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"If you were a cow, what would you want?" Findings from participatory workshops with dairy farmers

Katelyn E. Mills [a], Penny R. Payne [a,c], Katie Saunders [b], Gosia Zobel [a,*]

[a] AgResearch Ltd., Ruakura Research Centre, Hamilton, New Zealand
[b] DairyNZ, Canterbury, New Zealand
[c] University of Waikato, Environmental Research Institute, Hamilton, New Zealand

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ABSTRACT

When looking to improve animal welfare, it is essential to understand the viewpoints of stakeholders in the industry. Previous research has engaged stakeholders such as farmers, veterinarians, and the public to better understand future dairy industry directions. However, the use of perspective-taking as a tool to overcome farmer's focus on current barriers to the industry has not been explored. Therefore, the aims of this study were to have farmers take the perspective of the cow, to elicit: (1) farm elements that are essential to create a cow-centric dairy system, and (2) how this system can be achieved in the next 50 years. To do this, we employed participatory methods (photo elicitation, timelining) to generate discussion with 12 New Zealand dairy farmers. Pasture access is frequently cited as an integral component for promoting good welfare in dairy cows, thus, this cohort of farmers was considered a good case study as they all had experience managing cows in grazing systems. Participants were asked to create a cow-centric farm design, and a pathway to implementation. Following thematic analysis of the multiple data sources, the results are presented under the following three themes: (1) cow-centric farm designs (environmental considerations, cow handling and care), (2) timeline to achieve and sequence of implementation ("low hanging fruit" and long-term investments), and (3) assumptions and resources needed (including financial considerations, technology, farmer buy-in, regulations and enforcement and other stakeholder involvement). By better understanding how current industry practice aligns, and also differs, from what the cow would want, we can work towards future management systems that incorporate the requirements of all stakeholders, including the cow.

Implications

To promote the dairy industry's social sustainability, it is important to consider the perspective of all stakeholders. Using a small cohort of dairy farmers, this study aimed to understand what a cow-centric dairy farm could look like and how it could be achieved in the next 50 years. New Zealand farms offered a unique exemplar as they are traditionally pasture-based. By utilising a participatory approach where farmers take the perspective of the cow, novel farm designs were identified, as were short- and long-term implementation pathways and the assumptions (farmer buy-in, financial, technological, regulatory) required to achieve cow-centric future dairy systems.

Introduction

Globally, dairy farms are increasing in size (Barkema et al., 2015); while increased efficiency is both a driver and an outcome, this growth is, at least in part, made possible by the advent of new technologies. As technological advancements allow for changes in how cows are managed, we must also consider how new practices impact the welfare of the animals. If we focus on animal welfare, the academic literature has shown there are many different conceptions of what this means (Weary and Robbins, 2019). Industry stakeholders differ in their definitions of animal welfare (Ventura et al., 2016) and those definitions can sometimes conflict (Cardoso et al., 2019). For example, farmers frequently place greater importance on health than on affective states or natural behaviour (see review by Balzani and Hanlon, 2020). Similarly, veterinarians also place an emphasis on health (Koch, 2009), while the public values naturalness (Hötzel et al., 2017). While there are many definitions of animal welfare, we have chosen to use the con-

* Corresponding author.
E-mail address: Gosia.Zobel@agresearch.co.nz (G. Zobel).

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ceptual framework developed by Fraser et al (1997) in which animal welfare is comprised of a balance between three main concerns: biological health, natural living (including natural behaviours that animals are highly motivated to perform) and affective state (the emotional state of the animal).

Involving relevant stakeholders in the research process allows for a research design that asks targeted questions, leads to higher-quality data, and improves dissemination of the results (Bolton and von Keyserlingk, 2021; Flicker, 2008). Van Dijk et al. (2017) used a participatory policy-making framework to develop an antimicrobial stewardship policy with dairy industry stakeholders (i.e., farmers, veterinarians, industry partners) in the United Kingdom. They found that this process provided learning opportunities for all involved and allowed for the development of practical, science-based recommendations. Similarly, Morgans et al. (2021) reported that farmer-led discussion groups about antimicrobial use on farms led to increased knowledge and peer support that helped farmers improve their own farm practices.

While farmer perspectives on issues facing their industry are integral to finding sustainable solutions, farmers can often focus on the practical limitations. For example, Ritter et al. (2020) conducted focus groups with Canadian dairy farmers to understand how they viewed the future of animal care in their industry in 20 years, yet participants had trouble thinking beyond current-day challenges. Burton et al. (2012) described how farm design, including barns and type of milking equipment, is based on historical and cultural knowledge of what a dairy farm "should" look like. Perspective-taking can aid in reframing the conversation away from existing barriers and towards future possibilities.

Perspective-taking (i.e., a method to help individuals take the viewpoint of another individual) has been shown to increase creativity in teams (Hoever et al., 2012), improve warmth and tolerance for those with differing political beliefs (Bilali and Godfrey, 2021) and decrease stereotype biases (Galinsky and Moskowitz, 2000). While much of this research has been focused on taking the perspective of another human, this approach has also been used to understand an animal's perspective. For example, Swim and Bloodhart (2015) examined support for climate change activism in relation to negative impacts on polar bears; participants that were asked to take the perspective of the polar bear in a photograph were more likely to support environmental conservation efforts. Similarly, in a survey of Canadian undergraduate students, witnessing an animal being killed resulted in an increase in perspective-taking scores (measured on a 5-point Likert scale) indicating higher cognitive empathy (Daly and Morton, 2008). To our knowledge, perspective-taking has not been employed in the context of a dairy cow.

Globally, there is a growing formal recognition in the legislation of animal sentience (i.e., animals being sentient beings that are aware and have emotions; Duncan, 2006). Its formal inclusion in federal laws and civil codes is suggested to be setting up a dramatic shift in how legal systems around the world will interpret animal care in future (Giménez-Candela et al., 2022). The significance of the recognition of animal awareness is more than just legislative; practically, there is a dramatic increase in the need to better understand what parts of production animal systems promote good life experiences, and what parts require improvement.

While stakeholder views are crucial to better understanding livestock systems, it is also important to understand the behavioural needs of the animal. Most of the available literature with dairy cattle has focused on the negative aspects of welfare (Napolitano et al., 2009) such as heat stress (see review by Polsky and von Keyserlingk, 2017) and health conditions (see review by Silva et al., 2021). While not without welfare concerns themselves (e.g., Beaver et al., 2020; Mee and Boyle, 2020), grazing systems, such as that of New Zealand (**NZ**), conceivably allow cows to have more choice over their environment, and to perform more natural behaviours (an important component of animal welfare; Yeates, 2018), compared to entirely indoor systems. With a growing emphasis on measuring positive affect (see review by Webb et al., 2019), the most animal welfare-friendly dairy systems will likely combine both indoor and pasture options (reviews: Arnott et al., 2017; Charlton and Rutter, 2017; Mee and Boyle, 2020; Smid et al., 2020); thus, many studies have approached future management improvements by providing pasture access to indoor housed cows and showing the welfare benefits (e.g., positive affect: Crump et al., 2021; choice: Shepley et al., 2017; reduced lameness: Hernandez-Mendo et al., 2007).

NZ is one of the numerous countries that has formally included animal sentience in its legislation (Parliament of New Zealand, 2015), and dairy contributes to 34% of the country's exports; therefore, there is a vested interest in ensuring the management of its farms is world leading. Over 4.9 million milking cows live on approximately 11 000 dairy farms, and these are predominately pasture-based (DairyNZ, 2020). As Franks (2019) argues, while asking animals what they want is important (i.e., motivation tests, preference tests, etc.), it is not always enough to ensure a life worth living for animals. To offer another perspective, we have engaged with farmers that are experienced with managing dairy cows in grazing systems and asked them to envision the future of dairy farming that embraces the cow as a sentient being. Using participatory arts-based methods, the aims of this study were to have a cohort of NZ dairy farmers take the perspective of the cow, to elicit: (1) farm elements that are essential to create a cow-centric dairy system, and (2) how this system could be achieved in the next 50 years.

Material and methods

Study design and questions were peer reviewed and assessed (#15.21) as compliant with the AgResearch People and Agriculture Team ethical guidelines for research. Ethical approval of research that is low risk is not legally required in NZ.

Study team

The study team included researchers (Mills, Payne and Zobel) from AgResearch (a Crown Research Institute in NZ which is independent of the dairy industry) and the lead animal care advisor (Saunders) from DairyNZ (NZ's dairy industry body). All authors have experience working with industry stakeholders and running workshops with farmers. Two authors (Mills and Payne) are trained in qualitative methods and have experience conducting and analysing focus groups and participatory research.

Recruitment and participants

Farmer participants consisted of a convenience sample (Miles et al., 2014) recruited through DairyNZ, some of whom were members of an existing group which routinely meets to discuss animal welfare in the dairy industry. All members of this group were sent an overview of the study and asked if they would be willing to participate. Participants were provided with lunch and a $50 credit card voucher.

Study design

To prompt participants in the creation of their cow-centric farm designs, we provided photos (i.e., photo elicitation; Bignante, 2010; Harper, 2002). To determine the photos that would be presented to participants in the workshops, an email survey was sent to an

international group of individuals (NZ, Canada and the USA) working in agriculture (e.g., researchers, veterinarians, dairy farmers, and dairy industry representatives), with the following question:

> *"If you were a dairy cow, what farm elements would be important to you?"*

The responses (n = 42) ranged from lists of specific needs (i.e., food, shelter, veterinary care) to more complex descriptions of an animal's life. All responses collected were analysed and photos of the topics discussed were collected from internal databases and creative commons websites, or when unavailable in these databases, drawings were commissioned; no copyright images were used. A total of 110 photos were included representing a range of elements that are currently used in dairy industries around the world (for a full list of image descriptions, see Supplementary Table S1). Photos were numbered and image descriptions with the corresponding number were provided to participants, to aid with consistent interpretation of the image.

In-person workshops took place on 26 May and 28 May 2021. Participants were first told the aims of the workshop with a brief presentation from the research team and were then asked to sign a consent form. The introduction to the workshop included a brainstorming activity during which participants were asked to each identify something that was done in the industry 50 years ago that would seem "strange" by today's standards. Participants wrote their idea on a sticky note and presented it to the group. This was used to help encourage reflection regarding industry change in the past 50 years and to prompt thinking about the magnitude of change that is possible in the next 50 years. The rest of the day was comprised of three parts: (1) designing a cow-centric farm, (2) pathways to implementation, and (3) group discussion. During each of the below sessions, facilitators (Payne, Saunders and Zobel) were available to answer questions and provide clarifications as needed. All sessions were recorded with a GoPro (HERO 7, GoPro, USA) camera to allow for analysis of the audio and the video interaction between participants during each session.

Session 1: Designing a cow-centric farm

Participants were divided into groups of two or three and asked to take the perspective of the cow to design a farm in the year 2071. To design their farm, each group was given a packet with the photos derived from the survey, a corresponding description of each photo, white poster paper, sticky tack, coloured paper, scissors, and markers. Each group also received two envelopes, one with an orange circle and one with a red circle; these were designed to reflect a traffic light system. It was explained that the orange envelope was for images that participants felt indifferent or unsure about being important to a cow and the red envelope was reserved for images that groups would not want to experience if they were a cow. Orange and red images did not appear in the farm designs. If there were elements that participants felt were missing from the provided photos, they were able to add it to their farm design using the markers and/or blank paper. Participants were given approximately 1 hour to complete their farm designs.

Session 2: Pathway to implementation

Following the development of their farm design, participants were asked to develop a 'pathway to implementation' (i.e., how do we achieve a cow-centric system). To do this, the art-based, graphic elicitation method of timelining (Kolar et al., 2015) was used in which a timeline was posted for each group on the wall, with 2021 on the left and 2071 on the right. To the left of the timeline was an image of a current 'business as usual' dairy farm. To the right is the farm design that the group created in Session 1. Participants were prompted to think about when this change might need to occur (on the timeline from 2021 to 2071), what assumptions are being made for the pathway to happen, the type of change needed (i.e., economic, social, structural) and who would need to be involved in this change. Participants were given approximately 1 hour to complete this session.

Session 3: Group discussion

For the final session, each group was asked to explain their farm design and implementation pathway to the wider group, and answer any questions posed by other participants and the facilitators.

Data analysis

Following the workshops, the video files were sent to a professional transcription service. The transcripts were then compared to the video files by the lead author (Mills). Data used for analysis included the transcripts from the three sessions and documents produced during Sessions 1 and 2 ('cow-centric farm designs' and 'implementation pathways').

The cow-centric farm designs were first deductively analysed to determine which of the photos: (1) were included on the canvas by participants (green), (2) participants were unsure they would want to experience as a cow (orange), or (3) participants did not want to experience as a cow (red). This quantitative analysis was first done to understand if there was consensus between the groups on the elements presented. In some instances, participants did not categorise the photos; this is denoted as "unsorted". For a full list of how participants categorised the provided images, see Supplementary Table S1. Data were then inductively analysed using thematic analysis by the lead author (Mills) using NVivo version 12 (QSR International; Burlington, MA) qualitative data analysis software. Multiple data sources (transcripts, 'cow-centric farm designs', and 'implementation pathways') allowed for triangulation (i.e., use of multiple methods to strengthen interpretation of the data) and a more robust interpretation of the data (Carter et al., 2014). A codebook was developed (MacQueen et al., 1998) and the authors met to discuss the codebook, which led to recoding of the data in an iterative approach. Quotes were chosen that best exemplified the codes, and each quote includes a participant identifier signalling the group number and the participant number (i.e., G1P1, G2P1). Quotes presented have in some instances been edited for clarity as indicated by square brackets or shortened with the use of ellipses.

Results

A total of 12 farmer participants (five groups) attended the workshops, seven in NZ's North Island and five in the South Island. The results are presented under the following three themes: (1) cow-centric farm designs, (2) timeline to achieve and sequence of implementation, and (3) assumptions and resources needed.

Theme 1: Cow-centric farm designs

Below descriptively depicts how participants designed their cow-centric farms (see Fig. 1 for example) in regard to: (1) environmental considerations (infrastructure, water access, calf management and enrichment), and (2) cow handling and care (health, forage choice, end of life, breeding and animal handling).

Environmental considerations

Shelter. Groups discussed many environmental factors that would fulfil a cow's needs. To begin, access to shelter for protection

Fig. 1. An example of a cow-centric farm by one of the farmer groups (G5). Farmers were provided with 110 photos illustrating elements that are currently used in dairy industries around the world (see Supplementary Table S1). In small groups, they selected photos they felt represented a cow-centric system 50 years into the future. Photos were numbered and had image descriptions to ensure consistent image interpretation. Most groups added their own components to their farm design (e.g., extra words, arrows etc.).

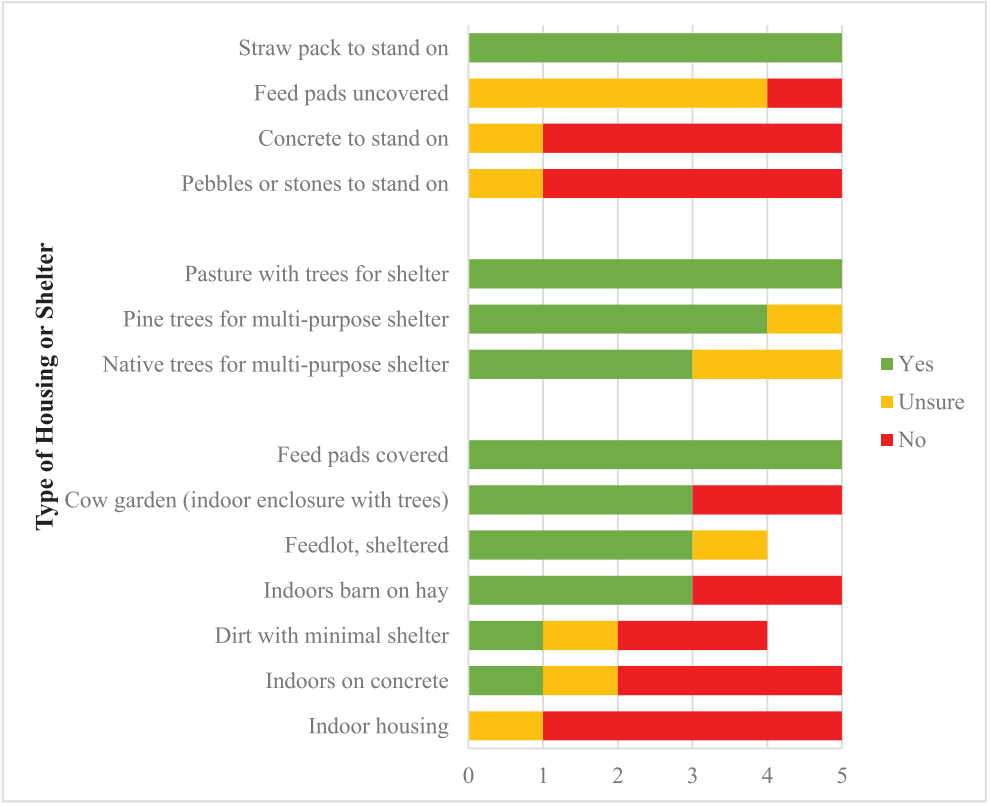

Fig. 2. Group (n = 5) preference for housing options, organised according to uncovered contained areas, pasture, and covered contained areas. Green indicates cows would want this (e.g., included on farm design), orange (e.g., "I am indifferent about this") and red (e.g., "I definitely wouldn't want this").

from extreme weather in the form of trees and physical infrastructure (Fig. 2). For example:

G5P1 *"Well they probably wouldn't be [want to be] out, it depends what's outside."*
G5P2 *"I think that most of them would choose to be inside if it was shitty... I know I was miserable yesterday morning."*
G5P1 *"And you had a jacket on."*
G5P2 *"Yes and by god was I moaning."*

However, a fully enclosed barn was not preferred due to the pasture-based management inherent to NZ (*"I'd still want to be part of our pasture-based system"* – G2P2). When discussing additional substrates (in addition to pasture, such as in shelters and farm races), groups agreed that the substrate needs to be soft to prevent injuries (*"Concrete, no, heaps of problems"* – G1P1).

In addition to the shelter options illustrated by the photographs provided, participants came up with their own ideas. For example, mobile shelters or pop-up shelters that could be easily moved between paddocks with the animals, as well as a more creative, technological solutions:

"*Let's have a hovercraft...you can shift it to the paddock that the cows are going to so then they've got the option to go and stand in some shade... I mean look at where technology is now compared to 1970, they would have thought these bloody collars on cows and stuff was a joke*" [G5P2].

Water Access. Water access, including sprinklers to keep cool and access to waterways, was viewed as vital for cows to regulate their temperature on hot days. Participants acknowledged that access to streams or ponds would be impractical due to environmental regulations, but manmade pools could achieve a similar goal. For example, *"I like the idea of the artificial dam and if it was you know, filtered or there was a solution added that created no bugs so mastitis wasn't an issue then I think that would be really great"* [G2P3].

Herd Size. Most groups agreed that herds under 200 cows would be preferable, with no groups preferring herds over 500 cows; they cited reasons for decreased care and farmer attention as farms increase in size (Fig. 3). For example, one group had the following exchange:

G2P2 "[gestures at picture depicting 1 000 cows] *Not 1 000, I want to be known and noticed...*"
G2P3 "*What about 500?*"
G2P1 "*Depends on how many people there are helping us. Like smaller the better really.*"
G2P2 "*I would pick 200. It's got enough scale that there's probably two sets of eyes on you.*"
G2P1 "*Yes you want to be taken care of.*"
G2P2 "*But you're not going to be missed.*"

Herd size was often talked about in terms of social grouping and social stress. For example, as explained by one participant: "the bigger your herd, the more social stress they have because they find it really hard to find their friends... If you had 1 000 cows in one herd it would be very stressful" [G5P2].

Technology. Milking technology that allowed for animals to have a choice, such as automatic milking machines, or that prevented having to walk long distances, such as portable milking machines, were preferable to parlours. While groups viewed personalised health data for each cow as valuable, research devices that collected these data were viewed as a nuisance, depending on the size of the device. For example, *"I don't give a shit if it's going to make it better for everyone else, I don't want it on me"* [G5P2].

All fences were viewed as less than ideal as they would keep a cow from where she wants to go. For example,

G4P2 "*No. If I'm a cow, I hate that fence, it's stopping me from getting food or...*".
G4P1 "*...Getting what I want.*".

However, virtual fences were viewed as the most preferred option (see Fig. 4).

Finally, groups discussed technological solutions to move cows to the cowshed without the need to walk long distances, such as canals with floating platforms or conveyor belts. For example:

G2P1 *"As a kid I used to dream my races were a big conveyor belt."*.
G2P2 *"Yes I've had the same thought."*.
G2P1 *"It'd be fricken awesome if you could do that. You would eliminate walking."*

Calf management. When it came to calf management, most participants were in favour of cow-calf contact systems *("if I was a mother, yeah I'd want to keep my kid around as long as I possibly can"* – G4P2; Fig. 5); however, cow personality must be considered due to some cows not having 'maternal instincts'. Participants also felt that it was necessary to consider the frequency of calving to manage surplus calves:

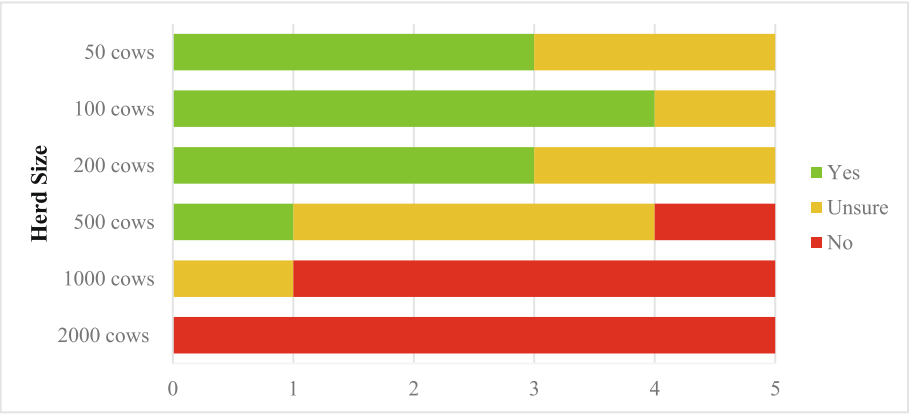

Fig. 3. Group (n = 5) preference for herd size. Green indicates cows would want this (e.g., included in farm design poster), orange (e.g., "I am indifferent about this") and red (e.g., "I definitely wouldn't want this").

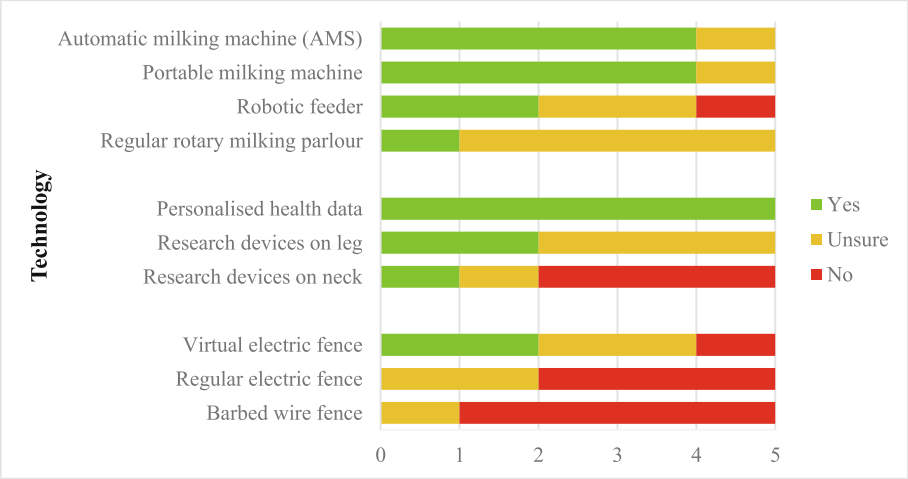

Fig. 4. Group (n = 5) preference for technology presented by milking technology, wearable technology, and fencing technology. Green indicates cows would want this (e.g., included on farm design poster), orange (e.g., "I am indifferent about this") and red (e.g., "I definitely wouldn't want this").

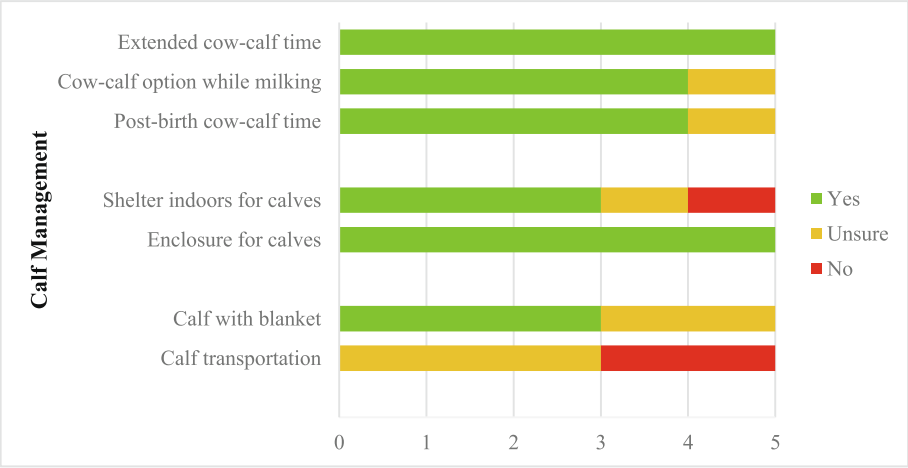

Fig. 5. Group (n = 5) preference for calf management. Green indicates cows would want this (e.g., included on farm design), orange (e.g., "I am indifferent about this") and red (e.g., "I definitely wouldn't want this").

"I'm still personally not sure that there's a place for all those calves no matter what we do. But we did talk otherwise about potentially slowing down that cycle because if cows were under less pressure [to] get in calf or just had a calf every 18 months then you would have less calves and maybe then you wouldn't need your bobby calves" [G2P2].

Enrichment. Enrichment items such as cow rubbing posts, balls to play with and brushes were all agreed to be positive for the cow (Fig. 6). However, some of the photos provided were viewed skeptically by farmer participants. For example, when discussing the use of a mirror as enrichment:

G5P2 *"I'd slime on it and the next cow would slime on it and then three cows in, you wouldn't be able to see anything."*
G5P1 *"Shit on it and it would be forgotten."*

Participants were also skeptical about cows keeping their horns to allow for natural scratching behaviour. For example,

G2P3 *"Cows with horns. I'm* [of] *two minds."*
G2P1 *"Naturally I suppose you'd want to keep them wouldn't you."*
G2P2 *"I think they'll hurt each other."*

Cow handling and care

Health. It was agreed by all groups that health and body condition monitoring were all important, though the cow may not see it that way. For example, when discussing vaccinations one participant described that: "*obviously she isn't aware of what that is, of what you are doing to her but if she was to be aware that the vaccination is for my benefit*" [G1P2]. This view also applied to hoof trimming as groups compared the stress of a standing chute versus a tilting chute:

G2P2 *"This one here I'm conflicted on because cows need their hoofs to be looked after but it's a bit of a terrifying way…"*
G2P3 *"Because we have a hoof trimmer guy come in and he has his nice one where he just lifts the leg up but… I'm not so sure about that one [points to a picture of a tilting chute]"*

End of life. When it came to end-of-life decisions, being killed on farm through euthanasia or mobile abattoirs was thought to be preferable, as this avoided transport to a slaughterhouse; however, these methods included the added stress of seeing the process happen to others: *"I'm going to choose to end my life now and I'll go to the mobile abattoir rather than going on a truck. But then I don't want to be seeing my friends being killed*" [G4P1].

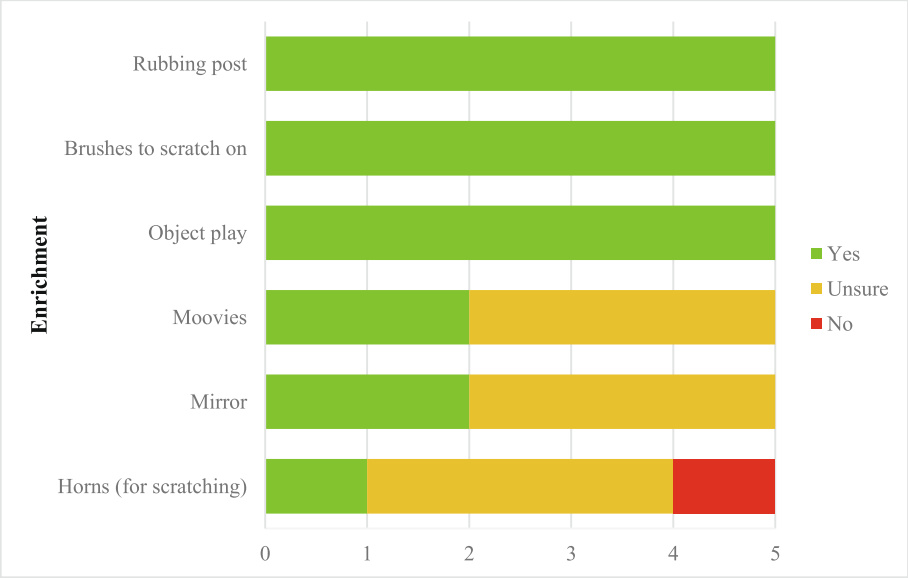

Fig. 6. Group (n = 5) preference for enrichment options. Green indicates cows would want this (e.g., included on farm design), orange (e.g., "I am indifferent about this") and red (e.g., "I definitely wouldn't want this").

Breeding. Breeding practices resulted in conflicting opinions from groups. For example, some groups were against artificial insemination (*"I wouldn't want a big guy with a big fat arm, AI. . .I'd be like hell no.*" – G2P1), whereas others believed it was preferable to natural breeding opportunities from bulls (*"You seen a bull. . ..? They're not always nice and they don't ask permission*" – G3P1). Finally, groups discussed how current management of breeding differs from natural cycles of cows coming into calf: *"if you left the bulls with the cow, they'd be having more calves more regularly than once a year potentially. What we do I don't think is necessarily any worse or better, it's just more controlled*" [G1P2].

Feed. Participants agreed that forage choice was important to cows, with options such as clover, silage, hay, herbs, and a variety of pasture species all viewed favourably. However, there was some disagreement on certain forage choices for ethical or health reasons. For example, some groups did not feel that waste food was an appropriate feed source for cows:

G1P1 *"Is it healthy for me?*".
G1P2 *"That's a good question, might not be very good. . ..*".
G1P1 *"No, the sugar.*".

Similar discussions were had in relation to palm kernel; for example, when discussing whether a cow would like palm kernel: "*as a cow, [it is] food. . .. if they knew where it came from, maybe not*" [G4P2].

Caretaker attitudes and animal handling. It was viewed that cows should be treated ethically by those that care for them; participants highlighted the necessity of cows' wants being considered when making management decisions. Additionally, it was thought that cows are often blamed for things that were the fault of humans, such as environmental damage or climate change. For example, *"to be quite honest humans probably have more to answer for than the odd cow. They just use me as a scapegoat*" [G5P1].

When it came to animal handling, farm vehicles for herding cows were not preferable: *"[cows] don't enjoy being chased. So, I'd say that's a dislike*" [G1P2]. Additionally, the use of dogs to herd animals was viewed negatively, though some participants remarked that it depends on the dog:

"These guys [referring to cows interacting with a dog in the picture] are really curious about this dog but I wouldn't want [the dog] running behind and yapping at me. Especially when I'm nine months pregnant" [G4P1].

Theme 2: Timeline to achieve cow-centric farm designs and sequence of implementation

When creating the implementation pathways (see example in Fig. 7), participants focused on: (1) "low hanging fruit", and (2) long-term investments. Additionally, participants discussed the magnitude of change that is possible in 50 years. For example,

G2P1 "*50 years is a long time. It's a huge amount of time.*"
G2P2 "*There's a lot of technology that we wouldn't have talked about 50 years ago.*"
G2P1 "*Exactly so if that's come that quick. . . 50 years. . .you can do anything.*".

"Low hanging fruit"

Some elements of the cow-centric farms were viewed as not difficult to achieve in the near future. For example, enrichment was thought to be "low hanging fruit" (i.e., changes that have perceived ease of implementation). As explained by one participant [G5P1]: *"we can start doing some things to improve their lives. . . we've got cow scratchers, we've got rubber bouncy balls, there's lots of little things. Maybe they don't bring us any money but perhaps they bring us happiness to watch the cows scratching on things.*".

While being a long-term outcome, planting of trees and diverse grass species was identified for easy and immediate implementation, which would allow them to become established over time. As one farmer described: *"start planting strategically and now otherwise we're not going to have anything in years to come*" [G4P2].

Animal and health monitoring were viewed as improvements that could be made in the near term. For example: "animal health improvements are things that probably a lot of us already do, a lot of farmers aren't and it's an easy thing that can be achieved" [G4P2].

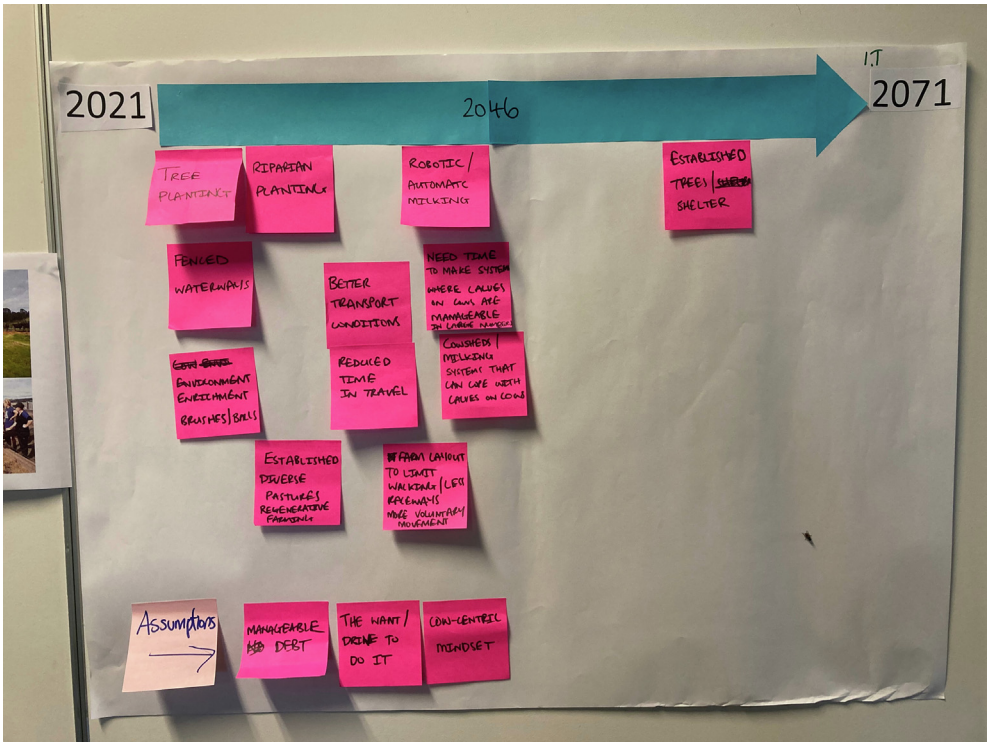

Fig. 7. An example of an implementation pathway for a cow-centric farm by one of the farmer groups (G1). On the left (2021), a 'business as usual' dairy farm was posted by the research team, and on the right (2071), the group posted their cow-centric farm design (e.g., Fig. 1). Groups were asked to think about when changes would happen on this time continuum, what assumptions would need to be made, the type of change needed (i.e., economic, social, structural) and who would need to be involved in this change. For example, this group identified tree planting as something that would need to occur immediately, while implementation of a robotic milking system could happen in a few decades. They made assumptions that the farmer would have to have manageable debt and a desire to implement a cow-centric farming system.

Farmers described that research is needed to support why and how to implement changes, as well as cow preference for the options presented. For example:

> G4P2 "*Over the next maybe five to ten years… identifying cows' preferences out of all these things that are being talked about here, to see what is going to be the best going forward and then… having evidence that there is a positive outcome.*"
> G4P1 "*It's all very well to give your cows a big variety of food, but is it actually the best thing for them? Like going to a party when you're a kid, you're going to eat all the lollies but not necessarily the best thing to do.*"

Long-term investment

Some elements of the farm designs were considered more difficult to implement. Infrastructure changes were thought to be long-term investments both in relation to the cost to build and the new designs needed. For example, when discussing cow-calf systems, one farmer described:

> *"Some of the bigger changes would be if we were to keep calves on cows, setting up systems in cowsheds that can cope with that so it's easily manageable. If you've got 600 cows and 600 calves together, there's just chaos in the cowshed… I think the technology is probably already there, it just needs someone to sit down actually want to design it because there's no demand for it really at the moment*" [G1P2].

Farmers were in favour of smaller herd sizes but recognised that this is in opposition to current farm trends. For example:

> G2P2 "*so this is the opposite of what farms have been doing, they're getting bigger and bigger, but I wonder if they could now…*."
> G2P1 "*Almost going backwards.*".

Cows having a choice was an important component of all farm designs: "a lot of our pictures on [the farm design are the] same as you guys, based on cows having a choice. A choice of [where] they want to go and do and us being able to provide them with the options of being able to keep cool in a stream or having a block of trees that they can go and hang out in for the day" [G4P2]. However, while some choice elements such as forage choice were viewed as easier to implement, participants also identified some structural and management changes that would be required.

> *"So that's going to take a while to get your systems changed so that you logistically can find a way that the cows can get from the palm kernel to the fodder beet to the clover and then the milking [parlour]*" [G4P1].

Theme 3: Assumptions and resources needed to achieve cow-centric farm systems

Assumptions and required resources to implement these changes were also discussed, including: (1) farmer buy-in, (2) financial considerations, (3) technology, (4) other stakeholder involvement, and (5) regulations and enforcement.

Farmer buy-in

Cow-centric farm systems would not be possible without the buy-in of farmers in the industry. For example: "a lot of these things don't happen because there's not a demand to make it happen but if every farmer was cow-centric then perhaps it would be happening a lot faster" [G1P2]. Additionally, this was reflected in comments regarding the need for farmers to care for their animals and how farmers' actions align with this need.

Financial considerations

The infrastructure or capital investment changes would require manageable current debt on the farm. Participants suggested that budgeting over several years would allow for large-scale changes:

> G2P1 "*we've all said that money would be an issue, but would it be over 50 years? If we made the right call and implemented things yearly, within 50 years I reckon we all could get there.*"
> G1P1 "*If your debt load is not too bad at the moment.*"
> G2P1 "*If we made small changes every year, 50 years is a long time.*"

Additionally, participants suggested that changing everything at once would result in production trade-offs that would impact the financial viability of the farm:

> *"A lot of those things we could literally do tomorrow, but it would mean that obviously our farm system may not be very productive... Because I mean we could leave calves on cows, we could plant a whole lot of trees tomorrow, we could take fences out...we could do all those things tomorrow, but our system is going to potentially collapse on us. We're not going to be profitable; we're not going to be farming for very long*" [G1P2].

Consequently, if farmers were to make changes, their product price would need to reflect that: *"we need to know we're going to get the money to make it all happen*" [G2P1]. However, it was discussed that in some cases large capital investments could result in long-term financial benefits: "*It's like that prevention better than cure thing, isn't it? It might cost you upfront but it's going to save you in the long run*" [G4P1].

Technology

Technology was viewed to be an important resource to ensure the implementation of cow-centric farms. Participants largely focused on the utilisation of existing technology. For example, *"most things are being thought about now and could actually be implemented in stages over the next wee while with those assumptions. So, I don't think anything is too difficult to get to, there's a lot of technology out there already*" [G1P2]. This view was also reflected in conversations about the decreasing cost of technology over time making it more feasible for individuals to implement.

Stakeholder involvement

Qualified advisors are needed to help achieve cow-centric farms, as well as industry outreach to train farmers in a cow-centric approach: *"I mean you need education and you need people that are passionate about agriculture to do those agricultural-type education courses, to then be able to go out and help others*" [G4P1]. Additionally, someone would need to lead the way in implementing a cow-centric farm design; for example, industry-run model farms or corporate farms, as they were viewed as being able to afford the perceived risk in implementing changes. However, caution was also expressed with such examples: *"You also need [average] farmers that are doing the changes, those that have got mortgages and pay tax and do it all themselves rather than farms that are run by a big corporate or something like that ...So we need to have farms that [are]...real farms*" [G4P1]. Additionally, cooperative farming was proposed to allow resources to be shared among several farmers.

Finally, it was discussed that one way to achieve cow-centric farms would be working with other industries, particularly the beef industry. For example:

> *"I went to [an event] centred around how beef farmers could be growing their animals better to get...better breeding values and... and I thought well, as a dairy farmer could I offer value by choosing high quality beef semen that... would provide quicker maturing animals with better intramuscular fat... There's probably an opportunity there... they may not have to go through the whole breeding cycle. We can speed it up for them*" [G2P3].

Regulations and enforcement

Regulations and enforcement were viewed as necessary to ensure successful on-farm changes. For example, transparency about management could be achieved by using cameras that could be viewed by third-party groups or the public, and a hotline could be implemented to report anonymous complaints:

> "*You could say if it was a high concern, like someone needs to go there now or just a low concern. But if they get rung up by five different people, they might need to go and check that out.... You see some cows and you think, "shit those are extremely skinny, is anyone even looking out for them, and I don't think they've been moved for five days*". *But you don't want to upset your neighbours, so you tend not to go and step on their feet. I would rather ring somebody*" [G2P2].

There are benefits and detriments of voluntary versus mandatory industry standards. For example, some participants felt that voluntary standards allowed them to differentiate themselves from their peers by applying higher standards to their own farms.

> *"If you mandate it, then you can sell that milk and say all farms do such and such because that is mandated, so you can get a premium for that. If you kind of jump too early, you're doing it for the common good but no one else is so they're like riding off the back of what you are doing, and I'd like it to be mandated because when it come[s to]...things like having to use pain relief for dehorning. No longer did I have to justify myself, economics versus what my heart feels, it just was the case, I just had to do it and it made it feel all okay*" [G2P2].

Discussion

The inclusion of animal sentience in laws and regulations in numerous regions around the world is an important signal to animal industries that management needs to consider how an animal experiences their life. The results from this study provide a reflection from a group of farmers on how current management practices in NZ's pasture-based dairy system align with, and differ from, what may be important from the cow's perspective. This knowledge subsequently provides insight regarding how industry practice could become more 'cow-centric' in the next 50 years. While the current study took place in NZ, we believe that the results can be used to inform discussions in other regions regarding the development of cow-centric dairy systems. NZ's pasture-based systems allow for grazing, arguably one of the most important natural behaviours a dairy cow is motivated to perform and yet the results of this study provide evidence that from farmers' perspectives, there is still room for improvement to achieve a cow-centric system.

While animal behaviour research is integral to understanding what the cow wants, including stakeholders, such as farmers, who have valuable knowledge of the animal in this discussion is pivotal. Through the utilisation of perspective-taking, practices identified as important to the cow (e.g., cow-calf contact, provision of choice and shelter) have been discussed as items of concern in previous research. For example, Brazilian members of the public were largely against the practice of zero-grazing and cow-calf separation, citing reasons of perceived negative welfare and loss of naturalness (Hötzel et al., 2017). Discussions with farmers however identify the practical limitations of changing such negatively

perceived practices (e.g., Neave et al., 2022). Thus, further research is needed to better understand how alternative practices can be achieved in a production setting; a concern echoed by participants in this study. While the use of perspective-taking allows us to better understand the farmers' perception of the cows' needs, further research is needed by asking the cow herself. Given farmers' deep knowledge of farm systems and their animals, we believe that our results can help guide future animal behaviour and welfare studies to further understand the experience of the cow. Participants identified numerous areas of consensus on the farm improvements, enrichments and practice changes that could contribute to improving a cow's life experience, however, these require science-based evaluation.

The resources needed to achieve cow-centric systems align with those in other studies. Wynands et al. (2021) found that time, money, and facility limitations were barriers to improving lameness management on dairy farms in the United States. Ritter et al. (2017) found that an individual farmer's beliefs and goals can influence decision-making regarding disease management programmes. Programmes or initiatives that allow for these resources or training to be provided to farmers could help facilitate the implementation of cow-centric systems. Participatory discussion groups with peer farmers have been shown to decrease somatic cell count (Dillon et al., 2016) and identify farm-specific goals while learning from peers (Vaarst et al., 2007). Ritter et al. (2020) found that collaboration between different stakeholders would be needed to best achieve future industry goals. Outreach may be particularly important for areas that participants in our study identified as "low hanging fruit", these included animal health monitoring, enrichment, and giving cows choice in their environment. Participants suggested that model farms or corporate farms could lead the way by providing examples to the wider industry, subsequently encouraging the uptake of practices. Therefore, we suggest these approaches could be considered by industry bodies, preferably with science-based monitoring to determine success.

Farmer participants in our study recognised that in some cases, there is a conflict between what is good for the cow and what she wants. For example, vaccinations and antibiotics were viewed to be disliked by cows, but ultimately beneficial for her health. While some handling and management practices can be aversive to cows, positive reinforcement training can be used to improve their association with these practices. Lomb et al. (2021) trained dairy heifers to voluntarily present for injections and reduced avoidance behaviours compared to a control treatment. Similarly, low stress handling and positive association with handlers had been shown to increase welfare and productivity (see review by Hemsworth, 2003). We suggest research examining positive reinforcement training to influence cow association to traditionally aversive, yet necessary practices (e.g., hoof trimming) would be influential for promoting future change.

Our study aimed to place participants 50 years into the future to encourage creative thought with less consideration for current barriers to change. Interestingly, while participants discussed creative practices such as cow conveyer belt systems, and pools (equipped with filtration systems), most of the discussion revolved around currently available technologies. Some cautioned that the cows may not appreciate all the technology that could be used (e.g., wearable tech may be too heavy); however, integration of technology was perceived as means of addressing some of the challenges faced when implementing a cow-centric system. Ritter et al. (2020) found that Canadian farmers considered technology to be pivotal to the future of the industry; in part due to the increasing difficulty in finding employees to work on farms or high turnover (Bitsch et al., 2006). In our study, caretaker-cow interactions were viewed from a different perspective; rather than viewing technology as the solution, most participants expressed a belief that for a farm to be cow-centric, it needed to allow for contact with the farmer who cares for them.

The study was a first step in better understanding what a cow-centric farming system may look like, and what farmers believe cows find important in such a system. Nonetheless, we caution that there are limitations to our work. First, most of the participants were part of a working group that regularly meet to discuss animal welfare. Given this, the participants in this study are likely progressive members of their community. While we believe that the thoughts expressed by participants are a valuable addition to the literature, we suggest future research engages a wider range of dairy farmers, both in NZ and in other dairy systems around the world. Additionally, farmers were in some cases unable to completely take the perspective of the cow and instead focused on practical limitations, a result that has been found in other studies (Ritter et al., 2020; Burton et al., 2012). Finally, the sample size of our study was small; however, the use of multiple data sources (transcripts, 'cow-centric farm designs', and 'implementation pathways') and participatory activities allowed for a more in-depth reflection from participants that would not be possible with other methods such as interviews or focus groups.

Conclusion

Designing a farm system that considers all stakeholder perspectives is vital to the sustainability of the industry; the cows in a dairy system are likely the most important stakeholder. Using social science methods to encourage farmers to reframe their thinking and take the perspective of the animal, we were able to better understand how the future of dairy farming can align with a cow-centric approach. Our participants were pasture-based farmers; thus, all groups started with an outdoor system and added various elements when they were envisioning what a cow might want. These elements included shelter from trees or fixed/portable infrastructure, access to cooling options (e.g., manmade ponds), various technologies and management options that promote choice (e.g., Automatic Milking System parlours, options for varied foraging, portable parlours or conveyor systems that reduce long walking distances), and environmental enrichment (particularly to promote scratching). Some farmers highlighted the need for small group size to reduce social stress, and the need to allow for maternal behaviour, if it worked with the personality of individual cows. The need for good health care created discussion amongst the groups, as most participants felt this was very important, but acknowledged the cows might not agree (e.g., vaccinations, hoof trimming). Other considerations included breeding (i.e., artificial insemination or natural), appropriate human care and attitudes (e.g., cautious use of herding dogs, importance of cows not being viewed as climate change and environmental degradation 'scapegoats') and caution regarding how technologies may impact cows (e.g., heavy collars). End-of-life considerations were important, with people opting for a mobile abattoir on farm to eliminate transport stress. To achieve a system which included these elements, farmers acknowledged that some changes could be done in the short term (e.g., health improvements, feeding diversity, enrichments) and others would need to happen over the long term (e.g., tree planting, technological options to handle changing herd sizes and managing cows and calves together). Factors required for change implementation included the necessity of farmer buy-in, planning for and spreading out the required financial investments, knowing which technology to invest in, guidance personnel and model farms, and regulations and/or enforcement. While the information presented needs to be explored from the cows' perspective, we suggest that the perspective-taking approach has gathered valuable farmer insight regarding what cows are likely

to want if a pasture-based dairy system were built around their needs. We are optimistic that others may apply a similar approach for different dairy systems around the world.

Supplementary material

Supplementary material to this article can be found online at https://doi.org/10.1016/j.animal.2023.100779.

Ethics approval

Study design and questions were peer reviewed and assessed (#15.21) as compliant with the AgResearch People and Agriculture Team ethical guidelines for research. Ethical approval of research that is low risk is not legally required in NZ.

Data and model availability statement

None of the data were deposited in an official repository. The data belong to AgResearch Ltd. and are not publicly available.

Author ORCIDs

Katelyn E. Mills: https://orcid.org/0000-0001-7296-9214.
Penny R. Payne: https://orcid.org/0000-0001-8215-1643.
Gosia Zobel: https://orcid.org/0000-0002-9883-9503.

Author contributions

Katelyn E. Mills: Conceptualisation, Methodology, Formal analysis, Writing – Original Draft, Visualisation. **Penny Payne**: Conceptualisation, Investigation, Resources, Data curation, Writing – Review and Editing, Project administration. **Katie Saunders**: Conceptualisation, Resources, Data curation, Writing – Review and Editing, Investigation, Funding acquisition. **Gosia Zobel**: Conceptualisation, Resources, Data curation, Writing – Review and Edition, Visualisation, Investigation, Project administration, Funding acquisition.

Declaration of interest

None.

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