Submission
No 25

PREVENTION OF CRUELTY TO ANIMALS AMENDMENT (VIRTUAL STOCK FENCING) BILL 2024

Organisation: Tasmanian Institute of Agriculture, University of Tasmania

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Committee on Investment, Industry and Regional Development
Parliament of New South Wales
Macquarie Street
Sydney
NSW 2000
AUSTRALIA

via online submission

SUBMISSION FROM TASMANIAN INSTITUTE OF AGRICULTURE ON THE PREVENTION OF CRUELTY TO ANIMALS AMENDMENT (VIRTUAL STOCK FENCING) BILL 2024

Background

The Tasmanian Institute of Agriculture

The Tasmanian Institute of Agriculture (TIA) is a joint venture between the Tasmanian Government and the University Tasmania. TIA delivers research, industry development and education for the agri-food industry of Tasmania, and from Tasmania to the world. The Livestock Production Center within TIA works to support Tasmania's standing as a global leader in environmentally sustainable and ethical grass-fed livestock systems. It does this through four broad programs; (1) Sustainable use of inputs, (2) Climate resilient feed-base, (3) Animal welfare and social acceptance, (4) Mitigation of greenhouse gas emissions. TIA's virtual fencing (VF) research cuts across the four programs of the Livestock Production Centre.

TIA's experience with VF technology in intensive grazing systems

In 2016 the Australian Government supported a nationally collaborative project titled 'Enhancing the profitability and productivity of livestock farming through virtual herding technology' through its Rural R&D for Profit program. TIA delivered research to this project assessing the application of the eShepherd VF technology to intensive grazing systems. This body of work includes experiments that scientifically examined factors that affect the ability of dairy cows to learn the association between the audio and electric stimuli (Verdon et al., 2020, Verdon and Rawnsley, 2020), was the first to assess the application of VF to strip-graze lactating dairy cows (Langworthy et al., 2021; Verdon et al., 2021), and the first to use virtual-fencing to cell graze angus beef cattle with front and back-fences (Verdon et al., 2021).

Recent years has seen New Zealand agri-tech company Halter emerge as a commercial leader in VF technology for intensive grazing systems. Halter has been deployed on nearly 20% of the Tasmanian dairy herd in under 2-years. Over 200,000 New Zealand dairy cattle are managed with Halter. In 2023, TIA conducted the world's first research into Halter VF technology (Verdon et al., 2024) including an assessment of cattle welfare under Halter management (un-published). We are continuing to collaborate with Halter to quantify the impact of this technology for Tasmania's beef and dairy industries.

TIA is now considered a global leader in the application of VF technologies to manage intensive grazing systems, and Tasmania is leading the nation in the commercial uptake of this technology. TIA remains the only research provider to have studied the application of VF to intensive grazing systems (e.g., lactating dairy and rotational/cell grazing). Our research has focused on the welfare of cattle managed by VF. We draw on this experience, and on the experience of broader Tasmanian livestock community, in this submission to the Committee considering the NSW Prevention of Cruelty to Animals Amendment (Virtual Stock Fencing) Bill 2024.

Nuances in the application of VF technology to different grazing systems

The application of VF to intensive grazing systems is distinct from its application to more extensive systems. Cattle in intensive grazing systems are kept at higher stocking rates, graze more vigorously, are frequently moved across the pastoral landscape, and are typically more habituated to humans. There are also differences between cattle types within intensive livestock systems. Dairy cattle are hand-reared from birth, are experienced with electric fencing, and are managed according on a consistent routine (e.g., moved from the paddock and along familiar laneways to the dairy for milking, and provided fresh pasture multiple times per day).

The nuances between systems requires discussion because they affect (1) the application of VF technologies, (2) how animals interact with the technology, and hence (3) animal welfare outcomes.

For example, TIA observed the development of abscesses and swellings on the necks of dairy and beef cattle after applying a VF technology designed for cattle in extensive systems to intensive grazing systems (Verdon et al., 2021a, 2021b). We suggest that these neck injuries were caused by the design of the prototype studied in combination with differences in the morphology, grazing behaviour, and management of cattle in intensive dairy compared with extensive beef systems. The same challenges were not observed when the same prototype was applied to extensively managed cattle and have not been observed when a different technology designed for intensive systems was applied to an intensive system.

Despite the differences between intensive and extensive livestock systems, and between dairy and beef animals, most VF technologies have been designed with large extensive beef grazing systems in mind. Consequently, most research applies to these systems and animals. TIA's experience suggests that VF technologies, and research on these technologies, should not be considered transferrable across systems unless their application across systems has been demonstrated.

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Virtual fencing in intensive grazing systems

In this submission we refer to virtual fencing as when cattle are held within a specified pastoral area or grazing zone ('inclusion area') via the VF technology. We assume in this submission that the Committee has a foundational knowledge of how VF technology works including the relationship between audio and electrical stimuli.

Cattle quickly learn to respond to the cues delivered by VF technology. The principles of virtual fencing are like those of electric fencing, except the visual cue of the fence is replaced by an audio cue. Angus and dairy cattle learn the association between audio and electrical stimuli within 3-5 interactions (Langworthy *et al.* 2021; Verdon et al., 2021a; Campbell et al., 2019), which is comparable to how many interactions are required to learn electric fencing (Verdon et al., 2020; Martiskainen et al., 2008). In dairy systems, prior experience with electric fencing (Verdon *et al.* 2020) and training animals close to adult age compared to ages less than 12-months (Verdon and Rawnsley 2020) results in faster learning of the audio/pulse association. There is no evidence in the dairy literature or from commercial dairy experience that a proportion of dairy cows fail to learn the association between audio and electrical stimulus.

After the learning period, VF is effective at maintaining cattle to an area of pasture. Langworthy *et al.* (2021) found a prototype of the eShepherd was 99% effective at managing grazing dairy cows off a fresh break of pasture, even when their allocation became depleted. This study also found uniform pasture utilisation within the inclusion area (i.e., the area where cows were able to move freely), indicating that cows did not avoid grazing near the virtual fence. Cows in this study received an average of 2 electric pulses per day with a pulse:audio ratio of 0.18. In other words, cows received a pulse in 18% of their interactions with the virtual fence.

The Halter VF technology see a lower ratio of pulse:audio cues than that reported by other technologies. Halter includes features that were not present in other technologies, such as a 'beeping' audio cue that increases in frequency the closer the cow gets to the virtual fence, a bi-directional audio signal that is delivered to by the left- or right-hand side of the device depending on whether the animal needs to move to her left or right to re-enter the inclusion area, and an algorithm that uses machine learning to determine the minimum electric pulse required to produce a response for an individual animal. TIA research found that dairy cows received a pulse in 4-5% of their interactions with the VF during training to Halter, and this reduced to 1% over the subsequent 4-weeks (Verdon et al., 2024).

That only simple grazing regimes have been studied is a limitation of the VF research literature. Aside from Verdon et al. (2021a), moving fence-lines or back-fencing has not been included in research. The application of Halter to beef cattle has also not been studied, although TIA has recently commenced a project to examine this.

VF technology should never be used in ways that compromise the animal's ability to avoid interacting with the fence, such as containing animals in very small areas, at very high stocking densities, with tight angles. The same is true for electric fences. It is recommended that the technology includes safeguards to prevent these misuses.

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Remote shifting also needs to be considered

All commercially available VF technologies enable cattle containment at pasture, but Halter is the only product that includes a function to shift cattle from one location to another. This function is not comparable to using VF technology to 'muster' cattle in extensive management systems. Research has demonstrated the difficulties in actively herding cattle under extensive conditions (Campbell et al., 2021).

In dairy systems, Halter's remote shifting function actively moves cows from the paddock to the milking shed and/or to a new pasture allocation. Some principles of Halter's virtual fencing function apply to remote shifting. For instance, in both functions a sound cue guides the animal in the correct direction, with delivery of an electric pulse if the sound is ignored. The remote shifting function, however, includes a third vibration stimulus. A longer vibration alerts the animal to pending changes in conditions, such as a shift to the milking parlor or to a new pasture allocation. The collar device also vibrates when a cow stops walking on the laneway as she moves to the dairy. If the cow re-commences walking the vibration ceases. If she stays stationary the intensity of the vibration gradually increases over 30 s period, followed by the electric pulse.

Importantly, the roles of the 3 sensory cues do not overlap i.e., different cues are never given at the same time. The sound cue's role is to guide cows to the correct direction. Once in the correct direction, the vibration keeps them moving forward. The electrical stimulus is only used if an animal ignores a sound or vibration cue.

Producers need to be taught how to support their cows while training in remote shifts, or otherwise the technology developer needs to have a representative manage the training process. Support includes the presence of familiar stockpeople conducting familiar routine handling practices. Typically, cows are moved as per normal commercial practice for the first few days of training, with the stockperson gradually removing pressure and allowing the cows to rely on the technology. This training regimen has been developed and refined through commercial experience gained from training hundreds of thousands of cattle to remote shifts and aligns with the published research on how cattle learn.

TIA's research shows that dairy cows quickly learn Halter's remote shifting function (Verdon et al., 2024). By day 4 of training cows were relying solely on technology during shifts from the paddock to the milking parlor. By the end of the 6-week experiment, the median cow received 0.15 pulses per day during remote shifts and nearly 40% of cows received zero pulses over the entire week. This research, in combination with the commercial experience of dairy farmers using Halter, proves that dairy cattle can learn complex tasks such as remote shifting.

In TIA's research, human error was a bigger risk to a high pulse then technical malfunction. Specifically, on 3 occasions a gate or temporary electric fence was not opened in time for cows shifting to the milking parlor. The occurrence of these events highlights the importance of safeguards that identify times where animals are failing to respond to the guidance cues and disables their delivery. This specific safeguard has since been implemented by Halter.

Remote shifting has been studied at the herd level and has not been applied to individuals or sub-groups within a herd. Cattle are gregarious species with strong herding instincts. Research has shown that the motivation for social reinstatement is strong enough for previously VF trained angus heifers to ignore the cues delivered by a VF technology (Verdon et al., 2021). We recommend the animal welfare implications of controlling movement of only a proportion of the group be validated before the technology is permitted for this use. At present, the drafting of individual animals using the remote shifting function should not be permitted.

Animal welfare in VF management systems

Timeframes are important in the assessment of animal welfare in VF systems. Cattle need to receive a pulse to learn the association with the audio cue. Electric shock is a short but painful and aversive cue. Thus, short-term stress is expected during the period where cows are learning the association between audio and electrical stimuli. As a single event an electric shock presents a relatively minor and acute risk to animal welfare. Ensuring fast and effective associative learning is key to providing cows with control over the receipt of electric shock thereby reducing the number of shocks received and the duration of the stress response.

Evidence across grazing systems consistently indicates that cattle quickly learn the association between audio and electric cues when held behind a virtual boundary at pasture, and typically within 3-5 interactions. A recent study of Halter found dairy cows received a pulse in 61% of interactions during their first 7 h with the technology, compared to 16% over the following 7 h (Verdon et al., 2024). Most cows received < 10 pulses on the first day of training in this study, which reduced to < 1 pulse/day for the remainder of the training period.

It took cows 4-days to learn to rely on the cues from VF technology during remote shifts. Remote shifting requires cattle to be guided to a specific location using sensory cues, which is a more complex task than learning to avoid an area while being held in zone. Despite the complexity of the task, the pulse:sound cue ratio during training to remote shifts using Halter was lower than when cows were held behind a virtual front-fence in previous research with other VF prototypes.

The predictability and controllability of electric shock is more important to animal welfare than the receipt of a shock per se. Environments that lack predictability and/or controllability are chronically stressful, regardless of whether the learning of the association between the audio cue and electrical stimulus has been effective.

Activation of the physiological stress pathways are detected through measurements of the hormone cortisol in biological samples such as blood, feces, saliva, and milk. In the study of animal welfare these measures must be considered in conjunction with changes in behaviour (e.g., grazing, ruminating, or lying time) and other indicators of physical health and function (e.g., illness, reproduction, milk yields, weight changes).

Behaviours indicative of a high aversion to the stimuli delivered by the VF devices have not been observed by any research (e.g., lunging, lifting, and shaking heads, bawling). The most frequent response of cattle to the cues delivered by VF is to turn and continue grazing.

There is no evidence of increased stress in the days or weeks post-VF training when the fence is (mostly) in a fixed location (Campbell et al., 2019, Hamidi et al., 2022, Sonne et al., 2022). A study by TIA placed dairy cows in a new paddock with a new virtual fence every 24-h. It found no change in cow behaviour or physiological stress in the 3-days following implementation of the technology, but there were indications of increasing stress and behavioural disruption from days 4-6. Ultimately the study's limited duration prevented conclusions on cow welfare beyond day 4 (Verdon *et al.* 2021).

A more recent TIA study compared the welfare of dairy cattle managed with Halter technology over 6-weeks (Verdon, unpublished data). Four groups of cattle were studied, with 40 animals in each group. Two groups were managed with Halter for virtual fencing and remote shifting. The other two groups were managed with electric fencing and a stockperson on a UTV brought animals to the dairy. The data presented here has not yet been subject to peer-review, but results suggest no difference between VF and conventional management systems in terms of milk production, cow body condition and live weight, or the response of cows to an approaching human. The Halter managed cows spent 5% (~20 mins) less time grazing/day, but this was of practical insignificant as there was no difference in pasture utilisation, milk production or rumination time.

The study also took 2,500 milk samples for a detailed assessment of milk cortisol concentrations. These samples are still being analysed. Preliminary data can be available to the Committee upon request by June 2024.

The research detailed above suggests that the welfare of cattle managed with VF technology is comparable to cattle managed conventionally, in both intensive and extensive grazing systems. To maintain this, the application of the technology must ensure the receipt of electric shock is predictable and controllable. For example, spatial and temporal consistency in the location and movements of the virtual boundary may be particularly important if VF is to be used to implement increasingly intense or complex grazing regime. There should also be a minimum space allowance provided to cows managed with VF which accounts for GPS error and ensures the animal can actively always avoid a pulse.

Animal welfare is a nuanced discipline. Its assessment in VF systems needs to consider indirect opportunities for benefits as well as harms, and the trade-offs between the two. Anecdotal evidence suggests there may be indirect benefits of VF to cow welfare, including a reduced risk of fear associated with being pushed by a stockperson on a bike/UTV or with a dog, of lameness caused by impatient stock handling on the laneway, of an improved human-animal relationship, and the enabling of a more natural social structure during movement. These potential benefits are logical but have not been scientifically proven. TIA is currently working with dairy farmers across Tasmania to quantify the potential indirect benefits of VF to cattle welfare.

Conclusion

VF technology can deliver environmental, social, and economic benefits to grazing livestock

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systems. However, new technologies such as VF must demonstrate preserved or improved animal welfare in these systems. There is no evidence in the scientific literature that VF negatively affects animal welfare, however, further research on more complex grazing systems is required. VF technologies must reduce the risk of deliberate or accidental use of their product via user training, safeguard mechanisms built into the technology, and by maintaining oversight over the application of their product.

Kind regards

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