Public Workshop: 2022 Scoping Plan Update

Natural and Working Lands Scenarios Technical Workshop

Comment by the Sierra Club California Agriculture Committee

Rev misstatement pp 1,2, 6 and 7 to correctly state our advocacy for 30 percent of acres (not 30 percent increase) for organic. 1/6/22

Thank you for the informative December 2 workshop about the models and scenarios for scoping carbon sinks and flux on natural and working lands. Our focus is on the agriculture sector. We commend the efforts of CARB staff to find a framework for more ambitious, persistent, additional carbon sequestration on farms. We appreciate your openness to explain the constraints of the model. We understand models for agriculture lands are at a nascent stage of development and that we lack quality data-sets to be able to forecast what is experienced in the field and reflected in the literature. We will be continuing to study ways that CARB can assess and improve the model so that it is a useful tool to develop and evaluate effective policies and programs to meet the 2030 climate goals.

We appreciate the opportunity to share the following observations, questions, and suggestions about what can be achieved building on the DayCent model.

We have one overarching comment about the agriculture portion of your scenarios, and the urgency of assuring all scenarios/modeling differentiates between agriculture that is organic versus agriculture using primarily chemical inputs (see below for rationale and details). Our understanding of the current scenarios is that scenario one will optimize for near-term carbon, especially carbon in perennial crops; scenario 2 will optimize for restoration and climate (and drought) resilience; scenario three optimizes current programs for climate smart ag, plus nutrient cycling and biodiversity; scenario four includes moderate increases over BAU, including increasing organic. However, as we document in the comments and references below, scenario(s) that increase(s) organic acreage are ALSO highly likely to optimize for increased soil carbon, biodiversity, drought resilience, and nutrient cycling. Therefore, it is ESSENTIAL that the models are able to distinguish organic acreage in their analyses. We understood that the model(s) will incorporate that capability.

Furthermore, in the agriculture area we urge you to design the four scenarios by using a target goal that 30 percent of California farming be organic acreage (aligned with the recommendation of the PANNA/CPR joint comment), and also run at least one scenario (maybe scenario 4) with a stretch goal of 45 be in organic acreage. We also encourage you to run at least one scenario based on maximizing carbon sequestration potential of agricultural lands (and ideally other components of NWL) irrespective of current programs or any assumed limits.

As CARB with its partners develop the strategies to implement the scenarios, in parallel CARB with its partners can assess and improve metrics for biodiversity, for small-scale water cycling, and for nutrient cycling. Such metrics could then be used to track how well your scenarios AND the supported programs are accomplishing these goals, in addition to documenting carbon sequestration.

DETAILED TECHNICAL COMMENTS

Organic: Planning for an increase in organic farming is basic and necessary, but this goal must be in all scenarios. It is the closest to a ready-made metric for scaling acreage to meet the GHG goals. It is usually as important for climate resilience as for GHG mitigation. We agree with the joint letter by Pesticide Action Network-North America and Californians for Pesticide Reform that 30 percent of acres use organic farming by 2030 is a minimum goal.

This requires a definition that the acreage be either certified or registered as in transition to organic, or meet a minimum standard of what is generally agreed to constitute an organic farming system regardless of certification. This can be an iterative standard improved as data is collected. A target organic acreage goal would increase the likelihood of success in NWL carbon sequestration goals because organic is the current best proxy for increase in soil carbon sequestered. Furthermore, the absence of harmful pesticides in organic acreage will directly increase biodiversity of everything from soil microbiome to pollinators and birds in those acres, as well as providing co-benefits for environmental justice and farmworkers."

Water: It is refreshing that water is apparently included in the DayCent model so it seems very important to develop ways to gather data on the well-known on-farm measures to restore small water cycles that maximize photosynthetic potential of crops, such as swales, contours, and key-line plowing, sometimes called 'amplified contour ripping', that may reduce compaction, increase aeration of subsoil and thus maximize productive use of rainfall and facilitate deeper, more uniform irrigation of land.

We do not think it is going to be at all fruitful to try to model conversion of land away from agriculture land use as a result of SGMA. First, farmers are finding mitigations, the most obvious being to change to less water-needy crops, but also to rainwater harvesting, desalination, and recycled water. Most importantly, nobody knows the upper bounds of water constraint. We cannot know this because of the profound lack of investment in programs to restore small water cycles by key-line, swales and contour. Changing some grading aspect on a farm, how furrows or tree rows are laid out, or the type of ripper tool to penetrate the compaction layer can profoundly increase water-holding and infiltration (not to mention the water retention from biodiverse cropping systems).

The result of better water management on farms can be the accumulation in soil of 20,000 to 25,000 gallons per acre per one percent increase in soil organic matter. It is welcome news that the DayCent model tracks so many water parameters that will allow for the measurement of truly climate-smart water management practices, however, we must repeat that the upper bounds of water constraint are yet to be explored. There is far too much variability inspired by farmer ingenuity and learning and the outcomes of investments focused on keyline, swales and contour to be able to predict the impact of SGMA on the farms in a watershed.

Finally we do not want SGMA to dictate any scenarios about the future of farmland because, ***in a world of increasing population, becoming more efficient and sustainable is what we want, not fallowing of more farmland.***

Nutrient cycling: Planning for an increase in nutrient cycling is of the utmost importance, but this goal must also be in all scenarios. It is also usually as important for climate resilience as for GHG mitigation and should correlate well with carbon sequestration. In fact, SB 1383 mandates diversion of organics from landfills and the resulting nutrients need viable markets, so state policy does require nutrient cycling. [SECTION 1. (b) "It is the intent of the Legislature to support the adoption of policies that improve organics recycling."

A definition and metric for nutrient cycling in soil is possible and necessary to develop. Many biological input-based and higher functioning biodiversity-based farming systems are managed with attention to ratios of minerals in soil. A metric such as the Base Cation Saturation Ratio (BCSR), perhaps weighted for increase in calcium is used to ensure optimum soil aeration and the many benefits of that condition. Soil tests that document that replacement could be part of an approach to defining nutrient cycling for the purposes of the model. The BCSR method was developed by William Albrecht at Missouri University in the 1930s and was adopted as a standard measure by most soil laboratories. While it has since been discarded by many due to a focus on yields rather than food quality and nutrient density, BCSR is used for monitoring and managing some biological input-based farms in the Midwest and for some organic orchard and vineyard systems in California. BCSR should be looked at closely as an existing simple metric to include alone or modified in the model.

The work of Gregg Young, Certified Crop Advisor (CCA in Mendocino County) and author of Quality First in Vineyard and Orchard Systems is based on the Albrecht (BCSR) method. Other prominent agronomists who focus on soil health and mineral balance are Neal Kinsey and Amigo Cantisano (deceased) See: www.qfirst.net; Kinsey Agricultural Services. BCSR correlates with improved soil structure, biological activity, resistance to plant diseases, food quality, animal health and crop yield. The improved aeration provided by these conditions improves the nitrogen cycle and allows reductions in N use, further maintaining C levels.

Soil mineral status is thought to reciprocate with biological activity according to Elaine Ingham, soil scientist and founder of the Soil Foodweb School. Soil foodweb practitioners and CCAs like Gregg Young who follow the Albrecht method for soil fertility may be able to collaborate and explore the correlation of mineral and microbial data and propose a metric for a continuum for nutrient cycling that may closely correlate with carbon sequestration and nitrogen fixation. It is surprising to hear that nitrogen is apparently not included in CARB's proposed model since it is a major feature of the original DayCent model as described by a lead creator of the DayCent model Melannie Hartmann of Colorado State University in her online lecture 2 of 4 at 17:55.

In summary, a standard metric for nutrient cycling needs to be established and the data collected. We anticipate as a result of programs guided by these metrics that the highest performing soils will be those with a fertilization program whether organic or conventional to replace nutrients based on crop removal (which includes minerals incorporated into woody parts of trees and vines).

Full Life Cycle Analysis of Compost: A full carbon Life Cycle Analysis (LCA) is imperative for many external inputs on farms, but seems especially important for compost to reduce emissions associated with processing, transportation, and distribution of manure and compost. Such analyses should furthermore compare compost per se with ways that sludge is handled and with processing to dry high quality composts that can be reconstituted to slurries or extracts.

Methane: The DayCent model currently uses only the 100-year time interval for CH_4 (methane) GWP. Considering the short atmospheric life of methane, this modeling practice needlessly distorts the short term impact of these emissions and is misleading to policy-makers and the public who are properly focused on meeting 2030 targets. To be more transparent about the near-term impacts of methane it is necessary and quite simple to run the model also using the 10-, 20- and 50-year time intervals methane GWPs along with the default 100-year time interval methane GWP. At a minimum, CARB should use the 2013 IPCC AR5 values (now dated), which include methane GWPs with climate-carbon feedbacks factored in. The public must be able to see the difference between the 20-year and the 100-year time interval methane GWP.

Throughout the Scoping Plan, CARB should end the practice of continuing to use a single GWP-100 metric for all CH_4 emissions as if they were the same. Instead, CARB should develop a "multi-basket" or new metric approach (e.g., Combined-GTP or GWP*) which takes California's near-term 2030 policy goals into account, and also more accurately accounts for the physical differences between CH_4-fossil and CH_4-non-fossil (including NO_2) emissions, as outlined in IPCC AR6 WG I Section 7.6.1.4, Table 7.15, and Box 3, Physical considerations in emission-metric choice, p.1740/3949).

Article 6 of the Paris Rulebook states that corresponding adjustments are required along with double-entry bookkeeping to ensure transparency. The new Scoping Plan should make clear how this will be accomplished in California.

Biodiversity: Planning for an increase in biodiversity is fundamental to increasing carbon sequestration. Definitions are needed in this area. While it would be ideal to have a baseline measurement for biodiversity, absence of a baseline does not justify ignoring a key variable in the analysis. Given evolving data in this area, modeling of necessity will be iterative. It is possible to account for discontinuities by running comparisons of results with the "old model" and results with a new improved model.

It is unclear what is meant by conservation versus restoration in scenarios 1 and 2. Definitions vary and there is lack of unity of thought in the field about a baseline for either goal. We recommend looking at a farming system in a biotechnical continuum from chemical input-based (minimum biodiversity), to biological input-based (above average biodiversity), to biodiversity-based systems based on the scheme presented in the review paper by Therond, et al 2017. Optimal biodiversity-based systems need little or no outside fertilizer inputs to maximize photosynthetic potential of crops because of these features:

- nutrient cycling through soil biology at a high level of function–***truly "healthy" soils***,
- minimize use of fumigants, pesticides and fungicides because crops in biodiverse systems tend to be much more resistant to common pests and diseases,
- minimize the use of herbicides because weeds in such systems can be understood as soil indicators contributing to biodiversity and managed without toxics, and
- encourage infiltration and retention of water to maintain nutrient cycling during drought.

Biodiversity below ground increases with above-ground plant biodiversity of both crops and cover crops: We strongly advocate establishing a set of practices that recognizes multi-species cropping systems. A small reward is warranted for simultaneous growing of two species. A large reward should be offered for cropping systems of five or more plant species for both resilience and carbon sequestration benefits.

Increased soil biological functioning is better documented for multi-species cover crops. The USDA Conservation Stewardship Program – Practice E340106Z2: Use of multi-species cover crops to improve soil health and increase soil organic matter exemplifies that trend. To quality for this payment, "The crop rotation, to include the cover crop species, shall consist of the four crop types: Cool Season Grass (CSG), Cool Season Broadleaves (CSB), Warm Season Grasses (WSG), and Warm Season Broadleaves (WSB). The multi-species cover crop mix must include at least 4 different species, of those 4 species at least two of them must be from one or more of the crop types needed to fill in the missing crop types in the crop rotation. The cover crop mix will increase diversity of the crop rotation."

This more recent, advanced USDA Conservation Enhancement Activity allows NRCS consultants to approve a third higher payment to clients for cover crops that may provide substantial co-benefits. However, neither USDA nor CARB should stop there in recognizing the climate benefits of biodiversity, particularly when implemented in biodiversity-based farming systems.

There is enough data and an abundance of rapidly growing practitioner experience to support creation of a multispecies cover crop practice with minimum eight species rewarded by a substantially higher payment than for cover crops with less than four species. When seven or eight species in a cover crop or pasture are in proximity, microbial quorum sensing causes a community tipping point increasing the rate of all functions of nutrient cycling including carbon sequestration and the potential to accumulate humus. That increase in all functionalities continues with increasing numbers of plant species whose roots are working together with fungal networks in soil. See DeAngelis et al (2008) below, one of many references about quorum sensing in soil creating higher nutrient cycling functionality.

Biodiversity–Broad-Scale Indicators and Red Flags: Wildfarm Alliance has developed tools using rough metrics for rating organic farms according to their compliance with the organic law to conserve biodiversity on the farm. This approach should be central to the 30 X 30 conservation plan. See references below to Wildfarm Alliance resources for training farmers and organic certifiers to document and rank biodiversity on organic farms. This approach can easily be developed into a three to six-point ranking system.

Find a way to characterize farming systems on the ground: The Sierra Club and many other organizations are ready to assist the County Agriculture Commissions, Resource Conservation Districts, USDA Natural Resource Conservation Districts, and/or the Metropolitan Planning Organizations along with universities or colleges to characterize farming systems according to degrees of biodiversity. All applications for Healthy Soils Program funds must participate in building a database and continuum of biodiversity for their farm in relation to other farms.

Find a way to compensate retroactively sequestered carbon in order to spotlight the most knowledgeable and committed exemplary farmers in a region: We believe the fastest way to scale transition of whole farming communities is to showcase and appropriately reward early adopters and support organizers that bring farmers together in farmer-to-farmer learning. This model was developed by California Alliance with Family Farmers (CAFF) in the 1990's Lighthouse Farmer Network. We suggest that more be invested in such organizers skilled in facilitating learning among farmers.

In some areas the Cooperative Extension HSP workers may be successful field organizers, and in others the Resource Conservation Districts are good. The impression of those with experience with the Lighthouse Farmer groups run by CAFF in the 1990s is that they are a model that could be revived and further explored to achieve objectives for not just facilitation of community learning, but also to achieve on-the-ground characterization of farming systems in a geographic program area towards a metric to add to the model to account for the highly influential variable of attainment of transition to biodiversity-based farming systems. The first step for such an organizer is to identify local "lighthouse" farmers and create a platform for them to facilitate learning. The sociological dynamics of the lighthouse model is enhanced when payments are used to recognize real, valued achievements.

The technology to pay for retroactively sequestered carbon has been developed by the Nori marketplace. In Nori's explanation of the ways they remove carbon they explain that offsets and removals are considered "real" when such activities can be proven to have genuinely taken place". From page 7 of NORI's Methodology: "To produce estimates of the incremental SOC stock change that are attributable to changes in practices, Nori asks crop producers to submit substantial historical information describing past practices on the land, including but not limited to: crop rotations, crop seeding dates; liming, fertilizer and nutrient applications; irrigation practices and water use; crop yields and uses; crop residues left on their fields; residue management and removal techniques and tillage practices. Access to this land use history is important, because ***past practices can be as important in the determination of future changes in SOC stocks as the operator's new practice choices.***" [bold font by us]. Nori uses independent verification by a third party of the history of a carbon credit supplier's carbon removal practices making it possible for a supplier to be paid for carbon sequestered during the prior ten years. A recent University of Kentucky overview of carbon markets states that issues of "how and when the baseline is established so additional carbon sequestered is measured and compensated accurately, and how early adopters are incentivized to enter carbon market programs" still need to be resolved for carbon markets to flourish. The Growing Climate Solutions Act, if enacted, aims to address issues blocking growth of the carbon market. More discussions are expected in the marketplace about metrics for models and ground-truthing.

Independent funding stream is necessary for verification studies. Well-designed verification studies relevant to a scenario with possible use of reference labs are essential to ensure quality verification. Funding to farmers should not have to be diverted to get high quality measurements that can help continuously improve the entire program.

Scenario 1: An increase in organic as well as an increase in nutrient cycling must be part of scenarios 1, 2, and 4. We would like to see some reference to organic included in scenario 3, except it is our understanding that there has been no prior data gathering about whether HSP applicants are organic or not so it doesn't seem to fit in your scenario 3 as defined. We believe that at least 30 percent of acreage should be in organic by 2030 because it can be measured and is ready to scale to meet climate goals. Organic systems are correlated with resilience not just to weather but often to economic impacts. Furthermore, the National Organic Standard requires respect for social justice and public health as part of the legal standard.

Scenario 2: Capturing the full potential for carbon sequestration of natural systems in agricultural soils is so essential and time critical that all three scenarios should start by incorporating documented successful practices such as organic farming, nutrient cycling, and biodiversity. We acknowledge the need for improved metrics in these areas, but scenarios should start by at a minimum incorporating information on current status of well recognized strategies. In parallel, CARB and CDFA can undertake technical workshops for defining organic and nutrient cycling as metrics that can be incorporated into NWL scenario modeling in an iterative process. Otherwise results are likely to be negative or nil from a number of the "climate-smart" practices when they are done in a chemical input-based farming system.

We suggest that the three 'future changes in action' scenarios 1, 2, and 4 should compare all main variables including increase in organic and increase in nutrient cycling at different levels with one of those levels being 'the sky is the limit' for biodiversity/ nutrient cycling, and aim for the highest possible transition to organic as a constant in all three scenarios. Again, the 30 percent of acreage advocated by the PANNA/CPR coalition letter is a very good goal for 2030 that achieves all the benefits and co-benefits and you have agreed that there is a way to set a baseline and track it.

All three of these scenarios must be able to identify the underlying agriculture type/ biotechnical farming system (essentially organic vs chemical input based) so that CDFA and CARB can track and understand outcomes. For example, there may be unexpectedly high amounts of carbon oxidation (and loss as CO_2) on farms that do not effectively incorporate short-term carbon;

conversely, unexpectedly high amounts of carbon sequestration may occur with deep aggregation of humus that is resistant to oxidation for decades or centuries. There must be accountability for what is likely to have been an over-estimation of carbon sequestration in chemical input-based farming systems, i.e. biologically dead soil from fumigant and herbicide use regardless of whether it is covered with mulch and holding water better than soil not covered with mulch. And we want to have durable carbon sequestration, as well as to properly reward farmers who are shifting their whole systems to be effective long-term.

Scenario 3: We need much more ambition reflected in every scenario, and improvements in metrics and verification over what has been tried to date.

Scenario 4: Increase of organic acreage to 30 percent of California farm acreage should be the goal in all scenarios. This scenario could also include a goal of a goal of 45 percent organic acreage.

Scenario 5: Some attempt for a metric for nutrient cycling must be included and scenarios might be run at 15 percent and 30 percent increase over a baseline. The value of this metric in the model is so important that the development of the database, baseline and goals can be iterative over the first five years of program implementation.

We note that all of these NWL scenarios are "ground up" modeling–NOT "target driven" per the powerpoint. Given the urgency of the climate crisis, shouldn't one or more of the scenarios be a target driven maximal, i.e. "What could NWL do if we could max it out?" That is the way ALL the electricity sector scenarios are developed–i.e. ***start with a GHG target*** and then model different ways (and costs) of getting there.

Summary: The role of biodiversity is key to carbon sequestration and since biodiversity conservation is a mandate in the National Organic Standard, organic farming is also key to scaling carbon sequestration. The role of nutrient cycling among other factors is a further key to how above-ground biodiversity through plant selection is reflected in below-ground biodiversity and functionality. We provide three references below that explain these principles.

These principles indicate the need for a more comprehensive, perhaps even radical, make-over of the NWL scenarios, and specifically the Healthy Soils Programs to ensure that biodiversity is a measurable factor along with the more easily measurable metric of whether a farming system is "organic" or not. Above all we need more visionary thinking to collect and use data documenting the maximum potential for carbon sequestration on agricultural land. NWL modeling can serve as a valuable framework for programs to help farmers maximize carbon sequestration. At the same time, cost-effective carbon sequestration is a central challenge for California–and the world–to meet greenhouse gas goals. CARB's leadership in NWL could be transformative for the state, the nation, and even the world in setting and achieving climate goals.

Yours,
Jan Dietrick, MPH
Chair, Sierra Club California, Agriculture Committee

Selected references about agricultural biodiversity, organic cropping systems, and pesticide use reduction correlated with carbon sequestration

Cardinale, B.J., Wright, J.P., Cadotte, M.W., Carroll, I.T., Hector, A., Srivastava, D.S., Loreau, M., & Weis, J.J. (2007). Impacts of plant diversity on biomass production increase through time because of species complementarity. *PNAS*, 104(46), 18123–18128.

> Accelerating rates of species extinction have prompted a growing number of researchers to manipulate the richness of various groups of organisms and examine how this aspect of diversity impacts ecological processes that control the functioning of ecosystems. We summarize the results of 44 experiments that have manipulated the richness of plants to examine how plant diversity affects the production of biomass. We show that mixtures of species produce an average of 1.7 times more biomass than species monocultures and are more productive than the average monoculture in 79% of all experiments. However, in only 12% of all experiments do diverse polycultures achieve greater biomass than their single most productive species. Previously, a positive net effect of diversity that is no greater than the most productive species has been interpreted as evidence for selection effects, which occur when diversity maximizes the chance that highly productive species will be included in and ultimately dominate the biomass of polycultures. Contrary to this, we show that although productive species do indeed contribute to diversity effects, these contributions are equaled or exceeded by species complementarity, where biomass is augmented by biological processes that involve multiple species. Importantly, both the net effect of diversity and the probability of polycultures being more productive than their most productive species increases through time, because the magnitude of complementarity increases as experiments are run longer. Our results suggest that experiments to date have, if anything, underestimated the impacts of species extinction on the productivity of ecosystems.

Elhakeem, A., van der Werf, W., Ajal, J., Lucà, D., Claus, S., Vico, R. A., & Bastiaans, L. (2019). Cover crop mixtures result in a positive net biodiversity effect irrespective of seeding configuration. *Agriculture, Ecosystems & Environment*, *285*, 106627.

> Highlights
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> • Mixtures of cover crops produce more biomass and accumulate more N than pure stands.
> • Mixture composition and weather have interactive effects on yield and N uptake.
> • Mixture seeding pattern did not consistently affect mixture performance.
> • Use of seed mixtures reduces the risk of poor cover crop performance.

Reicosky, D. C., Calegari, A., dos Santos, D. R., & Tiecher, T. (2021). Cover Crop Mixes for Diversity, Carbon and Conservation Agriculture. In *Cover Crops and Sustainable Agriculture* (pp. 169-208). CRC Press.

> Carbon is a major player in the greenhouse effect and climate mitigation, in soil health and ecosystem services, and in our food security. The multiple synergistic benefits of cover crop mixes and C management are required for sustainable production. Our objectives in this chapter are to analyze cover crop management to optimise C input for all CA system ecosystem services, soil health, sustainable production, climate mitigation and our food security for future generations. Emphasis will be on plant biodiversity for optimum C management, nutrient cycling and protection, and utilisation and minimum soil disturbance that represent holistic and systems regeneration and thinking with a focus on climate mitigation and global food security.

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Gunstone, T, et. al. (May 2021) Pesticides and Soil Invertebrates: A Hazard Assessment. Front. Environ. Sci., https://www.frontiersin.org/articles/10.3389/fenvs.2021.643847/full

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USDA CONSERVATION ENHANCEMENT ACTIVITY E340106Z2 Use of multi-species cover crop to improve soil health and increase soil organic matter.

Wildfarm Alliance. Biodiversity Conservation: An Organic Farmer's and Certifier's Guide from Wild Farm Alliance (2016).

Wildfarm Alliance. How to Conserve Biodiversity on the Farm: Actions to Take on a Continuum from Simple to Complex (2021)

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Wolf, K., Herrera, I., Tomich, T. P., & Scow, K. (2017). Long-term agricultural experiments inform the development of climate-smart agricultural practices. *California Agriculture*, 71: 120-124.