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MAPPING OUT A NEW PATH: WHY PRECISION AGRICULTURE TECHNOLOGY IS THE KEY TO "CLIMATE-SMART" AGRICULTURE

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Agricultural subsidies, both in the United States and globally, harm the environment and do not support small-scale farmers. The lack of political will to substantially revise the upcoming Farm Bill indicates that the solution lies not in revising existing law, but instead in investing and utilizing precision agriculture technology. Precision agriculture technology is a broad term that covers a variety of technologies, including new methods of gathering information, mapping fields, increasing agricultural yield, and applying pesticides.

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I. INTRODUCTION

The history of agriculture is a story of technological innovation.[1] From "simple hand tools" to modern tractors, planters, and harvesters, human ingenuity and innovation has led to the continuous development of technology designed to grow more with less labor.[2] Agricultural subsidies, however, were not aimed at continuing the trajectory of technological development. On the contrary, the first real Farm Bill (passed in 1933) paid farmers to *reduce* crop production.[3] The trend continues to this day. Modern agricultural subsidies still do not assist farmers with modernizing their equipment or increasing efficiency and crop yield; instead, they

[1] Elder J. van Henten, *The Evolution of Agricultural Technology*, INNOVATION NEWS NETWORK (July 8, 2020), https://www.innovationnewsnetwork.com/the-evolution-of-agricultural-technology/6039/ [https://perma.cc/SU66-TXPW].

[2] *See id.*

[3] Kimberly Amadeo, *How Farm Subsidies Affect the U.S. Economy*, BALANCE (Apr. 18, 2022), https://www.thebalancemoney.com/farm-subsidies-4173885 [https://perma.cc/Q6ZV-SWP2].

exist to "reduce risk" and soften the consequences of "disruptions in demand."[4] The United States Department of Agriculture's ("USDA") climate change mitigation programs focus more on alternative farming methods, such as planting more trees or promoting no-till farming, rather than subsidizing technology that could have enormous positive impacts on the industry.[5]

Major legislative reform of these programs is unlikely because of the deeply divided partisan politics that are a hallmark of the modern political climate.[6] Given this challenge, the passing of the Inflation Reduction Act ("IRA") has been called a win for Democrat lawmakers.[7] However, its passage may be the final nail in the coffin for bipartisan agricultural legislation. The IRA was passed through budget reconciliation, a process only used twenty-seven times since its creation in 1974. Budget reconciliation has evolved into a tool lawmakers can use when they lack a decisive majority in the Senate.[8]

Although critics from both sides of the aisle have demanded reform for years, the Democrats' difficulty in passing the IRA demonstrates that a bill as enormous as the Farm Bill may suffer similar setbacks.[9] Therefore, other avenues to fix the problem must

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[4] *Id.*

[5] *See USDA Conservation Stewardship Program Could Do More to Tackle Climate Emergency*, ENV'T WORKING GRP. (Aug. 3, 2022), https://www.ewg.org/news-insights/news/2022/08/usda-conservation-stewardship-program-could-do-more-tackle-climate [https://perma.cc/4MQP-XDQA].

[6] *See* Drew Desilver, *The Polarization in Today's Congress Has Roots That Go Back Decades*, PEW RSCH. CTR. (Mar. 10, 2022), https://www.pewresearch.org/fact-tank/2022/03/10/the-polarization-in-todays-congress-has-roots-that-go-back-decades/ [https://perma.cc/M54P-2DSC].

[7] Barbara Sprunt, *Biden Signs Sweeping Climate, Health Care, Tax Bill into Law*, NPR (Aug. 16, 2022, 4:35 PM), https://www.npr.org/2022/08/16/1117709411/biden-signs-sweeping-climate-health-care-tax-bill-into-law [https://perma.cc/N7LZ-XMSS].

[8] Richard Kogan & David Reich, *Introduction to Budget 'Reconciliation,'* CTR. ON BUDGET & POL'Y PRIORITIES (May 6, 2022), https://www.cbpp.org/research/federal-budget/introduction-to-budget-reconciliation [https://perma.cc/ZCD6-SET8].

[9] *See* Bradley R. Finney, *Capitalizing on the Kiwis: Using New Zealand's Success to Reform United States Agriculture*, 96 TUL. L. REV. 563, 573 (2022); William S. Eubanks II, *The Sustainable Farm Bill: A Proposal for Permanent Environmental Change*, 39 ENV'T L. REP. 10493, 10506 (2009).

be explored. Technology may be the key to fixing the farm subsidy failures.

To fight climate change, the IRA provided funding for agricultural conservation programs originally created by previous Farm Bills.[10] These programs are often inefficient and sometimes even harmful[11] because funding decisions are based on incomplete or non-existent data.[12] The needed information could be gathered through precision agriculture technology. Precision agriculture technology has traditionally been defined as technology that "maximizes yields," but has come to include technology that uses "information about surface and underground . . . systems in order to make the best viable decisions for . . . conservation of agricultural, rangeland, and natural areas."[13]

This Article examines which agricultural conservation and "climate-smart" farming programs are subsidized by the IRA and Farm Bill and how effectively these programs are meeting their goals. Next, an analysis of the evolution of the Farm Bill and omnibus legislation will underscore the political difficulties that could lead to the failure of the Farm Bill, resulting in a lack of political will to institute subsidy reform through legislation. Finally, this Article will highlight various types of precision agriculture technology that could resolve the issues underlying the currently-existing programs.

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[10] *See* Jonathan Coppess et al., *Reviewing the Inflation Reduction Act of 2022; Part 1*, U. ILL. FARMDOC DAILY (Aug. 12, 2022), https://farmdocdaily.illinois.edu/2022/08/reviewing-the-inflation-reduction-act-of-2022-part-1.html [https://perma.cc/H3S2-YB9D].

[11] *USDA Conservation Stewardship Program Could Do More to Tackle Climate Emergency*, *supra* note 5.

[12] *See Agricultural Conservation: USDA's Environmental Quality Incentives Program Could be Improved to Optimize Benefits*, GOV'T ACCOUNTABILITY OFF. (Apr. 13, 2017), https://www.gao.gov/products/gao-17-225 [https://perma.cc/24MC-XF5M].

[13] *See* Jorge A. Delgado & Joseph K. Berry, *Advances in Precision Conservation*, 98 ADVANCES IN AGRONOMY 1, 3–4 (2008).

II. BACKGROUND: AGRICULTURAL LEGISLATION AND AGRICULTURAL TECHNOLOGY

The recently-passed IRA takes three major approaches to funding climate-smart agriculture.[14] It will (1) provide funding for existing conservation programs; (2) incentivize sustainable farming practices; and (3) expand public-private partnerships for "locally-led conservation" efforts.[15]

In what may be a significant signal for future agriculture- and farming-focused legislation, the IRA passed through the reconciliation process along strict party lines.[16] Reconciliation is a process governed by federal budget law.[17] It is a method for fast-tracking legislation, because it requires only a simple majority vote in the Senate and avoids the possibility of a filibuster.[18] The reconciliation process is available for legislation "that changes spending, revenues, and . . . the federal debt limit" and covers "entitlement" spending, [19] which includes farm programs and the Supplemental Nutritional Assistance Program ("SNAP").[20] Reconciliation requires that Congress adopt a budget resolution—permitted once per fiscal year—which cannot be filibustered and does not require the President's signature.[21]

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[14] *See* U.S. Sen. Debbie Stabenow, *Agricultural Provisions in Inflation Reduction Act*, U.S. SENATE COMM. ON AGRIC., NUTRITION, & FORESTRY, https://www.agriculture.senate.gov/imo/media/doc/ag_reconciliation_one-pager.pdf [https://perma.cc/JS7V-7BA2]. Climate-smart agriculture is a broad term that can apply to not only specific practices (e.g., low-till farming) but also to a wide variety of technologies that increase yield, reduce over-application of pesticide, and closely monitor toxic substances and other conditions in fields. *See* Delgado & Berry, *supra* note 13, at 3–5.

[15] Stabenow, *supra* note 14.

[16] *Id.*

[17] 2 U.S.C. § 641.

[18] Kogan & Reich, *supra* note 8.

[19] *Id.*

[20] *See A Short History of SNAP*, U.S. DEP'T. AGRIC. FOOD & NUTRITION SERV. (Sept. 11, 2018), https://www.fns.usda.gov/snap/short-history-snap [https://perma.cc/P2MM-ET5G]. SNAP is the federal food stamp program which provides discounted food for the hungry. *Id.* As a welfare program, it has long been controversial, and food stamp reform is often a hot button political issue.

[21] *Id.*

One of the primary limits on reconciliation is the cap on the number of bills a budget resolution can generate.[22] One budget resolution can result in a maximum of two reconciliation bills per fiscal year: "a tax-and-spending bill or a spending-only bill and . . . a separate debt limit bill."[23] The "Byrd Rule"—another limit on reconciliation—"allows senators to block provisions of reconciliation bills that are 'extraneous' to reconciliation's basic purpose of implementing budget changes."[24] The definition of "extraneous" is detailed, but fundamentally requires that reconciliation cannot be used to pass legislation where the "change in spending or revenues is 'merely incidental' to the provision's non-budgetary effects."[25]

The next major piece of agricultural legislation on the horizon is the 2023 reauthorization of the Farm Bill. The Farm Bill "sets national agriculture, nutrition, conservation, and forestry policy" and is typically passed by Congress every five years.[26] Since its first iteration, the Farm Bill has expanded to include not just "farm commodity program support," but also nutrition (including SNAP), horticulture, conservation, rural development, agricultural research programs, forestry, energy, crop insurance, agricultural exports, international food assistance, and more.[27] Because the IRA emphasizes reducing the impacts of climate change through conservation-focused agriculture and the Farm Bill's breadth extends beyond conventional agricultural topics, these two pieces of legislation control the future of agricultural policy in our country.

Climate-smart agriculture is not synonymous with precision agriculture. The World Bank defines climate-smart agriculture as "an integrated approach to managing landscapes," including cropland and livestock, "that address the interlinked challenges of

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[22] *Id.*
[23] *Id.*
[24] *Id.*
[25] *Id.*
[26] *The Farm Bill*, U.S. SENATE COMM. ON AGRIC., NUTRITION, & FORESTRY, https://www.agriculture.senate.gov/farm-bill [https://perma.cc/44TZ-A6JF] (last visited Nov. 18, 2022).
[27] RENÉE JOHNSON & JIM MONKE, CONG. RSCH. SERV., IF12047, FARM BILL PRIMER: WHAT IS THE FARM BILL? (June 28, 2022).

food security and climate change."[28] However, technology—and precision agriculture technology specifically—is often the key to implementing the variety of programs that classify as climate-smart agriculture.[29] In summary, although not all precision agriculture technology is currently used primarily for climate-smart agriculture, using such technology in traditional farming often results in climate-smart agricultural practices.

For example, in North Carolina, precision agriculture takes a variety of forms. One farmer who utilizes this technology to great advantage is Kevin Matthews: a fourth-generation farmer in the North Carolina Piedmont who utilizes a variety of precision agriculture technologies (including technology used to create sophisticated soil maps, more efficient irrigation, and precision technology for planting and applying fertilizer) to increase crop yield on his farm, while reducing water and pesticide use.[30] As this example demonstrates, precision agriculture technology can rise to meet the challenge of transforming traditional agriculture into climate-smart agriculture while benefitting farmers.

III. FOLLOWING THE MONEY: INEFFICIENCIES IN THE IRA AND AGRICULTURAL SUBSIDIES

Subsidies are meant to protect farmers.[31] Yet many of the problems that farmers face (e.g., inefficient irrigation, a variety of soils, the steep price of over-fertilizing, and monitoring of their crops)[32] are more easily solved by technology than by paying farmers to plant certain crops. If small-scale farmers, who make up

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[28] *Climate-Smart Agriculture,* WORLD BANK (Apr. 5, 2021), https://www.worldbank.org/en/topic/climate-smart-agriculture [https://perma.cc/4BEY-D8E2].

[29] For example, the World Bank cites projects such as developing low-emission technology for dairy farms, technology that improves soil condition and irrigation, and a variety of technologies to improve efficiencies or provide renewable energy—the takeaway is that there are countless technologies needed to implement climate-smart agriculture. *See id.*

[30] Nancy Henderson, *North Carolina Smart Farms*, FARM LIFE (Feb. 27, 2017), https://ncfieldfamily.org/farm/north-carolina-smart-farms/ [https://perma.cc/4MC4-4U8G].

[31] Amadeo, *supra* note 3.

[32] Henderson, *supra* note 30.

most of America's farms,[33] were instead able to receive subsidy funding to improve their technology, they might be met with the same success as Kevin Matthews.

Water conservation serves as a concrete illustration of how this could work. Current conservation programs funded by the Farm Bill already support irrigation management for rice farmers,[34] and three of the six goals of the Environmental Quality Incentives Program ("EQIP") address water management.[35] One technology that could help farmers is the same subsurface drip irrigation system that Matthews utilized to "[double] the corn yield in his upland fields from 150 bushels to 300 using only 13 inches of water," which also "saved money on electricity, water[,] and fertilizer; and helped prevent erosion and leaching of chemicals into nearby streams."[36] These subsurface drip irrigation systems deliver water directly to the roots of plants, which avoids the issue of evaporation created by the traditional method of spraying it over the top of the soil.[37] These systems can be prohibitively expensive for farmers to install out of their own pocket (ranging from $1,200 to $2,000 per acre).[38] Therefore, using government farm subsidies to support these technology installations would be better tailored to achieve the environmental and yield goals of the climate-smart agriculture championed by the IRA.

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[33] Amadeo, *supra* note 3 ("There are 2.02 million U.S. farms, of which 98% are family owned.").

[34] *Climate-Smart Agriculture and Forestry (CSAF) Mitigation Activities List*, U.S. DEP'T OF AGRIC. NAT. RES. CONSERVATION SERV. (Feb. 2022), https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/climate/climate-smart-mitigation-activities [https://perma.cc/ED7U-7G8N].

[35] *Environmental Quality Incentives Program*, U.S. DEP'T OF AGRIC. NAT. RES. CONSERVATION SERV., https://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives [https://perma.cc/5L48-XMVN] (last visited Nov. 1, 2022). These goals include "improved water and air quality," "conserved ground and surface water," and "mitigation against drought." *Id.*

[36] Henderson, *supra* note 30.

[37] *Id.*

[38] *Id.*

A. Inefficiencies in Current Conservation Programs

While the IRA makes a considerable investment in agriculturally-focused environmental conservation programs, its funds are not allocated in either the most efficient or the most effective way. The existing conservation programs receiving the most funding are EQIP, the Regional Conservation Partnership Program ("RCPP"), and the Conservation Stewardship Program ("CSP").[39] For example, EQIP, which receives the largest share of IRA funding, distributes most of the funds for conservation to large farming operations that have historically received funds, rather than to areas of the highest environmental concern.[40] In fact, the Government Accountability Office ("GAO") reported that "the process for allocating EQIP funds to state offices was not based primarily on environmental concerns . . . partly because relevant, practical data on environmental concerns are not always available."[41] Furthermore, when data that attempts "to quantify the environmental effects of conservation practices" is made available through public-private partnerships, it often ignores the "practical . . . budget and statutory requirements" placed on EQIP, thereby rendering the data impractical for use.[42]

Although EQIP has begun to implement some of the changes recommended in the GAO report as of November 2021,[43] some states that implement EQIP's programs, such as Maine, have not.[44] In Maine, funds are allocated not based on previous project success, but by balancing the following three factors: (1) "the total demand in dollars of all ranked applications as a proportion of the total state demand;" (2) "the total number of landowners represented by those applications as a proportion of the entire state;" and (3) "the

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[39] Coppess et al., *supra* note 10.

[40] *See Agricultural Conservation*, *supra* note 12.

[41] *Id.*

[42] *Id.*

[43] *Id.*

[44] *How the Environmental Quality Incentives Program Works in Maine*, U.S. DEP'T OF AGRIC. NAT. RES. CONSERVATION SERV. ME., https://www.nrcs.usda.gov/conservation-basics/conservation-by-state/maine/how-the-environmental-quality-incentives-program [https://perma.cc/CFE8-XVTE] (last visited Oct. 17, 2022).

implementation rate of prior year contracts relative to the state's implementation rate."[45]

EQIP is not the only conservation program funded by the IRA that struggles with fulfilling its purpose. CSP, which receives the third highest amount of IRA funds, was recently evaluated using official USDA data by the Environmental Working Group ("EWG") for its effectiveness in fighting climate change.[46] Among its findings, EWG noted that "37 percent of CSP enhancements," including incentives for fencing improvements, did little to nothing to reduce greenhouse gas emissions.[47] EWG also analyzed EQIP, with the results showing that some of the practices funded by EQIP actually *increase* greenhouse gas emissions.[48] These findings raise the question: What are government funds actually subsidizing, and perhaps more critically, what *should* they subsidize instead?

B. The Biofuel Problem

Questionably effective conservation programs are not the only recipients of funding from the IRA; another $500 million subsidy was provided to increase and expand the market and infrastructure for biofuel.[49] It is unclear whether subsidizing the biofuel industry is a net positive for climate change mitigation—the very goal of the IRA's climate-smart agriculture push.

There are three types of biofuel, of which only two types are currently produced commercially in the United States.[50] The first type includes various crops, such as sugarcane, corn, and soybeans,

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[45] *Id.*

[46] *USDA Conservation Stewardship Program Could Do More to Tackle Climate Emergency*, *supra* note 5.

[47] *Id.*

[48] *Id.*

[49] Jonathan Coppess et. al., *Reviewing the Inflation Reduction Act of 2022; Part 2*, U. ILL. FARMDOC DAILY (Aug. 12, 2022), https://farmdocdaily.illinois.edu/2022/08/reviewing-the-inflation-reduction-act-of-2022-part-2.html [https://perma.cc/DR8A-AYA9].

[50] *Economics of Biofuels*, U.S. ENV'T PROT. AGENCY (Apr. 14, 2022), https://www.epa.gov/environmental-economics/economics-biofuels#:~:text=Replacing%20fossil%20fuels%20with%20biofuels,dependence%20on%20unstable%20foreign%20suppliers [https://perma.cc/GHF7-28KY].

which can be converted into ethanol, butanol, and propanol.[51] The second type includes fuels produced using cellulose derived from non-food crops.[52] The United States is the world's largest consumer, exporter, and producer of corn[53] and the largest producer of biofuel—generating nearly half of the world's output in the last ten years.[54]

The biofuel industry depends on water, land, and other environmental resources, which means that increasing our dependence on biofuel could lead to more greenhouse gas emissions, increased water and air pollution, higher food costs, and increased pressure on already limited water resources.[55] In fact, under certain conditions, the production and use of biofuels can emit more greenhouse gases than that of fossil fuels.[56] Increased farming of biofuel crops can lead to land loss and deforestation—which only worsens the climate change problem.[57]

Subsidizing biofuels, thereby making them cheaper (usually leading to higher demand), could lead to increased income for farmers growing the crops needed to produce biofuel,[58] but this hardly qualifies as climate-smart agriculture. Furthermore, the push for electric vehicles, one of the main goals of the IRA,[59] theoretically

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[51] *Id.*

[52] *Id.*

[53] *Feedgrains Sector at a Glance*, U.S. DEP'T OF AGRIC. ECON. RSCH. SERV. (Oct. 3, 2022), https://www.ers.usda.gov/topics/crops/corn-and-other-feedgrains/feedgrains-sector-at-a-glance/ [https://perma.cc/4XK6-QM4M].

[54] *See* Virginia Gewin, *How Corn Ethanol for Biofuel Fed Climate Change*, CIV. EATS (Feb. 14, 2022), https://civileats.com/2022/02/14/how-corn-ethanol-for-biofuel-fueled-climate-change/ [https://perma.cc/7VR4-CY28].

[55] *Id.*

[56] *Economics of Biofuels*, *supra* note 50.

[57] *See* Eduardo Porter, *A Biofuel Debate: Will Cutting Trees Cut Carbon?*, N.Y. TIMES (Feb. 10, 2015), https://www.nytimes.com/2015/02/11/business/economy/a-biofuel-debate-will-cutting-trees-cut-carbon.html [https://perma.cc/UEW7-Z89P].

[58] *Economics of Biofuels*, *supra* note 50.

[59] Sara Baldwin, *Inflation Reduction Act Benefits: Electric Vehicle Tax Incentives for Consumers and U.S. Automakers*, FORBES (Sept. 7, 2022, 7:30 AM), https://www.forbes.com/sites/energyinnovation/2022/09/07/inflation-reduction-act-benefits-electric-vehicle-tax-incentives-for-consumers-and-us-automakers/?sh=3cf0d654117e [https://perma.cc/Z9MB-KB85].

should reduce the need for biofuel agricultural production.[60] However, as the demand for electric vehicles increases, biofuel producers have begun shifting their focus to other modes of transportation that are more difficult to electrify, such as planes, large trucks, and large boats.[61] The potential for biofuel use is especially significant for long-distance, heavy-duty trucks, as the "lack of charging stations" and length of recharging times have made electrifying such vehicles an unpopular choice.[62] Thus, even with a high demand for electric vehicles, there is a potentially enormous market for biofuel. Therefore, subsidies for this area are unlikely to end.

C. Does Climate-Smart Agriculture Exist?

Looming over these smaller-scale issues of optimizing subsidies is the larger question of whether the current approach fights climate change or improves agricultural practices at all.[63] A 2021 United Nations report found that globally, farm subsidies have a negative impact on human health, the climate, conservation efforts, and further income inequality.[64] The report also found that the "emission-intensive" beef, milk, and rice industries receive the "most support worldwide."[65] This report emphasizes the very issue

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[60] *See* Josh Gabbatiss, *EVs vs. Biofuels: New Study Looks at Ethanol's Impact on Agricultural Land Use, Food Prices, and Emissions*, ENERGY POST (July 21, 2022), https://energypost.eu/evs-vs-biofuels-new-study-looks-at-ethanols-impact-on-agricultural-land-use-food-prices-emissions/ [https://perma.cc/M968-WKGW].

[61] Sean Goulding Caroll, *Rise of Electric Cars to Shift Biofuels Use to Other Transport Areas*, EURACTIV (July 12, 2022), https://www.euractiv.com/section/biofuels/news/rise-of-electric-cars-to-shift-biofuels-use-to-other-transport-areas/ [https://perma.cc/HD6N-NK4P].

[62] *Id.*

[63] *See* Damian Carrington, *Nearly All Global Farm Subsidies Harm People and Planet—UN*, GUARDIAN (Sept. 14, 2021), https://www.theguardian.com/environment/2021/sep/14/global-farm-subsidies-damage-people-planet-un-climate-crisis-nature-inequality [https://perma.cc/S9M6-3FAQ].

[64] FOOD & AGRIC. ORG. OF U.N. ET AL., A MULTI-BILLION-DOLLAR OPPORTUNITY-REPURPOSING AGRICULTURAL SUPPORT TO TRANSFORM FOOD SYSTEMS 3 (2021) https://www.fao.org/documents/card/en/c/cb6683en [https://perma.cc/UPL7-RV5W].

[65] *Id.* at 5.

that characterizes farm subsidies in the United States—pouring money into inefficient conservation programs is not enough to offset the enormous sums being paid to large-scale, large-emission agricultural producers to continue producing certain crops. Furthermore, this problem is only set to increase: the United Nations report estimates that by 2030, worldwide agricultural subsidies could total near $1.8 trillion, with a matched increase in negative environmental and health impacts.[66]

That is not to say that eliminating agricultural subsidies is the answer. In fact, attempting to do so could lead to disastrous consequences, including increased rates of poverty (due to a sudden and drastic cut in farmers' income) and malnutrition (as farmers may lose their farms or stop growing food others depend on).[67] Instead, if agricultural subsidies were used to increase technology use, those subsidies could deliver the major changes forecast by proponents of the IRA.[68]

IV. THE FARM BILL AND THE FUTURE OF AGRICULTURAL LEGISLATION

As two pieces of legislation focusing on agriculture and farming, the IRA and the 2023 Farm Bill are closely related. Title II of the Farm Bill authorizes the conservation programs funded by the IRA.[69] This Article highlights only those programs that are funded by the IRA.[70] The Farm Bill is perhaps the most crucial piece of agriculture-focused legislation, and it has a long and controversial history.[71]

A. The Farm Bill Subsidies: The Evolution of an Imperfect System

Various iterations of the Farm Bill created and funded EQIP, RCPP, and CSP, so it is no coincidence that critiques of these

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[66] *Id.* at 7.
[67] *Id.*
[68] *See id.* at 8, 10.
[69] Coppess et al., *supra* note 10.
[70] An exhaustive discussion of all conservation programs funded by the USDA is beyond the scope of this Article.
[71] *See* Finney, *supra* note 9, at 566–67 (discussing the history and resulting political controversy surrounding the Farm Bill).

programs apply to both the IRA and the Farm Bill.[72] Beyond just negative environmental impact, the Farm Bill has been accused of creating policies resulting in "record levels of obesity, heart disease, diabetes, and asthma . . . severe malnutrition and hunger, both domestically and abroad . . . overproduction, trade distortion, and depression of world market prices."[73]

The Farm Bill has evolved significantly since the 1933 Agricultural Adjustment Act instituted the original subsidy system to prop up a failing agrarian sector.[74] The concern in the 1930s was overproduction—supply outpaced demand to a ruinous degree.[75] This same concern arose again in the 1970s, when new technology and farming techniques again led to the production of more crops than could be profitably sold.[76] However, rather than waiting for government intervention, larger farming operations began to buy out struggling smaller-scale farmers;[77] the then-Secretary of the Interior decreed farmers had to "Get Big or Get Out."[78] The resulting distribution of farm subsidies now mostly favors big producers, rather than the small-scale farmers the program was designed to protect in 1933.

The government first responded to public criticism of inefficient subsidies by restructuring loans into direct payments,[79] then, in 2014, transitioning to a crop insurance model.[80] However, the 2014 "overhaul" did very little to address the issue at the heart of these programs, with critics asserting that the 2014 and 2018 Farm Bills

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[72] *See id.* at 572 (criticizing that the Farm Bill primarily funds Fortune 500 companies and billionaires, provides little to no support for most American farmers, and funds programs that actively harm the environment).

[73] Eubanks II, *supra* note 9, at 10493.

[74] *Id.* at 10494–95 (stating that the financial recovery of the farming industry depended on government subsidies).

[75] *Id*. at 10494 ("The nation's overzealous planting during the 1920s, combined with innovative advances in both mechanization and soil inputs, led to vast overproduction of most crops.").

[76] *Id*. at 10495.

[77] *Id.*

[78] *Id.* at 10496.

[79] Eubanks II, *supra* note 9, at 10496.

[80] *See* Finney, *supra* note 9, at 573.

merely changed the names of programs without meaningfully altering the overarching system of subsidized government support.[81]

B. What Technology Does the Farm Bill Fund?

The current Farm Bill (passed in 2018) funds a variety of technologies, little of which qualifies as precision agriculture technology.[82] For example, one new technology funded by the 2018 Farm Bill is a "web-based decision tool"[83] that will allow dairy farmers to evaluate what level of insurance coverage they may choose to buy, for a variety of scenarios in which the price of milk drops below current market level.[84] It also provides funding for increased technological access, such as enhanced rural broadband and electrification.[85] While this may indirectly benefit farmers attempting to use precision agriculture technology, it does nothing to assist farmers with the purchase and implementation of precision agriculture technology.

Title II of the 2018 Farm Bill funds the programs for which the IRA also increased funding, including EQIP, RCPP, and CSP.[86] Projects funded by these programs do include precision agriculture technology; for example, a $1.7 million project funded by RCPP uses a geographic information system ("GIS") tool "to guide practice implementation, including the planting of new pollinator habitat and the expanded use of [I]ntegrated [P]est [M]anagement and prescribed grazing."[87] However, no direct funding exists for

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[81] *Id.* at 574.

[82] *Farm Bill*, U.S. DEP'T AGRIC., https://www.usda.gov/farmbill [https://perma.cc/L4T5-GJ9Y] (last visited Nov. 2, 2022).

[83] *Id.*

[84] *Dairy Margin Coverage Program*, U.S. DEP'T AGRIC., https://www.fsa.usda.gov/programs-and-services/farm-bill/farm-safety-net/dairy-programs/index [https://perma.cc/6WRG-QHBR] (last visited Nov. 2, 2022).

[85] *Farm Bill*, RURAL DEVELOPMENT, U.S. DEP'T AGRIC., rd.usda.gov/about-rd/farm-bill [https://perma.cc/48R4-Q2ZA] (last visited Nov. 2, 2022).

[86] *Farm Bill*, *supra* note 82.

[87] *Regional Conservation Partnership Program 2022 Projects*, U.S. DEP'T OF AGRIC. NAT. RES. CONSERVATION SERV., https://www.nrcs.usda.gov/programs-initiatives/rcpp-regional-conservation-partnership-program/regional-

farmers to purchase precision agriculture technology equipment for day-to-day farm management.[88]

C. The Rise of the Omnibus Bill and the Death of Bipartisanship

As the Farm Bill grew to encompass a vast array of other programs, the bipartisan divide in Congress also continued to grow.[89] Increasingly partisan politics led to the proliferation of a type of legislation known as an omnibus bill.[90] Omnibus bills "are a consolidation of multiple bills, often times funding measures for different government agencies or departments, that will be voted on and treated as a single provision, rather than separately."[91]

Omnibus bills have been shockingly successful, especially when compared to standard new legislation: one study found that ninety-eight percent of the omnibus legislation examined was passed.[92] This astounding success rate can be attributed to the very nature of an omnibus bill: despite its size, it receives less committee oversight and culminates in a "take-it-or-leave-it" vote.[93] Historically, Congress members have used omnibus bills as a strategy for passing popular pieces of legislation alongside other provisions that garner less support.[94] This is certainly not a new idea, but the issue no longer centers on whether parties can work together across the aisle to pass such legislation. Rather, as the passage of the

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conservation-partnership-program-2022-projects [https://perma.cc/3FWY-6V9T] (last visited Nov. 2, 2022).

[88] *Farm Bill*, *supra* note 82.

[89] Jack Shafer, *'Bipartisanship' is Dead in Washington. That's Fine.*, POLITICO (May 29, 2021, 5:50 PM), https://www.politico.com/news/magazine/2021/05/28/bipartisan-congress-dead-washington-491372 [https://perma.cc/QB8K-TDEU].

[90] *See* Glen S. Krutz, *Tactical Maneuvering on Omnibus Bills in Congress*, 45 AM. J. POL. SCI. 210, 212 (2001).

[91] Ben Hachten, *What is an Omnibus Bill?*, VOTE SMART (June 27, 2016), https://votesmart.org/blog-archive/2016/jun/27/what-omnibus-bill/#.Y3vF4OzMKWA [https://perma.cc/4YH9-GBKH].

[92] Krutz, *supra* note 90, at 210.

[93] *Id.*

[94] *Id.* at 211 For example, if Congressmembers want to take credit for passing popular legislation, they can do so by adding items to the omnibus bill that will get other members on board. *Id.*

IRA so clearly illustrated,[95] the issue now is uniting the Democratic Party enough to pass these omnibus bills along strict party lines.

D. Why the Farm Bill Will Falter

With the Farm Bill up for reauthorization in early 2023, the divided Congress presents a similar issue as in 2018,[96] which resulted in negotiations over the Farm Bill stalling out and fears of potentially dire consequences.[97] If negotiations over programs such as SNAP prove to be as contentious as they have been in the past,[98] a bipartisan solution may be impossible to find. The debate over the SNAP funding in 2012 "helped stall negotiations on the entire Farm Bill, forcing Congress to pass a short-term extension rather than a full multiyear bill."[99] Two failed attempts followed in 2013, one of which was "derailed" when Republicans tried to remove the entire nutrition title (including all of SNAP) from the Farm Bill.[100] These unsuccessful efforts at finding a bipartisan solution delayed the passing of the Farm Bill until 2014.[101]

During the 2018 reauthorization of the Farm Bill, House Republicans attempted to include provisions which would have made nearly two million people ineligible to continue receiving federal aid through SNAP.[102] Although President Trump endorsed

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[95] *See* Sprunt, *supra* note 7 (discussing how the Inflation Reduction Act required a special deal for Senator Manchin to agree to vote for it).

[96] *Democrats Take Control of House but Republicans Tighten Grip on Senate*, GUARDIAN (Nov. 7, 2018), https://www.theguardian.com/us-news/2018/nov/06/midterm-elections-2018-exit-polls-voters [https://perma.cc/A4NL-PX5K].

[97] Kyla Kaplan et al., *What Happens if There is No New Farm Bill by October 1?* FARM BILL L. ENTERPRISE (Aug. 29, 2018), https://www.farmbilllaw.org/2018/08/29/what-happens-if-there-is-no-new-farm-bill-by-october-1-part-one/ [https://perma.cc/3WS2-PEEB] ("Although a few programs would survive, many of the farm bill programs we rely on would cease to operate, and others would revert to anachronistic structures that make no sense in today's world.").

[98] Vann R. Newkirk & Olivia Paschal, *The Farm Bill's Threat to Food Security,* ATLANTIC (Sept. 6, 2018), https://www.theatlantic.com/politics/archive/2018/09/the-farm-bills-threat-to-food-security/569464/ [https://perma.cc/T33L-N4WU] ("SNAP is always the most contentious part of the Farm Bill.").

[99] *Id.*

[100] *Id.*

[101] *Id.*

[102] *Id.*

that version of the bill, it did not initially pass the House due to "fractious" internal disagreement over unrelated immigration legislation.[103] The bill eventually passed by only two votes (213-211) along strict party lines, after "Democrats revolted over its proposed changes to" SNAP.[104] Despite this political merry-go-round, the final 2018 Farm Bill did not actually include the House provisions written to cut SNAP funding.[105]

It is possible that Democrats may attempt to pass the Farm Bill through the same process used for the IRA—reconciliation. That would require the passing of a budget resolution for the 2023 fiscal year (which can only be done once), and then careful writing to avoid violating the Byrd rule's directive against programs incidental to spending. Reconciliation would allow for shorter-term reauthorizations of certain programs, just as in the IRA,[106] but it would also limit any actual *changes* in the Farm Bill that cannot be tied to authorizing spending or increasing revenue.[107] If the Farm Bill founders, a scramble of short-term authorizations may ensue (as in 2012); or, if deep and bitter political divisions continue to preclude the possibility of bipartisan resolution, the Farm Bill as we know it could cease to exist.

V. POTENTIAL APPROACHES TO FIXING FARM SUBSIDY FAILURES

Although it is impossible to predict how, or even whether, the 2023 Farm Bill will pass, it is still possible to create the desperately needed reform of agricultural subsidies without amending the current laws. One alternative is to end subsidies altogether, resulting

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[103] Catherine Boudreau, *House Farm Bill Passes with Controversial Food Stamp Changes*, POLITICO (June 21, 2018, 6:01 PM), https://www.politico.com/story/2018/06/21/house-passes-farm-bill-663124 [https://perma.cc/VCJ7-9PVW].

[104] *Id.*

[105] Ellyn Ferguson, *Last Year's Food Stamps Battle was Contentious. This Year Trump Upped the Ante*, ROLL CALL (Mar. 19, 2019, 11:17 AM), https://rollcall.com/2019/03/19/last-years-food-stamps-battle-was-contentious-this-year-trump-upped-the-ante/ [https://perma.cc/XPC7-K47R].

[106] *See* Coppess et al., *supra* note 10.

[107] *See* Kogan & Reich, *supra* note 8.

in a complete free market for all farm products. This would take place if the Farm Bill was not reauthorized and the programs providing subsidies simply expired. Another alternative approach, if the Farm Bill fails to pass and expires, is to repeat what the 2013 Republicans attempted: Separate out the various provisions within the Farm Bill and pass them as individual pieces of legislation. Both these approaches, however, would face the serious stumbling blocks of the Senate filibuster (as it has been employed recently)[108] or presidential vetoes. These obstacles are monumental, making the alternative approaches impractical at best. Finally, as this Article advocates, the best approach would be to use precision agriculture technology to begin the six-step process of reforming agriculture subsidies as outlined by the United Nations report about global farming subsidies.[109]

A. Ending Subsidies Altogether: The New Zealand Cleanse

New Zealand initially claimed that its choice to end subsidies was an unmitigated success.[110] Starting in the early 1980s, New Zealand began to end government support of the farming sector amid concerns like those of the United States' current situation.[111] Today, it seems far more questionable if ending subsidies was as successful as was claimed.[112]

It is important to understand the difference in scale between New Zealand and the United States. New Zealand's population is approximately five million, whereas the United States' population

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[108] Hanna Kang, *Out of 18 Pro-democracy Bills in 2022, the U.S. Senate Filibuster Torpedoed 17 of Them*, BUS. INSIDER (Sept. 6, 2022, 10:00 AM), https://www.businessinsider.com/senate-filibuster-democracy-bill-passage-law-congress-2022-9 [https://perma.cc/KT5D-KU5D].

[109] FOOD & AGRIC. ORG. OF U.N. ET AL., *supra* note 64.

[110] *See* Finney, *supra* note 9, at 589.

[111] *Id.* at 590.

[112] *See* Baz Macdonald, *New Zealand Farmers Have Avoided Regulation for Decades. Now Their Bill Has Come Due,* GUARDIAN (Aug. 4, 2021), https://www.theguardian.com/world/commentisfree/2021/aug/05/new-zealand-farmers-have-avoided-regulation-for-decades-now-their-bill-has-come-due#:~:text=Over%20the%20past%2030%20years%2C%20New%20Zealand%20has%20experienced%20a,fertilisers%2C%20irrigation%20and%20imported%20feed [https://perma.cc/QK6P-A9MV].

is closer to 330 million.[113] New Zealand's agricultural sector contributes around seventeen percent to its gross domestic product ("GDP"), providing for about one in every eight jobs.[114] In comparison, a 2022 study of the United States' agricultural sector found it provides for "roughly one-fifth of the country's economic activity, directly supporting nearly 21.5 million jobs or more than 14 [percent] of U.S. employment."[115] When New Zealand phased out its subsidized support, approximately one percent of its farmers were "forced out" of the industry,[116] which equated to about 800 farms.[117] Forcing out even just one percent of the two million farms in the United States[118] would result in the loss of 20,000 farms, which could lead to a ripple effect, killing other jobs that depend on the agriculture industry. Completely ending agricultural subsidies could also have other very negative consequences, such as increasing the cost of healthy foods, and increasing poverty rates through the reduction of farm income.[119]

Finally, it is important to consider the environmental effects that occurred because of New Zealand's move to a free market. When subsidies were removed, New Zealand farmers shifted from sheep

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[113] *Population, Total*, WORLD BANK (2022), https://data.worldbank.org/indicator/SP.POP.TOTL [https://perma.cc/7DH2-FZLY].

[114] Tony St. Clair, *Viewpoint—Farming without Subsidies—a Better Way. Why New Zealand Agriculture is a World Leader*, POLITICO (July 17, 2002, 5:00 PM), https://www.politico.eu/article/viewpoint-farming-without-subsidies-a-better-way-why-new-zealand-agriculture-is-a-world-leader/ [https://perma.cc/G8ZN-TEY8].

[115] *U.S. Food and Agriculture Industries Economic Impact Study*, FEEDING THE ECON. (2022), https://feedingtheeconomy.com/ [https://perma.cc/VH89-WZVA].

[116] Mark Ross & Chris Edwards, *In New Zealand, Farmers Don't Want Subsidies*, CATO INST. (July 17, 2012), https://www.cato.org/commentary/new-zealand-farmers-dont-want-subsidies [https://perma.cc/QP53-7ZPQ].

[117] Josh Siegel, *What Happened When New Zealand Got Rid of Government Subsidies for Farmers*, DAILY SIGNAL (Sept. 22, 2016), https://www.dailysignal.com/2016/09/22/what-happened-when-new-zealand-got-rid-of-government-subsidies-for-farmers/ [https://perma.cc/3JJD-QKYY].

[118] *Farming and Farm Income*, U.S. DEP'T OF AGRIC. ECON. RSCH. SERV. (Sept. 1, 2022), https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/farming-and-farm-income/ [https://perma.cc/V3KK-9WNT].

[119] FOOD & AGRIC. ORG. OF U.N. ET AL., *supra* note 64.

farms to emission-intensive dairy farms.[120] The free-market approach had not taken the environmental cost of this production into account—including increasingly polluted fresh water and enormous amounts of greenhouse gas emissions.[121] New Zealand farmers are now facing the consequences of their switch from sheep to dairy farms, as the country's government is seeking to introduce new greenhouse gas emissions regulations, leading to the largest protest of farmers the country has ever experienced, with 60,000 farmers taking to the streets.[122] In hindsight, those who called New Zealand's total break with subsidies a success may have judged too early.

B. Using the United Nations Approach: Six Steps to a New System

An approach more appropriate for the size and political landscape of the United States would be following the six steps recommended by the 2021 United Nations report on farm subsidies: (1) assessing the current levels and types of support; (2) measuring the current results of that support; (3) designing a new system of support; (4) forecasting the results of the new system; (5) evaluating (and adjusting) the new strategy; and finally, (6) monitoring the implementation and outcomes of the new system.[123] These steps are generalized to acknowledge that there is "no one-size-fits-all optimal repurposing strategy."[124] This is critical to recognize, as sustainable agriculture changes not just from one environment to another, but also varies depending on a community's needs.[125] The key to this strategy is to holistically assess the agricultural support system, alongside the other policy systems it intersects, to gain a

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[120] Macdonald, *supra* note 112.

[121] *Id. See also* Tess McClure, *Emissions from Cows on New Zealand Dairy Farms Reach Record Levels*, GUARDIAN (Aug. 4, 2021), https://www.theguardian.com/world/2021/aug/05/emissions-from-cows-on-new-zealand-dairy-farms-reach-record-levels [https://perma.cc/AAC9-AQMW].

[122] Macdonald, *supra* note 112.

[123] FOOD & AGRIC. ORG. OF U.N. ET AL., *supra* note 64, at 10.

[124] *Id.*

[125] Eubanks II, *supra* note 9, at 10506.

deeper understanding of the impacts and effects of government support.[126]

This process requires a "transparent, multistakeholder approach," as well as a "communication and engagement strategy targeting stakeholders and the general public," to garner support for this reform.[127] A coalition comprised of scientists, farmers, nonprofit advocates, and USDA experts could convene to promulgate new standards for defining, analyzing, and implementing a new system of agricultural support[128] without requiring major political action. The first step is readily available, as the USDA already tracks levels of agricultural subsidies and other forms of support in each of its programs.[129] The second step, measuring the actual impact of support, can best be implemented using agriculture precision technology.

As the GAO recognized, a lack of data is a core concern for many conservation programs authorized and funded by the Farm Bill and the IRA.[130] Therefore, gathering this data and then using it to form a comprehensive assessment of the results of the funded conservation measures and agricultural practices would give the clearest picture of agriculture in the United States today. From there, precision agriculture technology could be used to refine these farming and conservation approaches.

VI. AGRICULTURE PRECISION TECHNOLOGY: THE (NOT SO) NEW CONSERVATION FRONTIER

Precision agriculture technology is a broad term and has evolved to cover a variety of technological approaches to farming.[131] The idea behind precision agriculture technology—growing as much

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[126] FOOD & AGRIC. ORG. OF U.N. ET AL., *supra* note 64, at 10.

[127] *Id.*

[128] Eubanks II, *supra* note 9, at 10507.

[129] *Government Payments by Program*, U.S. DEP'T OF AGRIC. ECON. RSCH. SERV. (Sept. 1, 2022), https://data.ers.usda.gov/reports.aspx?ID=17833 [https://perma.cc/WN48-SVUA].

[130] *See Agricultural Conservation*, *supra* note 12.

[131] Neal Rasmussen, *From Precision Agriculture to Market Manipulation: A New Frontier in the Legal Community*, 17 MINN. J. L. SCI. & TECH. 489, 492 (2016).

food at as low a cost as possible—is not a new one, but the technology that has been developed to meet this goal is underutilized.[132] Furthermore, this technology allows farmers to meet the conservation goals of the IRA, and provides information necessary to overhaul current farming practices.[133]

Precision agriculture technology utilizes "spatial technologies such as global positioning systems ('GPS'), remote sensing ('RS'), and geographic information systems ('GIS')"[134] to develop "multimedia mapping, data structure, and analysis."[135] Analysis of this data can create sophisticated and comprehensive 3D maps which are used to model and track working lands and conservation efforts.[136] The information needed to understand ecosystem interactions is highly intricate, which is why this technology is so crucial—it can "integrate complex, variable information about land and field conditions, along with weather and hydrology, to help guide farm management."[137] The data gathered through precision agriculture technology can do more than just provide farmers with a more accurate, in-depth understanding of their working lands: It can also be used to further conservation efforts while improving farming outcomes.[138]

To illustrate what this technology can do, it might be easiest to begin with what maps *not* using this technology provide. Previous analysis took the gathered data and only created a statistical average and the standard deviation; essentially, the program might indicate that the average amount of toxic substance in the ground was 22 parts per million ("ppm"), with a standard deviation of 18 ppm.[139] A farmer might look at these results and assume that no part of the

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[132] *Id.*

[133] Jonathan Coppess, *A Return to the Crossroads: Farming, Nutrient Loss, and Conservation*, 39 U. ARK. L. REV. 351, 379 (2017).

[134] Delgado & Berry, *supra* note 13, at 2. GPS is used to pinpoint locations (such as where a farmer is planting seeds or applying pesticide), remote sensing is closely related (collecting data from areas without a farmer directly going there to measure), and GIS is used to create highly sophisticated maps.

[135] Coppess, *supra* note 133, at 379.

[136] *Id.* at 379.

[137] *Id.* at 381.

[138] *See* Delgado & Berry, *supra* note 13, at 3–4.

[139] *Id.* at 6–8.

field exceeded 40 ppm for the toxic substance, and if the limit for safety was 50 ppm, the farmer would conclude that the entire field was safe.[140] A map created with precision agriculture technology, on the other hand, would use "surface modeling"—a technique that uses the same data as previously gathered to create an accurate, 3D model of the field—where a farmer could see that, in fact, the average exists nearly nowhere in the field, and that there are certain areas where run-off has created an extremely high concentration of the toxic substance.[141] Once this information is available, a farmer could receive funding from EQIP to plant cover crops that improve soil health to attempt to remove the toxic substance, increase field borders to prevent the toxic substance from impacting water quality, or a number of other funded programs.[142]

One significant challenge for technology in the wilderness is the sheer incompatibility of wild spaces with fragile technology—a computer must be able to withstand weather, dirt, and curious animals if it is to successfully monitor and report the information it was meant to gather.[143] In answer to this question, scientists at the University of California, Berkeley and Intel created a tiny device, called a "mote."[144] Motes are a kind of nature-proof sensor—protected from the environment by "small, inexpensive shells" and used "in large numbers to gather very detailed information about the environment."[145] UC Berkeley and Intel's version, named the "Mica," is only slightly larger than two AA batteries and uses wireless sensor technology to gather data and

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[140] *Id.* at 8.

[141] *Id.* at 8–9.

[142] *Climate-Smart Agriculture and Forestry (CSAF) Mitigation Activities List*, U.S. DEP'T AGRIC. (Feb. 2022), https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/climate/climate-smart-mitigation-activities [https://perma.cc/ED7U-7G8N].

[143] David E. Culler & Hans Mulder, *Smart Sensors to Network the World*, 290 SCI. AM. 84, 86 (2004).

[144] *Id.*

[145] *Id.*

transmit it back to the lab.[146] The Mica has already been deployed to great effect in conservation[147] and public health programs.[148]

The Mica was first used to study the environment of an endangered seabird.[149] Its sensors could "detect light, barometric pressure, relative humidity[,] and temperature conditions" as well as determine whether there was a bird in the burrow in which the mote was placed.[150] These minute environmental readings are critical—as illustrated above, knowing the average temperature or humidity is useful, but measuring the exact environmental conditions in multiple areas begins to paint a realistic picture of the complex environment in which we live.[151] Motes can be precisely adapted to gather the critical data needed to create the type of maps that precision agriculture technology can use to inform conservation decision-making in the future.

EQIP has an entire subsection of programs devoted to improving and maintaining fish and wildlife habitat, with such practices as wetland creation, enhancement, restoration, and management all receiving funding.[152] CSP and RCPP also provide funding for critical wildlife and fish habitat preservation, maintenance, and restoration.[153] Just as motes were used to gather information about seabird habitats, they could be employed to accurately determine the

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[146] *Id.*

[147] *Id.*

[148] Andrew Orlowski, *Intel: Sensors are of Mote*, REGISTER (Aug. 23, 2005, 6:25 PM), https://www.theregister.com/2005/08/23/intel_sensors/ [https://perma.cc/2583-873A].

[149] Culler & Mulder, *supra* note 143.

[150] *Id*.

[151] *Id.*

[152] *NRCS Conservation Programs, Environmental Quality Incentives Program*, U.S. DEP'T OF AGRIC. NAT. RES. CONSERVATION SERV. (Aug. 31, 2022), https://publicdashboards.dl.usda.gov/t/FPAC_PUB/views/RCAAcresRecieving ConservationbyProgramandFY/AcresReceivingConservationbyProgramandFiscalYear?%3Aembed=y&%3AisGuestRedirectFromVizportal=y [https://perma.cc/95LG-8F7V].

[153] *See RCPP 2021 Projects*, U.S. DEP'T OF AGRIC. NAT. RES. CONSERVATION SERV. (2021), https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/rcpp/?cid=nrcseprd1768428 [https://perma.cc/GG5Z-HM4G]; *NRCS Conservation Programs, Environmental Quality Incentives Program*, *supra* note 152.

threats current habitats face, and to monitor and assess the impact of restoration practices. Illustrating the underutilization of subsidies to support such technology, in 2021, North Carolina had only one RCPP-funded program, which neglected to use mote technology in the ways described above.[154]

Motes could also be adapted to analyze soil data necessary for the more traditional goal of increasing yield purposes in farming, by gathering data necessary to create sophisticated and accurate soil maps. Agricultural producers use soil maps, which display the type of soil, levels of nitrates, and pH, to determine where and what to plant.[155] With this data, farmers can then decide whether to begin precision planting in these areas, or whether to alter previous land use (e.g., growing a crop that reduces nitrate levels, or developing the field as pastureland for livestock).[156] As critical as these soil maps are, the data needed for them is currently lacking.[157] As a result, many producers are forced to rely only on aerial imagery provided by the USDA, which gives little to no insight into nitrate or pH levels.[158] Of course, the technology to solve this problem exists: the mote. If motes were programmed to measure these environmental factors and placed in a field, the data they store could create real-time maps that reflect the health and growing capacity of a field on a foot-by-foot basis. Using the subsequent soil maps to increase the yield of each field not only benefits the farmer by producing more crops, but also reduces the amount of forest or wild land that is converted into farmland to make up for exhausted fields—a win for both the farmer and the environment.

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[154] *See RCPP 2021 Projects*, *supra* note 153.

[155] David Schimmelpfennig, *Farm Profits and Adoption of Precision Agriculture*, U.S. DEP'T OF AGRIC. ECON. RSCH. SERV. (Oct. 2016), https://www.ers.usda.gov/webdocs/publications/80326/err-217.pdf?v=0 [https://perma.cc/JYD6-VZ6Y].

[156] *Id.*

[157] *Id.*

[158] *See id.*

VII. 'CLIMATE-SMART' BIOFUEL: PRECISION AGRICULTURE TECHNOLOGY IN PRACTICE

Precision agriculture technology has traditionally been used to increase crop yield, and this application could help address the biofuel problem. The passage of the IRA is not the only indication that biofuel subsidies are here to stay. The Energy Policy Acts of 2005 and 2007 created a variety of economic incentives to increase biofuel production and "expanded the Renewable Fuel Standard to increase biofuel production to 36 billion gallons by 2022."[159] Biofuel producers were also provided with $700 million to "help lower costs" for those producers who were impacted by the COVID-19 pandemic.[160] These payments were made to "195 biofuel production facilities to support the maintenance and viability of a significant market for agricultural producers of products such as corn, soybean[,] or biomass that supply biofuel production" in twenty-five states, including North Carolina.[161] Therefore, the best way to minimize the negative environmental impact of the biofuel industry would be to maximize crop yield, thereby disincentivizing further expansion of farmland at the expense of forest land.[162] If farmers can grow the corn or other biofuel crops that subsidies are signaling should be grown without cutting down trees or overusing pesticide, the environmental strains of biofuel production can be minimized.

A. Biofuel in North Carolina

North Carolina began incentivizing biofuels in 2007, when the North Carolina legislature released a strategic plan for developing biofuel sources other than corn.[163] Since then, North Carolina has instituted a variety of measures to encourage biofuel production and

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[159] *Economics of Biofuels*, *supra* note 50.

[160] *USDA Has Provided $700 Million to Restore Sustainable Fuel Markets Hit by Pandemic*, U.S. DEP'T OF AGRIC. (June 3, 2022), https://www.usda.gov/media/press-releases/2022/06/03/usda-has-provided-700-million-restore-sustainable-fuel-markets-hit [https://perma.cc/TJH6-P8AA].

[161] *Id.*

[162] *See* Delgado & Berry, *supra* note 13, at 3.

[163] Steven Burke et al., *Fueling North Carolina's Future*, N.C. GEN. ASSEMBLY ENV'T REV. COMM'N (Apr. 1, 2007), https://www.ncbiotech.org/sites/default/files/biofuels_plan_0.pdf [https://perma.cc/DP3F-XC64].

use, including tax exemptions for the retail sale and the "use, storage, or consumption" of "alternative fuel;"[164] setting goals for seventy-five percent of North Carolina's new or replacement light-duty cars and trucks to be either alternative fuel vehicles or low emission vehicles;[165] and establishing funds for purchasing biofuel for government vehicles.[166] Current research is being done to develop bioenergy crops that "maximize net energy production per unit area" which "can be grown on marginal land with minimal inputs."[167] Various areas of North Carolina are under consideration for the development of biofuel agriculture, including the Piedmont and coastal regions.[168] Given the prevalence of these statutes incentivizing the production of biofuel crops, North Carolina farmers should, and are, turning to precision agriculture for a climate-smart approach to growing these crops. With the right tools, these crops can be grown and sold with minimal cost to the environment.

B. Smart Farming: Using Precision Ag Tech to Increase Yield without Increasing Land Use

To meet the goals of growing as much of a crop on as little land as possible, the farming sector should turn to variable rate technologies ("VRTs"), which "enable farmers to make customized land management decisions to optimize the use of seeds, fertilizers[,] and pesticides."[169] Adopting VRTs "allows farmers to manage their seed, fertilizer, and pesticide applications foot by foot

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[164] N.C. GEN. STAT. § 105-164.13(11)(b) (effective Jan. 1, 2023).

[165] § 143-215.107C (2022).

[166] § 143-58.4 (2022).

[167] Nathan Lynch, *Bioenergy Crops*, N.C. STATE EXTENSION, N.C. STATE UNIV. (July 2022), https://mcilab.ces.ncsu.edu/mcilab-research/bioenergy-crops/ [https://perma.cc/FTY8-ZZBN].

[168] Kaine Korzekwa, *Selecting the Best Bioenergy Crops for the North Carolina Piedmont*, AM. SOC'Y AGRONOMY (July 6, 2021), https://www.agronomy.org/news/science-news/selecting-best-bioenergy-crops-north-carolina-piedmont/ [https://perma.cc/6PNS-D7Y3].

[169] Raviv Itzhaky, *Artificial Intelligence and Precision Farming: The Dawn of The Next Agricultural Revolution*, FORBES (Jan. 7, 2021, 7:50 AM), https://www.forbes.com/sites/forbestechcouncil/2021/01/07/artificial-intelligence-and-precision-farming-the-dawn-of-the-next-agricultural-revolution/?sh=781a49a01dbe [https://perma.cc/J6HV-95ZL].

rather than field by field."[170] To successfully implement VRTs, farmers require: (1) a map that specifies where and what quantity of seeds, fertilizers, or pesticides must be applied; (2) equipment that is capable of changing rates while operating; and (3) a GPS system in their equipment to follow the application map.[171]

Past yield data is critical to determine where and what farmers are planning to grow in the future. Currently, farmers can measure yield by monitoring how many seeds are dispensed along with GPS data that records where those seeds are placed.[172] Farmers then compare crop yield (how much they harvest) on a year-after-year basis, informing their decisions about what type of crop to grow in which area.[173] The combination of yield data and soil maps is used to preprogram the VRT equipment, telling the machine how much to plant (or spray) at different GPS locations based on the map uploaded into the equipment.[174] The equipment then "adjust[s] the levels of inputs from each nozzle or feeder on command from a computer program that uses the geo-referenced data points."[175] This sophisticated method of planting can be enhanced even further with a technique known as prescription planting.[176] Prescription planting occurs when different seed types are planted in different locations, all within one field.[177] This type of planting is especially successful in fields that have different soil types—farmers can use their soil maps to match an area with the type of seed best suited to grow in it.[178]

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[170] Daniel Hellerstein et al., *Agricultural Resources and Environmental Indicators*, U.S. DEP'T OF AGRIC. ECON. RSCH. SERV. (May 2019), https://www.ers.usda.gov/webdocs/publications/93026/eib-208.pdf [https://perma.cc/ML69-EZ9F].

[171] *Variable Rate Technology*, N.D. STATE UNIV. (2022), https://www.ndsu.edu/agriculture/ag-hub/ag-topics/ag-technology/precision-ag/variable-rate-technology [https://perma.cc/SEA4-JB2P].

[172] Hellerstein et al., *supra* note 170.

[173] *Id.*

[174] Schimmelpfennig, *supra* note 155.

[175] *Id.*

[176] *Id.*

[177] *Id.*

[178] Gil Gullickson, *What to Know About Prescription Seeding*, SUCCESSFUL FARMING (Nov. 1, 2013), https://www.agriculture.com/crops/corn/technology/

In practice, this process can look like what occurred on Kevin Matthews's 5,000-acre farm in the North Carolina Piedmont.[179] Matthews grows corn, soybeans, barley, and wheat on fields with irregular elevation and multiple different soil types, ranging from sandy silt to red clay.[180] Through the installation of a GPS system that divided his land into separate zones and VRT application, Matthews closely monitors which crops are planted, ensuring that all portions of his land are evenly planted and fertilized.[181] The combination of these precision agriculture technologies, alongside others, led to the doubling of crop yield within his upland fields from 150 to 300 bushels of corn.[182]

C. Precision Pesticide: Less Pollution, More Crops

Pesticide use in the United States is incredibly prevalent.[183] According to a 2019 USDA study, using data collected from 2007 to 2012, spending on pesticides by agricultural producers rose to over $9 billion, an increase of nearly thirty-two percent.[184] Five commonly subsidized crops (corn, cotton, fall potatoes, wheat, and soybeans) account for approximately two-thirds of all pesticide application, with 634 million pounds of pesticide applied in 2014 alone.[185] Herbicide is the most common type of pesticide employed, and the "heavy, and often exclusive, reliance" on one type of herbicide has led to herbicide-resistant weeds, which leads to farmers applying herbicide more often.[186]

Integrated Pest Management ("IPM") is another program area covered by EQIP, CSP, and RCPP.[187] However, critics have noted that previous versions of Farm Bill-funded conservation programs fell short of fostering IPM practices, especially in areas that are

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what-to-know-about-prescription-seeding_139-sl34963 [https://perma.cc/3XK4-LHHE].

[179] Henderson, *supra* note 30.

[180] *Id.*

[181] *Id.*

[182] *Id.*

[183] Hellerstein et al., *supra* note 170.

[184] *Id.*

[185] *Id.*

[186] *Id.*

[187] *NRCS Conservation Programs*, *supra* note 152.

highly impacted by pesticide application.[188] From 2003–2005, fewer than two percent of funds distributed by EQIP were allocated to pest management.[189] According to 2021 USDA data, IPM makes up a little over eight percent of soil quality improvement practices, and fewer than six percent of water quality conservation practices.[190] With these subsidies again falling short of solving the problem, precision agriculture technology can be used.

To avoid over-spraying these pesticides, farmers can use artificial intelligence technology, including the "lettuce bot," which uses a computer to "see" whether the plant is a crop or a weed by processing an image every fifty milliseconds and then comparing this image to its database containing over 300,000 images of weeds and crops, to ensure that no pesticides are applied to the actual crop.[191] The lettuce bot has resulted in a dramatic reduction of pesticide use—with farmers using the lettuce bot needing only ten percent of the amount of pesticide they previously applied.[192]

A newer approach to pesticide application—in-furrow pesticide—can also benefit from precision technology.[193] In-furrow application means placing the pesticide in with the seed, rather than spraying the plants after they begin to grow.[194] It is a rapidly-growing trend,[195] but can sometimes lead to poor results

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[188] *More Integrated Pest Management Please: How USDA Could Deliver Greater Environmental Benefits from Farm Bill Conservation Programs*, NAT. RES. DEF. COUNCIL (2007), https://www.nrdc.org/sites/default/files/fipm.pdf [https://perma.cc/5F9H-QF79].

[189] *Id.*

[190] *NRCS Conservation Programs, supra* note 152.

[191] Tanya M. Anandan, *Cultivating Robotics and AI for Sustainable Agriculture*, ASS'N FOR ADVANCING AUTOMATION (July 22, 2019), https://www.automate.org/industry-insights/cultivating-robotics-and-ai-for-sustainable-agriculture [https://perma.cc/N9XN-AZU3].

[192] *Id.*

[193] Jodie Wehrspann, *Thinking In-furrow for Improved Performance*, SE. FARM PRESS (Jan. 26, 2016), https://www.farmprogress.com/technology/using-precision-applications-furrow-granular-pesticides [https://perma.cc/ZK6R-5QY8].

[194] *Id.*

[195] *Id.*

when technological malfunctions prevent the appropriate rate of application.[196]

To prevent such technological malfunctions, further sophisticated technologies have been developed: the SmartBox and the vDrive.[197] The SmartBox "utilizes an electronically controlled auger to accurately meter the product on each row."[198] The vDrive, on the other hand, "monitors the product on each row-unit individually" and can alert the operator if the machine encounters a "stopped up meter or an empty chemical box."[199] Both of these also use VRT to produce the best possible results when applying pesticide during the planting process.[200]

Pesticide management is not limited to precision application. The same soil data gathered for yield maps can be used to predict where common pests are likely to appear.[201] Take, for example, the corn earworm: a common pest on a common biofuel crop.[202] Researchers combined soil temperature data with earworm monitoring data to create maps divided into different temperate zones, which challenged the traditional thinking that the pest could not survive above 40 degrees latitude, and demonstrated that the earworm's habitat range was in fact expanding.[203] With this knowledge, farmers know not only when, but *where* to spray pesticide to effectively fight this bug—a model that could be translated to other heat-sensitive pests.[204]

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[196] Simer Virk & Bob Kemerait, *Using Precision Applications for In-furrow Granular Pesticides*, SE. FARM PRESS (May 18, 2022), https://www.farmprogress.com/technology/using-precision-applications-furrow-granular-pesticides [https://perma.cc/2CEZ-9G4H].

[197] *Id.*

[198] *Id.*

[199] *Id.*

[200] *Id.*

[201] Hugo Claver, *Soil Temperature Can Predict Spread of Corn Earworm in Crops*, FUTURE FARMING, https://www.futurefarming.com/crop-solutions/weed-pest-control/soil-temperature-can-predict-spread-of-corn-earworm-in-crops/ [https://perma.cc/WT29-3CC5] (last visited Oct. 18, 2022).

[202] *Id.*

[203] *Id.*

[204] *Id.*

VIII. CONCLUSION

The current deeply divided political atmosphere makes sweeping legislative reforms to the Farm Bill and its agricultural subsidies and conservation programs improbable. Therefore, current subsidies should fund precision agriculture technology to gather the information necessary to make existing programs function.

The history of agricultural support in the United States is long and contentious, and the controversies are far from over.[205] Over time, the issues facing farmers have only grown more complex, which is reflected in the now enormous range of programs covered in the modern Farm Bill.[206] With nutrition programs such as SNAP creating political controversy and grinding compromise and bipartisanship to a halt,[207] Congress members have had to innovate to circumvent the traditional legislative process.[208] The most recent innovation resulted in the passing of the IRA through the budget reconciliation process.[209] While the IRA aims to mitigate the effects of climate change, the farm subsidies and conservation programs it is funding are not producing the necessary change.[210] In fact, farm subsidies are leading to disastrous consequences across the globe.[211]

The next piece of agricultural legislation slated for Congressional review is the Farm Bill, which has been a subject of increasingly bitter debates over the last ten years.[212] As bipartisanship on the Hill seems to be on its deathbed,[213] the fate of the Farm Bill depends heavily on how Congress attempts to get it passed. Senate Democrats could use the limited method of reconciliation to pass the Farm Bill, or they may attempt the

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[205] *See* Eubanks II, *supra* note 9, at 10494–97.
[206] *Id.*
[207] Ferguson, *supra* note 105.
[208] *See* Krutz, *supra* note 90, at 212.
[209] Coppess et al., *supra* note 10.
[210] *See USDA Conservation Stewardship Program Could Do More to Tackle Climate Emergency*, *supra* note 5.
[211] FOOD & AGRIC. ORG. OF U.N. ET AL., *supra* note 64.
[212] Newkirk & Paschal, *supra* note 98.
[213] Shafer, *supra* note 89.

omnibus bill strategy. Democrats also face divisions within their own party that may halt the Bill's progress.[214]

A solution to this political crisis may lie in the reform of agricultural subsidies. If the sophisticated technology available to farmers is used to gather critical information about the current level of agricultural support, as well as the current state of ecosystems in need of conservation, a coalition of experts could promulgate a new system of support that could succeed where current subsidies fail.

To improve the effectiveness of conservation programs like EQIP or CSP, more data is required.[215] Motes, tiny computers that gather critical environmental data, can be used to gather this data and, in turn, implement the best habitat conservation and restoration programs.

To solve the problem biofuel poses—cutting down trees to grow crops for which there is not an *actual* market[216]—the industry could turn to a variety of precision agriculture technologies. Motes or other data-gathering devices could be used to create sophisticated soil maps, which in combination with yield data could be used to program variable rate technology equipment to plant the best type of seed for each soil present in a farmer's land.[217] VRT could then be used to apply the precise amount of fertilizer and pesticide needed to ensure that crops flourish, thereby leading to maximum yield on a minimum of land.[218]

Agricultural subsidies aimed at conservation fail due to a lack of data,[219] while other subsidies fund crops that are environmentally harmful.[220] Legislation is unlikely to fix the problem, as there is a continued lack of bipartisanship[221] and political will to pass major

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[214] Ron Elving, *Democrats are Having a Unity Problem*, NPR (Oct. 10, 2021, 6:00 AM), https://www.npr.org/2021/10/10/1044019366/democrats-are-having-a-unity-problem-thats-familiar-territory-for-them [https://perma.cc/4S22-2CEK].

[215] *See Agricultural Conservation*, *supra* note 12.

[216] *See Economics of Biofuels*, *supra* note 50.

[217] *See* Gullickson, *supra* note 178.

[218] *Id.*

[219] *See Economics of Biofuels*, *supra* note 50.

[220] *See USDA Conservation Stewardship Program Could Do More to Tackle Climate Emergency, supra* note 5; Carrington, *supra* note 63.

[221] *See* Shafer, *supra* note 89.

agricultural legislation. The hope for climate-smart agriculture thus does not lie with Congress, but with precision agriculture technology.