January 14, 2017

Ms. Rajinder Sahota
Cap-and-Trade Program
California Air Resources Board
1001 I Street
Sacramento, CA 95814
Submitted via ARB comments webpage:
https://www.arb.ca.gov/lispub/comm2/bcsubform.php?listname=sp2030nwlmodeling-ws&comm_period=1

Re: Public Workshop on Carbon Sequestration Modeling Methods and Initial Results for the Natural & Working Lands Sector in the 2030 Target Scoping Plan

Dear Ms. Sahota:

Please accept the following feedback from Environmental Defense Fund (EDF) in response to the public solicitation for comments on the workshop held on December 14 to discuss the Carbon Sequestration Modeling Methods and Initial Results for the Natural & Working Lands Sector in the 2030 Target Scoping Plan (hereforward "Workshop").

EDF is committed to promoting science-based solutions for farmers, ranchers, and landowners to help the state address the impacts of climate change and bring greenhouse gas emissions to 40% below 1990 levels by 2030. EDF is dedicated to understanding the value and promoting the climate benefits that working lands provide. We appreciate the continued effort that ARB, CDFA, and CNRA have put into identifying how climate-smart agriculture can be a part of the climate solution.

We do, however, have several questions and concerns with both the modeling and initial results presented during the Workshop and the related Natural and Working Lands targets included in the latest version of the Scoping Plan.[1] We reiterate our comment from the December 16 submission that some of the promoted practices must be reviewed and potentially revised with an eye to geographic and crop specific dynamics that determine whether a practice is a net benefit or net emitter. Broadly applied practice-based recommendations for carbon sequestration and greenhouse gas mitigation are challenging when trying to address California's complex agroecosystems. EDF's team of scientists has thoroughly investigated the practices that can lead to

[1] See EDF's comments on the Target Scoping Plan, submitted on December 16: https://www.arb.ca.gov/lists/com-attach/156-sp2030disc-dec16-ws-VDEBYwNkV1tQNQNs.pdf

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mitigation and sequestration of greenhouse gases on Natural and Working Lands in California and across the United States. We have two main comments on the CALAND modeling method for the Scoping Plan:

I. Sharing of model data, calibration and validation, uncertainty analysis and sensitivity analysis

We recommend that the detailed list of data and references used to create the California natural and working lands carbon model (CALAND) be made public. Only when the supporting documentation for the model is made available can our team fully evaluate the model and its objective of informing the goal, target acreage and practice recommendations within the Scoping Plan for accounting for agricultural lands as a carbon sink (which was the objective expressed by CNRA during the Workshop). Clarification on the emissions scope and boundaries, whether soil organic carbon or related methane and nitrous oxide flux, should be explicitly identified for this model, since there can be a substantial impact on CH_4 and N_2O through the implementation of the management scenarios listed. In addition, information presented on the uncertainty in the model (slides 10-12) is incredibly valuable to understanding the modeling exercise and the potential impact on the presented results. However, there was limited documentation provided at the Workshop to understand the calculation of the uncertainty. Any and all supporting journal articles, references, and research for the model, abatement calculations, and uncertainty analyses should be shared with the public. This is common practice for natural and working lands carbon quantification methodologies.

II. Revisit the recommended practices

We recommend that the practices and management scenarios included in the model be reviewed with not only for immediate climate benefits, but should be evaluated for impacts over the residence time of carbon in the atmosphere – 100 years (slide 5, Workshop presentation). While there is mention of the model accounting for both sequestration and mitigation opportunities, both the presentation and the conversation during the Workshop focused only on the sequestration potential for natural and working lands as a carbon sink. As EDF mentioned in previous comments, we encourage a review of additional journal articles on the sequestration potential of the two practices highlighted for croplands in California- conservation tillage and cover crop use. Further comments on each of these practices is provided below.

<u>Sequestration- Conservation Tillage and Cover Crops</u>

It is clear that ARB is thoughtfully considering a variety of agricultural working lands practices that can help mitigate greenhouse gas emissions and/or sequester carbon and we strongly encourage additional research and investigation in this space. For all the practices recommended, the CALAND model should include references to the literature used to develop the estimates of sequestration from practices. Given the state of the science on soil carbon sequestration, recommendations for practices that sequester carbon and targets for state-level sequestration must address potential constraints, as outlined in Powlson et al, 2010.[2] The practices identified in this version of the CALAND model (conservation tillage and the use of cover crops) have shown to improve soil health and EDF supports and promotes the use of such practices and the implementation of the Healthy Soils Program for incentivizing these practices. However, varied results in the scientific literature indicate that these practices, implemented individually, may actually increase or decrease overall sequestration depending on soil type, geography, and additional interacting practices. Additionally, methods of implementation of these practices varies significantly in row and perennial crops. Therefore, it is not

[2] Powlson, Whitmore and Goulding, 2010. Soil carbon sequestration to mitigate climate change: a critical re-examination to identify the true and the false. European Journal of Soil Science, Feb 2011, 62, pp.42-55

appropriate to make broad statements regarding the sequestration potential of these practices without additional research. Even then, the practices should be specified by crop, geography, and soil type at a minimum.

Specifically for no-till, early suggestions that this practice could sequester soil carbon have been discredited; it appears that no-till redistributes carbon within the soil profile but does not sequester additional carbon.[3] In addition, it appears that the effects of no-till on nitrous oxide (N_2O) emissions are highly variable, are not clearly expressed unless no-till is maintained for more than 10 years, and in some cases no-till may actually increase N_2O emissions.[4,5]

For cover crops, a recent meta-analysis concludes that cover crops can sequester soil carbon, although the extent of carbon uptake is ultimately limited by SOC saturation.[6] However, increasing soil organic carbon can increase N_2O emissions, leading to uncertain net impacts in greenhouse gas emissions.[7] Another recent meta-analysis likewise concluded that the impact of cover crops on N_2O emissions was extremely variable, in some cases leading to a decrease but in other cases leading to an increase in N_2O emissions.[8]

The one practice where there is significant science to support carbon sequestration is the avoided conversion of rangelands to croplands or urban infrastructure. When grasslands are disturbed, such as when the land is tilled for crop cultivation, a significant portion of the stored carbon oxidizes and decays, releasing CO_2 into the atmosphere. This is carbon which has been stored in the soil over decades by natural cycles of growth and decay. By preserving intact grasslands or rangelands, ARB can maintain the carbon sequestered throughout the state. This is particularly important as rangeland ecosystems cover approximately half the land area of California.[9, 10]

In the next draft of the CALAND model, we recommend that ARB fully cite the literature sources used to justify the inclusion of these practices, along with information on the uncertainty associated with the projected sequestration benefits in order to provide agricultural proponents with a full picture of various working lands' sequestration capacity.

Mitigation

Given the complexity and uniqueness of California's diverse agricultural crops, sequestration and mitigation potential throughout the state will vary significantly and cannot be summarized by land type as is done

[3] Powlson, D.S., Stirling, C.M., Jat, M.L., Gerard, B.G., Palm, C.A., Sanchez, P.A. and Cassman, K.G., 2014. Limited potential of no-till agriculture for climate change mitigation. Nature Climate Change, 4(8), pp.678-683

[4] Kessel, C., Venterea, R., Six, J., Adviento-Borbe, M.A., Linquist, B. and Groenigen, K.J., 2013. Climate, duration, and N placement determine N2O emissions in reduced tillage systems: a meta-analysis. Global Change Biology, 19(1), pp.33-44

[5] Six, J., Ogle, S.M., Conant, R.T., Mosier, A.R. and Paustian, K., 2004. The potential to mitigate global warming with no-tillage management is only realized when practised in the long term. Global change biology, 10(2), pp.155-160.

[6] Poeplau, C. and Don, A., 2015. Carbon sequestration in agricultural soils via cultivation of cover crops–A meta-analysis. Agriculture, Ecosystems & Environment, 200, pp.33-41.

[7] Bos, J.F., ten Berge, H.F., Verhagen, J. and van Ittersum, M.K., 2016. Trade-offs in soil fertility management on arable farms. Agricultural Systems

[8] Basche, A.D., Miguez, F.E., Kaspar, T.C. and Castellano, M.J., 2014. Do cover crops increase or decrease nitrous oxide emissions? A meta-analysis. Journal of Soil and Water Conservation, 69(6), pp.471-482

[9] Brown, S., A. Dushku, T. Pearson, D. Shoch, J. Winsten, S. Sweet, J. Kadyszewski. 2004. Carbon supply from changes in management of forest, range, and agricultural lands of California. Winrock International, for the California Energy Commission, *PIER Energy-Related Environmental Research*. 500-04-068F. 144 p

[10] Havstad, K., D. Peters, B. Allen-Diaz, J. Bartolome, B. Besterlmeyer, D. Briske, J. Brown, M. W. Burnson, J. Herrick, L. Huntsinger. 2009. The Western United States Rangeland: A Major Resource. Grassland: quietness and strength for a new *American agriculture. American Society of Agronomy* 75-94

through this modeling exercise. Currently, efforts by EDF, the Almond Board of California, DNDC-ART and UC Davis through a Specialty Crop Block Grant can help inform the mitigation potential of various nitrogen management practices in almond orchards and potentially in other nut trees in different regions and on different soils in California. EDF will make the results of this work available to ARB and collaborating agencies.

There is a clear opportunity to use natural and working lands as a carbon sink once the research has been conducted. In the meantime, there is significant potential for emissions reductions in agriculture from greenhouse gas mitigation opportunities, as outlined in ARB research results, including research by UC Davis researchers Martin Burger, [11] Will Horwath, and Chris van Kessel and as summarized in the Nicholas Institute's report series *Greenhouse Gas Mitigation Opportunities.*[12]

The Management scenarios table (slide 5) and Table II-2. Land Management and Restoration Activities on page 64 of the Scoping Plan, include no mention of quantification of cropland management for mitigation, only sequestration. With over 300 specialty crops in the state, many of which require large amounts of nitrogen fertilizer, there is a need to focus on emissions from suboptimal nitrogen applications, as demonstrated through research from CDFA's FREP, UC Davis, the Almond Board of California and others.

In conclusion, we request that the next update to the CALAND model provide detailed, peer-reviewed literature to support the practices, mitigation and sequestration potential, and uncertainty analysis for the outcomes identified in the Scoping Plan. ARB should create a website with supporting documentation, citations and references for the model sequestration estimations. We are anxious to understand modeling improvements, so we can adequately assess its ability to inform the goal, target acreage and practice recommendations for agricultural land sequestration and mitigation potential within the Scoping Plan.

We thank ARB for the opportunity to provide comments. We look forward to continued collaboration with ARB and other stakeholders throughout the design and implementation of the Scoping Plan Update and the modeling to inform realistic, yet ambitious greenhouse gas mitigation and sequestration goals from natural and working lands in California.

Sincerely,

Robert Parkhurst
Director, Agriculture Greenhouse Gas Markets
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[11] Burger, Martin. "Evaluating Mitigation Options of Nitrous Oxide Emissions in California Cropping Systems." Seminar: Air Pollution Research Seminar Series. California Air Resources Board, 16 June 2016.

[12] Information Support for a Greenhouse Gas Reduction Strategy for California Agriculture. Duke Nicholas Institute for Environmental Policy Solutions, Feb. 2014. Web. 13 Jan. 2017. <https://nicholasinstitute.duke.edu/focal-areas/technical-working-group-agricultural-greenhouse-gases-t-agg/california-project>.