CARBON MARKETS 101: UNDERSTANDING HOW CARBON CONTRACTS OPERATE

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ABSTRACT

Agriculture, like many industries, will face impacts from climate change, but at the same time can offer services that can be utilized to combat climate change. One of those services is sequestering of greenhouse gases (GHGs). This can occur by the agricultural operator changing practices to those that encourage the sequestering of carbon, such as planting of carbon crops and using no-till. Companies have begun to offer landowners contracts for the sequestering of GHGs through the adoption of new conservation practices. This is currently taking place in regions of the country with lower conservation practice adoption, such as the Midwest and Southern High Plains. As landowners are presented with these contracts, they often need help understanding the terms and how they will potentially be compensated.

Maryland currently has a large number of agricultural operations that have adopted conservation practices in order to meet water quality goals for the Chesapeake Bay watershed. Companies are beginning to offer landowners contracts to adopt additional practices to sequester GHGs in Maryland. Landowners presenting these contracts will need to understand the science behind GHG sequestration, the cost of implementing new practices, and the legal contract being presented to them. This commentary walks through many of these issues to highlight what the landowner might consider doing with these contracts.

I. INTRODUCTION

In the United States, 895 million acres of land are engaged in agricultural practices.[1] In Maryland, two million acres of land are in agricultural use.[2] This agricultural land, although utilized for food and fiber production, possibly has additional benefits to help combat climate change through sequestering of greenhouse gas (GHG) emissions, such as carbon dioxide. Several companies have begun offering contracts to agricultural landowners to encourage adoption of practices that sequester greenhouse gases (GHGs). This is currently taking place in regions of the country with lower conservation practice adoption; such as the Midwest. As landowners are presented with these contracts, they often need help understanding the terms and how they will potentially be compensated.

Maryland agricultural operators have a long history of adopting conservation

1. Nat'l Agric. Stats. Serv., U.S. Dep't of Agric., Farms and Land in Farms 2021 Summary 5 (2022), https://www.nass.usda.gov/Publications/Todays_Reports/reports/fnlo0222.pdf [https://perma.cc/FL34-4JRC].

2. *Id*. at 6.

practices, such as implementing no-till and planting cover crops, and therefore, could be prime candidates to work with these companies. This Article will explore the legal framework behind the sequestration of GHGs, the science behind sequestering GHG emissions, the parties involved in the process of a carbon contract, and finally, what a carbon contract would look like. Section II will highlight the legal framework (A) and carbon credits in practice (B). Section III will explore carbon storage, including an overview of carbon, the benefits of sequestration, and a case study involving cover crops. Section IV will highlight current policy approaches. Section V will provide an overview of how the market currently operates. Section VI will explore all the parties typically involved in a normal sequestration contract beyond the landowner and the company seeking sequestration. This Article will not explore contracts themselves but limits itself to the framework needed to develop a carbon contract or any GHG emissions sequestering contract.

II. CARBON CREDITS EXPLAINED

A. Legal Overview

For 50 years, "sulfur dioxide pollution—mostly from coal-fired power plants—was causing acid rain and snow, killing aquatic life and forests."[3] The 1990 Clean Air Act created a cap-and-trade approach placing a cap on GHG emissions where companies could buy and sell allowances through trade.[4] "Sulfur emissions went down faster than predicted and at one-fourth of the projected cost."[5] Today, the government has set caps on GHG emissions across various industries.[6] "The total amount of the cap is split into allowances, each permitting a company to emit one ton of emissions."[7] A carbon credit signifies the right to emit GHGs equivalent to one ton of carbon dioxide.[8] According to the Environmental Defense Fund, that is the equivalent of a 2,400-mile drive, roughly the distance between New York and Las Vegas.[9] Companies or countries buy

3. *How Economics Solved Acid Rain*, ENV'T DEF. FUND (Mar. 11, 2023, 9:51 PM), https://www.edf.org/approach/markets/acid-rain [https://perma.cc/LTQ4-3J6D].

4. *Id.*

5. *Id.*

6. *How Cap and Trade Works*, ENV'T DEF. FUND (Mar. 11, 2023, 9:50 PM), https://www.edf.org/climate/how-cap-and-trade-works [https://perma.cc/EH4V-DFPS].

7. *Id.*

8. Will Kenton, *Carbon Credits and How They Can Offset Your Carbon Footprint*, INVESTOPEDIA (Aug. 19, 2022), https://www.investopedia.com/terms/c/carbon_credit.asp#citation-1 [https://perma.cc/7ALX-FGUZ].

9. *How Cap and Trade Works*, *supra* note 6.

carbon credits when they cannot reduce their own carbon footprint.[10]

In 1997, the United Nations' Intergovernmental Panel on Climate Change (IPCC) developed a carbon credit proposal in the Kyoto Protocol.[11] The agreement set binding emission reduction targets for the countries that signed it.[12] The later Marrakesh Accords spelled out the rules for how the system would work.[13] In 2015, the Paris Agreement set emission standards and allowed emissions trading.[14] In 2021, the Glasgow COP26 Climate Change Summit implemented Article 6 of the 2015 Paris Agreement.[15] This allowed nations to work toward their climate targets by buying offset credits representing emission reductions by other countries.[16]

In the United States, California created its cap-and-trade program in 2013, and 10 Northeast states banded together to create the Regional Greenhouse Gas Initiative (RGGI).[17] The program includes Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.[18] Since 2009, RGGI has set a cap on carbon dioxide emissions from power plants throughout the region, with many regulated entities trading emission allowances.[19] The non-profit RGGI, Inc. administers the program, but individual state governments have enforcement authority.[20] In August 2017, the members

10. COTTON INC. & NAT'L COTTON COUNCIL OF AM., WHAT COTTON GROWERS SHOULD ASK – AND WHY – WHEN IT COMES TO CARBON 1 2022.

11. *What is the Kyoto Protocol?*, UNITED NATIONS (Mar. 12, 2023, 2:40 PM), https://unfccc.int/kyoto_protocol [https://perma.cc/Y6PS-KMPW].

12. *Id*.

13. *The Guidelines to Implement the Kyoto Protocol: The Marrakesh Accords and the 5,7 & 8 Implications*, UNITED NATIONS (Mar. 12, 2023, 2:39 PM), https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-kyoto-protocol/overview/background-and-resources/the-guidelines-to-implement-the-kyoto-protocol-the-marrakesh-accords-and-the-578-implications [https://perma.cc/CV3K-Q8TK].

14. Ciara Nugent, *How an Obscure Part of the Paris Climate Agreement Could Cut Twice as Many Carbon Emissions — Or Become a 'Massive Loophole' for Polluters*, TIME (Dec. 12, 2019, 12:43 PM), https://time.com/5748374/carbon-markets-paris-agreement/ [https://perma.cc/4GZF-3AWM].

15. Jake Springs & Kate Abnett, *U.N. Climate Summit Reaches Carbon Market Deal*, REUTERS (Nov. 13, 2021, 4:44 PM), https://www.reuters.com/business/cop/outline-carbon-markets-deal-emerges-un-climate-summit-2021-11-13/ [https://perma.cc/8H98-B3Y6].

16. *Id*.

17. *Multi-State Initiatives*, CTR. FOR CLIMATE & ENERGY SOLS. (Mar. 11, 2023, 8:01 PM), https://www.c2es.org/content/multi-state-initiatives/ [https://perma.cc/9BUA-X42W].

18. REG'L GREENHOUSE GAS INITIATIVE (Mar. 11, 2023, 10:37 PM), https://www.rggi.org/ [https://perma.cc/B4WH-JT9N].

19. *Elements of RGGI*, REG'L GREENHOUSE GAS INITIATIVE (Mar. 11, 2023, 10:26 PM), https://www.rggi.org/program-overview-and-design/elements [https://perma.cc/TMA8-3H75].

20. *Multi-State Initiatives, supra* note 17.

decided to reduce the cap by an additional 30% between 2020 and 2030.[21]

B. Carbon Credits in Practice

The carbon credit market provides an opportunity to businesses that produce a commodity from the potential carbon sequestration value that a section of land produces.[22] The more an area sequesters, the "better" the area is doing in a carbon context. More biologically productive areas of land are considered valuable as their excess carbon sequestration can be commodified as a so-called right to use from larger businesses.[23] The right to use refers to the way the owner wishes to use the property.[24] As long as the owner has possession of the property, they can use it however they desire.[25] Each property owner has carbon offsets or permits that allow the carbon credit owner to emit a certain amount of carbon dioxide or other GHGs.[26] These offsets are the property owner's rights if they have an excess as they can be sold to larger companies to use instead.[27] Carbon policy and land management are closely related topics.

The logic is that larger entities that produce a significant amount of carbon can then offset their footprint by purchasing carbon-production rights from a landholder that owns those rights. The better-managed properties could offset the total amount of carbon released by the other parties enrolled in purchasing carbon credits.[28] The offsets of selling and buying carbon credits is referred to as "emissions trading" and is a proposed solution to carbon overproduction and

21. Bruce Ho & Jackson Morris, *RGGI Agrees to Cut Power Plant Pollution by Another 30%*, NAT. RES. DEF. COUNCIL (Aug. 23, 2017), https://www.nrdc.org/experts/bruce-ho/rggi-agrees-cut-power-plant-pollution-another-30 [https://perma.cc/JL8Q-FA7Z].

22. *See* Nugent, *supra* note 14; *What Is Emissions Trading?,* U.S. ENV'T PROT. AGENCY (Mar. 11, 2023, 9:53 PM), https://www.epa.gov/emissions-trading-resources/what-emissions-trading [https://perma.cc/397M-BU5H].

23. *See What is Carbon Sequestration and How Does it Work?,* CLEAR CTR., UNIV. CAL. DAVIS (Sept. 20, 2019), https://clear.ucdavis.edu/explainers/what-carbon-sequestration [https://perma.cc/F857-VM52]; *see generally The Ultimate Guide to Understanding Carbon Credits*, CARBON CREDITS.COM (Apr. 12, 2023, 3:12 P.M), https://carboncredits.com/the-ultimate-guide-to-understanding-carbon-credits/ [https://perma.cc/2N24-YM3S].

24. *See generally The Ultimate Guide to Understanding Carbon Credits, supra* note 23.

25. *See generally id.*

26. *See* Robin Pomeroy, *Carbon Offsets - How Do They Work, and Who Sets the Rules?*, WORLD ECON. F., (Sept. 2, 2022), https://www.weforum.org/agenda/2022/09/carbon-offsets-radio-davos/ [https://perma.cc/3HRB-V4W6].

27. *The Ultimate Guide to Understanding Carbon Credits, supra* note 23.

28. *United Nations Carbon Offset Platform*, UNITED NATIONS CLIMATE CHANGE (Apr. 12, 2023, 3:17 PM), https://unfccc.int/climate-action/united-nations-carbon-offset-platform [https://perma.cc/D39N-FY48].

reducing carbon emissions.[29] The carbon market runs off a system that attempts to quantify who has the right to release carbon and who is responsible for "taking care" of the byproducts by growing plants to sequester carbon.[30]

This trading system can be used to moderate the release of carbon and the relationship between carbon and modern lifestyles.[31] Trading carbon does not only hold people responsible for producing carbon. Carbon trading also holds companies accountable for their carbon production and encourages them to take action to keep their practices more sustainable.[32] Carbon commodities are a useful tool for modern business practices.[33] Business entities can purchase these credits for state compliance and sometimes can purchase or produce credits for tax breaks.[34] They can also use their carbon neutrality as a marketing tool.[35]

III. SPECIFICS OF CARBON STORAGE

A. Carbon Explained

Carbon gas is a natural byproduct of our planet's functions.[36] Fire was one of the first producers of carbon gases.[37] Remarkable carbon gas reduction of our planet took place in the geologic period that shares its namesake, the Carboniferous.[38] Carbon is very natural, and most living beings on our planet have

29. *What Is Emissions Trading?*, *supra* note 22.

30. *See* Stefffan Dalsgaard, *The Commensurability of Carbon*, 3 J. ETHNOGRAPHIC THEORY 80, 86 –87 (2013).

31. Graciela Chichilnisky, *Financial Innovations and Carbon Markets*, UNITED NATIONS (Mar. 11, 2023, 9:54 PM), https://www.un.org/en/chronicle/article/financial-innovations-and-carbon-markets [https://perma.cc/W6BY-PQ7H].

32. *How Cap and Trade Works*, *supra* note 6.

33. Craig White, *Voluntary Carbon Offsets: The Evolution of a Business Expense*, THE TAX ADVISOR (Jan. 1, 2022), https://www.thetaxadviser.com/issues/2022/jan/voluntary-carbon-offsets-business-expense.html [https://perma.cc/5ZLF-E4KT].

34. Michael Rodgers & Brandon Dubov, *U.S. Tax Credit Encourage Investment in Carbon Capture and Storage*, WHITE & CASE (Jan. 29, 2021), https://www.whitecase.com/insight-our-thinking/us-tax-credit-encourages-investment-carbon-capture-and-storage [https://perma.cc/YD3G-QQG5].

35. Daniel Halbheer, *The Role of Marketing in Climate Change: Carbon Footprinting and Pricing*, HEC PARIS (Oct. 14, 2019), https:\www.hec.edu\en\knowledge\articles\role-marketing-climate-change-carbon-footprinting-and-pricing [https://perma.cc/LZ54-AW3D].

36. *What is Carbon Sequestration and How Does it Work?*, *supra* note 23.

37. *See* Joanna Haigh, *A Brief History of the Earth's CO2*, BBC NEWS (Oct. 19, 2017), https://www.bbc.com/news/science-environment-41671770 [https://perma.cc/SU2T-CKBN].

38. *Carboniferous Period Information and Prehistoric Facts,* NAT'L GEOGRAPHIC (Mar.

carbon-based bodies.[39] The natural release of carbon comes from things like volcanic activity and burning anything animal or plant-based.[40] Anthropogenic, or man-made carbon, comes from cars, factories, and other human activity.[41] Excess carbon in the Earth's atmosphere has been causing numerous health and environmental issues in the past few decades.[42] However, excess carbon, which is one of the causes of global warming, can be reduced by such means as carbon sequestration.[43]

Sequestering carbon is a process that can be facilitated through living tissues of autotrophic organisms like plants and soil microbia.[44] The carbon dioxide is taken out of the atmosphere by plants when they are growing and producing chlorophyll.[45] Even more carbon is taken in from the atmosphere during the respiration process of these organisms.[46] Carbon is then stored in the tissues of these organisms until they die and their remains return carbon back to the soil.[47]

The anthropogenic, man-made, carbon can be intentionally sequestered in the soil with the conscious planting of high-carbon plant tissues and maintaining the microbial health of the soil.[48] Microbes, like plants, use a lot of carbon, and the microbial health of the soil is the reason it can keep plants alive in the first place.[49]

11, 2023, 10:17 PM), https://www.nationalgeographic.com/science/article/carboniferous [https://perma.cc/C3W8-8434].

39. *Carbon Sequestration in Soils*, ECOLOGICAL SOC'Y OF AM. (Mar. 11, 2023, 6:56 PM), https://www.esa.org/esa/wp-content/uploads/2012/12/carbonsequestrationinsoils.pdf [https://perma.cc/7K9T-LRHL].

40. *What is Carbon Sequestration and How Does it Work?*, *supra* note 23.

41. *Id*.

42. *See Effects of Changing the Carbon Cycle*, NAT'L AERONAUTICS & SPACE ADMIN. (June 16, 2011), https://earthobservatory.nasa.gov/features/CarbonCycle/page5.php [https://perma.cc/GR39-LXZF].

43. *Carbon Sequestration*, FOREST SERV. U.S. DEP'T AGRIC. (Mar. 12, 2023, 2:36 PM), https://www.fs.usda.gov/ecosystemservices/carbon.shtml [https://perma.cc/CG69-XHGE].

44. *What is Carbon Sequestration and How Does it Work*, s*upra* note 23.

45. *Id*.

46. *Carbon Sources and Sinks,* NAT'L GEOGRAPHIC (Mar. 11, 2023, 10:13 PM), https://education.nationalgeographic.org/resource/carbon-sources-and-sinks/ [https://perma.cc/654S-5UNC].

47. *Id*.

48. Christos Gougoulias et al., *The Role of Soil Microbes in the Global Carbon Cycle: Tracking the Below-Ground Microbial Processing of Plant-Derived Carbon for Manipulating Carbon Dynamics in Agricultural Systems*, 94 J. SCI. FOOD AGRIC. 2362, 2365 (2014).

49. V. Nihorimbere et al., *Beneficial Effect of the Rhizosphere Microbial Community for Plant Growth and Health*, 15 BIOTECHNOLOGIE, AGRONOMIE, SOCIÉTÉ ET ENVIRONNEMENT [BIOTECHNOLOGY, AGRONOMY, SOC'Y & ENV'T] 327, 328–29 (2011).

Microbes need soils that are well-managed to keep plant production at its best.[50] Carbon sequestration works through carbon being absorbed into the tissues of living organisms that produce their own food through photosynthetic actions.[51] Carbon sequestration allows for a reduction in atmospheric carbon that causes the greenhouse effect.[52] A healthy balance of carbon in our atmosphere could turn the tides of climate change by slowing the progress of global warming.

B. Benefits of Carbon Sequestration

Determining carbon credit benefits can be done in several ways. Multiple different methods of farming can be useful while facilitating the sequestration of carbon.[53] The most effective and efficient way to remove carbon from the atmosphere naturally would be to sequester the carbon by natural means. Planting things like woody plants, trees, and crops can promote the removal of existing carbon in the atmosphere.[54] Some of these sequestration methods involve the use of cover crops.[55] The system of cover cropping works usually after a crop is harvested and another form of seed or legume is spread over that field and left to grow.[56] The growth of the plants and the bottom layers of soil being covered regulates microbial soil health.[57]

Much of the value plant production soil has, is strongly dependent on the health of the fungi and other microbes that live within the soil.[58] These microbiotas are sensitive to different conditions that modern agricultural practices can impose on an area.[59] They can be sensitive to exposure to the sun, levels of nutrients, crops planted, and soil type.[60] Some farmers utilize methods which regulate the amount

50. *Id*.

51. *What is Carbon Sequestration and How Does it Work?*, *supra* note 23.

52. *Overview of Greenhouse Gases*, U.S. ENV'T. PROT. AGENCY (Mar. 12, 2023, 2:33 PM), https://www.epa.gov/ghgemissions/overview-greenhouse-gases [https://perma.cc/3N3G-KEWU].

53. *Carbon Sequestration in Soils*, *supra* note 39.

54. *Id*.

55. *Id*.

56. *Id*.

57. SARA VIA, IZAAK WALTON LEAGUE OF AM. & NAT'L WILDLIFE FED'N, INCREASING SOIL HEALTH AND SEQUESTERING CARBON IN AGRICULTURAL SOILS: A NATURAL CLIMATE SOLUTION 11 (2021), https://www.iwla.org/docs/default-source/conservation-docs/agriculture-documents/via-2021-carbon-sequestration-report-final_lowres.pdf?sfvrsn=2bb28e0d_12 [https://perma.cc/H23X-LRRF].

58. *Id*. at 14.

59. *See generally id*.

60. Chris R. Smith et al., *Microbial Community Responses to Soil Tillage and Crop Rotation in a Corn/Soybean Agroecosystem*, 6 ECOLOGY AND EVOLUTION 8075, 8076 (2016).

of tilling which must be done in their fields, while others are opting for low and no-till farming techniques.[61] When an undisturbed layer of topsoil is left intact, or a beneficial plant species remains, the fungi and microbiota are able to remain thriving.[62]

Different aspects of land use provide a more diverse approach to modern farming in the credit market.[63] For example, farmers who keep an old-growth forest standing rather than clearcutting would need retroactive accreditation.[64] Forests, ponds, marshes, swamps, prairies, and other natural features the original land presented are usually the best at capturing carbon from the atmosphere.[65] Farmers who preserve these lands should get additional carbon credit payoffs for maintaining endangered ecosystems. The ultimate plan would be to incentivize planting mycorrhizal fungi spores and maintaining good soil health and natural fungal repositories.[66]

In practice, specifically in Maryland, the retroactive credit system is not very common.[67] Though many companies do not outwardly advertise this, some have methods to determine and pay for these benefits.[68] The methods involved in calculating retroactive credits are still in their early stages and are not assumed to be the most accurate.[69]

Agricultural practices that are less beneficial in a carbon context, unfortunately, persist as common practice in the present.[70] Monocrop systems,

61. *Id*. at 8081.

62. *Id*. at 8079.

63. *Carbon Farming: Multiple Approaches for Carbon Offsets*, CARBON CREDITS.COM (Mar. 11, 2022), https://carboncredits.com/carbon-farming-multiple-approaches-for-carbon-offsets/ [https://perma.cc/KLB5-EM3E].

64. *See* Aijing Li et al., *Can We Count on Forest Carbon Credits?*, RMI (Oct. 10, 2022), https://rmi.org/can-we-count-on-forest-carbon-credits/ [https://perma.cc/A86Q-7M9H].

65. *See Peatlands Store Twice as Much Carbon as All the World's Forests*, UNITED NATIONS ENV'T PROGRAMME (Feb. 1, 2019), https://www.unep.org/news-and-stories/story/peatlands-store-twice-much-carbon-all-worlds-forests [https://perma.cc/ZY7Q-U4YX].

66. VIA, *supra* note 57, at 12.

67. *See* MARYLAND DEPARTMENT OF THE ENVIRONMENT, THE TREE SOLUTIONS NOW ACT OF 2021: FINAL PLAN FOR GROWING 5 MILLION TREES IN MARYLAND 45 (2022).

68. *See* Christopher S. Galik et al., *Crediting Temporary Forest Carbon: Retrospective and Empirical Perspectives on Accounting Options*, FRONTIERS FORESTS & GLOB. CHANGE, Aug. 12, 2022, at 3.

69. *See id*.

70. Ivory Schley et al., *Long-term Tillage and Soil CO2 Fluxes*, CROPWATCH (Feb. 13, 2018), https://cropwatch.unl.edu/2018/long-term-tillage-and-soil-co2-fluxes [https://perma.cc/VU2R-EG57].

while they sequester carbon, also present unique soil health detriments and reduce biodiversity.[71] Therefore, farmers with less beneficial practices would not have the ability to receive the same quantity of financial reward from lands not healthfully farmed.[72] Different aspects of land features can provide different benefits to the area on top of sequestering carbon.[73] Using cover crops within a carbon sequestration program is a wonderful way to generate income and produce carbon offsets.[74] These different land features could provide much needed substrate for cover crops to flourish.

C. An Example of Carbon Sequestration: Adopting Cover Crop

A recent peer-reviewed article from Humberto Blanco-Canqui states that cover crops may not sequester as much carbon, if not any, when planted.[75] Biomass studies and productivity surveys found that cover crops are not always as effective as they would be in theory.[76] In practice, using cover crops is not always feasible and does not always produce the desired results that are needed to sell carbon credits.[77] Data must be collected and analyzed to compare the cost-benefit and projected results when a contractor is planning on using cover crops.[78] The effectiveness of the cover crops must be measured and verified before any sort of payment is made for the carbon sequestered.[79]

71. *Contra Cover Crop$ Tool,* NAT. RES. CONSERVATION SERV., U.S. DEP'T OF AGRIC. (March 11, 2023, 7:18 PM), https://www.nrcs.usda.gov/sites/default/files/2022-08/nrcseprd334424.pdf [https://perma.cc/SY7E-URC6].

72. *See* Jordan Shockley & Will Snell, *Carbon Markets 101*, ECON. & POL'Y UPDATE, Apr. 29, 2021, at 1, 1.

73. *See* Stefan Zeeman, *Exploring the Carbon Capture Potential of Different Land Types,* CARBON REWILD (Sept. 14, 2020), https://carbonrewild.com/exploring-the-carbon-capture-potential-of-different-land-types/ [https://perma.cc/X59A-JPB7].

74. *See* SUSTAINABLE AGRIC. RSCH. & EDUC., COVER CROP FACTS (2018), https://cra.missouri.edu/wp-content/uploads/2021/08/Cover-Crops-and-Carbon-Sequestration.pdf [https://perma.cc/5B73-JPWH].

75. Lindsey Anderson et al., *Cover Crop Grazing Impacts on Soil Properties and Crop Yields Under Irrigated No-Till Corn-Soybean Management*, 86 SOIL SCI. SOC'Y AM. J. 118, 131 (2021).

76. Dan Looker, *The Economics of Cover Crops,* SUCCESSFUL FARMING (Oct. 29, 2018), https://www.agriculture.com/crops/cover-crops/the-economics-of-cover-crops [https://perma.cc/CJ24-5YA2].

77. *Id.*

78. *Id.*

79. Tom Edwards, *Measuring and Reporting Soil Organic Carbon*, GOV'T OF W. AUSTL. DEP'T OF PRIMARY INDUS. & REG'L DEV. (Sept. 15, 2021, 2:48 PM), https://www.agric.wa.gov.au/soil-carbon/measuring-and-reporting-soil-organic-carbon [https://perma.cc/F5TH-KXK9].

The American Society for Agronomy, the Crop Science Society of America, and the Soil Science Society of America worked together to publish a 2021 report which discusses the efficient and equitable management of cover crops.[80] Special efforts were made in this report to discuss the profitable and less profitable uses of cover crops.[81] Short-term studies have found data that supports certain cover crops' ability to sequester carbon and produce biomass.[82] However, long-term studies are needed to understand the effects of environmental services on the ecological output of cultivated lands.[83] Moreover, studies are needed to determine the effectiveness of different crops and their associated growing conditions.

Eventually, with this information, a public database can be frequently updated and can give information on what the best carbon-sequestration crop is for a particular geographic area, fertilization methods, geographic-specific environmental conditions, non-monocultivar strategies (concurrent crop planting, including with mycorrhizal fungi), and soil type.[84] Different types of environmental areas in the restored land could contribute more than estimated in a carbon market program. Through ecological hypothesis, a field restored to a prairie could sequester more carbon, but restoring a field back to a wetland does more than merely sequestering carbon. This hypothetical wetland could also restore species diversity and biomass to the area.[85] Biomass and diversity are very important ecologically as they are often an indicator that the environment is doing well enough for complex and healthy ecosystems to build.[86] Balanced ecosystems

80. *See generally* Susan V. Fisk, *Cover Crops, Compost and Carbon*, AM. SOC'Y OF AGRONOMY, (Aug. 5, 2019), https://www.agronomy.org/news/science-news/cover-crops-compost-and-carbon [https://perma.cc/43ZG-5YVT].

81. *See generally Maryland's 2022-2023 Cover Crop Program*, MD. DEP'T OF AGRIC. (Mar. 11, 2023, 10:07 PM), https://mda.maryland.gov/resource_conservation/pages/cover_crop.aspx [https://perma.cc/CQW9-YEEY].

82. *Carbon Sequestration in Soils*, *supra* note 39.

83. *See generally* Patrick Koss et al., *Factors Associated with Carbon Sequestration*, UNIV. OF WIS. - GREEN BAY, (Mar. 19, 2023, 3:51 PM), http://scholar.googleusercontent.com/scholar?q=cache:QX8aYWdC_0EJ:scholar.google.com/+koss+Factors+Associated+with+Carbon+Sequestration&hl=en&as_sdt=0,21&as_vis=1 [https://perma.cc/LG7C-KP7H].

84. *See generally id*.

85. *Why are Wetlands Important?*, U.S. ENV'T. PROT. AGENCY (Mar. 23, 2022), https://www.epa.gov/wetlands/why-are-wetlands-important [https://perma.cc/7PD7-L8P2].

86. Wetland & Aquatic Rsch. Ctr., *Biodiversity Critical to Maintaining Healthy Ecosystems,* U.S. GEOLOGICAL SURV. (Jan. 15, 2016), https://www.usgs.gov/news/biodiversity-critical-maintaining-healthy-ecosystems [https://perma.cc/BBV8-4CEQ].

are considered ideal environments for endangered and threatened species.[87] Maintaining a powerful source of environmental health in one area should be counted for more in an environmental service. This is because these areas are producing important ecological services beyond carbon sequestration, and therefore are a greater asset to the land. Important ecological services provided by a farmland's natural features can be why some endangered species survive in an area.[88]

IV. CURRENT POLICY APPROACHES

The Growing Climate Solutions Act (the Act) was introduced in the 117th Congress by Indiana Senator Mike Braun and Michigan Senator Debbie Stabenow.[89] The Act called for a certification program at USDA to help farmers and forest landowners participate in the carbon credit market.[90] The Act was passed as part of the Consolidated Appropriations Act, 2023 and signed by the President into law in 2022.[91] Private carbon markets have been launched by companies including Indigo Ag Carbon, Nori, and Farmers Business Network.[92] Other private agribusinesses have developed carbon market programs, such as Bayer and Nutrien.[93] Further legislation is being considered based on Food and Agriculture Climate Alliance (FACA) recommendations.[94] FACA consists of organizations

87. *Ecosystems*, N.H. PUB. BROAD. SERV. NATURE WORKS, (Mar. 11, 2023, 10:12 PM), https://nhpbs.org/natureworks/nwepecosystems.htm [https://perma.cc/372H-2B2J].

88. *See Endangered Species on Farmland*, ONT. FARMLAND TR. (May 20, 2021), https://ontariofarmlandtrust.ca/2021/05/20/endangered-species-on-farmland/ [https://perma.cc/CP3J-S6FV].

89. Growing Climate Solutions Act of 2021, S. 1251, 117th Cong. (2021).

90. *See id*.

91. *Congress Passes Fiscal Year 2023 Omnibus Appropriations Bill*, NAT'L ASS'N OF WHEAT GROWERS (Dec. 23, 2022), https://wheatworld.org/congress-passes-fiscal-year-2023-omnibus-appropriations-bill/ [https://perma.cc/Z5WN-PDAG].

92. *See About Indigo Ag*, INDIGO (Apr. 11, 2023, 11:46 AM), https://www.indigoag.com/about [https://perma.cc/GND9-QR9S]; *see generally About Nori's Carbon Removal Marketplace*, NORI (Apr. 11, 2023, 11:52 AM), https://nori.com/about [https://perma.cc/B47K-MSV9]; *Farm-Born Values*, FARMERS BUS. NETWORK (Apr. 11, 2023, 11:54 AM), https://www.fbn.com/about [https://perma.cc/FG2P-DU8N].

93. *See Bayer Carbon*, BAYER (Aug. 12, 2022), https://www.bayer.com/en/agriculture/carbon-program-united-states [https://perma.cc/VFR2-682W]; *see generally Carbon Program: Feeding the Planet Sustainably*, NUTRIEN (Apr. 11, 2023, 11:57 AM), https://www.nutrien.com/sustainability/strategy/carbon-program [https://perma.cc/5FMV-CRWG].

94. *See generally* FOOD & AGRIC. CLIMATE ALL., FARM BILL POLICY PRIORITIES: RECOMMENDATIONS TO THE 118TH CONGRESS (Mar. 21, 2023, 11:04 AM), https://agclimatealliance.com/files/2023/02/farm-bill-recommendations.pdf [https://perma.cc/DJ82-6SU6].

representing farmers, ranchers, forest owners, agribusinesses, manufacturers, the food and innovation sector, state governments, sportsmen, and environmental advocates.[95]

The FACA recommendations provide voluntary, incentive-based tools to maximize the sequestration of carbon, reduce GHG emissions, and increase the resilience of the land.[96] FACA policies focus on supporting the development and oversight of private sector markets for GHG credits.[97] FACA highlights promoting public and private sector tools to incentivize farmers, ranchers, and forest owners to prioritize and scale climate-smart practices.[98] Moreover, FACA suggests offering incentives for farmers to reduce energy consumption, increase the use of on-farm renewable energy, and make continued progress toward reducing the lifecycle GHG emissions of agriculture and forestry-based renewable energy.[99]

Recently, FACA has made several suggestions that would require government intervention.[100] These include streamlining consumer-facing packaging and implementing public-private partnerships to reduce the GHG impact of food waste and loss.[101] The biggest request FACA is advocating for is a substantial and continuous increase of federal investment in agriculture, forestry, and food-related research.[102]

Because carbon credit markets are still relatively new, there are lingering issues that have not yet been resolved.[103] The main issues can be summarized as quality control and verification.[104] A "high-quality" carbon credit must have documentation, data privacy, access to rural broadband, tech adoption, and most importantly demand.[105] There are three main questions individuals and entities interested in entering the carbon credit market must ask: "What changes in agricultural production practices will qualify for credit and how long must they be in existence? How and when the baseline is established so additional carbon sequestered is measured and compensated accurately? How are early adopters

95. *Id*. at 5.
96. *Id*. at 10.
97. *Id*. at 9.
98. *Id*. at 12.
99. *See id*. at 23.
100. *See id*. at 17–29.
101. *Id*. at 17.
102. *See id*. at 28.
103. Shockley & Snell, *supra* note 72, at 3.
104. *Id*.
105. *Id*.

incentivized to enter carbon market programs?"[106] As it stands, the answers to these questions vary from region to region and organization to organization.[107] Nevertheless, for any market to flourish there must be a set standard.

V. BUYING & SELLING CARBON CREDITS

A. Buyer and Seller

There are five main parties involved in the soil carbon storage process: the buyer, the seller, the measurer, the verifier, and the broker.[108] The buyer is usually a company that needs to purchase a certain amount of soil carbon to offset its carbon footprint, such as American Airlines, Google, Marathon Oil, or another large entity with high carbon emissions.[109] Carbon credits also attract corporate buyers like General Mills, Nestle, and McDonald's, agribusinesses like Cargill, Syngenta, and Corteva, and even government entities.[110] The seller is the owner of real property that implements regenerative farming practices to store carbon.[111] Sellers, typically farmers, are paid for generating carbon credits by adopting management practices that meet specific beneficial ecosystem criteria.[112] These practices include no-till/reduced-till, cover crops, crop rotation, and buffer strips that sequester carbon.[113] In Maryland alone, there are more than 12,000 farms that produce a variety of commodities on nearly two million acres, many of which may be eligible for carbon storage.[114]

B. How Payments Work

Sellers are paid based on the amount of carbon sequestered, either on a per-

106. *Id*.

107. *Id*. at 2.

108. Jesse Daystar, Chief Sustainability Officer & Vice President of Sustainability, Cotton Inc., & Anson Howard, Uhl Fitzsimons, Presentation at the State Bar of Texas' 15th Annual John Huffaker Agricultural Law Conference: What Is Soil Carbon Storage and How Do We Contract for It? 1 (May 26-27, 2022) (on file with authors).

109. *Id*.

110. Shelby Myers, *Sustainability Markets, Part 1: Agricultural Ecosystem Credit Markets – the Primer,* AM. FARM BUREAU FED'N (Mar. 2, 2021), https://www.fb.org/market-intel/sustainability-markets-part-1-agricultural-ecosystem-credit-markets-the-primer [https://perma.cc/KA8N-MRNY].

111. Daystar & Howard, *supra* note 108.

112. Myers, *supra* note 110.

113. *Id*.

114. NAT'L AGRIC. STATS. SERV., U.S. DEP'T OF AGRIC., AC-17-A-51, 2017 CENSUS OF AGRICULTURE MARYLAND STATE AND COUNTY DATA 176 (2019).

acre or per-ton amount of carbon sequestered.[115] Typically, contracts have a rough estimate of land per unit of measurement with a standard level of carbon it could sequester.[116] When the land is being biologically productive, carbon credits can begin to be sold.[117] Payments usually begin a few years after the contract goes into effect.[118] Typically, payments occur every year or every five years.[119] Payment timetables depend on the type of contract the seller has enrolled in.[120] Under certain contracts, payments can be canceled for not abiding by contract terms and natural disasters.[121]

C. What Questions Should a Seller Ask About Carbon Markets?

A seller must begin to ask difficult questions when considering enrollment into a carbon market program.[122] One of the first would be to ask if the labor needed for the project is worth the financial investment that the carbon contract needs.[123] For example, some sellers do not have financial access to the resources they need to fulfill the requirements of their carbon contract.[124] Additionally, the equipment that would be necessary for such service is often unavailable due to geographic location, financial issues, maintenance issues, or any of the other roadblocks that sellers encounter when managing a crop growing project.[125]

115. Tiffany Dowell, *Understanding & Evaluating Carbon Contracts,* TEX. A&M AGRILIFE EXTENSION: TEX. AGRIC. L. BLOG (Jan. 24, 2022), https://agrilife.org/texasaglaw/2022/01/24/understanding-evaluating-carbon-contracts/ [https://perma.cc/EKG2-MCVD].

116. *Id*.

117. *See id*.

118. Chelsea Dinterman, *What Farmers Need to Know About Carbon Contracts*, SUCCESSFUL FARMING (Apr. 14, 2022), https://www.agriculture.com/crops/conservation/what-farmers-need-to-know-about-carbon-contracts [https://perma.cc/HXC6-PCYT].

119. *The Ultimate Guide to Understanding Carbon Credits, supra* note 23.

120. *Id*.

121. Contract Gamma (on-file with authors).

122. *See* Sarah Sellers et al., *What Questions Should Farmers Ask about Selling Carbon Credits?*, UNIV. OF ILL. FarmdocDAILY (Apr. 13, 2021), https://farmdocdaily.illinois.edu/2021/04/what-questions-should-farmers-ask-about-selling-carbon-credits.html [https://perma.cc/F4A9-DA2T].

123. *Id*.

124. *See generally id*.; *Carbon Pricing: What is a Carbon Credit Worth*?, GOLD STANDARD (Apr. 12, 2023, 4:49 PM), https://www.goldstandard.org/blog-item/carbon-pricing-what-carbon-credit-worth [https://perma.cc/GJX2-AXDW].

125. *See generally* Peter Scharpe, *Economics of No-Till and Cover Crop; Does It Really Pay Off?*, MINN. FARM GUIDE (Jan. 13, 2020), https://www.agupdate.com/minnesotafarmguide/news/crop/economics-of-no-till-and-cover-crop-does-it-really-pay-off/article_ff5a1af2-33f1-11ea-8fae-1b260289c126.html [https://perma.cc/875Z-3EXX].

Some practices are simply impossible to fulfill in an agricultural context. Making sure a carbon contract is accessible and affordable is often one of the largest challenges in the adoption of a large carbon market program.[126] Some people simply see it as too much work and not enough pay off.

Before signing a carbon contract, a diligent seller must understand the terms, conditions, and information that are communicated by the contract and broker.[127] Understanding how property can be enrolled and the amount of success that can be projected after the program is crucial.[128] A seller should have a solid understanding of what they are getting into before they enter a contract with good intentions.[129]

VI. PARTIES INVOLVED IN CARBON CREDITS

A. Measurers

Measuring refers to finding data to support the research into carbon sequestration and efficiency of practice on associated farms enrolled in the carbon program.[130] The ultimate goal would be to create a cohesive, singular, and centralized registry or compilation of data.[131] This helps prevent the enrollment of one parcel of land into many different contracts, also known as stacking.[132] A singular registry can help track which entities are enrolled in a carbon contract.[133] This singular registry would be helpful because stacking investigations would be much faster and more efficient when this is used because it is easier to check one

126. *See A National Government's Need for a Carbon Registry and Auction Platform*, S&P GLOBAL (Sep. 26, 2022), https://www.spglobal.com/esg/case-studies/a-national-government-s-need-for-a-carbon-registry-and-auction-platform [https://perma.cc/2RTJ-8LEQ].

127. Dowell, *supra* note 115.

128. *Id*.

129. *Id*.

130. *Id*.

131. *A National Government's Need for a Carbon Registry and Auction Platform*, *supra* note 126; *see also* GREENHOUSE GAS MGMT. INST. & THE STOCKHOLM ENV'T INST., *Registries & Enforcement*, CARBON OFFSET GUIDE (Mar. 11, 2023, 9:48 PM), https://www.offsetguide.org/understanding-carbon-offsets/carbon-offset-programs/registries-enforcement/ [https://perma.cc/44HZ-N23X] (includes a list of voluntary market registries).

132. Dowell, *supra* note 115.

133. *A National Government's Need for a Carbon Registry and Auction Platform*, *supra* note 126; *see also* BECCA MADSEN ET AL., ELEC. POWER RSCH. INST., OFFSET CREDIT STACKING 17-18 (2012), https://eea.epri.com/pdf/ghg-offset-policy-dialogue/workshop13/Background-Paper_EPRI-Offsets-W13_Credit-Stacking_Final_Locked.pdf [https://perma.cc/Q7LQ-SKCM].

registry than several for a single property.[134]

This stacking dataset would have to comply with pre-existing data privacy terms on contracts that are currently in place.[135] Different contracts may have differing privacy terms, so making one contract from the two can sometimes be difficult. One solution to this might be a state-managed carbon program.[136] Enforcing a state-managed carbon program can encourage cooperation from farmers.[137] As seen in practice, not all state-managed programs are always successful, sometimes they need more resources and organization.[138] A state-managed program also opens more opportunities for federal funding, which could draw more participants into the carbon market.[139] Based on numerous endeavors in rural co-op failures, the public may be wary of private carbon markets.[140]

Prominent private registries include: American Carbon, which provides measuring and verifying;[141] Gold Standard (an international company with most credits awarded in Asia and Africa), which verifies but does not measure soil samples;[142] Climate Action Reserve, which measures soil samples and provides the option to enter data on one's own;[143] Plan Vivo, which includes self-reported information and does not verify the results through the company;[144] and VCS-Verra, which uses third party verification from independent soil sampling.[145]

134. *See* MADSEN ET AL., *supra* note 133; *A National Government's Need for a Carbon Registry and Auction Platform*, *supra* note 126.

135. *See generally* Sellers et al., *supra* note 122; Dowell, *supra* note 115.

136. *See generally Regional Greenhouse Gas Initiative (RGGI)*, CTR. FOR CLIMATE & ENERGY SOLS. (Mar. 11, 2023, 8:04 PM), https://www.c2es.org/content/regional-greenhouse-gas-initiative-rggi/ [https://perma.cc/RJL2-V7H8].

137. *See generally id*.

138. *See generally The Ultimate Guide to Understanding Carbon Credits, supra* note 23.

139. *See generally* Gail L. Achterman & Robert Mauger, *The State and Regional Role in Developing Ecosystem Service Markets*, 20 DUKE ENV'T. L. & POL'Y F. 291, 333 (2010).

140. *See generally id*.

141. *Public Registry*, AM. CARBON REGISTRY AT WINROCK INT'L (Apr. 10, 2023, 9:53 AM), https://americancarbonregistry.org/how-it-works/registry-reports [https://perma.cc/WLL6-DF6L].

142. *Vision + Impacts*, GOLD STANDARD (Mar. 11, 2023, 9:54 PM), https://www.goldstandard.org/about-us/vision-and-mission [https://perma.cc/Q89J-V5TC].

143. *Voluntary Offset Program*, CLIMATE ACTION RSRV. (Mar. 11, 2023, 8:22 PM), https://www.climateactionreserve.org/how/voluntary-offset-program/ [https://perma.cc/ZL39-667U].

144. *See generally* PLAN VIVO FOUND. (Mar. 11, 2023, 10:25 PM), https://www.planvivo.org/ [https://perma.cc/C3VU-PH88].

145. *Program Overview*, VERIFIED CARBON STANDARD (Mar. 12, 2023, 2:43 PM), https://verra.org/project/vcs-program/ [https://perma.cc/L8GH-HNBG].

Third-party soil sampling is beneficial because it promotes honesty on the part of all parties.[146] Keeping the carbon company and the soil testing company accountable for their data keeps bias from affecting reported data.[147]

B. Registries and Necessary Data

A registry stands to create a list of companies and people who are participating in a specific carbon credit program.[148] A registry means that everyone who has land enrolled in the carbon market program has been recorded somewhere, and their data corresponds to the correct account registered.[149] The registry can serve as a private database owned by the carbon company.[150] Privacy terms vary between different carbon contract plans and can possibly be negotiated.[151] Privacy of data is a very serious concern for farmers. They do not want to share the specs and production of their fields because that information can harm their work. There is much distrust over data security and central organizations.[152] Furthermore, there is an initiative to maintain data privacy within carbon and agricultural contexts called Ag Data Transparent.[153] This is a commission of companies dedicated to farm-related data security.[154]

According to Natural Resources Conservation Service (NRCS), the data needed for this program to have meaningful success would include different measurements of carbon sequestration abilities for potential land enrolled.[155] The data that is absolutely necessary for success would be soil content, crops planted, and irrigation.[156] A crucial part of this data set would be information on

146. Todd Janzen, *The Six Building Blocks of a Soil Carbon Contract*, JANZEN AG L.: JANZEN AG TECH BLOG (Nov. 5, 2021), https://www.aglaw.us/janzenaglaw/2021/9/22/the-building-blocks-of-a-soil-carbon-contract [https://perma.cc/E6K8-SX8K].

147. *See* GREENHOUSE GAS MGMT. INST. & THE STOCKHOLM ENV'T INST., *supra* note 131.

148. *Id*.

149. *See generally id*.

150. *See generally Vision + Impacts*, *supra* note 142.

151. Kelly T. Wilfert, *Carefully Consider Carbon Credit Contracts,* JD SUPRA (May 13, 2022), https://www.jdsupra.com/legalnews/carefully-consider-carbon-credit-4311468/ [https://perma.cc/74Y3-MQ36].

152. *What Does It Mean to be Ag Data Transparent*, AG DATA TRANSPARENT (March 11, 2023, 7:56 PM), https://www.agdatatransparent.com/about [https://perma.cc/D8HZ-DX66].

153. *Id*.

154. *Id*.

155. *See Environmental Markets at NRCS*, NAT. RES. CONSERVATION SERV., U.S. DEP'T OF AGRIC. (March 12, 2023, 2:32 PM), https://www.nrcs.usda.gov/resources/education-and-teaching-materials/environmental-markets-at-nrcs [https://perma.cc/3JBS-GF97].

156. Paul Schattenberg, *Is Carbon Farming The "Crop" of The Future?*, AGRILIFE

sequestration methods used like no-till, low till, use of cover crops, and changes in nutrient applications on different lands.[157] Data used in agricultural contexts is a hot topic in modern farming. Data about field productivity and content are very closely guarded by farmers and their field data is typically considered secret.[158] Farmers want to be able to trust a secure source with their data. The fewer places the data is located, the more secure this system can be. If farmers' data is protected with a larger program, they would have a more efficient software network that maintains the data properly.[159]

More useful data would include the size of land enrolled, type of soil, irrigation techniques employed, type of crops planted, crop rotation strategies, tilling strategies, land type (categories like former wetlands, cleared forests, prairie, etc.), chemical storage sites, current plant landscape, water table, etc.[160] These are all important because they give a good idea of the land's carbon potential and how much money the farmer could receive from the completed contract.[161]

C. How Does Sampling Work?

Soil core sampling is a method of testing that involves taking a core of soil and cutting it vertically to expose the layers of soil.[162] After this core is processed and prepared, it is sent to a lab to have its carbon content analyzed.[163] Plants, through photosynthesis, take in atmospheric carbon and use it in their structures.[164] This process "cleans" the atmosphere of carbon that causes many of the

TODAY (May 27, 2021), https://agrilifetoday.tamu.edu/2021/05/27/is-carbon-the-crop-of-the-future/ [https://perma.cc/GB2G-JW49].

157. JEFF SCHAHCZENSKI & HOLLY HILL, NAT'L SUSTAINABLE AGRIC. INFO. SERV., NAT'L CTR. FOR APPROPRIATE TECH., AGRICULTURE, CLIMATE CHANGE AND CARBON SEQUESTRATION 6-7 (2009), https://www.canr.msu.edu/foodsystems/uploads/files/ag-climate-change.pdf [https://perma.cc/8ACP-CBXK].

158. Ashley Ellixson et al., *Legal and Economic Implications of Farm Data: Ownership and Possible Protections*, 24 Drake J. Agric. L. 49, 57 (2019).

159. *A National Government's Need for a Carbon Registry and Auction Platform*, *supra* note 126.

160. Koss et al., *supra* note 83.

161. *See id.*; TONY L. PROVIN & JOHN L. PITT, TEX. A&M AGRILIFE EXTENSION, SCSC-PU-043, TESTING YOUR SOIL: HOW TO COLLECT AND SEND SAMPLES 1 *passim* (2022), https://cdn-de.agrilife.org/extension/departments/scsc/scsc-pu-043/publications/files/testing-your-soil-how-to-collect-and-send-samples.pdf [https://perma.cc/3XUM-UR67].

162. Edwards, *supra* note 79.

163. *Id.*

164. *What is Carbon Sequestration and How Does it Work?*, *supra* note 23.

anthropogenic issues our society faces today, like global warming.[165]

In some programs, 15–20 soil cores from less than 20 acres are sampled and analyzed for carbon content.[166] This costs about $7–$10 an acre.[167] Cores are typically collected within a given contract in the first and fifth (often the final) year.[168] This is frequently a time-consuming endeavor on behalf of the farmer. Soil sampling also does not provide a gradient of information but more of a "battleship" type method of soil production monitoring.[169] The sampling methods use core sampling from coordinates rather than an overall analysis of the entire field.[170]

Technology is being developed in satellite and modeling areas to measure the content of soils remotely.[171] Satellite images can provide context about what kind of soil the farmer is working with and how well it can support plants that sequester carbon.[172]

Sampling can take place remotely in the future, mitigating costs associated with in-person field sampling.[173] Remote sensing is much more accessible and less labor intensive.[174] Remote sensing is a crucial service that will decrease in cost by order of magnitude once it becomes more developed.[175] Farmers could potentially not have to pay to get soil samples collected and tested as often. If remote sensing becomes more advanced, farmers would only have to send samples in for problem-shooting soil issues. The effort to collect and test the samples would be a less

165. *What is Carbon Sequestration?*, U.S. GEOLOGICAL SURV., U.S. DEP'T OF THE INTERIOR (Mar. 12, 2023, 2:38 PM), https://www.usgs.gov/faqs/what-carbon-sequestration [https://perma.cc/UEY5-PVB6].

166. NAT. RES. CONSERVATION SERV., SMALL SCALE SOLUTIONS FOR YOUR FARM: SOIL TESTING 2 (2022), https://www.farmers.gov/sites/default/files/2022-09/farmersgov-small-scale-factsheet-soil-testing-9-2022.pdf [https://perma.cc/E4RW-K5TJ].

167. *Id*. at 3.

168. Dowell, *supra* note 115.

169. Mary Pohlman, *Fall Soil Sampling: To Grid or Not to Grid*, MIDWESTERN BIOAG (Mar. 11, 2023, 10:06 PM), https://www.midwesternbioag.com/fall-soil-sampling-grid-not-grid/ [https://perma.cc/ZCJ3-4MV3].

170. *Id*.

171. John Nowatzki et al., *Agricultural Remote Sensing Basics*, N.D. STATE UNIV. (June 2017), https://www.ag.ndsu.edu/publications/crops/agricultural-remote-sensing-basics [https://perma.cc/B3JQ-JFPD].

172. See *id*.

173. Amy Schmidt, *Remote Work, Agriculture & the Food Industry*, PRODUCERS STORIES (Dec. 2, 2021), https://producersmarket.com/blog/remote-work-agriculture-food-where-are-we-now/ [https://perma.cc/ND8A-L9AG].

174. *Id*.

175. *Id*.

physically intense endeavor.[176] Lack of in-person collection and verification can be more equitable for farmers who cannot afford intensive soil testing.

Changes in the carbon contract will have to be accounted for as agriculture is anticipating future advancements in sampling methods and technology.[177] The plans for testing are changing rapidly with future technological advancements.[178]

D. Verifiers

Verifying is the process of checking the reported data and sampling system to create an accurate depiction of the carbon study.[179] A third party is used to verify the data and samples provided.[180] The third party will help to reduce or remove bias in the processing of accurate metrics.[181] The third party should also be responsible for communicating changes in technology or lab procedures that may skew reporting statistics.[182] The other entities listed within this contract should plan their responses to this action accordingly. Third-party soil verifiers should not be financially associated with the carbon industries or farms to reduce conflict of interest.[183] The data kept by the person verifying data will comply with the previously agreed upon carbon contract data privacy policy.[184]

Every piece of land is different and has different needs, and the CarbOn Management Evaluation Tool (COMET) Model works well to account for these

176. Sami Khanal et al., *Remote Sensing in Precision Agriculture*, OHIOLINE (March 30, 2017), https://ohioline.osu.edu/factsheet/fabe-5541 [https://perma.cc/3JTD-3PZQ].

177. Michael Sterenberg, *Can New Technology Incentivize Farmers to Capture Carbon in Their Soil?*, COLUM. CLIMATE SCH. STATE OF THE PLANET (July 21, 2021), https://news.climate.columbia.edu/2021/07/21/can-new-technology-incentivize-farmers-to-capture-carbon-in-their-soil/ [https://perma.cc/X3RR-PCX3].

178. *Technological Carbon Sequestration*, UNIV. OF CA. DAVIS (Mar. 12, 2023, 2:42 PM), https://www.ucdavis.edu/climate/definitions/carbon-sequestration/technological [https://perma.cc/X73J-59DY].

179. Dowell, *supra* note 115.

180. Thomas L. Jensen, *Third-Party Soil Sampling: What You Need to Know*, MOSAIC (Mar. 11, 2023, 10:10 PM), https://www.cropnutrition.com/resource-library/third-party-soil-sampling-what-you-need-to-know [https://perma.cc/H4TP-5YQW].

181. Calogero de Andrade et al., *Collecting the Dirt on Soils: Advancements in Plot-Level Soil Testing and Implications for Agricultural Statistics* 15 (World Bank Open Knowledge Repository, Working Paper No. 8057, 2017), https://openknowledge.worldbank.org/server/api/core/bitstreams/3c33f163-a5c2-53e7-81a0-a1862d235824/content [https://perma.cc/A239-KGXQ].

182. *Id.*

183. *Carbon Markets 101*, KY CORN GROWERS ASS'N (April 12, 2023, 8:36 AM), https://www.kycorn.org/carbon-markets-101 [https://perma.cc/DL5K-WTFY].

184. Ellixson et al., *supra* note 158, at 62.

differences.[185] The COMET Model is a tool that is a template for farmers to understand the agronomic report of soil profiles on their property.[186] Understanding this helps create a carbon sequestration program by explaining what methods would sequester the most carbon.[187] This website is a product of the collaborative works of Colorado State University (CSU) and the NRCS.[188]

The COMET Model includes spatially explicit data to create an idea of the enrolled landscape.[189] Using this dataset can generate an informed model of the carbon footprint of the business or entity enrolled.[190] This data can be used to tailor a carbon sequestration plan to fit the needs of an individual organization.[191] A user could go to COMET's website and use their geographic location and soil quality data to create an individualized carbon sequestration plan.[192]

Using a custom-made plan to fit the needs of a property is a modern adaptive strategy to address problems in a typical catchall carbon plan.[193] The website provided by CSU and NRCS provides a field guide on the type of soil and what to grow in a particular geographic area within a state.[194] The COMET model also provides more useful information on their website about crops and the carbon market.[195]

This website is transparent about the type of data they will ask for when someone enrolls in their program.[196] The COMET site is also very open about the privacy strategies and policies they use.[197] The website creators try to communicate

185. Spencer Miller, *COMET-Farm: Conservation Calculation*, U.S. DEP'T OF AGRIC. (Feb. 21, 2017), https://www.usda.gov/media/blog/2013/08/21/comet-farmtm-conservation-calculation [https://perma.cc/L6FP-VUM8].

186. *Id*.

187. CHRISTOPHER BONASIA ET AL., VT. SOIL HEALTH & PAYMENT FOR ECOSYSTEM SERVS. WORKING GRP., TECH. RSCH. REP. NO. 7, WHOLE FARM NET ZERO 34 (2022), https://agriculture.vermont.gov/sites/agriculture/files/documents/Water_Quality/PES/Whole%20farm%20net%20zero_VTPES%20Task%207.pdf [https://perma.cc/4BDF-2X48].

188. Miller, *supra* note 185.

189. *See* Nat. Res. Conservation Serv., U.S. DEP'T OF AGRIC., COMET-PLANNER (Mar. 11, 2023, 7:53 PM), http://www.comet-planner.com/ [https://perma.cc/PKX4-JQ88].

190. *See id*.

191. BONASIA ET AL., *supra* note 187.

192. Nat. Res. Conservation Serv., U.S. DEP'T OF AGRIC., *supra* note 189.

193. *See id*.

194. *Id*.

195. *Id*.

196. *See id*.

197. *See* Nat. Res. Conservation Serv., U.S. DEP'T OF AGRIC., *Is my Information Safe?*, COMET FARM (Apr. 11, 2032, 11:12 AM), https://comet-farm.com/ [https://perma.cc/KMN4-W26Y].

that they understand farmers may be reluctant to hand over their information.[198] The website also carries the option to submit information anonymously.[199] Users can work with this system with an unregistered or registered account.[200] Unregistered accounts will purge the data input.[201] The only way the data can be saved is by creating an account and registering your information on the website.[202] The website mentions that USDA will not use or even view the information that gets entered into the website.[203]

Future technologies project that artificial intelligence (AI) could analyze satellite images of fields to assess the quality and type of soil within a property.[204] When this technology is made more readily available, modifications can be made in this process to assess carbon sequestration potential. Other advancements in soil sampling technology are being developed and can be modified to fit a carbon contract's needs.[205]

E. Brokers

The broker is the "group that: (1) identifies the Landowner capable of soil carbon storage; (2) enters into a contract with the Landowner to broker the Landowner's soil carbon storage; (3) arranges for the Measurer to assess and visit the property to collect soil cores; (4) coordinates for the Verifier to estimate the soil carbon storage potential of the property; and (5) sells the estimated soil carbon storage to a Buyer."[206] Brokers usually work with ten acres or more.[207] The more acres a farmer has, the greater their bargaining power when forming a contract. For this reason, it is beneficial for farmers to contract in a group such as a cooperative, employee-owned company, etc.[208]

198. *See id*.
199. *See id*.
200. *Id*.
201. *Id*.
202. *See id*.
203. *Id*.
204. Khanal et al., *supra* note 176.
205. *What is Carbon Sequestration and How Does it Work?*, *supra* note 23.
206. Daystar & Howard, *supra* note 108, at 2.
207. *See e.g., Clarity on Carbon's Potential: Compare Nine of the Leading Markets*, AG-WEB FARM J. (Feb. 16, 2021), https://www.agweb.com/news/business/technology/clarity-carbons-potential-compare-nine-leading-markets [https://perma.cc/X2TX-WWN3].
208. *See generally* Ed Maixner & Philip Brasher, *Carbon Markets Lure Farmers, but Will Benefits be Enough to Hook Them?*, AGRI-PULSE (Nov. 23, 2020, 1:00 PM), https://www.agri-pulse.com/articles/14880-carbon-markets-lure-farmers-but-are-benefits-enough-to-hook-them [https://perma.cc/XB8A-YPEY].

VII. CONCLUSION

This area is a developing space that will require practitioners to become aware of the moving pieces to better assist clients with their individual needs. Landowners and farmers may often be presented with contracts where they need help understanding all the terms or requirements of the contract. By better understanding the science, legal framework, and parties involved in the contracts, practitioners will be better able to understand the contracts that they are being presented with and negotiate better deals for clients.