MITIGATING LEGAL RISKS FROM USING ARTIFICIAL INTELLIGENCE (AI) IN PRECISION AGRICULTURE

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ABSTRACT

Precision Agriculture has long used technology, like the Global Positioning System (GPS), sensors, and monitoring software, to improve the efficiency of both crop and livestock production. Using Artificial Intelligence (AI) to power these methods opens vast new potentials for producing more food using and impacting fewer resources, including environmental resources. Technical, legal, privacy, security, and financial concerns have slowed the widespread adoption of AI systems in United States agriculture. This Essay discusses how Congress and industry groups have been working on easing some of the concerns farmers have and clarifying the legal situation around using AI in agriculture. Specific measures discussed include: the voluntary AI Risk Management Framework published by the National Institute of Standards and Technology; suggestions to certify AI software used in agriculture; the certifications, guidelines and model agreements for agtech data from the non-profit Ag Data Transparent; voluntary codes of conduct from equipment providers; voluntary collaboration platforms controlled by farmers; financial assistance and tax credits for farmers that adopt AI technologies; incentives to expand internet connectivity to remote rural areas and satellite use; cybersecurity best practices; efforts by the Food and Agriculture Sharing and Analysis Center; voluntary participation by farmers in a secure government-backed data center for collecting, analyzing and sharing agricultural data; and interconnectivity standards for precision agriculture.

I. USES OF AI IN PRECISION AGRICULTURE

AI in precision agriculture does not typically involve generative AI such as ChatGPT, but often uses predictive machine learning (ML).[1] The "learning" in machine learning means training.[2] Training is a procedure for adjusting the internal parameter of the ML system to improve accuracy or performance.[3] Following training, the ML algorithms can make predictions that are useful for farmers based on new, unseen input data.[4] Examples include predicting soil properties; weather

1. U.S. GOV'T ACCOUNTABILITY OFF., GAO-24-105962, PRECISION AGRICULTURE: BENEFITS AND CHALLENGES FOR TECHNOLOGY ADOPTION AND USE 1, 16 (2024).; James R. Ladlee, Adriana Murillo-Williams & Ryan Spelman, *Exploring Artificial Intelligence Applications in Agriculture*, PENN STATE EXTENSION (Apr. 1, 2025), https://extension.psu.edu/exploring-artificial-intelligence-applications-in-agriculture [https://perma.cc/D7LR-4AV7].

2. *What is Machine Learning?*, IBM, (Sep. 6, 2025, at 17:05 CT), https://www.ibm.com/think/topics/machine-learning [https://perma.cc/DE5L-MWGR].

3. *See* MEHRYAR MOHRI, AFSHIN ROSTAMIZADEH & AMEET TALWALKAR, FOUNDATIONS OF MACHINE LEARNING 1, 4–5 (Francis Bach ed., 2012).

4. *Id* at 1–2; ANDRIY BURKOV, THE HUNDRED-PAGE MACHINE LEARNING BOOK 8 (2019); *AI-Powered Crop Yield Prediction in Agriculture*, OMDENA: AI INSIGHTS (Nov. 15,

prediction; estimating crop yields; disease and weed detection; drip irrigation; livestock production and management; or recommending harvesting techniques.[5]

II. GUIDELINES AND CERTIFICATIONS TO MANAGE TECHNOLOGY RISKS INHERENT IN AI

While predictions from AI systems are increasingly accurate, there is also a risk that outputs are erroneous or misleading.[6] The fact that AI output may contain errors contributes to some farmers' hesitation to adopt AI into their agricultural operation.[7] AI software can be defective like any other software, especially when the ML algorithm is simply wrong.[8] Additionally, so-called hallucinations are phenomena inherent to some AI algorithms which make their output "confidently wrong."[9] Since the AI system seems to back up its erroneous findings by convincing evidence, these types of inaccurate results are more difficult to detect.[10] To manage the risk of errors and hallucinations, providers constantly seek to improve the system or software.[11] A helpful guidance in this context is the voluntary AI Risk Management Framework published by the National Institute of Standards and Technology (NIST).[12] The framework is "rights-preserving, non-sector-specific, and use-case agnostic."[13] Further, it provides guidelines for managing AI risks and for responsibly developing trustworthy AI systems that are generally applicable to producers and consumers of AI technologies in the

2023), www.omdena.com/blog/ai-powered-crop-yield-prediction-in-agriculture [https://perma.cc/2RHU-86AY].

5. *See* Abhinav Sharma et al., *Machine Learning Applications for Precision Agriculture: A Comprehensive Review*, 9 IEEE ACCESS 4843, 4843 (2021).

6. OSONDE OSOBA & WILLIAM WELSER IV, AN INTELLIGENCE IN OUR IMAGE: THE RISKS OF BIAS AND ERRORS IN ARTIFICIAL INTELLIGENCE iii (2017), https://www.rand.org/content/dam/rand/pubs/research_reports/RR1700/RR1744/RAND_RR1744.pdf [https://perma.cc/5RF4-EG4G].

7. *See* JOESSE DE BAERDEMAEKER ET AL., EUR. PARLIAMENTARY RSCH. SERV., PE 734.711, ARTIFICIAL INTELLIGENCE IN THE AGRI-FOOD SECTOR: APPLICATION, RISKS AND IMPACTS 59 (2023).

8. *Id.*

9. Vimal Kansal, *Understanding and Mitigating AI Hallucinations*, MEDIUM (Feb. 14, 2025), https://medium.com/@vimalkansal/understanding-and-mitigating-ai-hallucinations-57053511fef6 [https://perma.cc/Q9UZ-SQPF].

10. *Id.*

11. *Id.*

12. *See generally* NAT'L INST. OF STANDARDS & TECH., U.S. DEP'T OF COM., ARTIFICIAL INTELLIGENCE RISK MANAGEMENT FRAMEWORK (AI RMF 1.0) (2023), https://nvlpubs.nist.gov/nistpubs/ai/nist.ai.100-1.pdf [https://perma.cc/EU7M-M4TN].

13. *Id.* at 2.

precision agriculture space.[14] The Farm Tech Act of 2023 would have authorized the Secretary of Agriculture to establish a program to "certify artificial intelligence software used in connection with producing agricultural products," but the bill never left committee.[15] The certification was to be based on the NIST AI Risk Management Framework and would have required the AI software to meet accuracy standards and to comply with all applicable Federal and State licensure, certification, and permitting requirements specific to tasks in agriculture.[16] Target application examples included manure application, pesticide application, and self-driving machinery.[17] Absent certification, it is even more important to provide farmers with better education about the use and limitations of the AI systems to manage these risks.[18]

III. DEVELOPING CASE LAW, MARKETING LANGUAGE, AND CONTRACTUAL PROVISIONS WILL HELP ALLOCATE LIABILITY FOR ERRONEOUS AI OUTPUT

One of the key legal questions surrounding the use of AI in farming is who would be responsible or liable if the recommendations or other output generated by the AI system are inaccurate, thereby causing issues such as crop loss, environmental damage, or increased costs for nutrients, fertilizer, or labor. There could also be penalties or other sanctions for non-compliance with legal requirements, such as those set by the Food and Drug Administration (FDA). An example would be an orchard management software that uses AI to output precision recommendations for pesticide applications.[19] If an AI model recommends the user apply pesticide at a concentration that violates government regulations, is the farmer liable or the software provider?[20] Would the farmer be responsible for such losses, the developer of the AI software, provider of the AI system, or even the owner or originator of the data that were used to train the AI model, *e.g.*, another farmer? The body of law around these issues is nascent and largely untested. Under existing law, the farmer using an AI system will likely bear

14. *Id.*
15. Farm Tech Act, H.R. 6806, 118th Cong. (2023).
16. *Id.*
17. *Id.*
18. U.S. GOV'T ACCOUNTABILITY OFF., GAO-24-105962, *supra* note 1, at 19, 47.
19. Siegmar Pohl & Jordan Glassman, *AI Can Transform Precision Agriculture, but What Are the Legal Risks?*, AGFUNDERNEWS (July 15, 2024), https://agfundernews.com/guest-article-ai-can-transform-precision-agriculture-but-what-are-the-legal-risks [https://perma.cc/Q79Q-A3SV].
20. *Id.*

the burden of the violation, which is of course concerning to farmers.[21] At the same time, system providers may fear liability for erroneous recommendations generated by their systems.[22] A case to watch in this context is a lawsuit that a solar firm in Minnesota brought against Google for defamation, based on the allegation that the tech company's AI overviews created lies about the solar company which damaged the company's business.[23] The AI industry is following this case closely as it is expected to shape accountability for artificial intelligence output, even if limited to the context of defamation.[24] Could the provider of AI be responsible if the AI system generates misinformation?

To reduce the risk of liability, "developers of precision agriculture technologies[,] and software that rely on AI models perceived as accurate[,] should choose their marketing language with care and set reasonable, bounded expectations on the accuracy of AI model output."[25] Developers of AI precision agriculture products should anticipate a growing expectation by users that AI products produce accurate results. Expectations of AI systems can be tempered to mitigate the risk of implied warranties and product liability claims.[26] In addition, it is important that contracts and licenses clearly allocate liability for such errors or hallucinations either to the user or to the system provider.[27]

IV. ACCESS TO DATA FROM MORE FARMERS WOULD REDUCE THE RISK OF DATA BIAS IN AI OUTPUT

Inaccuracies in output can also be caused if the amount of input data is too small, which means that it is insufficient as a basis for reliable predictions in

21. *See* Amy Buttell, *Who is Liable When AI Goes Wrong?*, COMMC'NS OF THE ACM (May 21, 2025), https://cacm.acm.org/news/who-is-liable-when-ai-goes-wrong/ [https://perma.cc/NC85-XHYE]; Pohl & Glassman, *supra* note 19.

22. *See* Buttell, *supra* note 21.

23. *See generally* Complaint, LTL LED, LLC v. Google LLC, No. 62-CV-25-4594 (Minn. Dist. Ct. Ramsey Cnty. 2025) (on July 9, 2025, Google filed a notice of removal to federal court; *see* Notice of Removal, LTL LED, LLC v. Google LLC, No. 0:25-CV-02394, 2025 WL 1863437 (D. Minn., June 9, 2025)).

24. *Id.*

25. Pohl & Glassman, *supra* note 19.

26. *Mitigating Product Liability Risks for Companies Providing AI-Enabled Products*, MORRIS, MANNING & MARTIN, LLP (June 11, 2024), https://www.mmmlaw.com/news-resources/mitigating-product-liability-risks-for-companies-providing-ai-enabled-products/ [https://perma.cc/2QHE-EBAD].

27. *See id.*

output.[28] Some data sets are too small because not all farmers share their data.[29] Similarly, bias in data and output create another possible source of inaccuracy.[30] For example, training data from particular geographies, crop types, seasons, weather, or farm scale result in a model that does not generalize.[31] Biases in inclusion or representation and reflecting training data can creep into output and the predictions made by ML algorithms thereby perpetuating biases.[32] Bigger datasets that are more representative of different regions, crop types, soil types, and farming methods could be generated if more farmers shared their data with AI models.[33] In addition to concerns about inaccurate data and liability for damage caused by erroneous AI output, some farmers hesitate adopting AI systems and sharing their data for various reasons as further described below.

V. FARMER'S CONCERNS REGARDING CONTROL AND OWNERSHIP OF THEIR FARM DATA

Farmers are also concerned about losing control over their farming data.[34] If a farmer has developed a farming method or patterns for feeding nutrients to its

28. *Innovation in American Agriculture: Leveraging Technology and Artificial Intelligence: Hearing Before the S. Comm. on Agric., Nutrition, & Forestry*, 118th Cong. 24 (2023) (statement of Jahmy Hindman, Ph.D., Senior Vice President & Chief Tech. Officer, Deere & Co.) ("[I]t is relatively easy to get a machine learning model to be 80 percent accurate. It is much harder to get it to be 99, 95 percent accurate, and the difference . . . is how much data you have . . . to train the model.").

29. *See id.* at 14 (discussing how some farmers are reluctant to share data with companies).

30. *See* Maaz Gardezi et al., *Artificial Intelligence in Farming: Challenges and Opportunities for Building Trust*, 116 AGRONOMY J. 1217, 1222 (2024), https://acsess.onlinelibrary.wiley.com/doi/pdf/10.1002/agj2.21353 [https://perma.cc/SYZ7-YLAP].

31. *See id.* (discussing an example of how training a model with data from only one type of apple could cause errors when the model is used more broadly).

32. *See Innovation in American Agriculture: Leveraging Technology and Artificial Intelligence: Hearing Before the S. Comm. on Agric., Nutrition, & Forestry*, 118th Cong. 2 (2023) (statement of Sen. Debbie Stabenow, Chairwoman, S. Comm. on Agric., Nutrition, & Forestry); Oyekunle Claudius Oyeniran et al., *Ethical AI: Addressing Bias in Machine Learning Models and Software Applications*, 3 COMPUT. SCI. & IT RSCH. J. 115, 116–118 (2022); Pohl & Glassman, *supra* note 19.

33. U.S. GOV'T ACCOUNTABILITY OFF., GAO-24-105962, *supra* note 1, at 54; Pohl & Glassman, *supra* note 19.

34. Esha Kher, *The Legal Landscape of Data Privacy in AI-Driven Precision Agriculture*, WASH. J.L., TECH. & ARTS: BLOG (Feb. 25, 2025), https://wjlta.com/2025/02/25/the-legal-landscape-of-data-privacy-in-ai-driven-precision-agriculture/ [https://perma.cc/H2NF-E34M]; U.S. GOV'T ACCOUNTABILITY OFF., GAO-24-105962, *supra* note 1, at 40.

crop, the farmer does not necessarily want an AI system to feed that method to another farmer, who might be a competitor, without compensation.[35] The same may be true for other training data and input data such as prompts, uploads, or embeddings.[36] However, farmers are concerned that this type of involuntary data sharing could happen if one farmer's methods are used to train an AI model that another farmer can use to manage his or her farm.[37] Farmers are also wary that the owners of AI systems will try to own and monetize this type of data.[38]

VI. LIMITED IP PROTECTION FOR FARM DATA

These concerns are not unfounded, as the protections afforded to farming data by intellectual property laws is limited.[39] Some compilations of training data are copyrighted, *e.g.*, the FAOSTAT database, and its unauthorized use during training may expose producers or users to liability,[40] but copyright protection for farming data appears to be the exception, and the courts are currently discussing to what extent it can be "fair use" to train AI models with copyrighted materials.[41]

35. *See* U.S. GOV'T ACCOUNTABILITY OFF., GAO-24-105962, *supra* note 1, at 40 ("[S]ome farmers are reluctant to share their data with third-party entities because of concerns about disclosures that may result in a loss of a competitive advantage.").

36. *See id.*

37. *See* Rosita Dara, Seyed Mehdi Hazrati Fard & Jasmine Kaur, *Recommendations for Ethical and Responsible Use of Artificial Intelligence in Digital Agriculture*, FRONTIERS IN A.I. 4–5 (2022), https://pmc.ncbi.nlm.nih.gov/articles/PMC9372537/pdf/frai-05-884192.pdf [https://perma.cc/C2FY-URTR]; Todd Janzen, *Legal Issues to Address as AI Crops Up in Agriculture*, LAW360 (July 3, 2023, at 16:27 ET) [hereinafter *Legal Issues to Address as AI Crops Up in Agriculture*], https://www.law360.com/articles/1690418/legal-issues-to-address-as-ai-crops-up-in-agriculture; Carrie S. Alexander, Mark Yarborough & Aaron Smith, *Who is Responsible for 'Responsible AI'?: Navigating Challenges to Build Trust in AI Agriculture and Food System Technology*, 25 PRECISION AGRICULTURE 146, 170 (2024).

38. Jody L. Ferris, *Data Privacy and Protection in the Agriculture Industry: Is Federal Regulation Necessary?,* 18 MINN. J.L. SCI. & TECH. 309, 317 (2017); *see also* Gardezi et al., *supra* note 30, at 1224 ("There is a risk that the corporations could utilize big data generated from farms to recommend new products to sell and profit from this asymmetric relationship.").

39. Kher, *supra* note 34 ("The absence of a universal legal framework defining data ownership in agriculture creates ambiguities around rights related to access, modification, and distribution.").

40. *See FAO Statistical Database Terms of Use*, FOOD AND AGRIC. ORG. OF THE UNITED NATIONS (July 14, 2025, at 12:52 CT), https://www.fao.org/contact-us/terms/db-terms-of-use/en [https://perma.cc/62EN-YGJL].

41. David M. McIntosh et al., *A Tale of Three Cases: How Fair Use is Playing out in AI Copyright Lawsuits*, ROPES & GRAY (July 7, 2025), https://www.ropesgray.com/en/insights/alerts/2025/07/a-tale-of-three-cases-how-fair-use-is-playing-out-in-ai-copyright-lawsuits

Some agricultural data may be protected as trade secret, but feeding such data into AI systems as training data can implicate trade secret protection to the extent public disclosures without secrecy obligations may destroy trade secret protections.[42] A small subset of farming data could theoretically also reflect a method that is patented, in which case the user of AI output that has been trained with such data would infringe such patent without knowing it.[43] Developers of AI systems should consider asking for representations from farmers that upload data into the AI system that such data is not patented or grant a license to the developer and the end-users to use such patents. Some data might also reflect an agricultural method that is patentable.[44] Using such data as training data might constitute public disclosure of the method, which means the method cannot be patented anymore.[45] As a consequence, farmers should verify that there is no intent to patent underlying methods of farming or data collection before sharing data.[46]

VII. CONTRACTUAL PROTECTIONS FOR FARM DATA

A. From AI Providers

The vast majority of farm data used to train AI models is likely not protected.[47] Farmers focus on ownership and control of their farming data.[48] Contracts and licenses for AI systems should give farmers clear control or

[https://perma.cc/XGL6-9E5Q]; Shannon L. Ferrell, *Legal Issues on the Farm Data Frontier, Part I: Managing First-Degree Relationships in Farm Data Transfers*, 21 DRAKE J. AGRIC. L. 13, 14 (2016) ("The current intellectual property framework fails to provide a clear niche for farm data in the realms of trademark, patent, or copyright law.").

42. ASHLEY C. ELLIXSON & TERRY GRIFFIN, UNIV. OF MD. COLL. OF AGRIC. & NAT'L RES., FARM DATA: OWNERSHIP AND PROTECTIONS 5 (2017), https://extension.umd.edu/sites/extension.umd.edu/files/publications/FarmData-OwnershipandProtections_FS-1055_ada.pdf [https://perma.cc/BSB8-T29D].

43. Tiffany Dowell, *Big Data on the Farm (Part II): What Laws Might Protect It?*, TEX. A&M AGRILIFE EXTENSION: TEX. AGRIC. L. BLOG (Sep. 8, 2015), https://agrilife.org/texasaglaw/2015/09/08/big-data-on-the-farm-part-ii-what-laws-might-protect-it [https://perma.cc/GE52-STKH].

44. *Id.*

45. *What You Should Know About the Patent Disclosure and on Sale Bars*, GRANT ATT'YS AT L. (July 14, 2025, at 12:55 CT), https://grant.legal/what-you-should-know-about-the-patent-disclosure-and-on-sale-bars/ [https://perma.cc/A7Y9-Z8Y7]; Pohl & Glassman, *supra* note 19.

46. *See What You Should Know About the Patent Disclosure and on Sale Bars*, *supra* note 45; Ferrell, *supra* note 41, at 29.

47. Dowell, *supra* note 44.

48. U.S. GOV'T ACCOUNTABILITY OFF., GAO-24-105962, *supra* note 1, at 40; Alexander, Yarborough & Smith, *supra* note 37, at 170.

ownership over their data. Some manufacturers follow and publicize their principle that all farm data will be controlled by the farmer, including how data is collected, stored, processed, and shared.[49] Since most farmers are not lawyers, agreements need to be drafted using simple, clearly written and transparent terms to make farmers comfortable.[50] Ag Data Transparent (ADT) is a non-profit organization that recognizes this issue and has, among other things, published basic guidelines for agriculture tech providers for collecting, using, storing, and transferring farmers' agricultural data.[51] It also provides a model agreement as a template for contracts covering agricultural data.[52] Section 2 of that Model Ag Data Use Agreement provides: "Your Ownership of Ag Data. The Company believes that you are the owner of Ag Data that originates from your farm, device, or equipment."[53] The following alternative contract language might be even more definitive than ADT's model in establishing the farmer's data ownership: Customer has and retains sole ownership of all right, title, and interest in and to the Inputs, related models, and Outputs, including all intellectual property rights arising therefrom or relating thereto. Section 2 of the ADT Model Agreement also provides that "[y]ou shall indemnify the Company from any claims that someone else owns the Ag Data uploaded to your account[,]" which puts the onus on the farmer to make sure that ownership of his or her data have not already been assigned to another entity such as the equipment manufacturer, which may deter

49. *Innovation in American Agriculture: Leveraging Technology and Artificial Intelligence: Hearing Before the S. Comm. on Agric., Nutrition, & Forestry*, 118th Cong. 12 (2023) (statement of Dr. Jahmy Hindman).

50. Jasmin Kaur & Rozita Dara, *Analysis of Farm Data License Agreements: Do Data Agreements Adequately Reflect on Farm Data Practices and Farmers' Data Rights?*, AGRIC., Nov. 2023, at 1, 24; Todd Janzen, *Updated Core Principles for Ag Data (2024)*, JANZEN SCHROEDER AG L.: JANZEN AG TECH BLOG (Apr. 26, 2024), https://www.aglaw.us/janzenaglaw/2024/4/26/the-updated-core-principles-for-use-of-ag-data-2024 [https://perma.cc/HP94-A3T8].

51. *Learn More About Ag Data Transparent*, AG DATA TRANSPARENT (July 14, 2025, at 12:59 CT), https://www.agdatatransparent.com/about [https://perma.cc/T6HW-A5GF].

52. AG DATA TRANSPARENT, MODEL AG DATA USE AGREEMENT § 2 (2019) (on file with author); *see Model Ag Data Use Agreement*, AG DATA TRANSPARENT (July 14, 2025, at 1:00 CT), https://www.agdatatransparent.com/model-agreement [https://perma.cc/Y95T-DCBC] (providing a Model Agreement template for download located at the bottom of the webpage).

53. AG DATA TRANSPARENT, MODEL AG DATA USE AGREEMENT § 2 (2019) (on file with author); *see Model Ag Data Use Agreement*, AG DATA TRANSPARENT (July 14, 2025, at 1:00 CT), https://www.agdatatransparent.com/model-agreement [https://perma.cc/Y95T-DCBC] (providing a Model Agreement template for download located at the bottom of the webpage).

farmers that do not want to engage attorneys for a due diligence on their data rights situation before purchasing farm equipment.[54]

B. From Recipients of Data Output

Whichever contractual protections may be negotiated, they may not extend beyond the initial contracting party (*e.g.*, if data is transferred to another party).[55] Additional protection could be established if the farmers did not only enter into agreements with the AI providers, but if the data originators signed contracts with third parties that will be able use or benefit from the data (such as terms of service (ToS) agreements, end user license agreements (EULAs), or privacy policies). Still, farmers may have limited ability to negotiate terms for the use of AI tools and may be faced with a take-it-or-leave-it situation.[56]

C. From Codes of Conduct and Certifications

A way to make farmers more comfortable with adopting AI solutions are voluntary codes of conduct that are being developed to obligate equipment providers to leave data ownership with the farmers. If equipment providers certify that they comply with a code of conduct that is known for its respect for farmers and their data ownership rights, it will be easier for farmers to trust the providers and adopt the technology.[57] For example, ADT reviews data contracts and awards certification when they align with core principles.[58] ADT's core principles comprise and address: farmer education; simple contracts; ownership and control; collection; notice of changes; transparency; choice; portability; identity of the provider; identity of data partners; disclosure and sale limitation; data retention and deletion; termination; anti-competitive activities; anonymization and aggregation; and security.[59]

54. AG DATA TRANSPARENT, MODEL AG DATA USE AGREEMENT § 2 (2019) (on file with author); *see Model Ag Data Use Agreement*, AG DATA TRANSPARENT (July 14, 2025, at 1:00 CT), https://www.agdatatransparent.com/model-agreement [https://perma.cc/Y95T-DCBC].

55. *See* AG DATA TRANSPARENT, MODEL AG DATA USE AGREEMENT § 5 (2019) (on file with author); *see Model Ag Data Use Agreement*, AG DATA TRANSPARENT (July 14, 2025, at 1:00 CT), https://www.agdatatransparent.com/model-agreement [https://perma.cc/Y95T-DCBC].

56. Jennifer Zwagerman, *Agriculture & Data Privacy: I Want a Hipaa(Potamus) for Christmas . . . Maybe*, 8 TEX. A&M L. REV. 685, 697, 707–08 (2021) (discussing the power imbalance between companies and small farmers that reduces or eliminates farmers' ability to negotiate).

57. Kaur & Dara, *supra* note 50, at 3.

58. *Model Ag Data Use Agreement*, *supra* note 52.

59. *Ag Data Core Principles*, AG DATA TRANSPARENT (Aug. 24, 2025, at 18:32 CT), https://www.agdatatransparent.com/principles [https://perma.cc/A67V-GGNU].

VIII. PROTECTION OF FARM DATA THROUGH AGGREGATION

Nevertheless, the benefits of data sharing are asymmetric between farmers and AI providers, meaning if farmers do not own the data, AI providers might control them or be able to use and commercialize them to others.[60] If farmers do not want a third party for-profit corporation to accumulate and control all the insights and benefits derived from the analysis of all the data individual farmers originate, farmers could also share their data in aggregated and anonymized form on voluntary collaboration platforms that they have some joint control over.[61]

Relatedly, the privacy of farm data is another obstacle to the widespread adoption of AI systems in farming. Farm data do not necessarily fall under "personally identifiable information" of the kind protected under privacy laws.[62] Still, farmers may not want manufacturers, software companies, the government, or competitors to know what they are farming, when they are working, who is working, and how much they produce.[63] The output from the AI systems may be anonymous, but depending on the type of data, or certain rare crops or soil conditions, the output might still allow conclusions about from which farm the data stems from and as such make the farm and its data identifiable.[64] In order to mitigate certain farmers' fears that they and their farming practices might be identified and exposed, AI providers could contractually guarantee to keep identifiable data confidential (see, for example, Section 4.2 of ADT's Model Ad Data Use Agreement) and, to comply with all data privacy laws and cybersecurity best practices. For example, language in an agreement could require that aggregated data that is made accessible to other users is provided in datasets that are large enough to prevent identification of farmers.[65] Providers should also covenant that identifiable data will also, where possible, be filtered out of training data and out of data output.[66] Such a covenant could be phrased as follows: [AI

60. Kher, *supra* note 34.

61. *Innovation in American Agriculture: Leveraging Technology and Artificial Intelligence: Hearing Before the S. Comm. on Agric., Nutrition, & Forestry*, 118th Cong. 55 (2023) (testimony of Sanjeev Krishnan, Director S2G Ventures).

62. *See* Ferris, *supra* note 38, at 333; James C. Wilgenbusch et al., *Addressing New Data Privacy Realities Affecting Agricultural Research and Development: A Tiered-Risk, Standards-Based Approach*, 114 AGRONOMY J. 2653, 2656–57 (2022).

63. *See* Wilgenbusch et al., *supra* note 62, at 2654, 2658.

64. *See id.* at 2656.

65. AG DATA TRANSPARENT, MODEL AG DATA USE AGREEMENT § 4.2 (2019) (on file with author); *see Model Ag Data Use Agreement*, AG DATA TRANSPARENT (July 14, 2025, at 1:00 CT), https://www.agdatatransparent.com/model-agreement [https://perma.cc/Y95T-DCBC].

66. *See* Wilgenbusch et al., *supra* note 62, at 2659.

System Provider] sanitizes training data and output data by applying state-of-the art pre-generation and post-generation filters. Of course, a more fundamental protection for the farmers would be to not share data individually, but only as part of data sharing cooperatives. Such cooperatives help create large data sets, making it harder to identify individual farmers.[67]

IX. FINANCIAL ASSISTANCE FOR THE ADOPTION OF AI TECHNOLOGY

Another adoption barrier for AI systems is that especially smaller farmers simply cannot afford purchasing advanced AI systems, or the use of the system is not efficient for a farm of their size.[68] To address this problem, farmers and ranchers can already receive some financial assistance or loans under several USDA programs, such as Farm Service Agency (FSA) loans or rural development grants and loans, that can likely be used for AI-related projects when integrated into other projects.[69] The 2024 Farm Bill would have provided further support programs, such as the Producing Responsible Energy and Conservation Incentives and Solutions for the Environment (PRECISE) Act that was introduced in 2023, or the Precision Agriculture Loan Program Act.[70] The proposed legislation would have expanded loan and loan guarantee programs for adopting precision agriculture technology under the Consolidated Farm and Rural Development, such as GPS mapping, sensors, and data management software.[71] The proposed changes to the loan criteria and procedures to encourage adoption of precision agriculture would have included special incentives for socially disadvantaged and beginning farmers.[72] Loan guarantees of 90% of the principal amount would be available for loans used for purchasing precision agriculture technology.[73] The Precision Agriculture Loan Program Act of 2023, which died in committee, would have established a loan program administered by the Farm Service Agency (FSA) to assist agricultural producers in purchasing precision agriculture equipment and

67. *Innovation in American Agriculture: Leveraging Technology and Artificial Intelligence: Hearing Before the S. Comm. on Agric., Nutrition, and Forestry*, 118th Cong. 55 (2023) (statement of Sanjeev Krishnan, Chief Investment Officer and Senior Managing Director, S2G Ventures).

68. *Id.* at 60 (testimony of Dr. José-Marie Griffiths, President, Dakota State University).

69. *See Grants and Loans*, U.S. DEP'T OF AGRIC. (Sep. 6, 2025, at 23:43 CT), https://www.usda.gov/farming-and-ranching/financial-resources-farmers-and-ranchers/grants-and-loans [https://perma.cc/J99H-WG53].

70. *See generally* PRECISE Act, H.R. 1459, 118th Cong. (2023); Precision Agriculture Loan Program Act of 2023, H.R. 1495, 118th Cong. (2023).

71. PRECISE Act, H.R. 1459, 118th Cong. §§ 2–3, 5 (2023).

72. *Id.* § 2.

73. *Id.*

technology.[74] Two years later, similar legislation was introduced as the Precision Agriculture Loan Program Act of 2025 that would amend the Food, Conservation, and Energy Act of 2008 to establish a precision agriculture loan program.[75] The government loans could be used, if adopted, to purchase equipment or technology, such as data management software, advanced analytics, and "any other technology, as determined by the Secretary, that leads to a reduction in, or improves efficiency of," inputs used in crop or livestock production.[76]

Additionally, a new tax credit has been proposed as part of the new Supporting Innovation in Agriculture Act of 2025, which would, if adopted, introduce a new tax credit in the amount of 30% of any investment in any "innovative agricultural project."[77] An innovative agricultural project means an agricultural technology system "for which the primary purpose is to produce, store, process, and package specialty crops . . . using . . . precision agriculture, or . . . controlled environment agriculture."[78] This would include, among other things, "data management, advanced analytics, machine learning, and artificial intelligence systems" that are "designed as part of or sold in connection with other precision agriculture technology . . . ."[79] If adopted, the tax credit would be added to the tax credits for renewable energy in a new Section 48F of the Internal Revenue Code.[80]

X. CONNECTIVITY OF SMALLER FARMERS IN RURAL AREAS

Even if financial incentives made the adoption of AI systems feasible for all farmers, the smaller farmers in rural or remote areas do not always have high speed internet access to connect their systems as needed to fully benefit from the AI system. The LAST ACRE Act 2023 would have expanded high-speed internet access to both unserved and underserved agricultural lands (focusing on supporting precision agriculture), but it also failed to advance out of committee.[81] The grants

74. Precision Agriculture Loan Program Act of 2023, H.R. 1495, 118th Cong. § 2 (2025).

75. Precision Agriculture Loan Program Act of 2025, H.R. 3211, 119th Cong. § 2 (2025).

76. *Id.*

77. Supporting Innovation in Agriculture Act of 2025, H.R. 1705, 119th Cong. § 2 (2025).

78. *Id.*

79. *Id.*

80. *Id.*

81. LAST ACRE Act of 2023, H.R. 6142, 118th Cong. § 2 (2023); *see also* LAST ACRE Act of 2023, S. 2542, 118th Cong. § 2 (2023) (the companion bill introduced in the Senate).

and loans to broadband providers under the LAST ACRE Act were intended to extend internet connectivity to eligible agricultural land by prioritizing unserved or underserved areas, and included provisions for cybersecurity, federal funding limits, and a competitive bidding process for service providers.[82] It also would have mandated enhanced data collection on broadband adoption in certain rural areas.[83] A new broadband bill was introduced in the Senate in 2025 that is intended "to advance precision agriculture connectivity nationwide" and "to augment last mile broadband deployment for agricultural producers by expanding high-speed internet access across the last acre."[84] If adopted, the bill would authorize the Last Acre Program under which the government would be authorized "to make grants and loans to covered providers on a competitive basis to provide qualifying connectivity to unserved and underserved eligible land."[85] Up to 10% of the funds may be awarded to certain agricultural research centers.[86] Another new bill introduced in 2025 would require the Federal Communications Commission (FCC) to review and recommend changes to its satellite rules to promote precision agriculture, including various crop management tools and practices that leverage technology like GPS equipment and uncrewed aircraft systems (commonly known as drones) to optimize production and sustainability.[87]

XI. CYBERSECURITY RISKS

Farmers are also concerned that cyberattacks could affect them in more severe ways if their farms are more connected to and rely on data from AI systems.[88] In fact, reliance on AI systems makes farming more vulnerable to cyberattacks.[89] It is possible that the input data are stolen or manipulated by cyber criminals.[90] AI systems are becoming an integral part of food production and food

82. LAST ACRE Act of 2023, H.R. 6142, 118th Cong. § 2 (2023).

83. *Id.* § 3.

84. *See* LAST ACRE Act of 2025, S. 1617, 119th Cong. § 2 (2025).

85. *Id.*

86. *Id.*

87. *See* Precision Agriculture Satellite Connectivity Act, H.R. 1618, 119th Cong. (2025).

88. Susan D'Agostino, *Who Hacked the Slaughterhouse? When Robots and AI Take Over Farms*, BULL. OF THE ATOMIC SCIENTISTS (May 23, 2022), https://thebulletin.org/2022/05/who-hacked-the-slaughterhouse-when-robots-and-ai-take-over-farms/ [https://perma.cc/ED8W-TK69].

89. *See* Alexis Stevens, *Artificial Intelligence and Cybersecurity: The Future of Grain Farming*, AG DECISION MAKER, Feb. 2025, at 11, https://www.extension.iastate.edu/agdm/newsletters/nl2025/feb25.pdf [https://perma.cc/7U9A-LPTS].

90. D'Agostino, *supra* note 88.

security in the United States.[91] AI tools may be able to breach privacy walls that humans cannot.[92] Agricultural data have been the frequent target of cyberattacks.[93] Cybercriminals have already targeted the food and agriculture sector, namely grain cooperatives and suppliers of seed and fertilizer.[94] Farmers and providers of AI systems and platforms need to upgrade their defense systems, and follow standard cybersecurity best practices.[95] However, not all farmers can afford state-of-the-art cybersecurity defenses.[96] In the United States, the Cybersecurity & Infrastructure Security Agency (CISA) is tasked with improving security and assisting the defense against attacks.[97] In 2015, a Food and Agriculture Sector-Specific Plan—which now requires updating—was developed by CISA in close collaboration with other agencies and partners to protect the nation's food and agricultural critical infrastructure by establishing sector priorities that guide security and resilience efforts, inform partner decisions, reflect activities to enhance security and resilience, and improve risk management practices.[98] The Food and Agriculture Sharing and Analysis Center plays another important role in the protection of agriculture against cyberattacks.[99] Established in 2013, the non-profit organization

91. ADAM GREEN, MIT TECH. REV. INSIGHTS, POWERING THE FOOD INDUSTRY WITH AI 3, 5 (2025), https://wp.technologyreview.com/wp-content/uploads/2025/03/MITTR-25RevvitySignals_V9_03172025.pdf [https://perma.cc/8FB4-B58X].

92. *See* Troy Lowry, *How AI Threatens Privacy*, LSAC (Nov. 2, 2023), https://www.lsac.org/blog/how-ai-threatens-privacy [https://perma.cc/J5N7-FJUG]; *Legal Issues to Address as AI Crops Up in Agriculture, supra* note 37; Pohl & Glassman, *supra* note 19.

93. *GIAC Cyber Security Discussion Paper*, AGRIC. MKTG. SERV., U.S. DEP'T OF AGRIC. (May 2024), https://www.ams.usda.gov/about-ams/giac-may-2024-meeting/cybersecurity [https://perma.cc/NJZ6-UYS3].

94. *Id.*; *see* D'Agostino, *supra* note 88; Pohl & Glassman, *supra* note 19.

95. *See generally* CYBERSECURITY & INFRASTRUCTURE SEC. AGENCY, AI DATA SECURITY: BEST PRACTICES FOR SECURING DATA USED TO TRAIN & OPERATE AI SYSTEMS 5–8 (2025), https://media.defense.gov/2025/May/22/2003720601/-1/-1/0/CSI_AI_DATA_SECURITY.PDF [https://perma.cc/WWW3-54QK].

96. *See* Chuck Abbott, *Security and Affordability Will Be Key for AI in Agriculture,* SUCCESSFUL FARMING (Nov. 15, 2023), https://www.agriculture.com/security-and-affordability-will-be-key-for-ai-in-agriculture-8402077 [https://perma.cc/3A2G-YNYD].

97. *See About CISA*, CYBERSECURITY & INFRASTRUCTURE SEC. AGENCY (July 21, 2025, at 13:01 CT), https://www.cisa.gov./about [https://perma.cc/J77M-M6T8].

98. CYBERSECURITY & INFRASTRUCTURE SEC. AGENCY, FOOD AND AGRICULTURE SECTOR-SPECIFIC PLAN 1 (2015), https://www.cisa.gov/sites/default/files/publications/nipp-ssp-food-ag-2015-508.pdf [https://perma.cc/2R4C-VLL7].

99. *See* FOOD AND AG-ISAC, FOOD AND AG CYBERSECURITY: A GUIDE FOR SMALL & MEDIUM ENTERPRISES 1 (2023), https://www.fsis.usda.gov/sites/default/files/media_file/documents/Food_and_Ag-ISAC_Cybersecurity_Guide.pdf [https://perma.cc/8G5F-C2DV].

provides cyber security resources to food and agriculture companies.[100] It is a subsidiary of Information Technology-Information Sharing and Analysis Centers (ISAC), which was established in 2000.[101] It provides threat intelligence, analysis, and effective security practices that help food and agriculture companies detect attacks, respond to incidents, and share indicators.[102]

The Agriculture Innovation Act of 2023, which was never adopted, would have authorized the establishment of a secure data center for collecting and sharing agricultural data.[103] Under the bill, the government would have been instructed to identify, collect, link, and analyze data on the impact of conservation and production practices on farm and ranch profitability, including risk-reducing factors such as enhancing crop yields, soil health, or ecosystem services.[104] The Secretary of Agriculture would have established assistance with data collection, analysis, and technology for conservation practices (aiming to improve productivity, profitability, and environmental outcomes).[105] It would have authorized a secure data center to collect, store, and share agricultural data, including with research institutions.[106] It would have also enabled the voluntary data collection by producers, and future research programs.[107] However, there was no authority to compel producer participation.[108]

The Promoting Precision Agriculture Act of 2023, which was included in the Farm Bill, also never left committee.[109] It would have authorized the Secretary to create voluntary, consensus-based interconnectivity standards for precision agriculture, in consultation with private sector, industry organizations, and government agencies, such as the FCC and the NIST.[110] These standards would have addressed the connectivity demands of precision agriculture equipment, considered cybersecurity threats, and served to emphasize "the impact of advanced wireless communications" and AI on farming practices.[111] A new bill introduced in 2025 would require the USDA to develop voluntary standards for precision

100. *Id.*
101. *Id.*
102. *Id.*
103. Agriculture Innovation Act of 2023, S. 98, 118th Cong. § 2 (2023).
104. *Id.*
105. *Id.*
106. *Id.*
107. *Id.*
108. *Id.*
109. Promoting Precision Agriculture Act of 2023, H.R. 1697, 118th Cong. (2023).
110. *Id.* § 2.
111. *Id.*

agriculture.[112] The USDA would have to consult with the NIST and the FCC to accomplish this goal.[113] It would have to consider factors including "the connectivity needs of precision agriculture equipment[,] cybersecurity challenges facing precision agriculture . . . [and] the impact of artificial intelligence on precision agriculture."[114] The private sector would lead the effort to set voluntary standards, and the result needs to be consensus-based. Under the bill, standards would include "interconnectivity standards, guidelines, and best practices for precision agriculture" to "promote economies of scale and ease the burden of adoption . . . ."[115] The USDA must "coordinate with relevant public and trusted private sector stakeholders and other relevant industry organizations" and "consult with sector-specific agencies . . . and state and local governments."[116]

XII. CONCLUSION

AI has huge potential helping farmers produce more food using fewer resources, which environmental and societal factors will increasingly require. Yet widespread adoption still faces hurdles caused by technology risk, legal uncertainty around farm data ownership control and privacy, IP and contractual protection, affordability for smaller farmers, connectivity, and vulnerability of the food sector to cyberattacks. Over several years, the private sector and the legislature have been making attempts to make AI and its farming recommendations more reliable and accessible to all farmers. Initiatives that have been attempted range from standardization and simplification of data agreements to certification of AI products, voluntary farmer collaboration platforms, government supported secure farming data centers, financial assistance for AI research and the acquisition of AI-related farming equipment, and for connecting the last acre of smaller farms to a reliable communication infrastructure. The next few years will show which combination of these legal, technological and financial measures will be the winning mix for all stakeholders involved.

112. Promoting Precision Agriculture Act of 2025, S. 507, 119th Cong. §§ 2–5 (2025).
113. *Id.* § 4.
114. *Id.*
115. *Id.*
116. *Id.*