for significant differences between the options in each of the four Likert-scale questions. Posthoc analysis with Wilcoxon signed-rank tests with a Bonferroni correction applied was then used to examine where differences occurred.

Results

Survey exclusions and response

Three paper and five online responses were excluded due to incomplete responses, dam-reared kids, or incorrect species. After removals, 14 paper copies were used, 212 responses from 16 countries were collected from the English online version, the Dutch translation received one response (from The Netherlands), and the French version gained 15 responses (eight from France, seven from Canada), giving an overall total of 242 surveys included in the analysis. These responses were from the USA (72), UK (71), Australia (33), Canada (23), New Zealand (20), the European Union (14), and 'Other countries' (9) which included South Africa (2), Thailand, Nigeria, Indonesia, Guatemala, Iran, Jamaica and Portugal. Farms rearing less than 100 kids per year were overrepresented – making up 74% of the responses (180/242 farms). Further detail regarding system characteristics can be found in Vickery et al. (2022).

Changing management practices – Gradual weaning

Gradual weaning from ad libitum systems

All respondents were asked how willing they would be to change to three different gradual weaning methods, one respondent answered the wrong section and was therefore excluded, giving a total of 47 responses. There was no significant difference in willingness to change to different proposed gradual weaning methods (Table 1). Where respondents were given the opportunity to explain their rating in open text, seven felt that their abrupt weaning system worked well and therefore did not feel the need to change. Nine responses mentioned that changes at a machine level were not possible as one machine fed multiple pens of kids of different ages that would not be ready to wean at the same time, such as: *"We have different age range of kids on the milk machine. It wouldn't be possible to reduce temperature or decrease milk powder without affecting younger kids"* (Respondent 1).

Feasibility concerns were mentioned by eight, including the ability to get staff to change routine, time needed, and machine limitations (such as an inability to change milk temperature and powder ratios). Health concerns were mentioned by seven; of those, five were concerned that milk teat removal would cause issues related to gorging and competition once milk access was returned. For example, they stated, *"When kids are deprived of milk for a certain period, they force-feed themselves afterwards and bloat problems appear"* (Respondent 2).

Concerns about scouring and weight loss with a powder ratio change were mentioned by two; *"Watering it down results in malnourishment and bloating – the kids cannot get the nutrition they require... and just keep on drinking. This leads to bloat and death"*

(Respondent 3), and one fed whole milk so was unable to change powder ratios.

Gradual weaning from bottle feeding

All respondents currently abruptly weaning from bottle feeding were asked to rate how willing they would be to change to different gradual weaning methods, one respondent answered the wrong section and was therefore excluded, leaving a total of 18 responses. There was no significant difference in willingness to change to different gradual weaning methods (Table 1). Respondents were given the opportunity to explain their rating, and common themes were identified. Health-related reasons were stated by four including that *"abrupt weaning gives less chance of bloat"* (Respondent 4), and the other three specifically mentioned milk dilution; *"I would never decrease the ratio of milk powder to water because feeding a kid too much water from a bottle can cause death. I'd only reduce the ratio in a young kid who has stomach upset from powder overload. Never in a healthy kid"* (Respondent 5). Six respondents felt their current abrupt weaning system worked well and expressed not seeing any reason to change such as: *"It is simply delaying the inevitable and prolonging stress"* (Respondent 6).

Environmental enrichment

All 242 respondents were asked to rate how willing they would be to supply different types of enrichment, there was a difference in willingness to provide enrichment depending on the type (Table 1). Respondents were given the opportunity to explain their score, and 132 open-text responses were collected and thematically analysed (Table 2); safety was the main concern, particularly around hanging objects.

Barriers to uptake

All 242 respondents rated how important different factors were to them when deciding whether to implement a new management practice, and there were significant differences between the importance of different factors (Table 3). Respondents were given the option to make further comments on barriers to uptake of new practices; 16 chose to write a response. Issues related to feasibility and practicality were stated by four, *"Farmers are practical. They have to be. If changing a practice has benefit in the long run and has some backing to it, most will entertain the thought. But whatever the suggestion is, it must be practical"* (Respondent 7). Economic considerations were mentioned by a further four, *"Inputs need to be justified by output... a lot of the scientific reports on welfare are unquantifiable so not relevant"* (Respondent 8), and *"The cost of milk replacer continues to rise... I feel I have to compromise because of cost"* (Respondent 9). Four respondents felt that a lack of research is a barrier; *"We will implement anything that benefits the kids – but we don't have much info on what to change!"* (Respondent 10). Three responses stated that they preferred anecdotal/trial and error experience over scientific research; and *"Performance is key, tend to rely on experience rather than scientific evidence"* (Respondent 11). Additionally, one response explained how Johne's disease control impacted their ability to change management.

Discussion

This is the first study to use qualitative techniques to attempt to understand goat farmers' perspectives on changing management, providing valuable insight but with the recognised limitations of an anonymous recall-based survey approach. The survey received more responses from certain geographical areas. This is likely in part due to these regions being predominantly Englishspeaking,

Table 1

Results from Friedman tests of Likert-scale (1 – highly unwilling, 4 – neither willing nor unwilling, 7 – highly willing) responses to questions with posthoc Wilcoxon signed-rank tests of how willing farmers are to change management practices of goat kids reared artificially ($n = 242$).

	Likert-scale							Median (IQR ¹)	χ^2	P
	1	2	3	4	5	6	7			
How willing would you be to change to the following gradual weaning methods from an ad libitum milk feeder (n = 48)?										
Decrease the ratio of milk powder to water	20	5	2	4	8	4	4	2	2.687	0.261
Reduce milk temperature to cold	18	5	2	8	4	2	8	(1–5) 3		
Remove <i>ad lib.</i> teats for a set period of hours per day	19	6	4	11	4	2	1	(1–5) 2		
								(1–4)		
How willing would you be to change to the following gradual weaning methods from bottle feeding (n = 18)?										
Decrease the ratio of milk powder to water	11	1	0	1	2	0	3	1	5.515	0.630
Reduce the quantity of milk in each feed	7	1	3	2	0	1	4	(1–5) 3		
Reduce the number of bottle feeds per day	5	2	1	2	2	1	5	(1–6.25) 4		
								(1–7)		
How willing would you be to supply the following enrichment items (n = 242)?										
Loose items in the pen	23	16	8	37	31	16	111	6 ^a	190.114	<0.001
Swinging items	106	12	12	32	16	14	50	(4–7) 3 ^b		
An object that allows the kids to climb on top of it	21	6	5	14	13	14	169	(1–6) 7 ^c		
								(6–7)		

¹ IQR = Interquartile Range.

^{a,b,c,d} Values within a row with different superscripts differ significantly at $P < 0.01$.

thus able to complete the English survey and more likely to be reached by the researchers' social networks; they may also have greater organisation into groups/associations that enabled more efficient survey distribution. Responses were skewed towards greater representation of smaller farms and likely represent a diverse range of management practices, as explored in the first part of this survey (Vickery et al., 2022). Despite diversity in both geography and husbandry, common themes were identified, suggesting that they prevail across a heterogeneous sample and are likely to be relevant to a wide range of goat keepers. However, it is acknowledged the responses received may not be typical of all goat keepers, and those willing to participate in a voluntary survey could have biased views. Some farmers chose not to leave detailed open-text responses, and we recognise that alternative tools such as in-depth interviews would have enabled deeper investigation and coverage of more factors influencing practice, but may not have reached the same breadth of farmers. Whilst both broader and deeper methods of exploring farmers' views would enable greater understanding of influencing factors such as farm type, productivity drivers and sociodemographic variables, the Likert responses and open-text comments collected in our study provide a useful starting point in this novel area and are explored throughout the rest of this discussion.

Gradual weaning

Weaning animals from artificial milk supply systems is stressful and can cause reduced growth (Newberry and Swanson, 2008), increased vocalisations (Budzynska and Weary, 2008) and the development of stereotypies (Atasoglu et al., 2008). Calf studies indicate that gradual weaning can mitigate these detrimental

impacts (Scoley et al., 2019; Weary et al., 2008), yet within the goat industry, large farms (>100 kids) feeding milk *ad libitum* are most likely to wean abruptly (Vickery et al., 2022), possibly due to a lack of feasible group-level gradual weaning methods. Indeed, our survey found that those currently abruptly weaning from *ad libitum* systems had concerns relating to feasibility, particularly around the ability to wean on a penlevel. Concerns were expressed that *ad libitum* milk-feeding machines with limited technical capabilities (beyond mixing milk and maintaining temperature) feed multiple pens of kids of different ages. Therefore, machine-level changes, such as reduction in milk temperature or dilution, would affect all kids being fed – when they may not be ready for weaning over the same timeframe. We propose that for recommendations to be feasible for use on goat farms feeding milk *ad libitum*, they should be targeted at pen-level strategies.

Other strategies to attenuate postweaning stress could include the use of social facilitation with the addition of older animals and positive human contact (higher weight gains and lower cortisol in lambs; Pascual-Alonso et al., 2015; reducing abnormal behaviours, cortisol and encouraging positive social behaviours in foals; Henry et al., 2012). This survey considered only physical methods of weaning from milk that are relevant to many production systems; however, future research could consider social strategies and the feasibility of implementing them.

There was consistent unwillingness among those surveyed to adopt all three proposed gradual weaning strategies, but respondents explained concerns specific to removing *ad libitum* teats, and how this could cause gorging and subsequent bloat when milk access is reinstated, as well as injuries related to increased competitive interactions due to the provision of one teat to multiple kids. No literature could be found to address these concerns, and there-

Table 2

Thematic analysis of 132 comments received in response to asking participants why they were unwilling to provide enrichment to artificially reared goat kids.

Theme of free-text comments	n (%) for theme	Example quotes from theme
Safety	101 (76.5) ¹	<p>"Why let them hang themselves after all the bloody hard work or having to set limbs cos they broke a leg in the hay net" (Respondent 12)</p> <p>"I consider hay nets extremely high risk for goats, and even a hanging ball etc has the potential for the rope/chain it is hanging from to wrap around a kid's neck and strangle it." (Respondent 13)</p> <p>"Our goats make a determined effort to find inventive ways to kill or injure themselves. ... Adding new ways for them to injure themselves/destroy more fencing and feeders etc isn't very appealing" (Respondent 14)</p> <p>"Baby goats and a net makes me think of legs caught in the net-been there, done that, got the \$450 vet bill to prove it" (Respondent 15)</p>
Feasibility	9 (6.8)	<p>"Bulk object complicates litter management" (Respondent 2)</p> <p>"I don't have the ability to safely install a hanging item" (Respondent 16)</p>
Provided before but not used	9 (6.8)	<p>"I've tried the ball and hanging ball idea and it never really did anything for them" (Respondent 17)</p> <p>"We have previously put a loose ball in the pen for the kids to play with and they took no interest" (Respondent 1)</p>
Future behavioural issues	6 (2.5)	<p>"Hanging items teach a goat to rear and jump - which can make it difficult to manage the behaviour of that animal in the future" (Respondent 7)</p> <p>"Swinging items encourage head butting random things including yourself. Table being so high can encourage jumping fences" (Respondent 18)</p> <p>"Experience has shown me that with play structures, they develop reflexes to jump outside the pens" (Respondent 19)</p>
Hygiene	5 (2.1)	<p>"It can be very difficult to thoroughly clean/sanitize these items, therefore increasing disease in our pens" (Respondent 20)</p>
Not necessary	2 (0.8)	<p>"Not necessary" (Respondent 21)</p>

¹ Of these responses, 53 specifically mentioned that hanging nets are of high safety concern.

fore, understanding feeding competition and milk intake relating to removing and replacing *ad libitum* milk access needs investigation. Similar views were expressed by those who bottle feed, including the statement that abrupt weaning gives less chance of bloat; a common concern expressed in personal communication with farmers, yet no literature can be found to support this belief. This highlights the importance of understanding why farmers are concerned about potential strategies, to be able to perform

research which clearly addresses these and improves the likelihood of adoption of new practices. Perceived negative impact on animal health appears to be a major barrier to adoption and is therefore a high priority for future work.

Environmental enrichment

Environmental enrichment is widely used with the aim of improving captive animal welfare (Newberry, 1995), and there is copious evidence from other species that enrichment improves welfare (farm animal review: Bolt and George, 2019). Effective enrichment must be biologically appropriate (Newberry, 1995) and should consider the species' natural ethology. Wild goats inhabit terrains of varying elevations (Parrini et al., 2003), and are both browsers and grazers (Goetsch et al., 2010), that spend time browsing bipedally (Sanon et al., 2007), therefore providing enrichment that enables goat kids to exhibit a behavioural repertoire including climbing, hiding, and browsing within captive conditions could improve welfare. To choose effective enrichment provisions, preference tests can help to identify species-specific characteristics of preferred items (Mench, 1998); whilst these have limitations, they can form a useful basis for decisions, yet none have been conducted for goats. Caution should be taken to ensure items are not chosen anthropomorphically which can result in ineffective provisions and could be the reason for comments saying kids had not used enrichment, indeed Van de Weerd et al. (2003) advise using behavioural observations to identify efficacious enrichment and ensure choosing on an intuitive basis is avoided. Further research to identify valuable enrichment for goat kids would be useful; whilst Rosas-Trigueros et al. (2017) found that kids enriched with sacks of henequen, trunks, tyres and coconuts had lower stress levels and recommended the use of environmental enrichment, the items were not assessed individually, and it is unclear which were most valued.

Even when enrichment has been validated, habituation remains a challenge around its long-term effectiveness (reviewed by Tarou and Bashaw, 2007), particularly for simple inanimate objects, which are often the most feasible addition and the focus of our survey. Habituation may be age-related, and whilst age difference effects have been scarcely studied in farm animals, they have been observed in pandas (Swaigood et al. 2001) and chimpanzees (Lambeth and Bloomsmith, 1992). There may be greater intrinsic reinforcement for play in juveniles (Fagen, 1981) which could explain differences in enrichment effectiveness between age groups, with young animals habituating more slowly. Communication to farmers around rotating enrichment items could combat habituation (evidenced in other species; Renner et al., 2000), and strategies to ensure enrichment is engaging long-term should be an important consideration for future research.

Zobel and Nawroth (2020) suggest that food provision enrichments could be biologically relevant, and in adult goats raised feeding surfaces increase intakes and appear to be valued (as

Table 3

Results from Friedman tests of a Likert-scale (1 – highly unimportant, 4 – neither unimportant nor important, 7 – highly important) question with posthoc Wilcoxon signed-rank tests of how important factors are to farmers rearing goat kids artificially when deciding whether to implement a new management practice (n = 242).

	Likert-scale							Median (IQR1)	χ^2	P
	1	2	3	4	5	6	7			
Evidence that it will benefit growth rates	14	7	10	30	30	52	99	6 ^a (4–7)	34.779	<0.001
Evidence that it will benefit health	15	5	10	19	25	57	111	6 ^b (5–7)		
Evidence that it will benefit welfare	14	8	10	21	38	56	95	6 ^{ac} (5–7)		
Cost required	15	10	10	36	61	38	72	5 ^d (4–7)		
Labour and time required	23	14	6	39	49	35	76	5 ^{ad} (4–7)		

a,b,c,d Values within a row with different superscripts differ significantly at $P < 0.01$.

¹ IQR = Interquartile Range.

inferred by it increasing the frequency of competitive interactions; Neave et al., 2018). Therefore, an example given in the survey for 'swinging items' was haynets – a common provision for many animals. This prompted a significant number of strong responses (Table 1) regarding concerns over safety. Zobel and Nawroth (2020) suggest that farmers' concerns could stem from goats lacking early-life experience (particularly with climbing structures) leading to problems when they are introduced and suggest that providing early-life enrichment is instrumental to goats being able to safely utilise enrichment later. Safety concerns may be addressed by allowing access to simple structures from a young age to increase spatial awareness and ability to safely navigate structures, and this needs to be communicated to farmers. It is essential that any enrichment suggested has been trialled and monitored for effectiveness and safety, in order to be able to effectively alleviate farmer concerns and therefore reduce a barrier to providing it. Some respondents expressed concern regarding enrichment encouraging future behavioural issues, such as head-butting and escaping from enclosures, a concern noted by Zobel and Nawroth (2020) who suggest that providing increased environmental complexity and variability would reduce boredom (a welfare concern; Meagher, 2019), and dissuade mischievous behaviour. Whilst no research has investigated this, Miranda-de-la-Lama et al. (2013) found that adult goats in enriched environments stayed on average one metre further away from humans which could be of concern to farmers. However, the same study also found that unenriched animals took longer to be caught, so the implications are unclear.

With little peer-reviewed research investigating enrichment for goat kids during the milk-feeding period, there is limited evidence with which to persuade caregivers of the benefits enrichment can provide. As enrichment is beneficial to many farm animal species (reviewed by Bolt and George, 2019), and in limited goat kid studies has been evidenced as providing growth benefits (Flint and Murray, 2001), increasing behavioural repertoires (Tolu et al., 2017), and reducing stress (Rosas-Trigueros et al. (2017)), there is a need for further research to identify suitable enrichment items. Whilst enrichment provisions could include the addition of older or suckler animals, for the purposes of this survey, the focus was on inert strategies that could be easily utilised within many systems. Research aiming to investigate specific provisions for goat kids in order to recommend safe and efficacious species-specific enrichment that improves overall welfare would be warranted. However, even in species where extensive research evidencing benefits exists, poor industry implementation remains (pigs; Van de Weerd and Ison, 2019) so improved communication with farmers remains an essential consideration.

Barriers to uptake

It has been proposed that whilst farmers see animal welfare as important, they struggle to implement changes to improve it (Kauppinen et al., 2010), a finding supported by this survey. It has also been suggested that farmers link 'welfare' to issues of basic husbandry (physical health, access to food and water) and factors important to optimising production (Te Velde et al., 2002). Anzuino et al. (2019) highlighted that farmers felt that kid health research was of key importance, a finding supported by our results, but farmers may need training on broader animal welfare concepts, in order to accurately give their perceptions.

In our study, some farmers expressed that they saw no need to use gradual weaning as their methods seemed to work, similar to Te Velde et al. (2002) who reported that farmers consistently believed that their livestock had no welfare issues. Research shows

that if farmers cannot be convinced that there will be tangible benefits, then changes are unlikely to occur (reviewed by Rose et al., 2018). This evidence illustrates the need for research to demonstrate potential for improvements. For example, Sumner et al. (2018) concluded that providing dairy cow farmers with access to data that could be used to judge their success (benchmarking) could promote and inform management changes.

It was suggested in a DEFRA (Department for Environment, Food and Rural Affairs) commissioned review (UK) that farmers should be involved (participatory engagement) in planning research to ensure that resulting findings are feasible and have the greatest potential of adoption (Rose et al., 2018). We agree, and believe it would be advisable that future research considers farmers' perspectives beforehand, and that findings quantify a range of possible incentives including kid health, cost and labour analyses. Yet even when research is available, many farmers feel that academic research does not reflect real-world conditions and is therefore not applicable to them (Alarcon et al., 2014), and whilst early-stage participatory engagement could help mitigate this, there are also farmers who stated a preference for anecdotal evidence. Wood et al. (2014) found that farmers value knowledge that is practice-based and that their learning often comes from personalised, local exchanges. A review by Blackstock et al. (2010) suggested that for farmers to consider a change, they must be persuaded that there is a problem, and that their actions could solve it – highlighting the importance of communicating research to farmers in order to address these steps and create on-farm change.

Underlying perceptions that impact farmers' behaviours are often overlooked when considering how management practices are utilised (Blackstock et al., 2010) and our study is the first to attempt to address this for goat kids. Our findings suggest that farmers are particularly concerned about kid health and survival, given several responses focused on avoidance of bloat, and the safety of enrichment items, however, practical considerations are crucial to feasibility. Overall, we suggest that more evidence is needed to guide farmers' management decisions, and research should aim to provide clear, practical information that enables them to make well-informed decisions about animal management. However, a low number of respondents provided open-text responses regarding barriers to uptake, possibly due to survey fatigue as it was the last survey question, so these responses must be considered cautiously as they may not be reflective of all goat farmers.

Results from Rehman et al. (2007) reinforce the importance of attitudes in the successful adoption of new technology and showed how knowledge transfer needs to consider opinions of potential adopters. In-person qualitative interviews may be beneficial to further uncovering farmer's attitudes towards management changes and could be used to identify links with sociodemographic and farm characteristics, however, this carries a greater risk of biasing answers, whereas the anonymity of this online survey should have resulted in honesty. Whilst information sources are crucial to the uptake of good practices, farmers often have difficulty accessing and understanding scientific findings (Alarcon et al., 2014), therefore, to improve goat kid welfare, successful dissemination of knowledge must be considered and planned. This could include open-access research articles and the involvement of influential stakeholders such as vets and agricultural extension/farmer education experts, as demonstrated by Atkinson et al. (2017) who found that involving producers and veterinarians in a benchmarking programme improved calf welfare outcomes. The results of this survey (highlighting areas important to farmers when deciding whether to implement a change) should be considered when research into goat kid management is being planned.

Conclusion

This novel survey highlights a need for more research in key areas that aim to address the identified common concerns of farmers raising goat kids, and ultimately provide improved communication with farmers, in order to progress towards improved goat kid welfare. Kid safety and health were concerns shared by many respondents with regard to environmental enrichment, and gradual weaning strategies and should be a priority for future research. Farmers need further information on enrichment in order to be persuaded that safe enrichment with clear benefits can be provided to young goat kids. Feasibility was a common theme found in farmers' responses across all parts of the survey, concerns over not implementing gradual weaning related to being able to apply the strategy. Therefore, it is recommended that feasibility be considered when planning research and that economic considerations should be included as an output of future projects, in order to provide findings that have the greatest chance of being utilised. This examination of goat farmers' attitudes towards changing kid-rearing management practices can help target future research based on farmer concerns and therefore increase the likelihood it will be implemented on-farm. Whilst further research with methodologies which enable in-depth analysis of farmer attitudes and consider more sociodemographic, production and farm size factors would be beneficial, this study provides a key initial insight.

Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.animal.2022.100548>.

Ethics approval

Ethical approval was granted by the University of Reading, School of Agriculture, Policy and Development (reference number 001095) and Dalhousie University (reference number 2019–4934).

Data and model availability statement

None of the data were deposited in an official repository; however, the data that support the study findings are available from the authors upon request.

Author ORCIDs

H.M. Vickery: <https://orcid.org/0000-0001-7533-1136>

R.A. Neal: <https://orcid.org/0000-0001-5017-7283>

R.K. Meagher: <https://orcid.org/0000-0002-6576-8155>

Author contributions

Holly Vickery: Conceptualization, Methodology, Investigation, Writing- Original draft preparation, Formal analysis.

Rachael Neal: Conceptualization, Methodology, Supervision, Writing – Review & Editing.

Rebecca Meagher: Conceptualization, Methodology, Supervision, Writing – Review & Editing.

Declaration of interest

The authors declare that there is no conflict of interest.

Acknowledgements

Thanks go to Annie Pritchard, Juliette Schillings, Dorit Albertson, Bas Rodenburg, Michal Korenar, Anne-Marieke Smid, Wouter Eilers and Jamie Ahloy Dallaire for assisting with survey translations. Thanks also to the Milking Goat Association, Goat Veterinary Society and the Dairy, Sheep and Goat Conference for distributing paper copies. Finally, our gratitude goes to everyone who shared the online survey, and especially to every farmer who kindly took the time to answer it.

Financial support statement

Financial support was provided by the School of Agriculture, Policy and Development, University of Reading, and the West Country Dairy Awards (Charity no. 306598).

References

- Alarcon, P., Wieland, B., Mateus, A.L.P., Dewberry, C., 2014. Pig farmers' perceptions, attitudes, influences and management of information in the decision-making process for disease control. *Preventive Veterinary Medicine* 116, 223–242. <https://doi.org/10.1016/j.prevetmed.2013.08.004>.
- Anzuino, K., Knowles, T.G., Lee, M.R.F., Grogono-Thomas, R., 2019. Survey of husbandry and health on UK commercial dairy goat farms. *Veterinary Record* 185, 267. <https://doi.org/10.1136/vr.105274>.
- Atasoglu, C., Yurtman, I.Y., Savas, T., Gültepe, M., Özcan, Ö., 2008. Effect of weaning on behavior and serum parameters in dairy goat kids. *Animal Science Journal* 79, 435–442. <https://doi.org/10.1111/j.1740-0929.2008.00547>.
- Atkinson, D.J., von Keyserlingk, M.A.G., Weary, D.M., 2017. Benchmarking passive transfer of immunity and growth in dairy calves. *Journal of Dairy Science* 100, 3773–3782. <https://doi.org/10.3168/jds.2016-11800>.
- Blackstock, K.L., Ingram, J., Burton, R., Brown, K.M., Slee, B., 2010. Understanding and influencing behaviour change by farmers to improve water quality. *Science of The Total Environment* 408, 5631–5638. <https://doi.org/10.1016/j.scitotenv.2009.04.029>.
- Boivin, X., Lensink, J., Tallet, C., Veissier, I., 2003. Stockmanship and farm animal welfare. *Animal Welfare* 12, 479–492.
- Bolt, S.L., George, A.J., 2019. The use of environmental enrichment on farms benefits animal welfare and productivity. *Livestock* 24, 183–188. <https://doi.org/10.12968/live.2019.24.4.183>.
- Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology* 3, 77–101. <https://doi.org/10.1191/1478088706qp0630a>.
- Budzynska, M., Weary, D.M., 2008. Weaning distress in dairy calves: Effects of alternative weaning procedures. *Applied Animal Behaviour Science* 112, 33–39. <https://doi.org/10.1016/j.applanim.2007.08.004>.
- Clemenson, G., Deng, W., Gage, F., 2015. Environmental enrichment and neurogenesis: From mice to humans. *Current Opinion in Behavioral Sciences* 4, 56–62. <https://doi.org/10.1016/j.cobeha.2015.02.005>.
- Collias, N.E., 1956. The Analysis of Socialization in Sheep and Goats. *Ecology* 37, 228–239. <https://doi.org/10.2307/1933135>.
- Fagen, R., 1981. *Animal play behavior*. Oxford University Press, New York, NY, USA.
- Flint, M., Murray, P., 2001. Lot-fed goats – the advantages of using an enriched environment. *Australian Journal of Experimental Agriculture* 41, 473–476. <https://doi.org/10.1071/EA99119>.
- Goetsch, A.L., Gipson, T.A., Askar, A.R., Puchala, R., 2010. Invited review: feeding behavior of goats. *Journal of Animal Science* 88, 361–373. <https://doi.org/10.2527/jas.2009-2332>.
- Hemsworth, P.H., 2003. Human–animal interactions in livestock production. *Applied Animal Behaviour Science* 81, 185–198. [https://doi.org/10.1016/S0168-1591\(02\)00280-0](https://doi.org/10.1016/S0168-1591(02)00280-0).
- Henry, S., Zanella, A.J., Sankey, C., Richard-Yris, M.-A., Marko, A., Hausberger, M., 2012. Adults may be used to alleviate weaning stress in domestic foals (*Equus caballus*). *Physiology of Behaviour* 106, 428–438. <https://doi.org/10.1016/j.physbeh.2012.02.025>.
- Hötzel, M.J., Cardoso, C.S., Roslindo, A., von Keyserlingk, M.A.G., 2017. Citizens' views on the practices of zero-grazing and cow-calf separation in the dairy industry: Does providing information increase acceptability? *Journal of Dairy Science* 100, 4150–4160. <https://doi.org/10.3168/jds.2016-11933>.
- Kauppinen, T., Vainio, A., Valros, A., Rita, H., Vesala, K., 2010. Improving animal welfare: qualitative and quantitative methodology in the study of farmers' attitudes. *Animal Welfare* 19, 523–536.
- Lambeth, S.P., Bloomsmith, M.A., 1992. Mirrors as enrichment for captive chimpanzees (*Pan troglodytes*). *Laboratory Animal Science* 42, 261–266.
- Meagher, R.K., 2019. Is boredom an animal welfare concern? *Animal Welfare* 28, 21–32. <https://doi.org/10.7120/09627286.28.1.021>.

- Mench, J., 1998. Why It Is Important to Understand Animal Behavior. *ILAR Journal* 39, 20–26. <https://doi.org/10.1093/ilar.39.1.20>.
- Miranda-de la Lama, G.C., Pinal, R., Fuchs, K., Montaldo, H.H., Ducoing, A., Galindo, F., 2013. Environmental enrichment and social rank affects the fear and stress response to regular handling of dairy goats. *Journal of Veterinary Behavior* 8, 342–348. <https://doi.org/10.1016/j.jveb.2013.03.001>.
- Neave, H.W., von Keyserlingk, M.A.G., Weary, D.M., Zobel, G., 2018. Feed intake and behavior of dairy goats when offered an elevated feed bunk. *Journal of Dairy Science* 101, 3303–3310. <https://doi.org/10.3168/jds.2017-13934>.
- Newberry, R.C., 1995. Environmental enrichment: Increasing the biological relevance of captive environments. *Applied Animal Behaviour Science* 44, 229–243. [https://doi.org/10.1016/0168-1591\(95\)00616-Z](https://doi.org/10.1016/0168-1591(95)00616-Z).
- Newberry, R.C., Swanson, J.C., 2008. Implications of breaking mother–young social bonds. *Applied Animal Behaviour Science* 110, 3–23. <https://doi.org/10.1016/j.applanim.2007.03.021>.
- Parrini, F., Grignolio, S., Luccarini, S., Bassano, B., Apollonio, M., 2003. Spatial behaviour of adult male Alpine ibex *Capra ibex ibex* in the Gran Paradiso National Park, Italy. *Acta Theriologica* 48, 411–423. <https://doi.org/10.1007/BF03194179>.
- Pascual-Alonso, M., Miranda-de la Lama, G.C., Aguayo-Ulloa, L., Ezquerro, L., Villarroel, M., Marín, R.H., María, G.A., 2015. Effect of Postweaning Handling Strategies on Welfare and Productive Traits in Lambs. *Journal of Applied Animal Welfare Science* 18, 42–56. <https://doi.org/10.1080/10888705.2014.941107>.
- Price, E.O., 1999. Behavioral development in animals undergoing domestication. *Applied Animal Behaviour Science* 65, 245–271. [https://doi.org/10.1016/S0168-1591\(99\)00087-8](https://doi.org/10.1016/S0168-1591(99)00087-8).
- Rehman, T., McKemey, K., Yates, C.M., Cooke, R.J., Garforth, C.J., Tranter, R.B., Park, J. R., Dorward, P.T., 2007. Identifying and understanding factors influencing the uptake of new technologies on dairy farms in SW England using the theory of reasoned action. *Agricultural Systems* 94, 281–293. <https://doi.org/10.1016/j.agsy.2006.09.006>.
- Renner, M.J., Feiner, A.J., Orr, M.G., Delaney, B.A., 2000. Environmental Enrichment for New World Primates: Introducing Food-Irrelevant Objects and Direct and Secondary Effects. *Journal of Applied Animal Welfare Science* 3, 23–32. https://doi.org/10.1207/S15327604JAWS0301_3.
- Rosas-Trigueros, A.P., Candanosa-Aranda, I.E., Ducoing-Watty, A.E., Gutiérrez-Molotla, J., Galindo, F., Sisto-Burt, A.M., 2017. Histological differences in the adrenal glands and cortisol levels of suckling dairy goat kids in enriched and non-enriched environments. *Research in Veterinary Science* 115, 221–225. <https://doi.org/10.1016/j.rvsc.2017.05.011>.
- Rose, D.C., Keating, C., Morris, C., 2018. Understanding how to influence farmers' decision-making behaviour: a social science literature review. Report for the Agriculture and Horticulture Development Board, Warwickshire, England, UK.
- Sanon, H.O., Kaboré-Zoungrana, C., Ledin, I., 2007. Behaviour of goats, sheep and cattle and their selection of browse species on natural pasture in a Sahelian area. *Small Ruminant Research* 67, 64–74. <https://doi.org/10.1016/j.smallrumres.2005.09.025>.
- Scoley, G., Gordon, A., Morrison, S., 2019. Performance and Behavioural Responses of Group Housed Dairy Calves to Two Different Weaning Methods. *Animals* 9, 895. <https://doi.org/10.3390/ani9110895>.
- Steele, M.A., Doelman, J.H., Leal, L.N., Soberon, F., Carson, M., Metcalf, J.A., 2017. Abrupt weaning reduces postweaning growth and is associated with alterations in gastrointestinal markers of development in dairy calves fed an elevated plane of nutrition during the preweaning period. *Journal of Dairy Science* 100, 5390–5399. <https://doi.org/10.3168/jds.2016-12310>.
- Sumner, C.L., von Keyserlingk, M.A.G., Weary, D.M., 2018. How benchmarking motivates farmers to improve dairy calf management. *Journal of Dairy Science* 101, 3323–3333. <https://doi.org/10.3168/jds.2017-13596>.
- Swaigood, R.R., White, A.M., Zhou, X., Zhang, H., Zhang, G., Wei, R., Hare, V.J., Tepper, E.M., Lindburg, D.G., 2001. A quantitative assessment of the efficacy of an environmental enrichment programme for giant pandas. *Animal Behaviour* 61, 447–457. <https://doi.org/10.1006/anbe.2000.1610>.
- Tarou, L.R., Bashaw, M.J., 2007. Maximizing the effectiveness of environmental enrichment: Suggestions from the experimental analysis of behavior. *Applied Animal Behaviour Science* 102, 189–204. <https://doi.org/10.1016/j.applanim.2006.05.026>.
- Te Velde, H., Aarts, N., Van Woerkum, C., 2002. Dealing with Ambivalence: Farmers' and Consumers' Perceptions of Animal Welfare in Livestock Breeding. *Journal of Agricultural and Environmental Ethics* 15, 203–219. <https://doi.org/10.1023/A:1015012403331>.
- Todd, C.C., Bruce, B., Deeming, L., Zobel, G., 2019. Short communication: Survival of replacement kids from birth to mating on commercial dairy goat farms in New Zealand. *Journal of Dairy Science* 102, 9382–9388. <https://doi.org/10.3168/jds.2019-16264>.
- Tolu, C., Gokturk, S., Savas, T., 2017. Effects of housing environment on social isolation response, weaning stress, and immune reaction in goat kids. *Turkish Journal of Veterinary Animal Science* 41, 635–642. <https://doi.org/10.3906/vet-1612-89>.
- Van de Weerd, H., Ison, S., 2019. Providing Effective Environmental Enrichment to Pigs: How Far Have We Come? *Animals* 9, 254. <https://doi.org/10.3390/ani9050254>.
- Van de Weerd, H.A., Docking, C.M., Day, J.E.L., Avery, P.J., Edwards, S.A., 2003. A systematic approach towards developing environmental enrichment for pigs. *Applied Animal Behaviour Science* 84, 101–118. [https://doi.org/10.1016/S0168-1591\(03\)00150-3](https://doi.org/10.1016/S0168-1591(03)00150-3).
- Vickery, H.M., Neal, R.A., Meagher, R.K., 2022. Rearing goat kids away from their dams 1. A survey to understand rearing methods. *Animal*. <https://doi.org/10.1016/j.animal.2022.100547>. In this issue 100547.
- Weary, D.M., Jasper, J., Hötzel, M.J., 2008. Understanding weaning distress. *Applied Animal Behaviour Science* 110, 24–41. <https://doi.org/10.1016/j.applanim.2007.03.025>.
- Wood, B.A., Blair, H.T., Gray, D.I., Kemp, P.D., Kenyon, P.R., Morris, S.T., Sewell, A.M., 2014. Agricultural Science in the Wild: A Social Network Analysis of Farmer Knowledge Exchange. *PLOS ONE* 9, e105203. <https://doi.org/10.1371/journal.pone.0105203>.
- Zobel, G., Nawroth, C., 2020. Current state of knowledge on the cognitive capacities of goats and its potential to inform species-specific enrichment. *Small Ruminant Research* 192, 106208. <https://doi.org/10.1016/j.smallrumres.2020.106208>.