Agricultural Soil Carbon Sequestration Offset Programs:

Strengths, Difficulties, and Suggestions for Their Potential Use in AB 32's Cap and Trade Program

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I.
INTRODUCTION

In 2006, California signed the Global Warming Solutions Act of 2006, or Assembly Bill 32 (AB 32), into law.[1] AB 32 aims to reduce California's greenhouse gas emissions to 1990 levels by 2020 through a variety of regulations promulgated by the California Air Resources Board (CARB) including a cap and trade program.[2] The cap and trade program already includes four offset programs that give capped entities the opportunity to meet their emissions limitations in the most economically efficient way available. Whereas the level of emissions in a compliance obligation that may be accounted for through an offset program is capped at 8%, the number of existing offset programs that may be used to reach this 8% can be increased to include additional offset programs.[3] Adding offset programs may

1. *See* J.R. DeShazo & Jody Freeman, *Timing and Form of Federal Regulation: The Case of Climate Change*, 155 U. PA. L. REV. 1499, 1526 (2007) (stating that California is so far the only state to independently cap greenhouse gas emissions).

2. *Id.* (noting that this provides for a 25% emissions cut in California).

3. CAL. AIR RES. BD., CLIMATE CHANGE SCOPING PLAN 67 (Dec. 2008),

be attractive to covered industries and government alike because offset programs allow covered entities to determine what the most economically efficient way to comply with emission limitations is for that specific entity while still complying with the overall program emissions cap.

CARB's implementing regulations for AB 32 do not address California's large agriculture sector as directly as other sectors, as its dominant strategy to reduce agricultural emissions is to encourage dairies to voluntarily install manure digesters.[4] However, California's agricultural sector, primarily manure and cropland management, provides ample opportunity for offset programs. It is a sector with significant greenhouse gas emissions and sinks that is not otherwise regulated by the cap and trade program. One offset program already takes advantage of this opportunity by issuing offset credits for capturing and destroying methane from dairies and swine farms using particular manure management systems.[5] Another opportunity for an agricultural-related offset program arises from the ability of agricultural soil to sequester carbon. Soil is an important sink for carbon, and the United Nations Food and Agriculture Organization estimates that soils can sequester over 10% of the anthropogenic carbon emissions in twenty-five years.[6] Whereas some cap and trade programs, such as the European Union's European Trading System and the first compliance period of the Kyoto Protocol, do not recognize offset credits from most carbon sequestration offset programs because the emission reductions are difficult to measure, verify, and track, future sequestration programs under AB 32's cap and trade program are possible.[7] AB

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available at http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf.

4. *See Agriculture*, CAL. AIR RES. BD., http://www.arb.ca.gov/cc/scopingplan/agriculture-sp/agriculture-sp.htm (last updated Nov. 18, 2009).

5. *See* CAL. AIR RES. BD., COMPLIANCE OFFSET PROTOCOL: LIVESTOCK PROJECTS (Oct. 20, 2011).

6. *Land Resources*, UNITED NATIONS FOOD & AGRIC. ORG., http://www.fao.org/nr/land/sustainable-land-management/soil-carbon-sequestration/en/ (last visited Apr. 19, 2013).

7. JONATHAN L. RAMSEUR, CONG. RES. SERV., THE ROLE OF OFFSETS IN A GREENHOUSE GAS EMISSIONS CAP-AND-TRADE PROGRAM: POTENTIAL BENEFITS AND CONCERNS 33-34 (Apr. 4, 2008); Josh Horton, *Soil Carbon Credit Standard*

32's cap and trade program already includes two carbon sequestration offset programs, both stemming from the power of trees to sequester carbon, and other types of sequestration programs are not prohibited in the regulations.[8]

Consequently, adopting an agricultural soil carbon sequestration offset program seems like a possible option for a future offset program under AB 32. In fact, the possibility has already been mentioned in a proposed bill that went before the California Assembly.[9] Additionally, agricultural soil carbon sequestration offset programs have been implemented around the world and likely would have played a role in the Waxman-Markey bill or Lieberman-Warner bill if either had passed both Congressional houses.[10]

Agricultural soil carbon sequestration offset programs have many benefits in that they take advantage of soil's effectiveness as a carbon sink to provide flexibility for covered entities in cap and trade programs. However, aside from problems with quantifiability, permanency, and additionality, which are typical considerations in carbon sequestration offset programs, agricultural soil carbon sequestration offset programs can be

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Proposed, GEOENGINEERING POL. (Mar. 18, 2011), http://geoengineeringpolitics.blogspot.com/2011/03/soil-carbon-credit-standard-proposed.html ("Soil credits have played a minimal role in carbon markets up to now, because soil carbon is viewed as difficult to measure, verify, and track."); *see LULUCF – Developments at Past COP and SB Sessions: Marrakesh Accords and COP 7*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/methods_and_science/lulucf/items/3063.php (last visited May 14, 2013).

8. *See* CAL. CODE REGS. tit. 17, §§ 95970-95988 (2012); CAL. ENVTL. PROT. AGENCY & CAL. AIR RES. BD., COMPLIANCE OFFSET PROTOCOL: U.S. FOREST PROJECTS (Oct. 20, 2011).

9. *See* A.B. 2563, 2011-12 Reg. Sess. (Cal. 2012) (proposing a streamlined review and approval process for new offset protocols). The main point of A.B. 2563 is to streamline the review and approval process for new offset protocols under AB 32, but, in an earlier version, mentioned programs that would maintain agricultural yields while decreasing emissions. *See id.*

10. *See* RENEE JOHNSON, CONG. RES. SERV., CLIMATE CHANGE: THE ROLE OF THE U.S. AGRICULTURE SECTOR 1 (Nov. 9, 2009); RAMSUER, *supra* note 7, at 26-30 (noting that many cap and trade proposals in the 110th Congress specifically allowed for biological sequestration offsets including agricultural sequestration offsets, and some proposals required a certain percentage of allowances to come from agricultural sequestration offsets under certain circumstances).

accompanied by detrimental incidental effects, particularly increased herbicide use. Increased herbicide use increases nitrous oxide emissions, which could jeopardize the cap and trade program's goal of reducing greenhouse gas emissions and negatively affect populations and the environment beyond the scope of the cap and trade program.

This Comment proposes that if CARB considers adopting an agricultural soil carbon sequestration offset program, as it might in the future, it should use an ecosystem approach to guide the offset program creation process and a project-by-project ecosystem approach for individual project measurements and approval, as opposed to the standards-based approach that CARB utilizes in its existing offset protocols. An ecosystem approach ensures that the complete scope of a program's environmental effects are measured, rather than only accounting for carbon sequestration. Using this approach, CARB can ensure that the complex incidental effects of agricultural soil carbon sequestration offset programs are completely accounted for in determining whether the program should be adopted, calculating projects' offset credits, and appropriately constructing the program's regulations to prevent undesirable effects. Additionally, this project-by-project ecosystem approach will help CARB to quantify the actual emissions and sinks of an offset project, determine whether an offset project is actually additional to business-as-usual, and determine the best pesticide management program to decrease emissions from herbicide use. A case-by-case ecosystem approach will help CARB to know to reject the program or an individual project if it cannot ultimately benefit AB 32's goal of reducing greenhouse gas emissions in California.

Part II of this Comment provides an overview of AB 32 and its cap and trade program. Part III describes the role that offset programs play in a cap and trade scheme and introduces a sampling of offset programs that currently exist in various cap and trade programs. Part IV details the agricultural sector's contribution to the United States' and California's greenhouse gas emissions and identifies two opportunities for decreasing agricultural greenhouse gas emissions through offset programs. These opportunities include improved manure management,

which is already being taken advantage of by AB 32's Livestock Project Compliance Offset Protocol, and improved agricultural soil management, which provides a possible opportunity for an additional offset program under AB 32. Part V discusses the problems with agricultural soil carbon sequestration offset projects, including difficulties in accurate measurement, permanency, additionality, and increased herbicide use which results in increased nitrous oxide emissions. Part VI argues that an ecosystem approach, which would implicate an analysis of the complete environmental effects of the offset program and a case-by-case analysis of the offset projects, would reduce the uncertainty and harm associated with agricultural soil carbon sequestration offset programs. For these types of offset programs, the ecosystem approach would be a more preferable approach than CARB's typical standards-based approach, which would likely not account for the complete effects of encouraging new agricultural practices through an offset protocol and may not properly account for whether a project is actually additional to business-as-usual. Part VII discusses some of the weaknesses of a case-by-case ecosystem approach and argues that despite these weaknesses, this approach is still preferable for agricultural soil carbon sequestration offset programs due to the extreme and varied nature of the issues associated with this type of program.

II.
THE BASICS OF AB 32 AND ITS CAP AND TRADE PROGRAM

California's Assembly Bill 32 (AB 32),[11] the Global Warming Solutions Act of 2006, is the first greenhouse gas reduction bill of its kind in the United States.[12] Passed by the California Legislature and signed by former-Governor Schwarzenegger, AB 32 has been implemented to include direct regulations, incentives, voluntary actions, and market mechanisms, including

11. CAL. HEALTH & SAFETY CODE §§ 38500-38599 (West 2012).

12. *See* Lauren E. Schmidt & Geoffrey M. Williamson, *Recent Developments in Climate Change Law*, 37 COLO. LAWYER 63, 71 (2008) (noting that the federal government is far behind state and regional greenhouse gas emission reduction programs, with AB 32 being the first of such programs).

reporting and verification requirements, early actions, and a cap and trade program.[13] The bill empowers the California Air Resources Board (CARB) to both set the emissions cap for the cap and trade program and conduct rulemakings to establish greenhouse gas regulations and rules governing the market mechanisms.[14] The ultimate goal of AB 32 is to have California emission levels return to 1990 emission levels by 2020.[15]

A prominent and controversial portion of AB 32 is the cap and trade program.[16] The program functions as a typical cap and

13. *See Assembly Bill 32: Global Warming Solutions Act*, CAL. AIR RES. BD., http://www.arb.ca.gov/cc/ab32/ab32.htm (last visited Apr. 30, 2012); *AB 32 Scoping Plan*, CAL. AIR RES. BD., http://www.arb.ca.gov/cc/scopingplan/scopingplan.htm (last visited Mar. 29, 2012).

14. *See Assembly Bill 32: Global Warming Solutions Act*, CAL. AIR RES. BD., *supra* note 13.

15. *See id.*

16. The cap and trade program, as expected, got negative feedback from supporters of industry who think a cap and trade program will drive business out of California. *See, e.g.*, *Fact Sheet: Why Do We Want to Suspend AB 32?*, SUSPENDAB32.ORG, http://www.suspendab32.org/AB32FactSheet.pdf (last visited Mar. 27, 2012). A political group proposed a measure, Proposition 23, financially backed by energy and oil companies like Valero and Tesoro, for the November 2010 ballot that would suspend AB 32 until unemployment in California dropped below 5.5% for a year. *See Proposition 23*, LEGIS. ANALYST'S OFF. (July 15, 2010), http://www.lao.ca.gov/ballot/2010/23_11_2010.aspx; *Campaign Finance: Yes on 23*, SEC'Y OF ST. DEBRA BOWEN, http://cal-access.ss.ca.gov/Campaign/Committees/Detail.aspx?id=1323890&session=2009&view=received (last visited Mar. 27, 2012). It was defeated. Margot Roosevelt, *Prop. 23 Campaign Concedes Defeat*, L.A. TIMES BLOG (Nov. 3, 2010 12:08 AM), http://latimesblogs.latimes.com/greenspace/2010/11/prop-23-defeat-global-warming-climate-change.html. However, some environmental justice organizations are also pushing back against the cap and trade program. *See* Statement of Decision: Order Granting in Part Petition for Writ of Mandate, Ass'n of Irritated Residents v. Cal. Air Res. Bd., No. CPF-09-509-562, 2011 WL 991534 (Cal. Super. Ct. Mar. 18, 2011) (challenging CARB's implementation of AB 32 for failing to comply with AB 32 and the California Environmental Quality Act (CEQA), and partially succeeding under the CEQA claim). These groups think that the California government should regulate greenhouse gas emissions through a carbon tax instead. *See* Ann Carlson, *AB 32 Lawsuit: Assessing the Environmental Justice Arguments Against Cap and Trade*, LEGAL PLANET (Mar. 22, 2011), http://legalplanet.wordpress.com/2011/03/22/ab-32-lawsuit-assessing-the-environmental-justice-arguments-against-cap-and-trade/. Cap and trade programs can be unpopular with some environmental justice groups because they typically do not provide a place for public participation aside from the possibility of public comment periods in the development of the program. *See* Sean Hecht, *Reflections on Environmental Justice and AB 32's*

trade. The regulator (here, CARB) sets an emissions cap and particular sectors or entities are chosen to be covered under the cap. Each entity covered by the cap has its own compliance obligation, or maximum emission levels. The regulator allocates or auctions allowances to entities regulated under the cap, and entities can buy allowances amongst themselves or fund a project in exchange for offset credits if they cannot meet their allotted compliance obligation by merely improving internal practices or technology.

California's cap and trade program was developed using input from stakeholders and was designed to incorporate input from the Environmental Justice Advisory Committee, a group built into AB 32 to represent environmental justice concerns.[17] A variety of sources, which can be generally categorized as utilities or industrial entities, are covered under the cap and trade program.[18] The cap and trade regulations took effect in January of 2012 but the start date of the program's enforceable compliance obligations was January 1, 2013.[19] Under the

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Emissions Trading Program, LEGAL PLANET (Mar. 23, 2011), http://legalplanet.wordpress.com/2011/03/23/reflections-on-environmental-justice-and-ab-32s-emissions-trading-program/. Additionally, environmental justice advocates fear that once the cap and trade program is in place, the biggest polluters will be able to continue polluting and simply buy their way into compliance by purchasing additional allowances and offset credits. *See* Press Release, Center on Race, Poverty and the Environment and Communities for a Better Environment, Environmental Justice Group Wins: California Air Resources Board Forces to Revisit Alternatives to Unjust Pollution Trading System (Mar. 21, 2011); Carlson, *supra*.

17. *See Cap-and-Trade Program*, CAL. AIR RES. BD., http://www.arb.ca.gov/cc/capandtrade/capandtrade.htm (last updated Apr. 30, 2012). Whether CARB paid the Environmental Justice Advisory Committee's recommendations any heed is disputed. *See, e.g.*, Ngoc Nguyen, *Climate-Change Law: Why CA Environmentalists Are Fighting Each Other*, NEW AMERICA MEDIA (Mar. 14, 2011), http://newamericamedia.org/2011/03/cap-and-trade-story-here.php.

18. *See Cap-and-Trade Regulation Applicability Guide*, CAL. AIR RES. BD., at 2-4 (Jan. 2012), http://www.arb.ca.gov/cc/capandtrade/registration/registration-guidance.pdf.

19. *Program Implementation*, CAL. AIR RES. BD., http://www.arb.ca.gov/cc/capandtrade/implementation/implementation.htm (last updated Sept. 25, 2012) ; *see also* Daniel B. Wood, *California Ready to Cut Greenhouse Gases. Next, Doing It.*, CHRISTIAN SCI. MONITOR (Mar. 13, 2012), http://www.csmonitor.com/Environment/2012/0313/California-ready-to-cut-greenhouse-gases.-Next-doing-it (noting the difficulties in creating a cap and trade program and the

program, these entities are obligated to cover each ton of their greenhouse gas emissions with one allowance or credit.[20] A number of allowances are distributed to capped entities for free and those entities have the opportunity to buy more allowances at auctions.[21] Additionally, a capped entity can purchase offset credits for up to 8% of its cap and trade compliance obligations.[22] Offset producers can generate offset credits through one of four protocols that have already been developed and approved by CARB:[23] U.S. forest projects,[24] livestock projects,[25] ozone depleting substances projects,[26] and urban forest projects.[27]

There is a possibility that California's cap and trade scheme may eventually become part of a regional program under the Western Climate Initiative (WCI).[28] The WCI is a non-profit

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specific issues that AB 32's implementation has faced).

20. "[C]arbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), nitrogen trifluoride (NF_3), and other fluorinated greenhouse gases" are included in AB 32's cap and trade scheme. CAL. CODE REGS. tit. 17, § 95810 (2012).

21. *See Major Activities for the Cap-and-Trade and Mandatory Reporting Program in 2012*, CAL. AIR RES. BD. (Jan. 26, 2012), http://www.arb.ca.gov/cc/capandtrade/2012activities.pdf. The first auction was held on November 14, 2012 and sold over 27 million allowances. *Auction Information*, CAL. AIR RES. BD., http://www.arb.ca.gov/cc/capandtrade/auction/auction.htm (last updated May 31, 2013).

22. *See Compliance Offset Program*, CAL. AIR RES. BD., http://www.arb.ca.gov/cc/capandtrade/offsets/offsets.htm (last updated May 23, 2013).

23. *See id.*

24. Reforestation, improved forest management, and avoided conversion are the eligible activities under the Forest Offset Protocol. *See* CAL. ENVTL. PROT. AGENCY & CAL. AIR RES. BD., COMPLIANCE OFFSET PROTOCOL: U.S. FOREST PROJECTS, *supra* note 8, at 61.

25. Under this protocol, entities get offset credits for installing "a biogas control system that captures and destroys methane gas from anaerobic manure treatment and/or storage facilities on livestock operations." *See* CAL. AIR RES. BD., COMPLIANCE OFFSET PROTOCOL: LIVESTOCK PROJECTS, *supra* note 5, at 5.

26. This protocol gives entities credits for destroying high global warming potential ozone depleting substances. *See* CAL. ENVTL. PROT. AGENCY & CAL. AIR RES. BD., COMPLIANCE OFFSET PROTOCOL: OZONE DEPLETING SUBSTANCES PROJECTS 4 (Oct. 20, 2011).

27. These projects include "a planned set of tree planting and maintenance activities" outside of a contiguous natural forested area. *See* CAL. ENVTL. PROT. AGENCY & CAL. AIR RES. BD. COMPLIANCE OFFSET PROTOCOL: URBAN FOREST PROJECTS 3 (Oct. 20, 2011).

28. *See* CAL. AIR RES. BD., CLIMATE CHANGE SCOPING PLAN, *supra* note 3, at

corporation that was created to provide administrative support for participating jurisdictions' emissions trading programs.[29] The WCI was originally comprised of seven U.S. states and four Canadian provinces, but every U.S. state besides California has dropped out.[30] California is now working with the WCI in order to harmonize California's cap and trade program policies with similar programs in British Columbia, Ontario, Quebec, and Manitoba, and in 2013, California's Governor Brown signed off on linking with Quebec's cap and trade program.[31]

III.
THE BASICS OF OFFSET PROGRAMS

Offset programs are common features of cap and trade programs. As mentioned above, AB 32's cap and trade scheme already includes four offset programs and most other cap and trade programs include offset programs.[32]

Offset programs primarily exist for two reasons: for the benefit of entities covered by a cap and trade program and for voluntary markets.[33] The more well-known purpose of offset programs is to provide capped entities with flexibility for how they meet emission reduction requirements under a cap and trade program. Many cap and trade programs, including California's cap and trade program, the Kyoto Protocol, the

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29. *See Cap-and-Trade Program*, CAL. AIR RES. BD., *supra* note 17.

30. *See* Committee Report, *Report of the Environmental Regulation Committee*, 32 ENERGY L J. 637, 654 (2011) (noting that the diminution of participants "is due to New Mexico revoking its necessary regulations to support participation"); Geoffrey Craig, *Six U.S. States Leave the Western Climate Initiative*, PLATTS (Nov. 18, 2011, 4:15 PM), http://www.platts.com/RSSFeed DetailedNews/RSSFeed/ElectricPower/6695863. The six state drop out was no surprise because they had previous expressed their intentions to do so. *U.S. States Quit Western Climate Initiative*, GLOBE-NET (Nov. 18, 2011), http://www.globe-net.com/articles/2011/november/18/us-states-quit-western-climate-initiative/. Instead, the six states joined thirteen other U.S. states and four Canadian provinces in an initiative called North America 2050. *Id.*

31. *See History*, W. CLIMATE INITIATIVE, http://www.westernclimateinitiative .org/history (last visited Apr. 7, 2013); Lynn Doan, *California Governor Clears Way for Carbon Market Link to Quebec*, BLOOMBERG (Apr. 8, 2013, 6:26 PM).

32. RAMSEUR, *supra* note 7, at 2.

33. *See id.* at 3-4.

European Emissions Trading System (EU ETS), and the Regional Greenhouse Gas Initiative (RGGI), incorporate at least one offset program. Offset programs can also exist as part of a voluntary market that sells offset credits to entities that want to offset their emissions, for example, as part of a corporate social responsibility campaign or to advertise their company as carbon neutral.[34]

Offset programs facilitate voluntary transactions between capped entities, which fund and assist in the implementation of greenhouse gas reducing projects, and offset producers, which are hosts to the projects and can be any unit such as a farm, forest, building, or factory approved in the offset program.[35] In exchange for funding the offset project, the capped entity will receive offset credits that count as units of emission reduction that can be used to help meet emission limitations or goals.[36] Various types of greenhouse gas reducing offset projects exist. Some are technology-based projects, such as renewable energy projects or energy efficiency projects, which decrease the offset producer's carbon intensity or greenhouse gas emissions.[37] Examples of these projects include installing wind farms or solar panels, making a building more energy efficient by upgrading appliances or machines, and installing devices that capture and destroy greenhouse gases.[38] Other projects utilize biological sequestration, which sequester carbon in some resource.[39] Examples of these projects include protecting or restoring forests, planting new trees, protecting or restoring wetlands, and changing cropland practices to increase carbon sequestration.[40]

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34. *See id.* at 4. For example, Bain & Company, a top consulting firm, is certified as a carbon neutral company, an initiative that was undertaken as part of their corporate social responsibility campaign. *See Corporate Responsibility*, BAIN & CO., http://www.bain.com/offices/social_impact/corporate-responsibility/index.aspx (last visited Apr. 20, 2013). To offset their carbon emissions, Bain has invested in six different projects, including wind power and methane capture in China and protecting old-growth forests in the United States. *Id.*

35. RAMSEUR, *supra* note 7, at 2.

36. *Id.* at 3.

37. *See id.* at 5-6.

38. *Id.*

39. *Id.* at 5.

40. *Id.*

Common criteria for a credible offset program are that the offsets generated under the program must be quantifiable, real, permanent, and additional.[41] To be quantifiable, the greenhouse gas reductions from a project must be capable of being measured.[42] "Real" typically means that an independent third party can verify the reductions.[43] An offset is permanent when the emissions that are reduced by the project will not be released in the future.[44] To be additional, a project must reduce emissions that would not have been reduced anyway in a business-as-usual scenario.[45]

Offset programs and the restrictions on using them vary in nature depending on the cap and trade program to which they are linked. One variation concerns whether the offset program project may take place outside of the region covered by the cap and trade program. For example, California's program recognizes offset credits generated from projects outside of California, subject to certain restrictions, even though only entities in California are directly covered under the California cap and trade program.[46] RGGI, on the other hand, only recognizes offset credits generated by projects within the states covered by RGGI.[47] Another variation is on the type of projects allowed. Cap and trade programs detail the types of projects that are recognized under their offset programs and sometimes certain types of projects are prohibited. For example, the Clean

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41. Howard Kenison & Jonathan P. Scoll, *Carbon Offsets From Soils and Forests – A Primer for Colorado Lawyers*, 38 COLO. LAW. 63, 63 (2009).

42. *Id.*

43. *Id.* at 63-64.

44. *Id.* at 64.

45. *Id.*; RAMSEUR, *supra* note 7, at 2.

46. *See, e.g.*, CAL. ENVTL. PROT. AGENCY & CAL. AIR RES. BD., COMPLIANCE OFFSET PROTOCOL: OZONE DEPLETING SUBSTANCES PROJECTS, *supra* note 26, at 7 (recognizing sources of ozone depleting substances from any state or territory of the United States, not just California); CAL. ENVTL. PROT. AGENCY & CAL. AIR RES. BD. COMPLIANCE OFFSET PROTOCOL: URBAN FOREST PROJECTS, *supra* note 27, at 4 (recognizing projects within the entire United States, not just California).

47. *See CO₂ Offsets*, REG'L GREENHOUSE GAS INITIATIVE, http://www.rggi.org/market/offsets (last visited Apr. 20, 2012) ("All offset projects must be located within one of the RGGI states.").

Development Mechanism under the first commitment period of the Kyoto Protocol does not recognize offset credits generated from land use, land use changes, and forestry projects except for afforestation and reforestation projects.[48] Cap and trade programs also differ in the maximum amount of offsets that may be used to meet compliance obligations. For example, California allows for no more than 8% of a compliance obligation to be met by offsets and RGGI allows for no more than 3.3% to be met by offsets.[49] Listing all the ways in which offset programs differ is beyond the scope of this Comment, but the variations discussed above provide a few examples of the great extent to which offset programs may vary.

Offset programs are attractive to entities covered by the cap and trade program, governments implementing the cap and trade program, and even certain entities outside of the cap and trade program. Offset programs make cap and trade programs "more attractive and palatable" to covered entities, as offset programs provide more flexibility to determine the lowest-cost method of reducing greenhouse gas emissions.[50] As long as an offset project will be cheaper than internally reducing emissions, capped entities will likely seek out credit for emission reductions through offset programs. Offset programs are beneficial for governments implementing cap and trade programs because it shows that they are trying to work with industry to find lower cost means of reducing emissions to the mandated level. Additionally, now that offset programs are widely implemented, it would likely be more difficult to gain support for a cap and trade program that did not include offset programs. Offset programs are also beneficial for sectors that are target hosts for offset projects because offset projects are a source of

48. RAMSEUR, *supra* note 7, at 33-34; *see LULUCF – Developments at Past COP and SB Sessions: Marrakesh Accords and COP 7*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, *supra* note 7.

49. *CO_2 Offsets*, REG'L GREENHOUSE GAS INITIATIVE, *supra* note 47.

50. RAMSEUR, *supra* note 7, at 12-14; Raina Wagner, *Adapting Environmental Justice: In the Age of Climate Change, Environmental Justice Demands Combined Adaptation-Mitigation Response*, 2 ARIZ. ENVTL. L. & POL'Y 153, 166-67 (2011).

improvements and an income opportunity for the host.[51] Typically, the project host receives financial incentives or some sort of technology, facilities, or practice upgrade that they could not afford or would not have undertaken otherwise. Thus, the benefits of offset programs not only affect the capped entities, but also sectors that are otherwise unaffected by the cap and trade program.

IV.
AGRICULTURAL OPPORTUNITIES FOR OFFSET PROGRAMS

In the United States, the U.S. Environmental Protection Agency (EPA) estimates that agriculture accounts for 8% of the country's greenhouse gas emissions.[52] The EPA estimates that half of these agricultural emissions come from management practices of agricultural soils, including fertilizer application, irrigation, and tillage methods, and that livestock manure management accounts for 15% of the agricultural emissions.[53] The livestock digestion process accounts for about one third of the agricultural emissions and the remainder comes from smaller sources, such as rice cultivation and burning crop residues.[54] These estimates do not include carbon dioxide emissions from on-farm energy use.[55]

CARB's Scoping Plan estimates that the agricultural sector contributes to about 6% of the total greenhouse gas emissions in California.[56] CARB also includes estimates of emissions based on the end use rather than the actual source of emissions.[57] When calculated in this manner, 9% of California's greenhouse gas emissions can be attributed to agriculture and food processing

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51. Kenison & Scoll, *supra* note 41, at 67.

52. *See Agriculture Sector Emissions*, U.S. ENVTL. PROT. AGENCY, http://www.epa. gov/climatechange/ghgemissions/sources/agriculture.html (last updated Apr. 17, 2013).

53. *Id.*

54. *Id.*

55. U.S. ENVTL. PROT. AGENCY, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2011 6-1 (Apr. 12, 2013).

56. *See* CAL. AIR RES. BD., CLIMATE CHANGE SCOPING PLAN, *supra* note 3, at 11-13.

57. *Id.* at 13.

industries.[58]

In general, the agricultural sector provides at least two strong avenues for reducing greenhouse gases through offset programs: decreasing emissions from raising livestock and sequestering carbon in agricultural soil.[59] California has already incorporated an offset program that takes advantage of the opportunity to decrease livestock emissions by installing biogas control systems (BCS), which capture and destroy methane, on dairies and swine farms.[60] An offset program that takes advantage of the second opportunity to decrease carbon concentrations in the agricultural sector by sequestering carbon in agricultural soil has been used in conjunction with other cap and trade programs and may provide an opportunity for an expansion of California's offset programs in the future.

A. *Decreasing Livestock Emissions Through Manure Management*

Many livestock operations manage livestock waste by using anaerobic liquid-based systems in lagoons, ponds, tanks, or pits.[61] Manure that is stored in this fashion emits methane,[62] a powerful greenhouse gas that is estimated to have a radiative forcing power, or global warming potential, twenty-five times that of carbon dioxide.[63] Manure management accounts for 15%

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58. *Id.*

59. *See* JOHNSON, *supra* note 10, at 4.

60. CAL. AIR RES. BD., COMPLIANCE OFFSET PROTOCOL: LIVESTOCK PROJECTS, *supra* note 5, at 4.

61. *Id.* at 5.

62. *Id.*

63. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS 212 Table 2.14 (S. Solomon et al. eds., 2007). The impact of different greenhouse gases is another factor to keep in mind when assessing agriculture's contribution to total greenhouse gas emissions. Carbon dioxide is perhaps the most well-known and prevalent greenhouse gas. Thus, other greenhouse gases are frequently measured in millions of tons of carbon dioxide equivalent ($MMTCO_2E$). A carbon dioxide equivalent measurement indicates what amount of CO_2 emissions would create the "same time-integrated radiative forcing, over a given time horizon," as any given greenhouse gas, such as methane and nitrous oxide. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007:

of the agricultural greenhouse gas emissions in the United States, and CARB's most recent estimates indicate that manure management accounts for 1% of California's total greenhouse gas emissions.[64]

Even though manure management is not the largest source of agricultural emissions, California's cap and trade program includes the Livestock Projects Compliance Offset Protocol (Livestock Protocol), an offset program that issues offset credits in exchange for installing biogas control systems (BCS), a type of manure digester, on dairies and swine farms.[65] BCSs capture methane from the livestock operation's manure storage facility before it is released into the atmosphere.[66] The Livestock Protocol permits the captured methane to be destroyed on-site, transferred offsite, or used to power vehicles, but "the ultimate fate of the methane must be destruction."[67] The dairies and swine farms may then sell the offset credits that they produce through this offset program on AB 32's carbon market. Each offset credit is equal to one metric ton of carbon dioxide equivalent.[68]

The Livestock Protocol is considered a standards-based offset protocol, as it "creates additionality thresholds for particular categories of projects instead of determining additionality individually for each project."[69] CARB's standards-based

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SYNTHESIS REPORT 36 (R.K. Pachauri & A. Reisinger eds., 2007). Because methane has a greater effects per unit than carbon dioxide, eliminating one ton of methane will have a greater effect on decreasing $MMTCO_2E$ levels than eliminating one ton of carbon dioxide. Additionally, the Intergovernmental Panel on Climate Change has measured that the current atmospheric concentration of methane is greater than its natural range in the last 650,000 years and that this human-made increase is largely due to agriculture. *Id.* at 37.

64. *Agriculture Sector Emissions*, U.S. ENVTL. PROT. AGENCY, *supra* note 52; *Manure Management*, CAL. AIR RES. BD., http://www.arb.ca.gov/ag/manuremgmt/manuremgmt.htm (last updated Aug. 20, 2012) (California's most recent estimates are from 1990 and 2004).

65. CAL. AIR RES. BD., COMPLIANCE OFFSET PROTOCOL: LIVESTOCK PROJECTS, *supra* note 5, at 4.

66. *Id.* at 5.

67. *Id.*

68. *Compliance Offset Program*, CAL. AIR RES. BD., *supra* note 22.

69. Citizens Climate Lobby et al. v. Cal. Air Res. Bd., No. CGC-12-519554, slip op. at 3 (Cal. Super. Ct. Jan. 25, 2013).

approach for its current offset protocols came under attack in *Citizens Climate Lobby et al. v. California Air Resources Board.*[70] Citizens Climate Lobby argued that CARB's standards-based approach results in non-additionality by issuing offset credits for greenhouse gas reducing projects that would have been completed anyway, which impermissibly enlarges the scope of AB 32, and that CARB should have adopted a project-by-project approach instead in order to perfectly determine whether each offset project is indeed additional to business-as-usual.[71] In addition to determining that using a standards-based approach for offset protocols was within CARB's authority, the court in *Citizens Climate Lobby* determined "that the Livestock Protocol is reasonably necessary to effectuate the purpose of [AB 32] and [CARB] was neither arbitrary nor capricious in its promulgation."[72] The court made this determination by reviewing evidence presented by CARB that less than 1% of dairies and swine farms in the United States install BCSs to dispose of manure, installing BCSs is not a standard or common practice, and that the cost of installing a BCS is the primary barrier to installation.[73] Because farms were not installing BCSs despite other favorable conditions for installation, the court stated that it is not arbitrary for CARB to use installation as the standard to determine additionality.[74] Thus, CARB maintains a standards-based approach, rather than a project-by-project approach, for its Livestock Protocol. The court reached a similar decision regarding CARB's three other offset protocols.[75]

B. *Decreasing Cropland Emissions Through Agricultural Soil Carbon Sequestration*

Considering that California created an offset program to address manure management, a practice that is only responsible

70. No. CGC-12-519554 (Cal. Super. Ct. Jan. 25, 2013).

71. *Id.* at 21, 23.

72. *Id.* at 29.

73. *Id.* at 13, 27.

74. *Id.* at 27. The BCSs must be installed in compliance with all of CARB's applicable regulations.

75. *Id.* at 33.

for 15% of the United States' agricultural emissions and 1% of California's total emissions, it seems that there is even more incentive to incorporate an offset program for agricultural soil carbon sequestration. Agricultural soil management practices contribute to half of the United States' agricultural greenhouse gas emissions and agricultural soil acts as an effective sink for carbon. Thus, there is much opportunity to decrease agriculture sector emissions by creating an offset program that encourages practices that result in the sequestration of carbon in agricultural soil.

1. Agricultural Soil's Ability to Sequester Carbon

Agricultural soil carbon sequestration offset programs function like other offset programs, but the projects can include switching to conservation practices including no till, conservation tillage, planting cover crops, utilizing high-diversity crop rotation, and other agricultural practice changes in order to increase the amount of carbon sequestered in the agricultural soil and reduce the amount of emissions from farm machinery.[76] All of these practice changes increase carbon sequestration by differing amounts. The U.S. Environmental Protection Agency estimated that conservation tillage can sequester between .6 and 1.1 metric tons of carbon dioxide per acre per year.[77] The U.S. Department of Agriculture (USDA) estimated that planting cover crops and improving crop rotations and fallowing practices can sequester between .2 and .4 metric tons of carbon dioxide per acre per year.[78] One assessment of the effects of conservation practices on cropland in the Missouri River Basin estimated that the studied area sequesters 9.9 million tons of carbon dioxide per

76. *See* R. Lal, *Soil Carbon Sequestration to Mitigate Climate Change*, 123 GEODERMA 1, 10 (2004), *available at* https://sustainability.water.ca.gov/documents/18/3407623/Soil+carbon+sequestration+to+mitigate+climate+change.pdf; *Biosequestration*, CTR. FOR CLIMATE & ENERGY SOLUTIONS, http://www.c2es.org/technology/factsheet/Biosequestration (last visited Apr. 21, 2013).

77. *Biosequestration*, CTR. FOR CLIMATE & ENERGY SOLUTIONS, *supra* note 76, at tbl. 1.

78. *Id.*

year.[79] Estimates of the global potential of soil sequestration vary greatly, but one estimate says .9 (plus or minus .3) petagrams of carbon per year may be sequestered globally, which is enough to offset one-fourth to one-third of the annual global increase in carbon dioxide concentrations.[80]

Soil's sequestration properties occur naturally when organic compounds produced by plants cycle through plants, animals, and microorganisms to create soil organic matter, which is where carbon is stored in the soil.[81] Carbon is released from the soil into the atmosphere when it is disturbed due to changes in water, air, and temperature conditions.[82] Thus, reducing tillage increases the carbon sequestered in the soil, and the level of sequestration depends on many variables including soil type, weather, precipitation, temperature, and other factors.

Aside from decreasing atmospheric carbon levels, the practices that encourage carbon sequestration boast local benefits such as reducing soil erosion and nutrient depletion while increasing water retention rates.[83] A USDA project that ran from 2003-2006 assessed the effects of cropland conservation practices, including tillage management along with a host of other conservation practices that also sequester carbon, in the Missouri River Basin.[84] The assessment determined that conservation practices decreased loads delivered from cropland to rivers and streams by 76% for sediment, 54% for nitrogen, and 60% for phosphorous.[85] These dramatic reductions cannot all be attributed to changes in

79. U.S. DEP'T OF AGRIC., NATURAL RES. CONSERVATION SERV., ASSESSMENT OF THE EFFECT OF CONSERVATION PRACTICES ON CULTIVATED CROPLAND IN THE MISSOURI RIVER BASIN 66 (June 2012).

80. Lal, *supra* note 76, at 1, 15.

81. Alan Sundermeier et al., *Soil Carbon Sequestration – Fundamentals*, OHIO STATE UNIV., http://ohioline.osu.edu/aex-fact/pdf/0510.pdf (last visited Apr. 21, 2013).

82. *Id.*

83. *Project Information Document: Kenya Agricultural Carbon Project*, WORLDBANK 2 (Feb. 1, 2010), http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2010/02/18/000333038_20100218004238/Rendered/PDF/530880PID0appr10Box345597B01PUBLIC1.pdf.

84. U.S. DEP'T OF AGRIC., NATURAL RES. CONSERVATION SERV., *supra* note 79.

85. *Id.* at 154.

tillage management or other carbon sequestering practices, as those were only some of the measures among many diverse strategies for decreasing sediment and nutrient loss from agricultural soil. Additionally, the assessment noted that carbon that is sequestered in agricultural soil "improves the soil's ability to function with respect to nutrient cycling, improves water holding capacity, and reduces erodibility through enhanced soil aggregate stability."[86] So, in addition to sequestering carbon, the conservation practices that are typically implemented in agricultural soil carbon sequestration offset projects provide many important benefits incidental to sequestering carbon.

2. Existing and Proposed Agricultural Soil Carbon Sequestration Offset Programs

The EU ETS, the Kyoto Protocol, and RGGI, some of the most major carbon markets in the world, currently do not recognize offset credits that are generated from soil carbon sequestration projects.[87] This is most likely "because soil carbon is viewed as difficult to measure, verify, and track."[88] However, some smaller markets recognize this opportunity for carbon sequestration and income for farmers, so some offset programs that generate credits for agricultural soil carbon sequestration are already in existence. In 2010, the World Bank implemented the Kenya Agricultural Carbon Project, which encourages "covering crops, crop rotation, compost management, and agro-forestry."[89] This method of farming generates credits that are sold to the World Bank's BioCarbon Fund.[90] Additionally, in 2012, the World Bank

86. *Id.* at 65.

87. *See* Gregory R. Pautsch et al., *The Efficiency of Sequestering Carbon in Agricultural Soils*, 19:2 CONTEMP. ECON. POL'Y 123, 123 (2001), http://onlinelibrary.wiley.com/doi/10.1111/j.1465-7287.2001.tb00055.x/pdf; *Section 3: Emissions Trading/Offset Credits – A Market Based Instrument*, UNIV. OF SASKATCHEWAN, https://wiki.usask.ca/kis/index.php/Section_3:_Emissions_Trading/Offset_Credits_%E2%80%93_A_Market_Based_Instrument#What_can_be_learned.3F.

88. Horton, *supra* note 7.

89. Sundermeier et al., *supra* note 81.

90. *See* WORLDBANK, *supra* note 83, at 4; Media Advisory, World Bank, First African Emissions Reductions Purchase Agreement for Soil Carbon to be Signed in the Hague: Kenyan Farming Project Could be Model for the Region,

created a new farming methodology, approved by the Verified Carbon Standard,[91] that encourages less plowing.[92] Before the Chicago Climate Exchange's closure in 2010, it verified and traded soil carbon offset credits generated by farmers in the United States using no-till practices.[93] The Oklahoma Carbon Program currently operates a voluntary program that verifies and issues credits for farmers who use conservation tillage.[94] Canada's guidance for its future offset programs indicates that it would include an agricultural soil carbon sequestration offset program to address the intensity of tillage operations, adopting crop rotations, and increasing cover crops.[95]

If the American Clean Energy and Security Act of 2009, better known as the Waxman-Markey bill, had been approved by both houses of the United States Congress, it is likely that agricultural soil carbon sequestration offset programs would

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http://siteresources.worldbank.org/INTCARBONFINANCE/Resources/Media_advisory_Kenya_ERPA_Oct_29_2010bis.pdf (last visited Apr. 16, 2013). In addition to purchasing emissions reductions that are eligible under the Clean Development Mechanism (CDM), a Kyoto Protocol program under which offset credits are generated internationally, the World Bank also purchases emission reductions "from land-use sector projects outside the CDM[,]" including REDD projects and agricultural soil carbon sequestration projects. *See, e.g.*, Press Release, World Bank, First African Emission Reductions Purchase Agreement for Soil Carbon Signed in the Hague (Nov. 3, 2010), *available at* http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:22753334~pagePK:34370~piPK:34424~theSitePK:4607,00.html.

91. The Verified Carbon Standard is an independent group that verifies and issues carbon credits in voluntary markets. *See How It Works,* VERIFIED CARBON STANDARD, http://www.v-c-s.org/how-it-works (last visited Apr. 16, 2013).

92. *See* Press Release, World Bank, New Soil Carbon Methodology Approved (Jan. 30, 2012), http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:23100745~pagePK:64257043~piPK:437376~theSitePK:4607,00.html.

93. *See* Doreen Stabinsky, *Fiddling with Soil Carbon Markets While Africa Burns…!*, ACTIONAID 6 (Sept. 2011), *available at* https://seors.unfccc.int/seors/attachments/get_attachment?code=77BXBDREBRKXBOWQXNM3D3GEBNIPMWNQ.

94. *Carbon Sequestration Certification Program: Agricultural Offsets*, OKLA. CONSERVATION COMM'N, http://www.ok.gov/conservation/Agency_Divisions/Water_Quality_Division/WQ_Carbon_Sequestration/Carbon_Agricultural_Offsets.html (last modified Jan. 21, 2011).

95. *See* GOV'T OF CAN., TURNING THE CORNER: CANADA'S OFFSET SYSTEM FOR GREENHOUSE GASES (Mar. 2008).

have played a role through that legislation's proposed nationwide cap and trade program.[96] The agricultural industry was concerned that other industries' products used by agriculture—fertilizer, diesel, electricity, etc.—would increase in price if the proposed legislation passed, in turn affecting the agricultural sector's expenses.[97] The National Corn Growers Association (NCGA) devised nine principles relating to cap and trade that had to be met before it would support any climate legislation bill.[98] The first principle is that "[t]he agricultural sector must not be subject to an emissions cap."[99] The second principle asks cap and trade to "fully recognize the wide range of carbon mitigation or sequestration benefits that agriculture can provide."[100] The fourth principle expects the USDA to create the regulations and oversee an agricultural offset program.[101] The fifth principle provides that "[t]he use of domestic offsets" is not "artificially limited."[102] This principle is directly at odds with current caps on offset credits that can be used to meet compliance obligations as in RGGI and AB 32's cap and trade program. Additionally, the Illinois and Iowa Corn Growers Associations owned Novecta, a group that was working on standardizing a program to reward farmers for no-till practices.[103] Agricultural soil carbon sequestration offset programs were also proposed and discussed in relation to the Lieberman-Warner bill, the cap and trade climate change bill that was introduced in the 110th Congress, just before the Waxman-Markey bill was introduced in the 111th Congress.[104] Considering this significant support for agriculture offset

96. *See* JOHNSON, *supra* note 10, at 1; RAMSUER, *supra* note 7, at 26-30.

97. *See Why Should Farmers Care About Greenhouse Gas Regulations?*, NEB. CORN BD. (Nov. 2009), http://www.nebraskacorn.org/wp-content/uploads/2010/07/cornstalk_nov09.pdf.

98. *See id.* at 4.

99. *Id.*

100. *Id.*

101. *Id.*

102. *Id.*

103. *See* Tom Philpott, *Will Big Ag Plow Under Waxman-Markey?*, GRIST (June 11, 2009, 5:33AM), http://grist.org/politics/2009-06-10-big-ag-waxman-markey/.

104. *See* RAMSUER, *supra* note 7, at 26-30.

programs, it is likely that an agricultural soil carbon sequestration offset program could have been implemented on a nationwide scale if Waxman-Markey Bill had passed.

Overall, agricultural soil carbon sequestration offset programs prove to be attractive because the farmers implementing the change are paid to change their practices.[105] This can be a welcome source of income, especially at a time when farmers, especially small-scale and those most affected by droughts and the changing climate, are having a difficult time maintaining productivity and income.

3. A Future Agricultural Soil Carbon Sequestration Offset Program for California?

Considering all the factors discussed above, it seems that a future natural step may be to adopt an agricultural soil carbon sequestration program to link to AB 32's cap and trade program. The possibility has already been recognized in a bill that was proposed to the California State Assembly. The proposed bill stated that new offset programs will be needed in order to supply the highest number of useable offset credits allowed under AB 32.[106] An early version of the proposed bill listed possible offset programs, including offset programs that maintain agricultural productivity while emitting less greenhouse gases—the idea behind soil carbon sequestration offset programs.[107] This proposed bill did not pass, but CARB is in the process of constructing a webpage that will provide information on proposed offset programs, and the agency affirmatively notes that it will be considering additional offset programs as a part of future rulemaking activities.[108] Thus, an agricultural soil carbon sequestration offset program may not be far from being proposed and considered as a possible offset program under California's cap and trade program.

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105. *See* Kenison & Scoll, *supra* note 41, at 67; NEB. CORN BD., *supra* note 97.

106. *See* A.B. 2563, 2011-12 Reg. Sess. (Cal. 2012).

107. *Id.*

108. *See Compliance Offset Program*, CAL. AIR RES. BD., *supra* note 22.

V.
THE DIFFICULTIES WITH SOIL CARBON SEQUESTRATION OFFSET PROGRAMS

Despite the extensive benefits of agricultural soil carbon sequestration, discussed in Part IV.B.1., some of the common conservation practices as they are implemented face significant uncertainties and problems that should not be overlooked if an agricultural soil carbon sequestration offset program is considered by CARB or any other body that develops or approves offset programs. These problems include verifiable measurements, permanency, and incidental effects of no till or conservation till practices.[109]

A. *Difficulties in Quantifiability, Permanency, and Additionality*

Ensuring that emission reductions are quantifiable, permanent, and additional are important considerations for any type of offset program but are particularly difficult in relation to agricultural soil carbon sequestration offset programs. Quantifiability and permanency are especially central concerns about offset programs, and it has been suggested that agricultural soil carbon sequestration plays such a minimal role in major carbon markets because soil carbon is considered difficult to measure, verify, and track.[110]

Deciding how to allocate offset credits can be challenging in any carbon sequestration program because it is difficult to accurately quantify how much carbon has really been sequestered.[111] Soil carbon sequestration depends on a

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109. Agricultural soil carbon sequestration offset programs are difficult to implement for a host of additional reasons not discussed here, including administrative oversight and costs. This Comment does not address these issues, as its scope is limited to the indicated issues.

110. *See* Horton, *supra* note 7.

111. *See* Steve Suppan & Shefali Sharma, *Elusive Promise of the Kenya Agricultural Carbon Project*, INST. FOR AGRIC. & TRADE POLICY (Sept. 9, 2011), http://www.iatp.org/documents/elusive-promises-of-the-kenya-agricultural-carbon-project (noting that the problems with sequestration measurement caused a particular project to discount 60% of the carbon claimed to be sequestered to cover for a margin of error before a credit is verified).

complicated living system that is constantly changing and not easy to directly quantify. A variety of factors determine how much carbon a unit of soil can sequester, including seasonal variations, weather, precipitation, plant species present, and the variation in soil type and quality.[112] This problem does not arise in offset programs that decrease emissions from point sources, such as smokestacks or manure lagoons, where measurement is more concentrated and accurate methods of measurement are established and verifiable. For example, a manure lagoon equipped with a BCS can use a meter to determine methane emissions from the entire lagoon. Adding to the complication of quantifiability, some studies dispute whether conservation tillage practices actually sequester carbon at all.[113]

The goal of permanency is problematic in agricultural soil carbon sequestration programs because the carbon reduction is easily reversible.[114] When carbon is sequestered in soil, it can be re-released into the atmosphere from a disturbance such as increased intensity of tilling, wind or water erosion, or a natural disaster such as an earthquake, fire, or disease outbreak.[115] One agricultural soil carbon sequestration offset program incorporates a 60% discount into its program to account for the uncertainty of permanency.[116] Compare this to destroying a unit of methane with a BCS or reducing a unit of carbon emissions from a smokestack by installing new technology. When that methane or carbon unit is destroyed or never created, that reduction is not reversible because it never existed. Carbon captured in soil already exists and is merely captured rather

112. CTR. FOR CLIMATE & ENERGY SOLUTIONS, *supra* note 76.

113. *See* Baker et al., *Tillage and Soil Carbon Sequestration—What Do We Really Know?*, 118 AGRIC., ECOSYSTEMS & ENV'T 1, 1(2007). Multiple studies show the difficulties in determining whether conservation tillage actually sequesters carbon. *See, e.g.*, R. Alvarez, *A Review of Nitrogen Fertilizer and Conservation Tillage Effects on Soil Organic Carbon Storage*, 21 SOIL USE & MGMT. 38 (2005).

114. *See* OFFSET QUALITY INITIATIVE, ENSURING OFFSET QUALITY: INTEGRATING HIGH QUALITY GREENHOUSE GAS OFFSETS INTO NORTH AMERICAN CAP-AND-TRADE POLICY 19 (July 2008).

115. U.S. DEP'T OF AGRIC., NATURAL RES. CONSERVATION SERV., *supra* note 79, at 65; GOV'T OF CAN., *supra* note 95, at 21.

116. *See* Suppan & Sharma, *supra* note 111, at 3.

than permanently destroyed. Simple disturbances can cause the loss of some or all of the carbon that was stored in the soil and essentially negate any climate change benefit.[117]

Additionality is also at issue with agricultural soil carbon sequestration offset programs because cropland conservation practices such as no till and conservation tillage are already widely used in at least some parts of the United States due to incentives programs set up by the USDA starting in the 1960s and 1970s.[118] The USDA study on cropland conservation practices in the Missouri River Basin indicates that within the 95 million acres of cropland studied between 2003 and 2006, 46% of the cropland met no-till criteria and 97% of the cropland "had evidence of some kind of reduced tillage on at least one crop in rotation."[119] Considering that cropland conservation practices seem to be common in at least some parts of the country, it may be difficult to tell if any given offset project under an agricultural soil carbon sequestration offset program would have occurred anyway in a business-as-usual scenario for purposes of determining additionality.

B. *Increased Herbicide Use Replaces Tilling When Sequestering Carbon*

The checkpoints for offset programs—that the offset credits generated are quantifiable, real, permanent, and additional—do not explicitly include an analysis of the tradeoffs or incidental effects of an offset program. However, in agricultural soil carbon sequestration offset programs, the considerations of incidental effects caused by the offset program should be a critical checkpoint to consider. Some of the conservation practices that most effectively sequester carbon in agricultural soil can present tradeoffs that bring new problems for farmers that must be fixed through alternative means. Primarily, tilling decreases weed growth, so farmers who infrequently or never till typically use

117. GOV'T OF CAN., *supra* note 95, at 21.

118. U.S. DEP'T OF AGRIC., NATURAL RES. CONSERVATION SERV., *supra* note 79, at 27.

119. *Id. at* 31.

more herbicide to keep weeds out of their field.[120] Farmers using the other sequestration practices encouraged under soil carbon sequestration programs besides no-till and conservation tillage are also reported as using much larger quantities of herbicide. For example, the Kenya Agricultural Carbon Project does not address the use of herbicides, and the World Bank reported that herbicides are heavily used on farms that are involved with the project.[121] An environmental and social monitor for a soil carbon sequestration program reported that "the herbicides are applied . . . without due regard to environmental consequences."[122] At least one assessment reported contrary findings, that less herbicide was used when conservation practices were employed.[123] However, this assessment utilized many types of conservation practices including improved pesticide management practices, which could explain the decrease in herbicide use in this study.

Increased herbicide use can be detrimental for reasons including environmental harm, pollutant emissions, and human health. Herbicides can migrate into the surrounding environment through soil, air, and waterways.[124] The resulting chemical residues can negatively affect the natural surroundings, as any chemical might.[125] The effects would depend largely on the toxicity of the chemicals used in the herbicide, the quantity used and leached, and the sensitivity of the surrounding environment.

Additionally, harmful air pollutants, including greenhouse gases, are released when using herbicides.[126] Herbicides release

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120. *See No Till Agriculture: Good for the Soil and the Bottom Line*, CONSERVATION CURRENTS (N. Va. Soil & Water Conservation Dist., Fairfax Cnty., Va.) Sept. 2005, *available at* http://www.fairfaxcounty.gov/nvswcd/newsletter/notill.htm.

121. *See* Suppan & Sharma, *supra* note 111, at 4.

122. *See id.*

123. U.S. DEP'T OF AGRIC., NATURAL RES. CONSERVATION SERV., *supra* note 79, at 91.

124. *Id.* at 88.

125. *Id.*

126. *See* K.A. Smith and F. Conen, *Impacts of Land Management on Fluxes of Trace Greenhouse Gases*, 20 SOIL USE & MGMT 255, 260-61 (2004) (stating that it is naïve to promote carbon credits for no-till programs until we can more

a large amount of nitrous oxide, a powerful pollutant with an estimated 298 times the global warming potential of carbon dioxide.[127] This can be seen as similar to the problem of co-pollutants. Co-pollutants are pollutants that are released simultaneously and from the same source as the greenhouse gas or pollutant at issue. Increasing emissions of the pollutant at issue will often increase co-pollutant emissions, which can be more localized and harmful in smaller quantities. Similarly, increasing herbicide use will increase nitrous oxide emissions that would not have otherwise occurred if not for increased herbicide use. Thus, even if an agricultural soil carbon sequestration offset program is measured to be carbon neutral, it may unintentionally provide an avenue for increased nitrous oxide emissions and harm to the environment.

Another incidental effect of increased herbicide use is that more chemicals will be put onto our food products and affect human uses of soil, water, and air.[128] Herbicides have been linked to serious diseases, such as non-Hodgkin's lymphoma, soft-tissue sarcoma, and Parkinson's disease.[129] Due to these health risks, some countries have started to mandate that farmers reduce the amount of herbicide used on their crops due to the harmful human health effects of herbicides.[130] These

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accurately quantify the total greenhouse gas emissions).

127. *Id.* at 255.

128. *See* Josephy P. Yenish et al., *Cover Crops for Herbicide Replacement in No-Tillage Corn (Zea Mays)*, 10 WEED TECH. 815, 815 (1996) (noting that compatibility with sustainable agriculture goals is one benefit of switching to using cover crops instead of herbicides).

129. *See, e.g.*, Mikael Eriksson et al., *Pesticide Exposure as Risk Factor for Non-Hodgkin Lymphoma Including Histopatholgical Subgroup Analysis*, 123 INT'L J. CANCER 1657, 1657 (2008); Aaron Blair, *Herbicides and Non-Hodgkin's Lymphoma: New Evidence From a Study of Saskatchewan Farmers*, 82 J. NAT'L CANCER INST. 544, 544 (1990); Robin Marantz Henig, *Parkinson's: The Pesticide Link*, ONEARTH (May 28, 2009), http://www.onearth.org/article/parkinsons-the-pesticide-link?page=1; Andrew M. Seaman, *Pesticides Again Tied to Parkinson's Disease*, REUTERS (May 28, 2013 2:36 PM), http://www.reuters.com/article/2013/05/28/us-parkinsons-disease-idUSBRE94R0TL20130528.

130. *See, e.g.*, David Pimentel et al., *Effects of Reducing Pesticide Use*, 41 BIOSCIENCE 402, 402 (1991) (noting that Denmark, Sweden, and the Netherlands mandated a significant reduction in pesticide (including herbicide) use).

circumstances have led some to sharply oppose the increased use of herbicide.

VI.
REDUCING UNCERTAINTY AND HARM IN AGRICULTURAL SOIL CARBON SEQUESTRATION OFFSET PROGRAMS THROUGH AN ECOSYSTEM APPROACH

If CARB considers including an agricultural soil carbon sequestration offset program in AB 32's repertoire of offset programs, the issues of quantifiability, permanency, additionality, and incidental effects of the offset projects should be addressed. Implementing a new agricultural soil carbon sequestration offset protocol under AB 32 without considering and compensating for these issues would jeopardize the purpose of AB 32's cap and trade program and likely inflate AB 32's carbon market with credits that do not actually represent the additional sequestration of one ton of carbon dioxide or its equivalent.[131] These issues may be most completely and accurately addressed by using an ecosystem approach to design the offset program and to approve and implement the resulting offset projects in a case-by-case manner. An ecosystem management approach acknowledges the interconnectivity of the parts within an ecosystem and sees the environment as a single functioning landscape.[132] This approach recognizes that considering only a single species, pollutant, or practice can be detrimental when it successfully decreases one harm but incidentally increases another harm that may be just as, if not more, harmful to the ecosystem. Accordingly, any increase in herbicide use, and subsequent nitrous oxide emissions, or any other potentially harmful externality would be accounted for in the offset program. Under an ecosystem approach, offset programs would not favor projects or regulations that induce harms of a larger or more detrimental magnitude than the harm

131. This was the fear at play in *Citizens Climate Lobby*. Citizens Climate Lobby et al. v. Cal. Air Res. Bd., No. CGC-12-519554, slip op. at 6 (Cal. Super. Ct. Jan. 25, 2013)

132. *See* J.B. Ruhl & Robert L. Fischman, *Adaptive Management in the Courts*, 95 MINN. L. REV. 424, 428 (2010).

which is to be prevented by the program.

The need for an ecosystem approach, and the regulating agency's response to this need, is illustrated by the Endangered Species Act.[133] Certain species are listed and protected under the Endangered Species Act and a federal budget is allocated to preserving those listed species. However, many believe that the environment and society would be better served by protecting and managing ecosystems on a larger scale as opposed to individual species.[134] Recognizing this and similar needs in different areas under their jurisdiction, the U.S. Fish and Wildlife Service (FWS) published An Ecosystem Approach to Fish and Wildlife Conservation, which includes guidelines the FWS strives to use in order to incorporate the ecosystem approach into their conservation work.

The Pacific Islands Forum Fisheries Agency (FFA), a group formed to help its Pacific Island members to manage, control, and develop the fisheries within the Exclusive Economic Zones, encourages its countries to utilize an ecosystem approach to manage their fisheries.[135] The FFA's Ecosystem Approach to Fisheries Management (EAFM) consists of four steps.[136] The first step is to determine the scope of the assessment by clearly identifying what is to be managed.[137] The second step is to identify all the issues to be assessed within five key areas and to agree on the values that are to be achieved for each issue.[138] The third step is to determine which issues should be directly managed.[139] The last step is to determine acceptable

133. Endangered Species Act of 1973, 16 U.S.C. §§ 1531-1544 (2006) (amended 1978).

134. *See, e.g.*, Oliver A. Houck, *On the Law of Biodiversity and Ecosystem Management*, 81 MINN. L. REV. 869, 870-74 (1997).

135. *Ecosystem Approach to Fisheries Management*, PAC. ISLANDS FORUM FISHERIES AGENCY, https://www.ffa.int/ecosystem_approach (last visited Apr. 9, 2013); *Welcome to the Pacific Islands Forum Fisheries Agency*, PAC. ISLANDS FORUM FISHERIES AGENCY, https://www.ffa.int/about (last visited Apr. 9, 2013).

136. *Ecosystem Approach to Fisheries Management*, PAC. ISLANDS FORUM FISHERIES AGENCY, https://www.ffa.int/ecosystem_approach (last visited Apr. 9, 2013).

137. *Id.*

138. *Id.*

139. *Id.*

performance levels, what management arrangements will achieve these levels, and the review process for assessing performance.[140]

During the creation of the offset program, an ecosystem approach could be utilized to determine whether the program should be created at all. If no agricultural soil carbon sequestration offset project could ever in theory have a net benefit when considering all the greenhouse gas sources and sinks and other externalities created by an individual project, then the analysis under an ecosystem approach may indicate that the offset program should not be approved. If the analysis of the offset program under an ecosystem approach indicates that only certain types of projects could result in a net benefit to the environment, the program could be limited to those particular types of projects.

The ecosystem approach could also be used to assist in determining on a case-by-case basis whether an agricultural soil carbon sequestration offset project should be approved under the offset program. Because the variables associated with each agricultural soil carbon sequestration project will be different for each project and have the potential to vary greatly, a case-by-case ecosystem approach for the approval process for each project would help decisionmakers to properly determine whether the offset project is quantifiable, permanent, real, and additional.

Which externalities should be included in an ecosystem approach analysis of agricultural soil carbon sequestration projects would be a basis for much disagreement, and would depend on scientific and policy analysis beyond the scope of this Comment. However, at a minimum, the effects of increased herbicide use on the surrounding ecosystem and the increase of nitrous oxide emissions should be included in the analysis, as those are some of the more egregious oversights in certain existing agricultural soil carbon sequestration programs, as discussed in Part V.B.

In addition to legitimizing a future offset program and resulting offset projects in general, applying case-by-case and

140. *Id.*

ecosystem approaches have the potential to resolve specific issues regarding quantifiability, additionality, and incidental effects identified in Part V.

A. Quantifying Carbon Sequestered in Agricultural Soil

At least two main methods of quantifying agricultural soil carbon sequestration for the purposes of allocating credits for agricultural soil carbon sequestration offset projects could be envisioned. One is a simpler standards-based approach and the other follows a case-by-case process. Although a case-by-case approach may be impracticable in practice, this example illustrates why a case-by-case approach would be more appropriate and crucial for an agricultural soil carbon sequestration offset program.

The standards-based option is to give an offset credit per a certain acreage of land covered by an offset project.[141] That particular acreage of land would, on average, sequester one metric ton of carbon dioxide or carbon dioxide equivalent regardless of individual features of the land. This is a standards-based approach, similar to that used by CARB to determine additionality for its current offset protocols, because it sets a single, uniform threshold that must be met for an offset credit to be issued. As long as the average rate of sequestration was accurate, variability between different projects may not matter because the effects of carbon dioxide are largely not localized and so a reduction in one location is just as good as a reduction in another location. Therefore, it may be administratively favorable and just as environmentally effective to calculate the average acreage required to sequester one metric ton of carbon dioxide, then calculate the offset credits to be issued to each offset project based on the acreage being offered for the offset project.[142] Different averages could be calculated for different regions, as soil type varies greatly by region.

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141. Researchers made a similar proposition in the context of government subsidies for carbon sequestration. *See* Pautsch et al., *supra* note 87, at 125 (offering farmers an invariable per-acre payment).

142. A program like this should also be accompanied by a conservative estimate of offsets, to provide a better buffer for accuracy. *See id.*

However, this approach would prove misleading if only plots with lower-than-average sequestration ability engaged in the program. This may occur if soil with higher sequestration ability can also support higher value uses than offset credit generation. If this is the case, the actual soil sequestered under the program would fall below the program's projected average. This may be indeterminable until the value of the offset credits is established in a market, although prices within a market can always fluctuate and thus not provide the desired stability that alternative uses may provide. Many of these same problems exist in other types of offset projects which have been approved and are currently in use despite their potential accounting inconsistencies.[143] Additionally, by using this standards-based approach, it is very likely that some projects' carbon sequestration abilities would be lower than the offset program's average and would be issued more offset credits than would be issued if the projects' actual carbon sequestration had been measured. This will always be an issue with a standards-based approach, as seen in the *Citizens Climate Lobby* litigation.

Another option is to require a variable amount of acreage per offset credit under an offset project based on how much carbon that particular land is actually estimated to sequester, based on factors that affect a particular land's sequestration abilities.[144]

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143. Forestry projects in particular share many of these same concerns. Nevertheless, many forestry projects are credited and the first forestry project to receive offset credits under the CDM was recently approved. *See* Press Release, World Bank, Finding a Sustainable Balance Between Industry and Nature (Apr. 13, 2012), http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:23169373~pagePK:34370~piPK:34424~theSitePK:4607,00.html (noting that an industry group in Brazil received over four million temporary Certified Emission Reductions for establishing 11,600 hectares, or just over 26,600 acres, of sustainably managed tree plantations). Under the Kyoto Protocol, afforestation and reforestation projects, the only forestry projects available under the CDM, can issue credits only once during a commitment period. *Id.* The Kyoto Protocol's first commitment period ended on December 31, 2012, and other forestry projects are currently undergoing verification and will likely be issued credits. *Id.*

144. Because performing actual soil sampling is prohibitively expensive, a World Bank sequestration project uses a computer-based model to account for the various factors and produce an estimate of carbon sequestered. Suppan & Sharma, *supra* note 111. Researchers also proposed this method in the context of government subsidies for carbon sequestration. *See* Pautsch et al., *supra* note

This project-by-project option would theoretically give a more accurate estimate of the amount of carbon sequestered by each project, and would thus give managers a better idea of whether a project has actually offset a whole carbon credit. On the other hand, it would also take much more administrative resources and time to administer due to the variability of different land and the measurements required to calculate that variability, which could hinder the offset program's implementation.[145] Additionally, project-by-project approaches do not always ensure accuracy. The Kyoto Protocol's Clean Development Mechanism utilized a project-by-project approach to determine additionality, and the results were reportedly rife with error and under- or over-exaggeration when it was convenient.[146] Experience has shown that not even a project-by-project approach will result in perfect (or even near-perfect) results. However, measures can be taken to try to avoid some of the shortcomings of a project-by-project approach. For example, some have suggested replacing opportunities for subjective determinations by the project proponent or host in the project approval or crediting process with objective criteria.[147] This would decrease the opportunities for the project proponent or host to control the outcome of the project's approval process. Some of the measurements and logistical work could be contracted out to independent third parties at the project proponent's expense. This practice is used by certification programs, such as the Forest Stewardship Council and the Sustainable Forestry Initiative, in order to save the certification program the resources that would be required to perform the measurements and verifications themselves. Likewise, establishing similar requirements for an offset program would decrease the resources required from CARB and

87, at 125-26 (offering farmers a variable per-acre payment based on the land's ability to sequester carbon).

145. *See Harnessing Farms and Forests: Domestic Greenhouse Gas Offsets for a Federal Cap and Trade Policy FAQs*, CLIMATE CHANGE POL'Y PARTNERSHIP 5, http://www.nicholas.duke.edu/ccpp/convenientguide/PDFs/harnessingfaqs.pdf (last visited Apr. 7, 2013).

146. *See, e.g.*, Citizens Climate Lobby et al. v. Cal. Air Res. Bd., No. CGC-12-519554, slip op. at 8-10 (Jan. 25, 2013).

147. *See id.* at 11.

should be acceptable to the project host and proponent as long as the cost is not prohibitive.

B. *Additionality of the Offset Project*

Whereas a standards-based approach may make sense for determining an offset project's additionality for the Livestock Protocol due to the protocol's relative simplicity, its measurability, and the uncommon use of BCSs without financial incentives, these factors are not as clearly present for a potential agricultural soil carbon sequestration offset program. The amount of methane captured by a BCS digester and subsequently destroyed under the Livestock Protocol is measured by a site-specific meter and thus does not present the same difficulties and variables that exist when measuring soil carbon sequestration.[148] The court in *Citizens Climate Lobby* indicated that a standards-based approach to determine additionality made sense for the Livestock Protocol because the technology was so infrequently used without the financial incentives from the offset protocol.[149] This line of thinking may not so clearly comport to a possible agricultural soil carbon sequestration offset program due to the existing prevalence of cropland conservation practices.[150] To determine whether this is true of whatever region would be included in the offset protocol, CARB could commission an outside group to analyze current prevalence as they did when formulating the Livestock Protocol.[151] Even if it was discovered that these conservation practices were generally uncommon, as with BCSs, so that additionality could be satisfied by a standards-based approach, the complications associated with other issues may be so complex and variable that a case-by-case measurement process using an ecosystem approach may still be preferable to determine whether the project's emission reductions are

148. CAL. AIR RES. BD., COMPLIANCE OFFSET PROTOCOL: LIVESTOCK PROJECTS, *supra* note 5, at 12, 26.

149. Citizens Climate Lobby et al. v. Cal. Air Res. Bd., No. CGC-12-519554, slip op. at 13 (Jan. 25, 2013).

150. *See supra* Part IV.A.

151. *See id.*

legitimate and lacking in egregious incidental effects.

C. *Understanding and Decreasing Herbicide Use*

Increased herbicide use as an incidental effect to agricultural soil carbon sequestration offset projects is unique to this type of offset program, but may also be resolved if approached from an ecosystem approach on a case-by-case basis. First, it would need to be determined whether increased herbicide use is actually a threat for the type of land that is participating in the offset program. If so, the effects of herbicide on the local resources and the increased nitrous oxide emissions should be accounted in the project's approval process. Actively finding and implementing alternatives to herbicide use that make sense for the particular project host would alleviate the effects of increased herbicide use. One option is to replace increased herbicide use due to no-till and conservation till practices with cover crops in combination with other agricultural practices. At least one study claims that cover crops can greatly reduce the need for herbicide.[152] Unfortunately, it seems that it is difficult to naturally replace the benefits of herbicide, as higher crop yields are reported when using herbicide instead of cover crops.[153] Because cover crops and other agricultural practices do not seem to replicate herbicide, it would be unlikely to see a voluntary decrease in herbicide use. If herbicide use was prohibited or limited under a future offset program and no-till or conservation tillage was a major part of the program, it is likely that farmers would not be interested in participating in the program due to the difficulty or impossibility of balancing these two requirements.

A better alternative may be to consider implementing a pesticide management program within the agricultural soil carbon sequestration offset project. The pesticide management program would differ by project, as different projects would likely have different crops with different surrounding environments and site-specific needs. The pesticide management

152. *See* Yenish et al., *supra* note 128.

153. *See id.*

program utilized by the USDA in the Missouri River Basin study observed a decrease in herbicide use when cropland conservation practices were implemented. These practices included prevention, avoidance, monitoring, and suppression strategies to reduce pesticide use. Prevention includes measures such as using seeds and transplants that are free of pests, preventing weeds from reproducing, eliminating hosts for pests and disease organisms, and scheduling irrigation to prevent disease development.[154] Avoidance practices include crop rotation to avoid the pest or disease, planting seeds with genetic resistance to pests, choosing crops that will mature and be harvested before pests or disease develops, and not planting in certain parts of the field that are prone to crop failure from pests and disease.[155] Monitoring includes testing to determine crop rotation selection and when suppression activities are required.[156] Suppression includes cultivating and temperature management for weed control, traps and exclusion devices for pest control, biological control by disrupting mating, and more deliberate and informed use of pesticides as a last resort.[157]

VII.
WEAKNESSES WITH CASE-BY-CASE ANALYSES WITHIN THE ECOSYSTEM APPROACH

The implementation of an ecosystem approach would not be perfect. A well-functioning ecosystem approach to management requires research and consulting with experts from many different disciplines to construct the program and to evaluate each project on a case-by-case basis. This approach requires resources and time above and beyond what would be required for a standards-based approach, the approach currently favored by CARB in its offset protocols. Even once the experts are secured, scientists may remain too narrowly focused on their specific disciplines to do a full or fair assessment for purposes of an

154. U.S. DEP'T OF AGRIC., NATURAL RES. CONSERVATION SERV., *supra* note 79, at 42.

155. *Id.*

156. *Id.*

157. *Id.*

ecosystem approach.[158] An ecosystem approach will identify tradeoffs, which can create a whole separate discussion of priorities and values that may require an extended time frame for considering any program or project evaluated under the ecosystem approach. Additionally, the court in *Citizens Climate Lobby* identified problems with offset programs that utilize the project-by-project analyses implicated in an ecosystem approach. Aside from being considered expensive and slow, the case-by-case analysis utilized under the Kyoto Protocol's Clean Development Mechanism is often criticized for being inaccurate due to excessively narrow or broad framing of answers to questions that are supposed to determine whether a project is actually additional to a business-as-usual scenario.[159]

Despite these drawbacks, following an ecosystem approach when considering an agricultural carbon sequestration offset program and its subsequent projects would be more meaningful and accurate. It would force decisionmakers to discuss whether a proposed offset program or project would be causing more overall harm than would be caused without the offset program or project and what sort of tradeoffs would be made. Currently, harmful externalities of existing agricultural soil carbon sequestration offset programs seem to be ignored in at least some of the programs that implement the offset projects. For example, monitors for one soil carbon sequestration offset project noted that although herbicides are applied without considering the environmental consequences, "these activities are not part of the project under discussion."[160] An ecosystem approach would ensure that herbicide use and other possibly harmful externalities would be included in discussions concerning the costs and benefits of offset programs and projects. This is especially important for offset programs and projects, which are in theory neutral—trading one ton of carbon in one location for one ton of carbon or carbon equivalent in another location—and

158. Kristin Carden, *Bridging the Divide: The Role of Science in Species Conservation Law*, 30 HARV. ENVTL. L. REV. 165, 169 (2006).

159. Citizens Climate Lobby et al. v. Cal. Air Res. Bd., No. CGC-12-519554, slip op. at 8-10 (Cal. Super. Ct. Jan. 25, 2013).

160. *See* Suppan & Sharma, *supra* note 111.

helping to implement the environmental purpose of the carbon market. Certain offset programs would garner less support if it was clear that their overall effect on the environment was a net negative. Thus, the ecosystem approach can help decisionmakers understand and create an agricultural soil carbon sequestration offset program with acceptable tradeoffs and incidental effects.

VIII.
CONCLUSION

Agricultural soil carbon sequestration offset programs boast many benefits for the environment, offset producers, and capped entities, including decreased global carbon emissions, improved soil structure and water retention, payments to participating offset project hosts, and flexibility for entities covered under a cap and trade program. However, the types of projects that are adopted under agricultural soil carbon sequestration offset programs, especially no-till and conservation tillage practices, are especially ill-equipped for ensuring quantifiability, permanency, and additionality and can induce increased herbicide use. Increased herbicide use releases nitrous oxide, a greenhouse gas pollutant far more powerful than carbon dioxide, which is not accounted for in some current agricultural soil carbon sequestration offset programs. All of these issues may jeopardize the credibility and integrity of the offset program and the goals of the carbon market to which the offset program is linked.

An ecosystem approach, which would include project-by-project analyses for particular aspects of each offset project, would help CARB to consider all externalities of the possible agricultural soil carbon sequestration offset program, including nitrous oxide emissions from compensatory herbicide use, in order to determine whether such an offset program could create a net benefit to greenhouse gas emission reductions and the environment. If an agricultural soil carbon sequestration offset program is adopted, a case-by-case ecosystem approach should be used to quantify emissions and sinks from the projects, determine additionality, and implement site-specific pesticide management programs to decrease herbicide use. Despite the

weaknesses of project-by-project and ecosystem approaches, they are still preferable to the standards-based approach that is utilized in CARB's four existing offset protocols because of the nature of the uncertainties and unique harms involved in agricultural soil carbon sequestration.