VIRTUAL FENCING: PUSHING THE BOUNDARIES OF LEGAL LIVESTOCK FENCING IN THE UNITED STATES

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ABSTRACT

Agritech is constantly developing to improve the efficiency and output of agriculture, and now VF has entered the chat. Virtual fencing (VF) technology is designed to track and contain animals through the use of global positioning systems. VF is currently being researched, developed, and sold by commercial companies in numerous countries for use with livestock in the agriculture sector. Due to the fact that VF is emerging technology, U.S. federal and state law do not currently address it, leaving farmers unsure of their legal risks in utilizing it. The wealth of benefits that VF offers to livestock, wild animals, farmers, and the environment will likely cause its use around the world to increase greatly over time, inevitably creating friction with existing fencing and property law. In the

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United States, provisions regarding VF should be adopted into state codes to create legal certainty in its use. Government agencies should create VF incentive programs and encourage the use of VF on both private and public lands. In the meantime, farmers and landowners should protect themselves from liability by entering into written, recorded fencing agreements with adjacent landowners concerning the use of VF and the use or non-use of physical fencing.

I. INTRODUCTION

On an unseasonably warm day in early November, a small herd of goats ruminate happily in the tall grasses next to the gravel road at Grass Belly Farm atop the Des Moines River valley in Boone County, Iowa. "We've had numerous people stop to make sure we know our goats are out," herd owner Meghan Filbert says.[1] "When I tell them they're not out, they are actually contained by virtual fence, they say, 'Oh! Cool!'"[2] Meghan is the Adoption Program Manager in the United States for Nofence, a virtual fencing (VF) company.[3] The goats sport new age-looking collars which keep them contained within an invisible boundary on their farm.[4] "We have no perimeter fencing here," Meghan explains.[5] In rural Iowa where people are accustomed to informing neighbors of their escaped livestock, it is no surprise that people are confused when livestock are not separated from the road by any visible fencing. Meghan says she had been following the VF industry for years before she invited representatives from Nofence to speak at a conference in central Iowa.[6] "While they were giving their presentation, I mean me and all of the farmers in the room are just sitting there . . . there's this buzz of energy like, 'Oh my gosh, it's becoming a reality, it's really happening.'[7] We've been talking about it for years. We kind of thought it was like sci-fi, but it's actually here."[8]

VF technology is being developed to track and contain animals through the use of global positioning systems (GPS).[9] VF differs from conventional physical

1. Interview with Meghan Filbert, Adoption Program Manager, USA, Nofence, in Pilot Mound, Iowa (Nov. 9, 2022) (on file with author).

2. *Id.*

3. Virtual Interview with Meghan Filbert, Adoption Program Manager, USA, Nofence (Nov. 16, 2022) (on file with Drake Journal of Agricultural Law).

4. *Id.*

5. Interview with Meghan Filbert, *supra* note 1.

6. Virtual Interview with Meghan Filbert, *supra* note 3.

7. *Id.*

8. *Id.*

9. *Automated Farming: Virtual Fencing*, FUTURE LEARN (Jan. 14, 2024, 11:22 PM), https://www.futurelearn.com/info/courses/revolutionising-the-food-chain/0/steps/170931 [https://perma.cc/FK2Q-55YM].

fencing in that it does not rely on physical materials such as posts and wires to create a boundary to contain an animal.[10] Through a mobile or computer application, a farmer can create "fence" boundaries on the land in which they would like to contain their livestock.[11] The farmer can open the application and change the boundaries at any time.[12] The livestock are outfitted with collars that include GPS tracking devices that remit information into a cloud database.[13] When the livestock get close to any boundary set by the farmer, the collars emit a series of warnings: first, a sound cue, and second, a mild electric pulse.[14] The livestock begin to associate the audible cues with the electric pulses, and in an effort to avoid them, learn to turn and move away when they hear the sound cue.[15]

The four largest developers of VF systems are Nofence, based in Norway; Vence, based in the United States; eShepherd based in Australia; and Halter, based in New Zealand.[16] Although the effects of VF on animals and the environment are still being studied, the initial data shows benefit to both.[17] In addition to these

10. *Virtual Fencing as a Climate Adaptation Strategy,* U.S. DEP'T OF AGRIC. CLIMATE HUBS (Mar. 2, 2024, 11:28 AM), https://www.climatehubs.usda.gov/hubs/international/topic/virtual-fencing-climate-adaptation-strategy [https://perma.cc/N4B2-UCL3].

11. Kaaren Latham, *Virtual Fences to Improve Labour Efficiency for Farmers*, NSW FARMERS (Jan. 2019), https://www.nswfarmers.org.au/NSWFA/Posts/The_Farmer/Innovation/Virtual_fences_to_improve_labour_efficiency_for_farmers.aspx [https://perma.cc/2RYH-8KV2].

12. Hallie Golden, *With Virtual Fencing, Ranchers Can Herd Cows from a Computer*, CASCADE PUB. MEDIA: CROSSCUT (Aug. 18, 2022, 4:40 PM), https://crosscut.com/environment/2022/08/virtual-fencing-ranchers-can-herd-cows-computer [https://perma.cc/EPY5-Q466].

13. Univ. of Cal. Agric. & Nat. Res., *Virtual Fencing to Herd and Exclude Cattle,* YOUTUBE (Mar. 3, 2021), https://www.youtube.com/watch?v=q0u7_Lq818c&t=38s [https://perma.cc/4TXY-GU9N].

14. Golden, *supra* note 12.

15. RAY KING, DAIRY AUSTL., RURAL R&D FOR PROFIT PROGRAM 5 (2020), https://cdn-prod.dairyaustralia.com.au/subtropical-dairy/-/media/project/dairy-australia-sites/national-home/resources/2021/02/15/virtual-herding-project-final-report/rural-rd-for-profit-final-report-vh-project.pdf?rev=49b9a726ef72427b82205e5f4e72838c [https://perma.cc/LNP3-YRZP].

16. *Automated Farming: Virtual Fencing*, *supra* note 9; *Unlocking More Productive and Sustainable Farming*, HALTER (Jan. 14, 2024, 11:38 PM), https://halterhq.com/how-halter-works [https://perma.cc/JQ3W-4EG8].

17. *See* Gilda V. Bryant, *The Future of Virtual Fencing*, PROGRESSIVE CATTLE (Oct. 24, 2019), https://www.agproud.com/articles/53938-the-future-of-virtual-fencing [https://perma.cc/G56S-HWVF]; F. Riesch et al., Univ. of Göttingen, Real-World Applications for Virtual Fences –What Are Potential Benefits for Conservation? Poster

benefits, VF has the potential to cut labor and costs for farmers.[18] There are few downsides of VF, but some challenges to be discussed and improved upon are effects on animal welfare, weaknesses in the technology, and the potential loss of ranching and cowboy jobs.[19] Since VF is only recently commercially available, fencing laws in the United States do not yet provide for VF explicitly, which can deter livestock farmers from buying into the technology.[20] To promote the use of this beneficial technology, states should amend fencing statutes to expressly include VF as legal fences for certain uses. Additionally, federal and state government agencies, such as the USDA's Natural Resources Conservation Service (NRCS), should provide incentives to farmers to encourage the use of VF.[21] This Note discusses these benefits and detriments and explores the legal aspects and issues posed by the use of VF.

II. BACKGROUND AND HISTORY OF VIRTUAL FENCING

Research into VF for livestock began in the late 1980s.[22] VF has been developed with an eye toward livestock farmers and a goal of benefiting farmers, their livestock, the livestock market, and the environment.[23] The basic concept of most VF systems involves the use of technologies such as the Internet of Things (IoT), the Long-Range and Wide-Area Network (LoRaWAN), radio frequency

Session from the XXIV International Grassland Congress / XI International Rangeland Congress Theme 3-2: Livestock Production Systems 3 (Oct. 2021), https://uknowledge.uky.edu/igc/24/3-2/17 [https://perma.cc/3P5N-C895].

18. Riesch et al., *supra* note 17, at 1.

19. *See* Caroline Lee et al., *A Framework to Assess the Impact of New Animal Management Technologies on Welfare: A Case Study of Virtual Fencing*, FRONTIERS IN VETERINARY SCI., Aug. 21, 2018, at 1, 1–5; Michael Elizabeth Sakas, *Virtual Fences May Help Cows Have Less of an Impact on Climate Change*, NAT'L PUB. RADIO (Oct. 19, 2021, 5:08 AM), https://www.npr.org/2021/10/19/1047223179/virtual-fences-may-help-cows-have-less-of-an-impact-on-climate-change [https://perma.cc/B2Q6-TLS2].

20. *See* Rusty W. Rumley, *States' "Fence Law" Statutes*, THE NAT'L AGRIC. L. CTR. (Sept. 2021), https://nationalaglawcenter.org/state-compilations/fence-laws/ [https://perma.cc/5FTZ-RWQW].

21. *Id.*

22. Yijie Xiong & Mitch Stephenson, *Technical Note: Where Are My Cattle at? – Part II: Virtual Fencing*, UNIV. OF NEB.-LINCOLN: BEEF (July 1, 2022), https://beef.unl.edu/beefwatch/2022/technical-note-where-are-my-cattle-%E2%80%93-part-ii-virtual-fencing [https://perma.cc/F73L-6Z7S].

23. *Researchers Deploy Virtual Fencing Technology to Improve Grazing and Water Quality,* OKLA. STATE UNIV. (June 24, 2021), https://news.okstate.edu/articles/agriculture/2021/ellis_virtual_fencing.html [https://perma.cc/B9C8-M8UU].

(RF), and GPS.[24] VF uses livestock collars enabled with these technologies to communicate with and store information in a cloud database for use by the farmer.[25] Each commercial VF system operates slightly differently and has unique strengths and weaknesses.[26]

Nofence was formed in 2011 and is a developer of VF based in Norway.[27] The company has since conducted market pilot projects in Europe and is currently initiating pilot projects in the United States.[28] Initially, Nofence focused on the development of VF for goats but has now expanded to include collars for sheep and cows.[29] Nofence collars are solar-powered, have rechargeable lithium batteries, and sport Bluetooth, GPS, and motion sensors.[30] There are two collar sizes: the larger is for use with cattle and the smaller for use with sheep and goats.[31] Nofence uses cellular networks to communicate with their application.[32] Therefore, in order to receive notifications and updates from the collars, cell service coverage in the pasture is required.[33] Nofence's mission is to bring modern technology and traditional farming together to create a "virtual fence system for grazing animals, improving agriculture and the environment all at once."[34]

24. Xiong & Stephenson, *supra* note 22.

25. Univ. of Cal. Agric. & Nat. Res., *supra* note 13.

26. *See About Us*, NOFENCE (Jan. 14, 2024, 11:42 PM) [hereinafter *About Nofence*], https://www.nofence.no/en/about-us [https://perma.cc/2X3J-WJ2S]; *About Vence*, MERCK ANIMAL HEALTH (Jan. 14, 2024, 11:43 PM), https://vence.io/about [https://perma.cc/M8K9-49HW]; *eShepherd Instantly Adaptable Virtual Fencing for Cattle Ranchers*, GALLAGHER (Jan. 14, 2024, 11:44 PM), https://am.gallagher.com/en-US/new-products/eShepherd [https://perma.cc/LYC8-49WH]; *Unlocking More Productive and Sustainable Farming, supra* note 16.

27. *Contact Us*, NOFENCE (Jan. 12, 2024, 11:47 PM), https://www.nofence.no/en/contact-us [https://perma.cc/HGZ3-TLHY].

28. *About Nofence*, *supra* note 26.

29. *Id.*

30. *Get to Know Our Products*, NOFENCE (Jan. 14, 2024, 11:47 PM), https://www.nofence.no/en/products [https://perma.cc/PM6E-UN4Z].

31. *Id.*

32. *Id.*

33. *Id.*

34. *About Nofence*, *supra* note 26.

Vence is a privately held VF company based in the United States.[35] It was recently acquired by Merck Animal Health, a division of Merck & Co., Inc.[36] Vence's VF technology is available to farmers in the United States and in parts of Australia.[37] Their mission is to increase the sustainable production of animal protein while using fewer resources.[38] This, they hope, will aid in producing enough food for the world's rapidly growing population in the future.[39] Vence is currently restricted to use with cattle and has historically worked only with large scale operations of 500+ head of cattle.[40] Unlike Nofence's system, Vence does not rely on cellular service for its VF system, but instead uses a system involving solar-powered base station towers on the pastureland that create a RF network that communicates with the collars.[41] Vence claims the use of its technology can cut farm labor costs by more than 25% and that customers can see up to 30% cost savings when they rotationally or strip graze their herds using VF.[42]

eShepherd is Australia's primary VF technology developer and is owned by Gallagher, a large animal management and electric fencing company.[43] eShepherd is a solar-powered, GPS-enabled neckband.[44] Before Gallagher bought eShepherd, Agersens, a Melbourne-based agritech startup, was producing eShepherd in partnership with the Australian government agency, the Commonwealth Scientific and Industrial Research Organisation (CSIRO).[45] eShepherd technology has been heavily researched and has a special focus on animal welfare.[46]

35. *Merck Animal Health to Acquire Vence*, BUSINESSWIRE (Sept. 22, 2022, 7:30 AM), https://www.businesswire.com/news/home/20220922005501/en/Merck-Animal-Health-to-Acquire-Vence [https://perma.cc/79W5-44QQ].

36. *Id.*

37. *Id.*

38. *About Vence*, *supra* note 26.

39. *Id.*

40. Whitney Haigwood, *Virtual Fencing for Beef Cattle*, FARMPROGRESS (Apr. 5, 2023), https://www.farmprogress.com/livestock/virtual-fencing-for-beef-cattle- [https://perma.cc/A99P-PNAL].

41. iSelectFund, *Vence: Streamlining Ranch Operations with Smart Livestock Management*, YOUTUBE (Sept. 24, 2021), https://www.youtube.com/watch?v=WPEH6nTtXDM [https://perma.cc/2S7E-RHM8].

42. Haigwood, *supra* note 40.

43. Bill Gallagher, Sr., *About Gallagher Animal Management*, GALLAGHER (Jan. 14, 2023), https://am.gallagher.com/en-US/About-Us [https://perma.cc/E8FF-GDRB].

44. *eShepherd Instantly Adaptable Virtual Fencing for Cattle Ranchers*, *supra* note 26.

45. Latham, *supra* note 11.

46. *Id.*

Halter, based in New Zealand, is also focused on animal welfare and has developed and patented certain algorithms, which the company calls "Cowgorithm," which translate animal behavior into usable information for farmers.[47] Halter offers three packages which include features such as scheduled herd movement, the ability to allow only certain chosen cows to cross a VF boundary, and LED collar lights to help farmers locate which cattle they have selected on the app.[48] Halter is currently in use by farmers on small and large farms across New Zealand.[49]

III. BENEFITS OF VIRTUAL FENCING

A. Environmental Benefits

VF technology has the potential to produce significant environmental benefits, including improved soil health, riparian and water health, disaster prevention and post-disaster care, and private land management.[50] For millennia, the relationship between animals and their environments facilitated and balanced itself.[51] However, as the human population has grown, our overuse and exploitation of the environment has begun to take serious tolls on the Earth.[52] One such overuse is the overgrazing of livestock.[53]

Overgrazing occurs when intensive livestock grazing (meaning grazing for an extended time or without recovery periods) weakens and destabilizes the roots

47. *Unlocking More Productive and Sustainable Farming, supra* note 16.

48. *Our Packages: Flexibility to Suit Your Form*, HALTER (Jan. 23, 2024, 10:05 AM), https://www.halterhq.com/our-packages [https://perma.cc/4PMQ-FAVT].

49. *See Farmers Leading the Future*, HALTER (Jan. 14, 2024, 11:56 PM), https://halterhq.com/halter-farmers [https://perma.cc/GZ7W-DZF6].

50. *See The Benefits of Virtual Fencing Technology when Integrating Livestock into Arable Systems,* PRECISE MAGAZINE (June 15, 2022), https://precisemag.net/the-benefits-of-virtual-fencing-technology-when-integrating-livestock-into-arable-systems/ [https://perma.cc/V5TF-VRYJ]; Chad S. Boyd et al., *Virtual Fencing Effectively Excludes Cattle from Burned Sagebrush Steppe*, 81 RANGELAND ECOLOGY & MGMT. 55, 55–62 (2022); *Virtual Fencing for Increased Livestock Management Flexibility on Nevada Rangelands,* NEV. AGRIC. EXPERIMENT STATION (Jan. 15, 2024, 12:00 AM), https://naes.unr.edu/research/project.aspx?GrantID=785 [https://perma.cc/X8GD-N42D].

51. *See generally Virtual Fencing for Increased Livestock Management Flexibility on Nevada Rangelands*, *supra* note 50.

52. Donovan Alexander, *11 Important Ways that Humans Impact the Earth's Environment*, INTERESTING ENG'G (Mar. 1, 2023, 4:48 PM), https://interestingengineering.com/science/11-ways-humans-impact-the-environment [https://perma.cc/W4C2-7F6V].

53. *Virtual Fencing as a Climate Adaptation Strategy, supra* note 10.

of the plants, which then decompose.[54] The weakness and lack of roots loosen the soil and reduce soil quality.[55] Overgrazing damages soil health by not allowing plants to fully recover after being grazed.[56] This slows regrowth, throws off nutrient balance, and can lead to soil erosion.[57] Healthy and sustainable grazing exists when the relationship between livestock and the land is mutually beneficial.[58] In this ideal relationship, the land provides the livestock with the sustenance and nutrients they need to maintain healthy lives and the livestock provide nutrients to the soil through manure.[59] Livestock also provide the helpful service of cutting back excess plant growth, which is necessary for healthy regeneration.[60]

VF helps to facilitate a healthy grazing of land in numerous ways.[61] VF can aid in moving cattle across the landscape, which, when facilitated by a farmer, is called rotational grazing.[62] Rotational grazing is a method by which livestock are moved periodically from pasture to pasture so that they do not graze one area to its detriment.[63] This allows the empty pastures to rest and regenerate until the herd is brought back to graze it again.[64] Carrying out rotational grazing and exclusion zones within pastures through the use and movement of physical fencing demands considerable labor and cost from farmers.[65] With VF, farmers can easily move their herd from pasture to pasture without having to move any physical fencing or even be present onsite.[66] Rotational grazing benefits the environment by promoting

54. *Id.*

55. *Id.*

56. *Id.*

57. *Id.*

58. *See* Savannah Bertrand et al., *The Climate and Economic Benefits of Rotational Livestock Grazing*, ENV'T. & ENERGY STUDY INST. (May 3, 2022), https://www.eesi.org/articles/view/the-climate-and-economic-benefits-of-rotational-livestock-grazing [https://perma.cc/4PUY-TJTL].

59. *The Benefits of Virtual Fencing Technology when Integrating Livestock into Arable Systems, supra* note 50.

60. *Id.*; Jason Blevins, *Colorado Ranchers Moove into The Future with Virtual Fences That Help Sustain Public Grasslands*, THE COLO. SUN (Sept. 28, 2022, 2:38 PM), https://coloradosun.com/2022/09/21/virtual-fencing-bureau-of-land-management-colorado/ [https://perma.cc/PAN3-NPTG].

61. *Virtual Fencing as a Climate Adaptation Strategy, supra* note 10.

62. *Id.*

63. Riesch et al., *supra* note 17, at 1.

64. *Id.*

65. *Id.*

66. *Virtual Fencing as a Climate Adaptation Strategy, supra* note 10.

pollinators, allowing the shelter and movement of wildlife, and by strengthening biodiversity by allowing plants to grow, flower, and seed.[67]

Additionally, VF can allow livestock to gain access to areas they normally would not have access to due to the topography of the land.[68] This is especially true in places with aggressive terrain, like Norway, where, in many areas, steep fjords and rocky cliffs prevent the installation of physical fencing.[69] Many places where goats and sheep are happy to graze, humans are not able to access due to physical obstruction or danger.[70] Physical fences are also difficult to install in wetlands, on rocky or frozen ground, and over streams and waterways.[71] VF gives livestock access to these difficult-to-fence places through the simple touch of a phone or computer screen.[72] This can provide a herd access to a larger amount and wider variety of food while allowing other areas to regenerate longer.[73]

Utilizing VF, a farmer can also create exclusion zones, which allows the farmer to exclude the herd from certain areas within the outer virtual fence.[74] This has a wide array of uses.[75] A farmer could exclude livestock from a sensitive area needing regeneration, like a riparian area, or an area of pasture that the livestock have begun to overgraze.[76] These exclusion zones could keep livestock away from an erosion-prone slope or allow the regrowth of an area of saplings or plants the farmer would like to spread on the landscape.[77]

The soil erosion caused by overgrazing in turn causes carbon stored in the soil to be released into the atmosphere.[78] This is significant because greenhouse gases in the atmosphere, such as carbon dioxide, absorb heat radiating from the

67. Riesch et al., *supra* note 17, at 1.

68. *What is Nofence?*, NOFENCE (Jan. 15, 2024, 12:04 AM), https://www.nofence.no/en/what-is-nofence [https://perma.cc/ZY2A-LZXA].

69. *Id.*

70. *See id.*

71. *See Virtual Fencing as a Climate Adaptation Strategy, supra* note 10; Sakas*, supra* note 19.

72. *What is Nofence?*, *supra* note 68.

73. Dean M. Anderson et al., *Virtual Herding for Flexible Livestock Management – A Review*, 36 RANGELAND J. 205, 214 (2014).

74. Dana L. M. Campbell et al., *Virtual Fencing Technology Excludes Beef Cattle from an Environmentally Sensitive Area*, ANIMALS 2 (June 20, 2020), https://doi.org/10.3390/ani10061069 [https://perma.cc/P8C6-K2SA].

75. *See id.*; *Unlocking More Productive and Sustainable Farming, supra* note 16.

76. Campbell et al., *supra* note 74, at 2.

77. *Virtual Fencing as a Climate Adaptation Strategy, supra* note 10; Campbell et al., *supra* note 74, at 2.

78. *Virtual Fencing as a Climate Adaptation Strategy, supra* note 10.

earth and re-release it, which leads to climate change.[79] While some carbon capture methods, like the use of carbon pipelines, are hotly debated, VF provides a less controversial choice.[80] VF aids in sequestering carbon simply by decreasing overgrazing and erosion and the concomitant release of carbon into the atmosphere.[81]

Overgrazing also affects water quality.[82] Clean water is a crucial natural resource and is becoming scarce in a significant portion of the United States.[83] Proponents of VF claim that it can aid accessibility to clean water by keeping livestock away from sensitive riparian areas.[84] This decreases soil erosion and prevents soil, carbon, and manure from entering waterways.[85]

VF offers significant benefits in the areas of disaster prevention and post-disaster care as well.[86] It can be utilized to graze areas at risk of wildfires or to create fuel breaks to stop wildfire spread.[87] VF can additionally aid in keeping livestock off of a wildfire devastated area to allow it to regenerate.[88] Similar benefits can be provided to flooded areas.[89] Excluding livestock from riparian areas prevents soil erosion and encourages plant growth around waterways.[90] Soil erosion in a riparian area can contribute to flooding by allowing water to rush quickly through the waterway, instead of being slowed down by plants and higher

79. Rebecca Lindsey, *Climate Change: Atmospheric Carbon Dioxide*, CLIMATE.GOV (May 12, 2023), https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide# [https://perma.cc/FQ72-QQ5C].

80. Clay Masters, *These Companies Say Their Carbon Pipelines Would Curb Climate Change. Farmers Object*, NAT'L PUB. RADIO (Apr. 4, 2022, 5:32 PM), https://www.npr.org/2022/04/01/1090192926/farmers-protest-companies-carbon-capture-pipelines [https://perma.cc/7GKT-TQDG].

81. *Virtual Fencing as a Climate Adaptation Strategy, supra* note 10.

82. *Id.*

83. *Id.*

84. *Id.*

85. *Id.*

86. *See Virtual Fencing for Increased Livestock Management Flexibility on Nevada Rangelands*, *supra* note 50.

87. Boyd et al., *supra* note 50.

88. *Id.*

89. *Id.*

90. Kurt Fesenmyer et al., *Livestock Management, Beaver, and Climate Influences on Riparian Vegetation in a Semi-Arid Landscape*, PLOS ONE 2 (Dec. 11, 2018), https://doi.org/10.1371/journal.pone.0208928 [https://perma.cc/X3E4-NTA2].

banks.[91] Post-flood, VF can be used to keep livestock away from dangerous waters or off water-soaked pasture.[92]

In pastureland and wooded areas alike, VF can work as an effective tool for land management by moving livestock strategically with the purpose of controlling weeds and invasive species.[93] Moreover, it can assist in seeding desired plants.[94] After seeds are planted, livestock can be grazed over the seeded area.[95] Their hooves aerate the soil and push the seeds into the ground.[96] Then, the livestock are kept off the area to allow the seeds to grow.[97] Grazing facilitated with VF also has application in unique and specialized locations such as under power lines and in solar parks, ski resorts, and other areas that are difficult or costly to mow or to install and move physical fencing.[98]

B. Animal Benefits

Animals also realize benefits from the use of VF.[99] VF can advantage the health, safety, and natural tendencies of livestock.[100] When livestock are herded solely by sound and shock cues, the stress from interaction with human and canine herders is eliminated.[101] VF also allows the herd to retain their natural social hierarchies, groupings, and movements.[102] These natural tendencies are thrown off by physical fencing as well as human and canine herders.[103]

A farmer can use VF exclusion zones to protect the health of the livestock.[104] This can be done by excluding livestock from dangerous areas like sinkholes,

91. Brianna Randall, *Simple Hand-Built Structures Can Help Streams Survive Wildfires and Drought*, SCIENCENEWS (Mar. 26, 2021, 6:00 AM), https://www.sciencenews.org/article/stream-survival-beaver-dam-simple-structures-wildfires-drought [https://perma.cc/ZQ2V-788W].

92. *See Unlocking More Productive and Sustainable Farming*, *supra* note 16.

93. *Virtual Fencing as a Climate Adaptation Strategy*, *supra* note 10.

94. Blevins, *supra* note 60.

95. *Id.*

96. *Id.*

97. *Id.*

98. *What is Solar Grazing?*, AM. SOLAR GRAZING ASS'N (Jan. 15, 2024, 1:48 PM), https://solargrazing.org/what-is-solar-grazing/ [https://perma.cc/56LN-EB8W].

99. *Unlocking More Productive and Sustainable Farming*, *supra* note 16.

100. *Id.*

101. *Id.*

102. *Id.*

103. *Id.*

104. Boyd et al., *supra* note 50.

perilous cliffs, or an area where plants toxic to the livestock grow.[105] During an extreme weather event like a flood, wildfire, or tornado, herds can easily be shifted to or held in a safe area, making the job of ensuring the safety of livestock much simpler in a crisis.[106]

Some VF products are equipped with sensors for tracking the animal's behavior in order to provide data to the farmer to suggest when the animal is sick, injured, or in heat.[107] This data allows the farmer to treat issues early in order to prevent further damage to the animal.[108] When health and reproductive issues are tended to quickly, an animal's chance of recovery is improved.[109] Furthermore, there is evidence that moving livestock with VF allows them to move at their own pace, which can prevent lameness.[110] Moving cattle with traditional methods, such as ATVs, dogs, and human interaction, is stressful for livestock and can result in weakened immune systems, slower weight gain, and lower conception rates.[111] VF can greatly decrease the need for these traditional herding methods.[112] As discussed above, VF can increase livestock's access to high-quality grazing, which provides better nutrition, more sustenance, and a more varied diet.[113] Moving livestock across the landscape can also decrease their parasite load.[114] Parasite load increases in heavily stocked pastures and in overgrazed areas due to proximity to fecal pats and areas where parasite larvae are highest.[115] Additionally, with no physical fence, there is no risk of physical injury, such as cuts from barbed wire, prolonged shock

105. *Id.*

106. *Unlocking More Productive and Sustainable Farming*, *supra* note 16; ANIMAL WELFARE COMM., OPINION ON THE WELFARE IMPLICATIONS OF USING VIRTUAL FENCING SYSTEMS TO CONTAIN, MOVE AND MONITOR LIVESTOCK 12 (2022), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1109654/awc-opinion-virtual-fencing-221005.pdf [https://perma.cc/M4NX-3Z2H].

107. *Unlocking More Productive and Sustainable Farming*, *supra* note 16.

108. *Id.*

109. *Id.*

110. *Id.*

111. Aleeya Laureola, *The Modern Cowboy and the Future of Livestock Operations*, AGDAILY (Oct. 30, 2019), https://www.agdaily.com/livestock/the-modern-cowboy-and-future-of-livestock-operations/ [https://perma.cc/G8HB-YUKU].

112. *Vence: Virtual Fencing for Livestock Management*, MERCK ANIMAL HEALTH (Jan. 15, 2024, 1:53 PM), https://vence.io/ [https://perma.cc/PB4N-TURX].

113. Anderson et al., *supra* note 73, at 215.

114. Bryant, *supra* note 17.

115. John Gilleard, *Parasites – Internal*, BEEF CATTLE RSCH. COUNCIL (July 18, 2023, 8:35 AM), https://www.beefresearch.ca/topics/parasites-internal/ [https://perma.cc/8SCW-Q6ZV].

from electric fence, or any other injury sustained from running into or becoming caught in fencing.[116]

VF benefits wild animals too.[117] Just as for livestock, when there is no physical fence, there is nothing in which wild animals can become caught.[118] With VF, a farmer can create exclusion zones for the safety of wild animals in specific areas.[119] For example, an exclusion zone could be created around a riparian area with beaver activity or where ground nesting birds have eggs or young offspring.[120]

Unlike VF, physical fences restrict the movement of livestock and wild animals alike, which is detrimental to wildlife.[121] Seasonal migration is critical to the life cycle of many animals.[122] Animals migrate as a critical act in their seasonal relationship to weather, food availability, predators, and other variables.[123] Physical fencing contributes to the isolation of populations of animal species, which is detrimental to a species' genetics and can cause a species to decline.[124]

The use of VF also protects spawning grounds for fish.[125] When livestock have unbridled access to riparian areas, feces enter and chemically heat the water which then contaminates the spawning grounds, damaging the fish's habitat.[126] VF is an effective tool for keeping livestock out of these sensitive spawning areas.[127]

116. MARCIA ARGUST ET AL., The PEW CHARITABLE TRUSTS, HOW TO CONSERVE WILDLIFE MIGRATIONS IN THE AMERICAN WEST 20 (2022), https://www.pewtrusts.org/-/media/assets/2022/10/how_to_conserve_wildlife_migrations.pdf [https://perma.cc/3GRJ-ZRGB].

117. *Id.*

118. *Id.*

119. *Id.* at 34.

120. Brian A. Small et al., *Livestock Grazing Limits Beaver Restoration in Northern New Mexico*, 24 RESTORATION ECOLOGY 646, 653 (2016).

121. ARGUST ET AL., *supra* note 116, at 20.

122. *Id.* at 1.

123. *Id.*

124. Golden, *supra* note 12.

125. *Id.*

126. *Id.*

127. *See id.*

C. Farmer Benefits

Farmers also stand to benefit greatly from VF.[128] VF has the ability to save farmers time and money while also providing them with peace of mind.[129] Installing, moving, and maintaining physical fences takes a lot of resources, like time, physical materials, and money.[130] Installing traditional fencing can cost up to $9,500 per mile when factoring in labor costs.[131] While VF may be costly initially, studies show a return on investment over time.[132] This return on investment includes cost benefits from knowing when an animal is experiencing an estrous cycle or when an animal is having health issues, like lameness, which needs to be treated.[133] Cost benefits also come from the utilization of all grazable land, which is the most cost-effective food source for livestock.[134]

As previously discussed, VF contributes to soil health which, in turn, can lead to increased production of pastureland.[135] Increased production of grasses leads to increased profitability for the farmer.[136] VF helps farmers manage a healthier work-life balance as well by allowing them to easily access important information about their herd without needing to venture out onto the land and also by giving them back the time they would have spent moving physical fencing.[137] Conveniently, VF further provides peace of mind by allowing farmers to locate individual members of their herd in real time and to track their health.[138] VF is flood and fire-proof, meaning farmers have less to worry about in the event of an oncoming wildfire or flood.[139] This can save farmers substantial amounts of money that would have been spent in the initial installation or replacement of fencing in

128. *Virtual Fencing as a Climate Adaptation Strategy, supra* note 10.

129. Joshua Haiar, *Virtual Fencing Saves Ranchers Cash and Improves Grassland*, S.D. PUB. BROAD. (Sept. 7, 2022, 12:16 PM), https://listen.sdpb.org/business-economics/2022-09-07/virtual-fencing-saves-ranchers-cash-and-improves-grassland [https://perma.cc/E8LW-7BB9].

130. *Id.*

131. *Id.*; Boyd et al., *supra* note 50.

132. Savannah Bertrand et al., *supra* note 58.

133. *Unlocking More Productive and Sustainable Farming, supra* note 16.

134. Philip Synnestvedt, *What are the Benefits of Virtual Fencing?*, NOFENCE (Oct. 22, 2021), https://www.nofence.no/en/blog/what-are-the-benefits-of-virtual-fencing [https://perma.cc/PDQ4-A775].

135. *What is Nofence?*, *supra* note 68.

136. *See id.*

137. Synnestvedt, *supra* note 134.

138. *Unlocking More Productive and Sustainable Farming*, *supra* note 16.

139. Golden, *supra* note 12.

disaster-prone areas.[140] Another scenario that causes farmers a lot of heartburn is the possibility that a cattle gate will be left open, allowing livestock to escape.[141] With VF, that worry is eliminated.[142] VF also exposes farmers to less danger themselves, such as the dangers associated with dealing with rusty barbed-wire fences, attempting to install or maintain fencing in dangerous areas, or physically moving their herds in inclement weather.[143] Finally, there is an aesthetic benefit to VF in that it does not obstruct views of the land.[144]

IV. DETRIMENTS OF VIRTUAL FENCING

A. Animal Welfare

Animal welfare is currently the most substantial concern about VF.[145] VF uses sound cues and electric pulses that are meant to annoy livestock enough to prompt a back-up response in them.[146] These stressors can be seen as detrimental to the welfare of the animal.[147] When livestock are first introduced to VF, there is a dip in their welfare because they have not yet learned to associate the sound cue with receiving the electric pulse and are therefore shocked more often than they are after they have made the association.[148] In addition, individual livestock learn the VF system at different rates, meaning some animals receive more cues than others and will experience a higher level of stress created by the VF system.[149] However, a study conducted in Australia showed evidence that the "physiological and behavioral responses of livestock indicated that they were no more adversely impacted by the cues involved in [VF] technology stimuli than they were by other commonly encountered stimuli."[150] VF also does not do away with all of the stressors livestock experience with traditional farming methods.[151] The technology does not allow for quick herding of animals.[152] Depending on the movement needed, farmers may still have to physically go out and bring livestock in for

140. *Id.*
141. Blevins, *supra* note 60.
142. *Id.*
143. *See* Laureola, *supra* note 111.
144. *See* Golden, *supra* note 12.
145. Latham, *supra* note 11.
146. Lee et al., *supra* note 19, at 3.
147. *Id.* at 1.
148. *Id.* at 5.
149. *Id.*
150. KING, *supra* note 15, at v.
151. *See* Virtual Interview with Meghan Filbert, *supra* note 3.
152. *Id.*

milking or to move them quickly in an emergency, which can be stressful for the animals.[153] That being said, the shock livestock receive from VF is of a lower voltage than that they receive by touching an electric fence, and once livestock learn to turn back when hearing the sound cue, it is possible they will never receive an electric pulse.[154] Some are also concerned about livestock having to wear collars at all times with VF systems.[155] This can be seen as cumbersome and heavy for the livestock to wear, and in one study led to abrasions on the lower jaws of cattle.[156]

B. Ranching Jobs

There is a concern among farmers that VF will eliminate ranching and cowboy jobs.[157] With VF in place, there is less need for farmers or ranch hands to be out on the land moving fencing or herding livestock.[158] This being said, VF does not yet do away with the need for the physical herding of livestock in all situations and can help free up farmers and ranch hands to work in other areas on the farm.[159] Farmers inspecting their livestock up close is still the best method for ensuring the health and safety of the herd.[160]

C. System Failures

As beneficial as VF technology is, it is not infallible.[161] VF cannot protect against situations in which an animal is made to bolt through the cues it receives.[162] This could lead an animal to run outside of the boundary set by the farmer.[163] It is also possible for cell service to go down in areas, which can create a "Jurassic Park"-like situation for farmers.[164] In these situations, physical herding by a farmer is needed.[165] There can also be issues that occur with collars. If a collar is ill-fitting or if a sheep's wool gets in the way of the electric pulse, the cues could fail and

153. *Id.*
154. Latham, *supra* note 11.
155. *Id.*
156. Rhiannon Handcock, *Virtual Fencing for Dairy Cows*, THE AGRISCIENCER (May 26, 2021), https://www.agrisciencer.com/post/virtual-fencing-for-dairy-cows [https://perma.cc/D8WT-GTEU].
157. Sakas*, supra* note 19.
158. *Id.*
159. Virtual Interview with Meghan Filbert, *supra* note 3.
160. *See* Sakas, *supra* note 19.
161. Virtual Interview with Meghan Filbert, *supra* note 3.
162. *Id.*
163. *Id.*
164. Blevins, *supra* note 60.
165. *Id.*; Virtual Interview with Meghan Filbert, *supra* note 3.

the animal could cross the boundary.[166] In general, older livestock learn the VF system more slowly than young livestock and also are willing to "break the rules" by ignoring cues in order to access their preferred grazing grounds.[167] This can "untrain the herd" when other livestock witness and follow.[168] In a similar vein, deaf livestock are not able to be trained to the VF system, as the first warning cue they will experience is the electric shock received when they reach the virtual boundary.[169]

VF is not without maintenance.[170] Batteries do need to be replaced in each collar occasionally.[171] The interval at which they need to be replaced differs depending on which VF system is being used, a collar's exposure to the sun, and how many times the animal nears the boundary, among other factors.[172] Also, if a farmer is utilizing VF to keep livestock out of riparian areas, a source of water will have to be provided to the livestock, which could mean time and labor to haul water out to the grazing zone.[173]

V. THE LEGAL PAST OF FENCING

Up to now, fencing law has existed to regulate physical fencing.[174] Physical fencing exists to serve different purposes, including marking boundaries and divisions of ownership and use, containing or excluding animals and humans, obstructing vision, improving aesthetics, and providing for safety.[175] In the United States, fencing law falls under the purview of the states.[176]

In the early days of the United States, population was low and open land was plentiful. This caused many states to enact laws compelling landowners to fence their property in order to keep other's livestock out as opposed to landowners

166. Latham, *supra* note 11.

167. Blevins, *supra* note 60.

168. *Id.*

169. Virtual Interview with Meghan Filbert, *supra* note 3.

170. Xiong & Stephenson, *supra* note 22.

171. *Id.*

172. *Id.*

173. Dustin Johnson, *Grazing Management Options for Riparian Areas*, OR. STATE UNIV. EXTENSION SERV. (Dec. 2019), https://extension.oregonstate.edu/crop-production/pastures-forages/grazing-management-options-riparian-areas [https://perma.cc/TD5M-VGT8].

174. Rumley, *supra* note 20.

175. *Fence*, ENCYC. BRITANNICA (Jan. 15, 2024), https://www.britannica.com/technology/fence-barrier [https://perma.cc/A2E6-KU87].

176. Rumley, *supra* note 20.

fencing to keep their livestock in.[177] As the population of the United States grew and land became increasingly settled, states began to amend their laws to compel landowners to fence in their livestock.[178] In some western states, "open range" or "fence-out" laws still exist.[179] In these states, if livestock graze on an area designated by local government as open range land, landowners have a duty to fence the livestock out of their private property.[180] In "closed range" areas, livestock owners have a duty to fence livestock in.[181] In other states, including much of the Midwest, there are "conditional fence-out" laws.[182] Conditional fence-out laws provide that livestock owners have a duty to fence in their livestock, but adjacent landowners also have a duty to fence out livestock by doing their part in maintaining shared partition fencing.[183]

VI. THE CURRENT LEGAL STATE OF VIRTUAL FENCING

Today, VF is becoming a reality for livestock owners around the world. To date there are no state or federal laws in the United States which deal expressly with VF, but with the rise in use of VF, there may soon be a need for legal regulation.[184] Currently, many state codes include a definition of "legal fence," which sets parameters determining when a landowner has a duty to erect and maintain a fence and what fencing materials and measurements are acceptable for fulfilling that duty.[185] As VF becomes more widely used in the United States, its developers and users are questioning whether containing livestock with VF fulfills a landowner's duty to fence in their livestock or if only physical fencing can fulfill that role.[186]

177. Yasuhide Kawashima, *Farmers, Ranchers, and the Railroad: The Evolution of Fence Law in the Great Plains, 1865-1900*, 30 GREAT PLAINS Q. 21, 23 (2010).

178. Rumley, *supra* note 20.

179. *Id.*

180. *Id.*

181. Kyle K. Weldon, *Fence Law: Keeping Legal Issues on the Other Side of the Fence*, PROGRESSIVE CATTLE (July 25, 2021), https://www.agproud.com/articles/53552-fence-law-keeping-legal-issues-on-the-other-side-of-the-fence [https://perma.cc/8DMN-CEMH].

182. Kristine A. Tidgren, *Iowa Fence Requirements: A Legal Review*, IOWA STATE UNIV., CTR. FOR AGRIC. L. & TAX'N (July 15, 2022), https://www.calt.iastate.edu/article/iowa-fence-requirements-legal-review [https://perma.cc/WHF7-P7HX].

183. *Id.*

184. *See* Rumley, *supra* note 20.

185. *See id.*

186. Virtual Interview with Meghan Filbert, *supra* note 3.

Some countries are further along than the United States in enacting legislation dealing with VF.[187] In much of the rest of the world, emphasis is put on animal welfare in the creation of regulations regarding the use of VF.[188] Many countries have conducted studies to discover whether VF hurts, stresses, or changes the behavior of livestock and whether or not the animals can learn the VF system quickly so as to avoid electric shock.[189] In Norway, there is no general rule regarding the use of electric equipment on animals, but certain types of devices that subject animals to electric shock are regulated.[190] The Norwegian Food Safety Authority undertook a study in 2017 into the effects of electric shock devices on animals.[191] They found that cattle and goats are able to learn the VF system but that some individuals learned more quickly than others.[192] They also found that goats were able to be moved to a new space without them associating the sound cue and electric pulse with a specific area.[193] The goats only associated the sound cue to the electric pulse.[194] This demonstrates that goats will not become fearful of the areas of grazing land where they hear the audio cues.[195] These types of studies help to inform legislation affecting the sale and use of VF.[196]

187. *See What is Virtual Fencing (or Virtual Herding) and Does it Impact Animal Welfare?*, RSCPA AUSTL.: KNOWLEDGEBASE (Sept. 2, 2022), https://kb.rspca.org.au/knowledge-base/what-is-virtual-fencing-or-virtual-herding-and-does-it-impact-animal-welfare/ [https://perma.cc/4BKT-DZ9P]; Magnus Fjord Aaser et al., *Is Virtual Fencing an Effective Way of Enclosing Cattle? Personality, Herd Behaviour and Welfare,* ANIMALS 2 (Mar. 27, 2022), https://doi.org/10.3390/ani12070842 [https://perma.cc/6XTR-2ZQX]; *SustAinimal*, RSCH. INST. OF SWED., https://www.ri.se/en/what-we-do/projects/sustainimal [https://perma.cc/XS3Z-QLHN].

188. *See* Lee et al., *supra* note 19, at 1; Dina Hamidi et al., *Heifers Don't Care: No Evidence of Negative Impact on Animal Welfare of Growing Heifers when Using Virtual Fences Compared to Physical Fences for Grazing,* ANIMAL, Sept. 2022, at 1.

189. *See* Lee et al., *supra* note 19, at 2; Hamidi et al., *supra* note 188; CECILIE MARIE MEJDELL ET AL., NORWEGIAN SCI. COMM. FOR FOOD & ENV'T, 2017:31, A REVIEW ON THE USE OF ELECTRIC DEVICES TO MODIFY ANIMAL BEHAVIOUR AND THE IMPACT ON ANIMAL WELFARE 9 (2017), https://vkm.no/download/18.5ae8113516051ba132647206/1513588569404 [https://perma.cc/LP3P-UTJX].

190. CECILIE MARIE MEJDELL ET AL., *supra* note 189, at 15.

191. *Id.* at 7; Silje Eftang et al., *Goats Are Able to Adapt to Virtual Fencing; A Field Study in Commercial Goat Herds on Norwegian Farms*, APPLIED ANIMAL BEHAV. SCI., Oct. 4, 2022, at 1, 2.

192. Eftang et al., *supra* note 191, at 2.

193. *Id.* at 3.

194. *Id.* at 6.

195. *See id.*

196. Latham, *supra* note 11.

Australia is also concerned with the animal welfare impacts of VF and has conducted numerous studies to advise their regulations of the sale and use of VF.[197] The government agency CSIRO began research and development in VF in 2005.[198] Studies funded by Australia's Department of Agriculture and Water Resources have examined how loud and strong the audio cues and electrical impulses need to be in order to effectively compel the animal to turn back while still minimizing the animals' stress.[199] Three Australian states currently allow the sale and use of VF for livestock: Queensland, Western Australia, and Tasmania, which together make up about 56% of Australia's cattle herd share and 25% of the country's sheep herd share.[200] Other Australian states currently only allow for VF trials due to concerns over animal welfare.[201] However, in New South Wales, which has the second largest cattle herd share of the Australian states, a review is underway to update animal welfare regulations which could make VF legal.[202] The Minister of Agriculture for New South Wales, Dugald Saunders, has announced he would consider legalizing VF as part of animal welfare legislation reform, to which there has been a mix of support and push-back within the state.[203] Only time will tell how Australian legislation changes regarding VF, but the trend is clearly toward legalization.[204] After legalization, Australian states and territories will have the same issues as the United States in working out whether changes to state or territory fencing laws and regulations are needed to allow for use of VF for livestock.[205]

197. *E.g.*, *id.*

198. *Id.*

199. *Id.*

200. *Herd and Flock Numbers for Each Region Released*, MEAT & LIVESTOCK AUSTL. (Sept. 15, 2022), https://www.mla.com.au/news-and-events/industry-news/herd-and-flock-numbers-for-each-region-released/ [https://perma.cc/UE3Y-R5RK].

201. Latham, *supra* note 11.

202. *Herd and Flock Numbers for Each Region Released, supra* note 200; Latham, *supra* note 11.

203. Sam McKeith, *Virtual Fences a Farming 'Game-changer'*, BEGA DIST. NEWS (Oct. 21, 2022, 12:53 AM), https://www.begadistrictnews.com.au/story/7951861/virtual-fences-a-farming-game-changer/ [https://perma.cc/ZE9U-UHC2].

204. *See Commercialisation of Virtual Fencing for Livestock,* GOV'T OF S. AUSTL., DEP'T OF PRIMARY INDUS. & REGIONS (Jan. 15, 2024, 2:10 PM), https://www.pir.sa.gov.au/research/agtech/agtech_research/virtual_fencing [https://perma.cc/D8WZ-QBED].

205. *See generally* Rumley, *supra* note 20.

VF is not banned in the United Kingdom, and interest and use has grown there over the last four years.[206] The Animal Welfare Committee—a committee of the United Kingdom's Department for Environment, Food, and Rural Affairs—has conducted research into VF and its effects on livestock and released a cautiously optimistic report which lists recommendations by the Animal Welfare Committee for those looking to use VF.[207]

In New Zealand, where Halter is based, there does not appear to be a ban or regulations on the use of VF, but farmers are concerned regardless about animal welfare.[208] VF is currently illegal in Denmark, Sweden, and most EU member states due to concerns surrounding the use of electric shock on animal welfare, but there has been enough interest in VF that field studies are being conducted in a few of them.[209]

Back in the United States, there are no animal welfare regulations concerning VF, and it can be sold and used throughout the country.[210] However, legal issues are sure to arise from the use of VF. Since fencing falls under the purview of each state, fencing law varies across the nation.[211] VF can be used in combination with physical fencing with no legal implications, but issues could arise when VF is employed on its own.[212]

VII. THE LEGAL FUTURE OF VIRTUAL FENCING

A big consideration for those who would like to make use of VF is that it serves some, but not all, of the same purposes of physical fencing.[213] VF can contain livestock just as a physical fence would, but since it is not visible, it does no good for visibly marking boundaries.[214] Since there is some risk of GPS drift

206. Tony McDougal, *Virtual Fencing and Cattle Welfare Explored*, DAIRY GLOB. (Oct. 19, 2022), https://www.dairyglobal.net/industry-and-markets/smart-farming/virtual-fencing-and-cattle-welfare-explored/ [https://perma.cc/3ULJ-PSUR].

207. *See* ANIMAL WELFARE COMM., *supra* note 106, at 16.

208. GREG SHEPHERD, KELLOGG RURAL LEADERSHIP PROGRAMME, VIRTUAL FENCING: LEADING THE DIGITAL TRANSFORMATION OF NEW ZEALAND PASTORAL FARMING (2018), https://ruralleaders.co.nz/virtual-fencing-leading-the-digital-transformation-of-new-zealand-pastoral-farming-greg-shepherd/ [https://perma.cc/74LE-ME22]; *Unlocking More Productive and Sustainable Farming*, *supra* note 16.

209. *See generally* Hamidi, *supra* note 188, at 8; Aaser et al., *supra* note 187, at 2; *SustAinimal*, *supra* note 187.

210. *See generally* 9 C.F.R. § 3.125 (2023).

211. Rumley, *supra* note 20.

212. ANIMAL WELFARE COMM., *supra* note 106, at 13.

213. *See* Virtual Interview with Meghan Filbert, *supra* note 3.

214. ANIMAL WELFARE COMM., *supra* note 106, at 5.

with the use of VF, it creates a less certain boundary than physical fencing.[215] VF does nothing to notify potential trespassers of a change in property ownership and also does little to keep humans safe.[216]

Potential legal issues of using VF without the backup of physical fencing include livestock trespassing onto another landowner's property due to GPS drift or confusion about the location of the property boundary.[217] There is also the potential that animals will bolt through the VF onto neighboring land or into dangerous areas like roads, highways, and cliffs.[218] Some farmers may want to try to use VF alone without the reinforcement of physical fencing, but if VF is not considered legal fencing as defined in the relevant state code, these farmers could find themselves being legally compelled by their neighbor to erect and maintain a physical fence while also paying to utilize VF for their livestock.[219]

These downfalls must be balanced with the benefits of VF, such as decreased fencing cost, improved view, freer migration of wild animals, and easier rotational grazing.[220] These affect not only private landowners but the country as a whole, which is why states should foster the use of VF. One way states can do this is to ensure that those who use VF have statutory or regulatory guidelines to follow so as to lessen the risk of legal liability. State legislatures should enact statutes to set out processes and perimeters for landowners and farmers to follow in regard to the use of VF.[221] This would create legal certainty and decrease the amount of litigation concerning VF. In some states, "fence viewers" have final say over what is considered legal fencing.[222] The increased use of VF may help establish it as a type of legal fencing in the minds of fence viewers. If VF does come to be considered a type of legal fencing, an important question to be determined is whether or not a landowner who wishes to use VF can compel their neighbor to pay half of the cost of the technology, which is a provision found currently in some states' existing legal fencing statutes.[223]

In the meantime, to help themselves, farmers who wish to use VF should enter into written agreements with adjacent landowners concerning the use of VF

215. *Id.* at 11.

216. *See* Virtual Interview with Meghan Filbert, *supra* note 3.

217. *See* ANIMAL WELFARE COMM., *supra* note 106, at 11.

218. *Id.* at 23; Virtual Interview with Meghan Filbert, *supra* note 3.

219. *See* Tidgren, *supra* note 182.

220. *See* Riesch et al., *supra* note 17, at 1; Golden, *supra* note 12; Anderson et al., *supra* note 73, at 209.

221. ANIMAL WELFARE COMM., *supra* note 106, at 26.

222. *See* Rumley, *supra* note 20; Tidgren, *supra* note 182.

223. *See* Rumley, *supra* note 20; Tidgren, *supra* note 182.

and the status of any physical fencing. These types of fencing agreements have traditionally been entered into by landowners for the management of physical fencing along property lines.[224] For example, in a state in which a landowner can compel an adjacent landowner to erect and maintain half of a partition fence, a farmer who wishes to utilize VF adjacent to property not separated by a physical fence, or which has a poorly maintained physical fence, could negotiate an agreement with the adjacent landowner.[225] Under this agreement, the farmer would agree not to compel the adjacent landowner to pay the cost of, or carry out building or maintaining half of, a physical partition fence if the adjacent landowner agrees to not hold the farmer liable if livestock accidentally escape across the virtual boundary.[226] Once farmers and landowners have entered into this written agreement, it should be recorded in the appropriate government office (usually the County Recorder) so that it may be accessible with the property records.[227] These agreements can be drafted to run with the property or to terminate when the property changes hands.[228]

With today's ability to view properties and their boundaries online, physical partition fences may not be as important as they used to be for marking property boundaries. Simple occasional property markers, like t-posts or wooden posts, along the property line could suffice, opposed to uninterrupted partition fencing. Property markers allow for the marking of property boundaries while also allowing for free migration of wild animals.[229] Further, property markers are substantially less costly than a full physical fence to install and maintain. VF used in conjunction with occasional property markers serves many of the purposes of physical fencing at a much lower cost. VF utilized with a single high-tensile wire or a less-than-well-maintained physical fence could provide many of the same benefits. Of course, due to the risks associated with GPS drift, livestock bolting across VF boundaries, and service failing, physical fencing is still the only viable option along roads, highways, airports, and other areas that pose risks to human and animal safety.[230]

The United States stands to gain from the widespread use of VF. Therefore, the federal government should encourage the use of VF by creating and maintaining incentive and cost-share programs through existing agencies like the

224. Tidgren, *supra* note 182.
225. *Id.*
226. *See generally id.*
227. *Id.*
228. *Id.*
229. *See generally* ARGUST ET AL., *supra* note 116.
230. Xiong & Stephenson, *supra* note 22.

NRCS. The NRCS currently funds Conservation Innovation Grants for developing new technologies to further natural resource conservation on private lands.[231] Utilizing grants like these to help farmers get started with a VF system could greatly increase the widespread use of VF. Agencies should include information about VF in sustainable agriculture and conservation education programs. The government should also encourage the use of VF by hiring farmers with livestock equipped with VF technology to graze wildfire buffer zones, and by ensuring regulation exists as to the use of VF from an animal welfare perspective. By educating the public about VF and publicly recognizing it as a powerful livestock management tool, the federal government would effectively be putting its stamp of approval on VF, which in turn would lead to increased trust in and utilization of the technology by farmers across the country.

VIII. CONCLUSION

Due to the wealth of benefits that VF offers to the environment, livestock, wild animals, and farmers, its use around the world will increase greatly over time, which will inevitably create friction with fencing and property laws. In the United States, provisions regarding VF should be adopted into state codes to create legal certainty in its use. Government agencies should create VF incentive programs and encourage the use of VF on both private and public lands. In the meantime, farmers and landowners should protect themselves from liability by entering into written, recorded fencing agreements with adjacent landowners concerning the use of VF and the use or non-use of physical fencing.

231. *See Virtual Fencing as a Climate Adaptation Strategy, supra* note 10.