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Exploring farmers' perceptions of the value and management of dairy-bred calves in block calving dairy systems

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ABSTRACT

Policies implemented by milk buyers and the Great Britain (GB) calf strategy aim to prevent the on-farm euthanasia of healthy dairy-bred calves and align the management with that of replacement heifers. The welfare of dairy-bred calves is influenced by multiple factors, many of which are driven by management decisions that reflect the values and perceptions of farm managers and calf rearers. Workload is maximized in block calving systems wherein calves are born within a 12-week period, thus potentially exaggerating differing views on calf value. This paper explores the perceived value of dairy heifer and surplus calves in English block calving systems and investigates how this and other factors affect calf management. Participants were recruited using purposive and "snowball" sampling, yielding 38 semi-structured interviews. Interviews were audio recorded, transcribed and thematically coded. Three key themes were identified - (1) the perceived value of calves; (2) the impact of value on management and welfare; and (3) the importance of simplicity in managing a system at capacity. Overall, replacement heifer calves were perceived as highly valuable and "the future of the herd" while the perceived value of surplus calves was variable. Some farmers prioritized simplicity whereby management protocols were standardized, however others justified suboptimal management practices including feeding poorer colostrum and lower quality milk to surplus calves due to their lower value. Further research is required to assess how these attitudes and behaviors toward calf value influence health and welfare to better inform the development of future calf-focused policies.

Key words: Welfare – Beef – Surplus calf

INTRODUCTION

Great Britain's dairy industry experiences seasonal influxes of calves, with the greatest number of reported calvings to dairy dams occurring in February, March, August and September – coinciding with the calving periods of spring-, autumn- and dual-block calving dairy systems (representing 5.4%, 7.2% and 4.2% of British dairy farms respectively) (AHDB, 2025). These block calving dairy systems are defined as calving 80% of the herd within a 4-mo period (February 1st to May 31st for spring-block systems, and August 1st to November 30th for autumn-block systems), or 90% of the herd between designated spring and autumn periods (AHBD, Gooderham and Clayton, 2022). While a proportion of calves are usually reared as dairy replacement animals for the milking herd (replacement heifer calves), other categories of calf, namely dairy-beef (calves sired by beef bulls on dairy cows); dairy bull (male dairy-bred calves); and unwanted dairy-bred heifers - may be surplus to requirements in the dairy-focused farm system. These calves will hereby be referred to collectively as 'surplus calves' unless a distinction must be made between the dairy-beef (either sex), dairy bull (male) or surplus dairy heifer calf (females). It is, however, important to note that they may be retained in systems operating other cattle enterprises alongside the main dairy herd.

With the treatment of surplus calves presenting a reputational issue for the UK dairy industry, one key policy that is aligned with several milk purchaser contract conditions is the GB Dairy Calf Strategy (NFU and AHDB, 2021). The strategy outlines actions to be taken by dairy producers based upon the commitment to ensure the rearing of all dairy-bred calves and avoidance of euthanasia (NFU and AHDB, 2021). Holding contracts with approximately 30% of British dairy farmers, Arla, a major milk processor (Arla, 2022), outlines key contractual expectations of their producers, including preventing the slaughter of any healthy calves before 56 d of age (Arla, 2021). This policy is similar to that held by Fonterra, one of the predominant milk buyers in New Zealand, whose terms

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The list of standard abbreviations for JDS is available at adsa.org/jds-abbreviations-26. Nonstandard abbreviations are available in the Notes.

of supply state that healthy calves must not be euthanized on farm (Fonterra, 2025). However, whereas calves born on Arla farms may not be slaughtered before 56 d of age, calves from Fonterra farms may be processed for meat from 4 d old.

In one study of British dairy farms, 3.3 million cattle deaths between 2010 and 2019 occurred on-farm, with 27% occurring within 3 mo of birth (Hyde et al. 2020). On-farm mortality rates were found to be higher in male calves than female calves (4.32% and 3.45% respectively). Additionally, dairy calf mortality was higher than that of non-dairy (beef) calves (6.00% and 2.86% respectively). Male dairy calves suffered the highest on-farm mortality rate of 7.37%. While perceived value may not be a direct indicator of calf mortality rates, it may have an indirect impact on the management of these calves. Several studies have explored the perceived value of calves on dairy farms with replacement heifer calves being highly valued due to being associated with the future of the milking herd (e.g., Palczynski et al., 2022; Wilson et al., 2023). Calf quality was also directly attributed to earlier entry into the herd and better milking cow performance (Fruscalso et al., 2017). In the case of surplus calves, however, studies have shown their perceived value to be more variable. In a study of Irish dairy farmers, for example, 38% of participants agreed with the statement "Male dairy calves are an unwanted by-product of dairy production" (Osawe et al., 2021). While in agreement with the status of surplus calves as a by-product of dairy production, Berry (2021) also identifies their capacity for use as a tool to aid cash-flow on-farm.

In addition to the perceived market value of calves, both use and non-use values influence farmers' decision making. Use-values refer to business operations and include those affecting earnings and time management, while non-use values were more closely related to personal ethics and emotions (Hansson and Lagerkvist, 2015). Most key factors associated with dairy-bred calf mortality link back to management choices. On farms where surplus calves are reared for veal, high mortality dairy farms (wherein the supply farm had greater mortality than the rearing farm) tended to bed calves on chopped straw or woodchip as opposed to long straw, as well as tube or pail feeding colostrum rather than bottle feeding (Renaud et al., 2018). A study by Yang et al., (2015) found that timely and sufficient colostrum feeding led to better weight gain in early life while also reducing the risk of severe diarrhea and calf mortality, thus evidencing the importance of colostrum in the development and survival of neonatal calves. Cuttance et al., (2017) linked mortality to calf sex, timing within the calving period, and weather conditions, with higher mortality among male calves, those born in the first week of calving, and those born during periods of increased rainfall. While male calf mortality was hypothesized to be due to increased incidence of dystocia, mortality based on time of calving was more likely due to lack of organization and observations during the first week of calving (Cuttance et al. 2017).

While the majority of the factors mentioned affect replacement and surplus dairy calves alike, there is evidence to suggest that perceived value does contribute to a difference in management protocols between the calf cohorts. For example, 4.9% farmers in one UK study specifically described feeding milk containing antibiotic residues to surplus calves (Higham et al., 2018). In another study, the short time for which surplus calves typically remain on farm was posed as justification for the feeding of waste milk (Palcyznski et al., 2021). A study of Canadian dairy farmers suggested more valuable calves would be better cared for by farmers (Wilson et al., 2024). Furthermore, a solution to the poorer treatment of surplus calves was proposed, with buyers pricing calves based on quality care to point of sale and dropping clients producing poor calves, incentivizing an improvement in management practices. Despite this, in another study stakeholders advocated for the welfare of surplus calves based on the social implications of calf euthanasia, with fears around the effect on the social license of dairy farming (Bolton et al., 2024). As such, these studies portray a multifaceted issue and 'wicked problem' (Rittel and Webber, 1973; Bolton and von Keyserlingk, 2021), potentially affecting multiple aspects of calf welfare as well as the economic and social sustainability of dairy farming.

With the introduction of calf-focused milk policies placing the responsibility for ensuring calves are reared to at least 56 d of age, block calving herds are likely to experience increased management pressure stemming from the influx of calves during the calving period and may not have the resources to handle increased workload effectively (Ham et al., 2026). In the absence of an assured market for surplus calves, it is reasonable to expect increased workload and the likely prioritization of higher value dairy heifer calves over lower value surplus calves. Block calving dairy herds have not received enough attention in the research literature, leaving an important gap in the knowledge of calf rearing that needs to be understood, especially since they are a growing component of the British dairy sector (AHDB, 2025). This study therefore aimed to determine of the differences in management practices and key attitudes between English farmers operating either autumn- or spring-block calving systems in addition to the effects of these factors on the welfare of calves emanating from these systems.

MATERIALS AND METHODS

Data collection and analysis in this paper were conducted through the lens of a critical realism approach whereby subjective personal experiences and beliefs are linked to real-world events and causative mechanisms and, as such, are valid in the understanding of the phenomena being studied (Fletcher, 2017). In-person semi-structured interviews were used to capture data, with participants recruited via purposive and "snowball" sampling (Cohen et al., 2007) and initially contacted via phone call and e-mail. The researcher approached the project from a background in animal science, with little prior in-depth knowledge of block calving dairy herds. Participants were approached as 'experts', while the interviewer positioned herself as wanting to learn about their experiences as farmers operating block calving systems.

The interviews were conducted by the first author, a female doctoral student with an interest in calf management and welfare. As the first author did not have industry experience, she was approaching participants from an 'outsider' stance (Darwin Holmes, 2020), seeking to gain an understanding of the practices of dairy farmers. As such, participants were invited as experts to provide their knowledge and opinions to the researcher. Furthermore, while other members of the research team had significant industry experience, all data analysis was carried out by the primary researcher, thus minimizing the influence of personal experience and beliefs on the representation and interpretation of themes arising from the interviews.

Informed consent was sought from all participants for the interviews to be audio recorded, transcribed and securely stored, and for anonymized extracts to be published. Field notes were recorded during interviews and stored in the same manner as audio recordings. Ethical approval for the project was obtained from the Harper Adams University Research Ethics Committee (0340–202304-PGMPHD) on June 13th, 2023.

Data collection - Interviews

Veterinarians and non-veterinary advisors known to the research team acted as gatekeepers (Crowhurst and Kennedy-Macfoy, 2013) through which participants were initially contacted, with further participants sought through associated networks such as farmer discussion groups. Thirty-eight in-depth, in-person, semi-structured interviews were conducted by the primary researcher between June 2023 and February 2025. Participants were located across the Midlands (n = 26), Northwest (n = 3), East (n = 5) and Southwest of England (n = 4), and were farmers operating spring- or autumn-calving dairy systems (18 spring and 20 autumn). Interviews took place either on-farm or at the participant's residence with either a single participant (n = 27), or joint interviews (n = 11) with 2 or 3 participants (n = 24). Interviewees included farm managers with (n = 8) or without (n = 27) significant involvement in calf rearing, calf rearers (n = 2), farm workers (n = 4) and family members (n = 9) (**Table 1**). Participants were required to have knowledge of decision-making processes regarding the main herd including feeding and fertility management in addition to calf care practices, including practical knowledge of key procedures such as feeding and colostrum management. No participants dropped out of the study.

Interviews had a mean length of 49 min and ranged from 27 to 103 min. A semi-structured interview guide was developed and piloted by the interviewer before commencing data collection and was reviewed and adjusted in an iterative process to guide, but not limit, the direction of the interviews (Varpio et al., 2020). Participants were asked a range of questions relating to farm demographics, adult cow feeding, management and fertility, labor, calf management, and system challenges. Most questions were open-ended to encourage participants to introduce and discuss topics that they perceived to be of particular interest or relevance (Albudaiwi, 2017), with an allowance for asking probing questions to further explore participants' responses where necessary.

Codes were assigned to participants with the letter representing their main role on the farm (e.g., FM for farm manager and CR for calf rearer) and interview numbers assigned chronologically based on the date of the interview. Where multiple participants had the same role, they were denoted as 'a' or 'b'. Data collection ceased at the point at which thematic saturation was deemed to have been achieved and no new themes identified.

Data analysis

Analysis was grounded in the data, with thematic codes generated iteratively based upon themes from the transcripts being derived from continual reviewing of data without any pre-determined analytical framework (Charmaz, 2014). Audio recordings were manually transcribed, with transcripts then thematically coded in *NVivo for Windows* (Version 14, Lumivero) by the primary researcher to group extracts of data into common themes. First-pass surface-level coding was carried out to identify initial key themes into which data was grouped (Charmaz, 2014. Pp 116 - 120) followed by repeated second-pass focused coding to further analyze specific topics (Charmaz, 2014).

Extracts were chosen that best represented the key perceptions and practices of participants that informed the coding structure. Key themes were often interconnected

Table 1. Interview codes with interview style, interviewee details (main role on-farm), herd size (number of milking animals) and location details of spring-block (SB) and autumn-block (AB) participants

Interview code	Interview style	Interviewee details	Farm details (Calving pattern, herd size)	Location within England
FM1	In-person	Farm manager	SB, 492	Midlands
FM2	In-person	Farm manager	SB, 1500	Midlands
FM3	Joint in-person	Farm manager	SB, 600	Northwest
FS3		Farmer's son/trainee manager		
S3		Spouse		
FM4	In-person	Farm manager/ calf rearer	SB, 600	Midlands
CR5	Joint in-person	Spouse/ calf rearer	SB, 330	Midlands
FM5		Farm manager		
FM6	In-person	Farm manager	SB, 393	Midlands
FM7	In-person	Farm manager	SB, 1200	Midlands
FM8	Joint in-person	Farm manager	SB, 275	Midlands
FF8		Farmer's father		
CR8		Calf rearer		
FM9	In-person	Farm manager	SB, 300	Midlands
FM10	In-person	Farm manager/ calf rearer	SB, 288	Midlands
FM11	Joint in-person	Farm manager	SB, 750	Midlands
CR11		Spouse / calf rearer		
FM12	In-person	Farm manager	SB, 640	Midlands
CR13	In-person	Spouse / calf rearer	SB, 460	Midlands
FM14	In-person	Farm manager/ calf rearer	SB, 400	Midlands
FM15	In-person	Farm manager/ calf rearer	SB, 280	Midlands
FM16	In-person	Farm manager	AB, 400	Midlands
FM17	Joint in-person	Farm manager	AB, 300	Northwest
CR17		Spouse / calf rearer		
FM18	In-person	Farm manager	AB, 460	Midlands
FM19	Joint in-person	Farm manager	AB, 350	Midlands
CR19		Spouse / calf rearer		
FW20	Joint in-person	Farm worker/calf rearer	AB, 500	Midlands
FM20		Farm manager		
FM21	Joint in-person	Farm manager	AB, 460	Midlands
FW21		Farm worker		
FM22	In-person	Farm manager	AB, 140	Midlands
FM23	In-person	Farm manager	AB, 620	Midlands
FM24	In-person	Farm manager	AB, 320	Northwest
FM25	In-person	Farm manager	AB, 320	Midlands
FM26	Joint in-person	Farm manager	AB, 500	Midlands
S26		Spouse		
FM27	In-person	Farm manager	AB, 580	Midlands
FM28	In-person	Farm manager	SB, 500	Midlands
FM29	In-person	Farm manager/ calf rearer	AB, 345	East of England
FM30	In-person	Farm manager	AB, 300	East of England
FM31	In-person	Farm manager	AB, 300	East of England
FM32	In-person	Farm manager	AB, 680	East of England
FM33	In-person	Farm manager	AB, 460	East of England
CR34	In-person	Calf rearer	AB, 300	Midlands
FW35a	Joint in-person	Farm worker	SB, 270	Southwest
FW35b		Farm worker		
FM36	Joint in-person	Farm manager	AB, 270	Southwest
CR36		Calf rearer		
FM37	In-person	Farm manager	AB, 400	Southwest
FM38	In-person	Farm manager	SB, 225	Southwest

and influenced several minor but commonly referenced themes.

Some quotes were shortened to improve clarity without adjusting meaning. Quotes are presented in the text using quotation marks, with omissions of text indicated using ellipses. Square brackets have been used to indicate clarifications or personal details that have been redacted for participant anonymity.

RESULTS

Three main themes were identified from the data: (1) the perceived value of calves; (2) the impact of value on management and welfare; and (3) the importance of simplicity in managing a system at capacity.

The perceived value of calves

Replacement heifer calves. The most consistently shared view among participants was that replacement heifers were of high value to the block calving system. Most participants emphasized that replacement heifer calves were "*The future of my herd*" (FM7, spring calving), often expressing the importance of the longevity of these animals:

> *"We want to maximize our time with them to get the best out of them."* (FM23, autumn calving)

Here it is clear that participants expressed an appreciation for the importance of replacement heifers to the future of the business and dairy herd, with a predominantly future-facing view providing the greatest motivation for current standard of practice. Additionally, some participants expressed that the number and quality of replacement heifers reared influenced their management decisions:

> *"They are one of my most important [groups] really for me because they are what is driving me to be able to make good culling decisions in my milking herd."* (FM21, autumn, calving)

> *"If you start losing heifers ...you keep cows that you probably shouldn't keep."* (FM37, autumn calving)

Here, the number and quality of replacement heifers is seen to affect decision making in the wider herd and was therefore also used to justify the level of investment and relative importance within the system by some participants, with some considering them to be the most important animals:

> *"Oh yeah, they're very important because they're our future cows. You know, the replacements are the most important animals."* (FM11, spring calving).

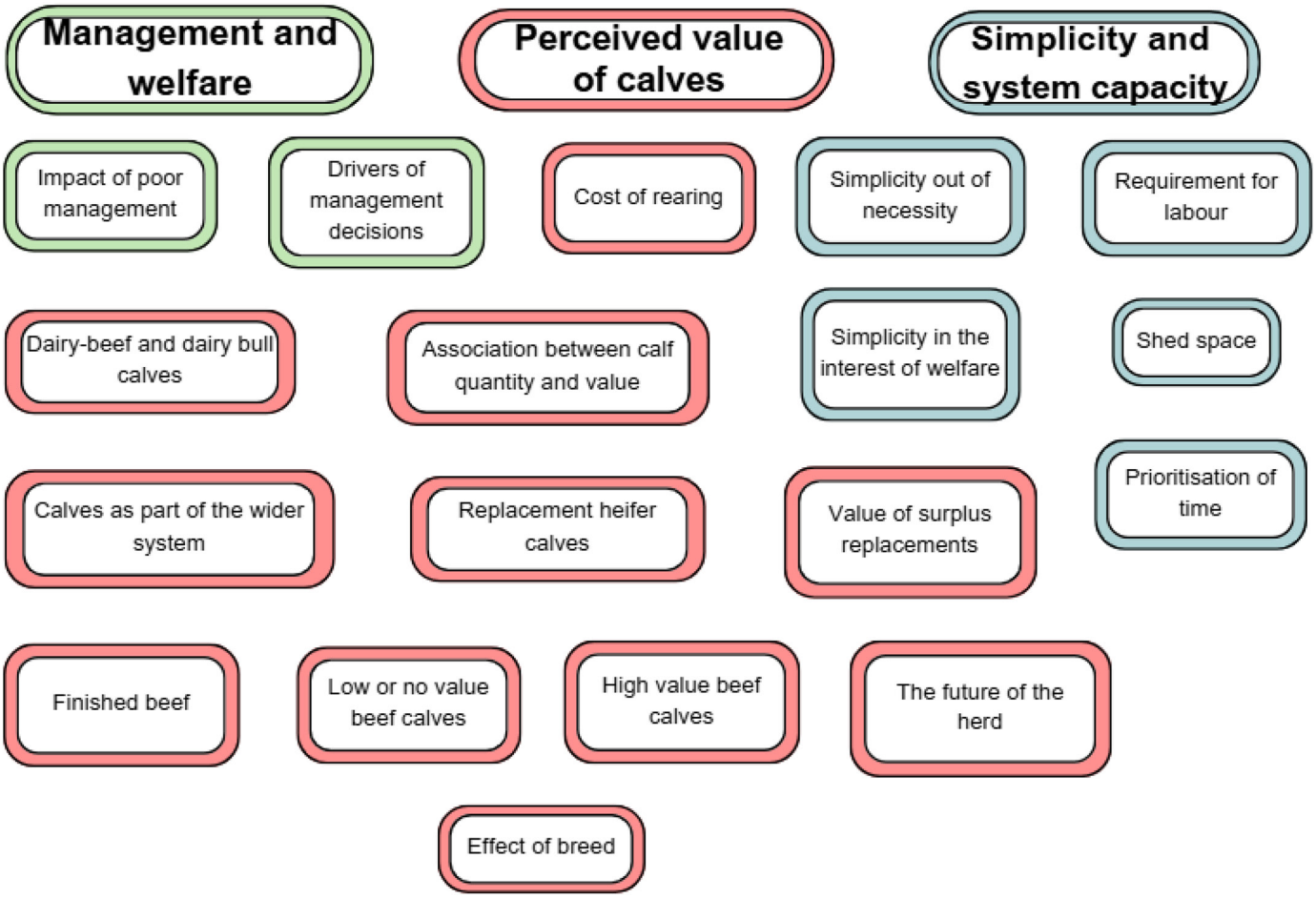

Figure 1. Thematic map of coding showing how key themes are related to sub-themes.

Furthermore, home-reared replacement heifers were often perceived to be of higher quality than bought-in alternatives. For many participants, this justified the cost and time spent rearing them:

> *"There's quite big hidden costs in rearing youngstock, but we've tried buying in heifers ... reality is you can buy an in-calf heifer cheaper than you could ever rear your own, but it's really hit and miss on what you get."* (FM10, spring calving).

However, it was also recognized that, despite the accepted importance to the future of the milking herd, the lack of financial return on replacement heifers within the first years of life defined them as of lower priority than current milking animals:

> *"On the whole, they're probably lower down where we spend our money because there's no physical cash return on them at that stage... but I suppose it's short-sighted because they are the future of your herd."* (FM30, autumn calving).

Herein lies the point at which participants first appeared to have to make seemingly difficult decisions: prioritizing time, effort and investment spent of the milking herd (current source of income) over that of the replacement heifers (future source of income).

Furthermore, many participants emphasized the potential impacts of poor management on the future performance and value of replacement heifers:

> *"Everyone knows the cost of a heifer that's coming into your herd… so if she's not doing well, so doesn't get in calf, she's become a burden on you... so you do have to put everything into them"* (FM19, autumn calver)

Crucially, participants also thought that the critical period of management starts very early on for these calves:

> *"If you don't get that start right, you'd be lucky to get it* [heifer] *in calf let alone getting it to calve down to then get it to do a lactation."* (FM29, autumn calver)

As such, the importance of preparation and time investment into early management was a key belief expressed by participants. Additionally, many participants aimed to calve their replacement heifers within the first half of the block to rear them as a single cohort, and mistakes during early rearing carried far-reaching consequences for the future herd:

> *"If you try and skimp on money at that age, you look at them when they're a bulling heifer and think 'I messed you up'. You know, if you do that to a group of 150 of them, you're knackered.'* (FM1, spring calving)

> *"If it goes wrong, it'll go wrong bad and* [it] *just takes such a long time for it to come through the system... you've got a long way to go before you can rectify that mistake."* (FM17, autumn calving)

However, for one farmer, replacement heifers did not necessarily need to attract significant rearing costs where management was of a sufficient quality:

> *"If you want to, you can absolutely throw money at calves, and I understand completely that they're the most important animals for the future of the herd and everything. But that said, I think if you get the basics right, you can actually rear calves very well without needing to do any of that."* (CR13, spring calving)

In contrast to the majority, for some participants the value of replacement animals and their place within the system was dependent upon early performance:

> *"We are quite brutal…if we have a group of dairy heifer calves that just don't do for whatever reason, they go at eight weeks. The first loss is the best loss."* (FM10, spring calving)

Here, while replacement heifers retained their importance to the future of the system, the participant placed a limit on the impact that poor performance was able to have on the cohort. This emphasizes the importance of meeting performance targets for animals within block calving systems.

Surplus calves. While the value of the dairy replacement heifer generally lay in their future as milking animals in each system and reflected in the capital investment involved in their rearing, the perceived value of surplus calves was more variable. For some farmers, dairy-beef calves were considered valuable productive animals to be reared off-farm:

> *"There's money in it* [rearing dairy-beef calves] *but you've got to do it well… there's money in it but it's not as profitable as a dairy cow… I've been on my soapbox for years about the Friesian bull thing, I think it's a disgrace!"* (FM26, autumn calving)

Here, the participant described the historic early culling of Friesian bull calves on-farm with an emotive non-use, value-based opposition to the practice that is potentially indicative of both personal ethics and opinions on business opportunities.

The higher perceived value of dairy-beef calves led to them being retained on-farm for longer in some systems to maximize their market value. It was noted, however, that they would not be kept past the point of needing to be tested for bovine tuberculosis (bTB):

> *"In the later stages when we've got less calves being born and we've got more pen space for new calves and we've got more of those more valuable beef cross calves coming through, we will potentially keep some of those longer."* (CR13, spring calving)

> *"The beef we'll keep longer - they'll perhaps stay 3 weeks and perhaps sometimes even towards a month because they've got a bit of value."* (FM14, spring calving)

With the quantity of calves entering the market in areas of multiple block calving units, participants stressed the importance of producing 'good quality' dairy-beef calves to ensure that they would be taken up by their regular buyers:

> *"If you are in an area where you are struggling, you have to do a really good job on the calves because they cherry pick, so you need to make sure it's yours they take."* (FM25, autumn calving)

Here, the interviewee's views on the importance of early calf management and rearing became more aligned with those expressed regarding replacement heifers, albeit with a different goal in mind.

Additionally, to guarantee the sales of dairy-beef calves without needing to use livestock markets, one participant stressed the importance of maintaining a relationship with the calf buyer regardless of the price paid per animal:

> *"All our Wagyu calves are sold [directly] through the one buyer ... we don't put them through the market. We don't always get the top price... that's really important that you need to have a really good relationship with your calf buyer."* (FM25, autumn calving)

For participants that relied on selling through markets, breed played a key role in the value of dairy-beef calves, with calves of European continental breeds such as the Belgian Blue having higher values attributed:

> *"Because we AI* [artificially inseminate] *all to Belgian Blue, the calves have quite a high value anyway…beef calves are pushed hard."* (FM21, autumn calving)

Participants expressed the value of calves of British native beef breeds to be more variable, with some holding value, but depending on their quality:

> *"They'll be more beefy because they will all be Herefords by then. If some of them are quite good then we'll lob them into the market on an Arla ticket at six weeks… if they're good calves, they get a nice price, so they should be sold to someone who wants to rear them as opposed to* [becoming] *dog food."* (FM6, spring calving)

> *"If we're selling privately, most people don't want the Herefords that aren't full Hereford… they're not worth anything."* (FM3, spring calving)

And while for some, dairy-bred Hereford calves were believed to have no market value, an alternative view valued their easy-calving qualities:

> *"And with the Herefords you can get easy calving Herefords… so, it's just easy calving"* (FM3, spring calving).

In the case of dairy bull calves, participants believed calves that were of Jersey breeding, including crossbreds, held no value, while calves of other dairy breeds could be more saleable:

> *"We use sexed* [semen] *for any Jersey insemination because they're the least saleable bull calf. I can sell my Friesian bull calves, they don't make much money, and then Norwegian Reds, but there is sort of a market for them."* (FM14, spring calving)

In some systems, dairy-beef calves were retained past the point of weaning, with the group of beef animals being integrated into the management of a still predominantly dairy farming enterprise:

> *"Because we've got more acres than we use to feed the cows… but if there's a shortage of grass then we would just sell the beef cattle early… a bit of a flexi system as a grass management tool."* (FM24, autumn calving)

Furthermore, one participant described rearing dairy-beef calves to sell on for further production elsewhere to aid cash flow:

> *"I think financially if they* [beef calves] *weren't there we would see a difference. We've taken them right through to fattening but to help with cash flow we have sold them as big stores* [feeder cattle]. *If we didn't have them, we wouldn't have them to sell."* (FM29, autumn calving)

In this case, the status of calves as either 'surplus' or as animals to be reared by the farm is fluid to support the business. Despite the fate of these calves being variable depending on wider system factors, the participant maintained the perception that they were valuable animals for the farm business.

Impact of value on management and welfare. For some participants, optimal calf management and health was applied across the whole cohort, irrespective of sex, with the aim of minimizing mortality across the system:

> *"The health status of all of them* [animals on farm] *is equally important. I'd sooner be proactive than reactive with calves… I'm not afraid to throw money at the calves, be that heifer calves or beef calves. I want mortality in the calves to be zero. That's one of my pet hates is dead calves."* (FM31, autumn calving)

In this point, the participant expressed views rooted more firmly in personal belief and ethics rather than the economic impact of calf disease.

Calf rearing was undertaken by family members rather than hired staff or calf rearers on some farms as participants believed that it would ensure more awareness about the standard of management:

> *"When it comes to calf health and looking at them, there's no corners cut whatsoever, because it's me and my mum doing it. [If] we have a load of sick calves, we're missing out, aren't we"?* (FS3, spring calving)

With the opportunity for differing management strategies starting at birth and the delivery of colostrum, some participants emphasized the provision of the same or similar quality of colostrum to all calves to prevent disease and save time on the treatment of sick animals:

> *"We don't want any disease to start at any point because it just spreads… it's far easier to feed a group of healthy calves than feed a group of calves... The healthy group of 100 would take you less than an hour; a group of 20 where they're all sick and half dead will take you an hour, so if you make your effort at the start, it's just so much easier."* (FM10, spring calving)

However, the greater perceived value of heifers often meant that they received better quality colostrum, with some farms feeding beef calves poorer quality colostrum, even where good quality colostrum was in surplus:

> *"We didn't feed anything less than* [Brix score] *24 to a heifer, which is pretty decent, I think. And the beef get what there is but if we've got a surplus and things are going alright, we'll freeze the heifer quality for next year and we'll feed the beefies some rubbish."* (FM6, spring calving)

Here, the participant described classifying colostrum, with all colostrum deemed to be of sufficient quality allocated for use on replacement animals while actively acknowledging that the colostrum fed to surplus animals is of insufficient quality. In this case, the prioritization of replacement animals is not only in the context of animals presently on-farm and influenced by time and resource constraints at the time, but also in the view of future animals born in the following season.

The disparity in management practices continued to milk feeding for some farms, with replacement heifers often prioritized with the feeding of milk replacer powders whereas surplus calves were fed whole or waste milk:

> *"I like to keep a bigger percentage of colostrum with the heifer replacements because I think it's such a good feed… once we've reached a point where all the heifers are on powder only, we turn off the pasteurizer. We don't bother with that anymore, they're just fed waste milk, however it is, to the bull calves."* (FM14, spring calving)

The long-term disease risk of these practices was not of concern to some farmers due to surplus animals exiting the system within weeks of birth and having a shorter overall rearing period:

> *"With the beef calves I don't worry too much because I think even if they are picking up some sort of disease or whatever, they're just going for killing at some point. They're only going to live for two years - it doesn't matter if they've got Johne's* [paratuberculosis]*."* (FM22, autumn calving)

Additionally, disease management was conducted more proactively for replacement heifers than surplus calves on some farms:

> *"With the beef we're a bit late, slow to react to it somewhat on purpose…If it was the heifers you would be more proactive... beefies are second class citizens because there's other things to do… the next calf is being born and that might be a heifer so where am I best spending my time? Messing around trying to save a beef animal which is worth £50* [$66] *tops… or concentrating on the next heifer"?* (FM6, spring calving)

> *"If it comes to a decision, if there's a sick beef calf, it would rather be shot and culled than let it have antibiotics."* (CR34, autumn calving)

Conversely, surplus calf health was sometimes seen as a priority to ensure calves exited the system quickly, with poor or diseased calves spending longer on the farm before they were able to be sold:

> *"We try and treat them the same because we don't want any reservoir of disease on the farm and we want those calves to be healthy, to be able to leave the farm as quickly as possible. So, it's still in our interests for those beef and male calves, whatever you want to call them, to be as healthy and well looked after as possible."* (CR13, spring calving)

Furthermore, it was acknowledged by one participant that surplus calves would likely receive better care and be more productive once they had moved off farm:

> *"The sooner we can get them* [Belgian Blue calves] *into those farms, the better they're going to get looked after and the more chance they're going to have of making money."* (FM27, autumn calving)

Despite generally viewing surplus calves as having little value to the block calving system, farmers expressed taking pride in the rearing of their youngstock, providing a moral reasoning behind prioritizing the management and welfare of all calves:

> *"I spend a lot of money on my calves because I'm very proud of my calves… I want to do a decent job and every calf received that, it wasn't like the bulls are getting some cheap whey and they're getting the rubbish, we spend our money and try and do a good job of it."* (FM7, spring calving)

Additionally, systems that reared their own beef animals to sell as stores or to finishing elsewhere generally chose to standardize management practices across replacement and surplus calves:

> *"Same* [colostrum protocol] *for everything because we finish beef cattle, we want them to be equally as healthy."* (FM9, spring calving)

In those systems, being able to measure the outcome of management decisions made to improve the early life care of surplus calves provided justification for improving management practices:

> *"One thing that's made the biggest difference - my father finishes the beef cattle and the one thing he's noticed since we've been giving them plentiful colostrum at birth is they're finishing about six months earlier at the same weights as they were before, so they're growing better, their health status is stronger."* (FM9, spring calving)

Rearing surplus calves along with replacement heifers did provide the challenge of housing capacity and cleanliness for one farmer:

> *"That also puts a bit of pressure on the beef calves' health and going into sheds that have had heifers in, so we have to make sure they're kept immaculately clean."* (FM9, spring calving)

While the standard of calf management and welfare was believed to be important by many participants, the practicality of labor provision for the care of the influx of calves through the block calving period was brought into question. While some systems hired additional staff for calving, calf management also needed to be balanced with the care of the milking herd and completion of other tasks on-farm:

> *"It'd be nice to think that calf health is the most important thing but at the same time we've got 500 cows to milk and other jobs to do."* (FM28, spring calving)

In this instance, calves as a cohort, irrespective of breed or future purpose, were less of an immediate priority to the system in the division of time and resources. This is indicative of the pressure on farm workers during the calving season in block calving herds, when time demand from calving cows, fresh cow management, milking, and calf rearing is at its highest.

The importance of simplicity in managing a system at capacity. One of the key challenges faced by partici-

pants, especially those operating systems where moving calves off farm early on was an issue, was system capacity. Keeping calves to rear them for extended periods of time was perceived to be a key challenge regarding labor and housing:

> *"In our current set up it would be a real challenge. We would have to make some pretty big changes like investing in additional housing, thinking about labor, that would really be a challenge I would say."* (CR13, spring calving)

> *"We're then forced rearers of calves if we have to keep them because we don't have the sheds available."* (FM28, spring calving)

As such, simplifying processes was used as a solution to cope with running at, or exceeding, housing capacity when selling older calves:

> *"We're just trying to make it easier to keep them in for longer. In the past we've gotten away with it because we could always sell beef calves at three weeks but we haven't been able to do that the last two years and it's put a lot of pressure on it. So we're just trying to set an easy system up so we can do a better job with rearing calves."* (FM10, spring calving)

Milk feeding was highlighted as a key area where simplicity was prioritized over reducing costs:

> *"The first year we bought heifer and beef powder, heifer being more expensive, good powder…we've binned that off and just bought one powder for everyone now because it's complicated. It was a pain just balancing it all out."* (FM6, spring calving)

> *"You can only do it across all the calves, you can't pick and choose. We're not a laboratory or anything, we make a decision, and it goes on everything."* (FM11, spring calver)

It was also a factor that drove decision-making and the direction of investment regarding calves and youngstock within some systems:

> *"It just needs to be something that either saves us time or makes something simpler, I think. You know, that aim is obviously to have great calf health and welfare… getting calves weaned on good weights."* (CR13, spring calving)

With many of the farms hiring in labor during the intensive block calving period, resulting in a transient section of the workforce annually, operating a simple system was essential to ensure adherence to protocols by all staff:

> *"The system is very simple for people to follow and it's relatively fast feeding that large number of calves, well it's very fast… easy management sort of thing."* (FM14, spring calving)

> *"It just makes everything easier, and everybody knows where they're up to and it just, it doesn't complicate anything."* (FM16, autumn calving)

DISCUSSION

The findings of this research reflect the influence of human attitudes and opinions on calf management, and the complexity of interactions and overlap between multiple factors in the management of calves on block calving dairy farms in England. For example, while subthemes such as the requirement for labor and availability of shed space are linked to the key theme 'simplicity and system capacity', they are also drivers of decision making and have influence on calf management and welfare. Similarly, the association between calf quantity and value is linked to sub-themes within both the perceived value of calves, and the importance of simplicity within system management through close association with the partitioning of resources and allocation of calf accommodation.

As identified in previous studies, a range of use and non-use values contributed to the motivation and decision-making of farmers (Hansson and Lagerkvist, 2015; Owusu-Sekeye et al., 2022). Use-values formed the principal motivations for the prioritization of replacement heifer calves due to their importance to the future of the milking herd – a key perception that has been reflected in other studies of English dairy farms (Palczynski et al., 2022). Additionally, despite a previous study of UK dairy farms showing rearing costs to be lower on spring and autumn calving farms than all-year-round systems (Boulton et al., 2017), the significant rearing costs, and time taken to recoup them, associated with the rearing of dairy heifers was also a driver for the prioritization of management for several participants. As in a previous study, the number and quality of replacement animals reared was also associated with the capacity to make voluntary culling decisions (Orpin and Esslemont, 2010), with the capacity to control replacement rate depending partially on the number of replacement heifers available to be served for the next production cycle. Furthermore, many participants in the present study perceived homebred heifers to

be of higher quality than bought-in alternatives, despite previous studies finding minimal to no significant differences in metrics such as age at first calving and growth rates between home-reared animals and those reared off-farm in Irish dairy systems (McCarthy et al., 2022a; McCarthy et al., 2022b).

Because of the awareness of time and financial investments into replacement heifers, management quality was perceived to be important from birth to ensure heifers were able to hit reproductive and growth targets. The impacts of poor management on system performance due to delayed milestones highlighted by participants were largely in fitting with existing literature, with poor growth rates linked to key performance indicators (KPIs) such as age at first calving, conception rates and survivability to next lactation (Bazeley et al., 2016). However, despite the dependency of the system on the performance of replacement heifers implied by many participants, they were also considered expendable if they did not reach targets set by farmers to remain within the system timings, as such holding value as a potentially saleable animal similar to that of the system's surplus calves. Replacement heifers were therefore the key focus of many interviewees' awareness with regards to youngstock management and investment. Some participants were willing to readily invest in dairy heifer rearing, particularly providing more expensive milk replacement powders that were perceived to be better quality, aligning with previous research by Palczynski et al. (2022) in which replacement calves were seen be the key to the future success of the herd despite being of lower priority to some participants than the current milking herd. The issue of surplus calf value and management has been recognized in previous studies, highlighting practices such as the feeding of waste milk from cows undergoing antibiotic treatment to surplus calves (Higham et al., 2018). As such, this has proven a key driver in bringing about the development of the GB calf strategy (NFU and AHDB, 2021). The description of surplus calves as 'second class citizens' in comparison to their replacement counterparts suggests a lack of care and value attributed to these animals. With participants generally expressing an appreciation for, and understanding of, animal welfare throughout the interview process, these attitudes highlight an active ethical portioning of animals based on their perceived value. Furthermore, similarly to replacement heifers, the value of surplus calves was predominantly based on use-values, most commonly market conditions and calf salability. While farmers believed there to be the potential for a viable business based around the rearing of dairy bull calves, dairy-beef calves were generally assigned lower values than dairy replacement counterparts.

In addition to the importance of breed composition, the salability of calves was attributed to geographical location (presence or absence of other block calving systems) and perceived 'quality' of surplus calves. With supply thought to exceed demand by most participants, dairy-beef calf quality and management were intrinsically linked and often influenced each other, with better quality calves perceived to be sold more easily, and for a better price, in areas with multiple block calving dairy systems in proximity. While participants did not specify KPIs or observations that belie the quality of these surplus calves, adequate bodyweight at the point of sale to rearing facilities has been cited as a crucial component in reducing mortality and disease risk of male dairy calves entering the veal or dairy-beef industry (Renaud and Pardon, 2022). While some participants described keeping more valuable surplus calves for longer before sale, several farmers described management practices that have been evidenced to hinder calf growth. With timing of feeding, cleanliness, and quantity of colostrum all being associated with the calves' ability to achieve an acceptable level of passive transfer of immunity (Godden et al., 2019), adequate colostrum provision has been linked to the development of the immune and endocrine systems of calves (Ontsouka et al., 2016), thus supporting growth and immune development (Yang et al., 2015). While participants generally understood and prioritized these concepts with regards to replacement heifer calves, failure to apply this to the management of surplus calves may have therefore contributed to failure of those calves to reach their potential value at the point of sale depending on the metrics rearers used to define 'quality'.

Some producers did, however, emphasize the consistent management of both replacement and surplus calves with regards to neonate management, in some cases extending to milk feeding of older calves, with disease prevention being a key motivating factor. Costs attributed to health management and disease in dairy heifers have been quantified in multiple ways, reflecting an average of 4.1% of rearing costs to first calving (Boulton et al., 2017), with respiratory diseases reportedly leading to an average 2-week delay to first calving, a reduction in first and second lactation yields, and total days in milk. This was quantified as £772 ($1013) per animal for dairy heifers compared with between £131 ($172) and £327 ($429) for surplus animals (Bartram et al., 2017), with beef animal production suffering due to lower daily liveweight gains and mortality (White and Larson, 2020). These findings may align with those of this study, where disease prevention was prioritized to differing levels between dairy and beef calves in several systems.

Block calving farmers in New Zealand are advised to calve all heifers within the first 6 weeks of the block to assist with fertility and maintaining the calving interval (Blackwell et al., 2017). With many participants in the study adopting the same principles, most surplus calves

in the system therefore enter the rearing sheds later in the calving period. Studies have identified environmental contamination from infected calves as being a key factor in the persistence of diseases such as calf diarrhea in dairy-bred calves (Cho and Yoon, 2014). Considering the increase in workload described by farmers toward the latter half of the calving period, less time is available for cleaning, especially where surplus calves are not prioritized. This supports farmers' beliefs that calves entering sheds during the latter weeks of the calving period are more at risk of disease. It would therefore be appropriate to assess these factors on beef calf morbidity and mortality in these systems as a further potential indirect effect of perceived calf value on welfare.

Surplus calves that were intended to be retained for rearing either to sell as feeder animals (stores) or to finish in an associated beef enterprise (wherein the main agricultural enterprise was still dairy production) were managed similarly to their replacement heifer counterparts. Decisions to improve management or invest in these calves were partially fueled in these cases by the measurability of results due to calves remaining on the farm for a longer period. This is supported by existing literature that has identified that while dairy farmers are motivated by a range of use- and non-use factors regarding farm animal welfare (Hansson et al., 2018), seeing evidence of calf performance was identified as a key motivating factor in improving dairy calf management (Sumner et al., 2018).

Due to the nature of the study and information provided to participants before enrolment, interviewees were likely to have particular involvement in calf rearing to be able to provide a detailed account on protocols and factors influencing decision-making regarding calves. While some systems relied on dedicated calf rearers that were often hired annually, calf rearing was often undertaken by family members. This was either due to being an undesirable job or because staff to whom the financial return on these animals would directly affect their livelihood or personal income would provide better care for calves. While family labor on farms in the Czech Republic, Hungary, Romania and Spain was found to benefit from better motivation and reduced management costs, it suffered from reduced efficiency due to a lack of effective management structure compared with commercial farms (Kostov et al., 2018). With Dutch dairy farmers found to have difficulty in prioritizing calves due to shortage of time (Santman-Berends et al., 2014), family labor may therefore result in the individual also being responsible for competing tasks on the farm. Conversely, farmers on Irish family farms believed operating a pasture-based spring calving system to be a key component in operating at high labor-efficiency to manage peak workloads during calving (Hogan et al., 2022).

A study of American farmers and farm workers involved in calf care found a combination of personal beliefs and standards, task enjoyment and fulfilment to be the most common motivational factors behind decisions regarding calf care (Moore et al., 2021). This broadly algins with the pride and excitement expressed by some participants when referring to calf management, as well as the opinion expressed by one participant with regards to becoming a better farmer because of their milk buyer's calf policies. Conversely, some farmers described experiencing fatigue and loss of interest toward the end of calving, with some justifying the loss of management consistency and potential increase in disease incidence with the low value of surplus calves. A study by Santman-Berends et al. (2014) reported similar findings, with farmers describing feeling powerless regarding calf mortality either due to not knowing or understanding the cause of mortality or knowing that they were not adhering to protocols for calves, with some simply accepting a certain level of calf mortality.

Lack of investment in calf facilities was a key factor highlighted by many participants in the current study. Furthermore, overcrowding and sharing airspace with older animals are among factors attributed with the increased risk of calf pneumonia on dairy farms (Lorenz et al., 2011). With the potential for a multitude of the factors mentioned by participants potentially leading to overcrowding in calf sheds wherein surplus calves are retained past the planned point of sale, it may be appropriate to further investigate the capacity and potential for overcrowding on these dairy farms to develop strategies to mitigate the risk.

CONCLUSION

Calves received suboptimal investment of time and effort on many farms due to the lack of immediate return and the transient nature of the calving period. Despite this, replacement heifer calves were generally the most highly valued cohort of calves due to their importance to the future dairy herd. The perceived value of surplus calves was, however, more variable, relying on several factors including breed, quantity available locally and quality. While some farms standardize calf management practices across all cohorts for disease management, simplicity or due to rearing surplus calves, this was not the case for others. Despite an awareness of the importance of colostrum in the development of immunity, surplus calves on some farms were still fed colostrum deemed unfit for heifers. Furthermore, surplus calves were more likely to have delayed disease treatment on some farms, highlighting time management and workload issues caused by the high number of calves being born across the calving period. Further research is needed to explore

the relationship between perceived calf value and other attitudinal factors on measures of calf health and welfare such as the effect of resulting management decisions on performance post-weaning and into first lactation for replacement heifers. This will provide a basis upon which recommendations regarding calf-based policies increasingly mandated by milk buyers can be made. What to do with surplus calves may indeed be a 'wicked problem' for the dairy industry, but it is imperative to ensure that calves are not merely kept alive for 56 d but are allowed to thrive under higher standards of health and welfare in the future.

Notes

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