



United States Department of Agriculture
Research, Education and Economics
Agricultural Research Service

State Water Resources Control Board
c/o Eric Gillman eric.gillman@waterboards.ca.gov.
Re: Written comments regarding Order No. R3-2021-0040

August 11, 2023

Dear State Water Resources Board,

Albert Einstein said “We cannot solve our problems with the same thinking we used when we created them.” This quote applies to efforts to solve the problem of nitrogen pollution of ground water in the Central Coast region of California. Based on my research experience working on climate-smart and organic agriculture in this region over the past 22 years, and my scientific knowledge, I think it’s accurate to say that the nitrogen problem was created by short-term thinking and leaky farming practices (i.e., decades of excessive nitrogen fertilizer use, and crop rotations with bare winter fallows and little cover cropping). Solving this ‘wicked problem’¹ will require adoption of far more efficient farming practices and a commitment to long-term, systems thinking. This new paradigm is what I referred to as ‘out of the produce box thinking’ in my article titled “Can we grow organic or conventional vegetables sustainably without cover crops?” (Brennan, 2017; see link to that article PDF and other cited references on the last page). Cover cropping is not a ‘silver bullet’, but non-legume cover crops are one of the most practical, time-tested, and efficient ways to significantly reduce nitrate leaching on fields that are normally bare fallow during the winter. **My comments** below are **focused on how to best incentivize cover cropping** and support the increasing interest in cover crops here. There is lots of room for improvement in this regard because remote sensing indicates that cover cropping in the Central Coast is extremely low ($\approx 5\%$ of the irrigated land; Symonds, 2021).

In my presentation on April 14, 2021 to the Central Coast Regional Water Quality Control Board (CCRWQB) at the adoption hearing of the General Waste Discharge Requirements for Discharges from Irrigated Lands Order No. R3-2021-0040 (Ag. Order 4.0), I advocated for higher cover crop nitrogen scavenging credits ($R_{scavenge}$) (Brennan, 2021). Thankfully, the **CCRWQB followed the science** and unanimously agreed to increase the cover crop nitrogen scavenging credits from a ‘one-size fits all’ low value, to a higher value that was based on nitrogen scavenging by cover crops that have a ratio of carbon to nitrogen of $\geq 20:1$ (this ratio reduces the risk of nitrogen leaching from cover crop residues). The decision by the CCRWQB to increase cover crop nitrogen scavenging credits in Ag Order 4.0 was a relief to farmers, and is supported by short-term studies in Salinas valley (Jackson et al. 1993, Wyland et al. 1996; Heirich et al. 2014), long-term systems research that I’ve led here (Brennan et al. 2012a, b, 2013, White et al. 2022), and meta-analyses (Tonitto et al., 2006; Thapa et al, 2018). These studies all illustrate the clear benefits of cover crops for reducing nitrate leaching. Since the adoption of Ag. Order 4.0, my colleagues and I were

¹ ‘Wicked problems generally lack clear solutions because each problem is linked to other problems, and the nature and characterization of each cannot be isolated (Rittel & Webber 1973)’ cited in Game et al. 2013.

tasked with collecting new data from on-farm and replicated trials at the USDA-ARS in Salinas to provide farmers with the tools needed to receive those cover crop nitrogen scavenging credits (Brennan, 2022a, b; Brennan and Smith, 2023). Based on grower feedback and the increased enthusiasm for cover cropping we have now expanded that work to include trials to determine the potential of fall incorporated cover crops to reduce nitrate leaching. This is exciting research that will add to our understanding of cover crop benefits.

The adoption of Ag. Order 4.0 is causing important improvements in nutrient management, but **I am concerned** about **some aspects** of the **remand of Ag. Order by the State Water Resources Control Board (SWRCB)**. Specifically, I believe that **concerns about cover crop nitrogen credits are not warranted and removing these credits will significantly delay and hamper the increased interest in cover crops that are critical to address the nitrate pollution problem** in the Central Coast region. I acknowledge that enforceable nitrogen discharge limits concern many in the agriculture industry, however, these discharge limits in Ag. Order 4.0 provide a rational, numeric framework for farmers to receive incentives for cover cropping and reduce nitrogen discharge. In other words, **I do not see how farmers would be able to receive fair and economically meaningful incentives for cover cropping without the use of nitrogen discharge limits**. These incentives are critical to increase cover crop adoption, and the science clearly shows that ground water protection will not be possible without increased cover cropping. I often think of nitrogen discharge limits as analogous to speed limits, or speed bumps for vehicles on our roads that improve public safety and increase the energy efficiency of our vehicles. Furthermore, I like to think of the cover crop nitrogen scavenging credits in Ag Order 4.0 as being somewhat similar to carpool lanes that are open to more efficient vehicles and incentivize more efficient practices (ride sharing). Nitrogen discharge limits and cover crop nitrogen scavenging credits in Ag Order 4.0 will slow and reduce the movement of nitrogen into the ground water by incentivizing farmers to adopt climate-smart practices (cover cropping) that recycle left-over nitrogen from one year to the next. Thus, cover crops will improve the nitrogen-use efficiency of production systems and will also improve soil health by adding carbon to the soil.

Having a metric – that incorporates information on applied nitrogen (A) and removed nitrogen (R) – that is easily understood by the agricultural industry and which accurately credits numeric incentives for best management practices like cover cropping, is critical to improving ground water quality. I greatly appreciate the value of the simple, robust A-R (A minus R) metric used by the CCRWQCB for calculating nitrogen discharge, rather than the difficult-to-understand A/R metric. While the Agricultural Expert Panel considered the A/R metric as ‘easy to understand’, and ‘as the simplest metric of good management’, I disagree. **Here’s an example to illustrate the problems with the A/R metric**. Consider two production systems: System 1 where the applied nitrogen (A) is 400 lbs per acre and System 2 where A is 40 lbs per acre. If the removed nitrogen (R) in System 1 is 200 lbs per acre versus System 2 with 20 lbs per acre, the A/R metric would be 2 for both systems (i.e., System 1: $400/200=2$; System 2: $40/20=2$). In other words both systems have the same A/R despite the fact that the magnitude of nitrogen discharge (A minus R) would be 10 times greater in System 1 (A-R = 200) than in System 2 (A-R=20). Thus, although both systems have the same A/R metric, they differ radically in the amounts of nitrogen discharge and in the risk of nitrate leaching. This illustrates why the A/R metric is confusing and can be a misleading way to access the risks of nitrogen discharge from contrasting systems.

In my opinion the CCRWQCB's development of Ag. Order 4.0 reflects long-term systems thinking and should be commended. Systems thinking recognizes complexity and the need for flexibility when solving problems, and does not support a 'one-size fits all' approach. Just as vehicle speed limits differ from residential neighborhoods to freeways, and from passenger cars to trucks towing trailers, the same thinking needs to occur with efforts to solve the nitrogen pollution problem in different parts of California and in different intensities of agricultural production. I acknowledge that achieving the lower nitrogen discharge limits in Ag Order 4.0 (i.e., ≤ 150 lbs per acre by 2036) will be more difficult than the higher targets and limits and may need to be reconsidered. However, I believe that the timeline for the targets and limits in Ag Order 4.0 is a good starting point.

In an ideal world, enforceable regulatory limits (i.e., driving speed limits, or nitrogen discharge limits) would not be needed to change practices, but, unfortunately in the real world such limits are often needed for the public good. Research with vehicle speed limits has shown that the social benefits greatly outweigh the social costs (Ang et al. 2020). I anticipate that the same will apply to nitrogen discharge limits that will help farmers reduce nitrogen discharge but also receive credits for best management practices like cover cropping.

In conclusion, **I whole heartedly support the inclusion of cover crop nitrogen scavenging credits ($R_{scavenge}$) in Ag. Order 4.0.** These credits are increasing interest and innovation around cover cropping in the Central Coast region, and removing these credits would be a major setback to groundwater protection here. A future Agricultural Expert Panel is not needed to validate the importance of cover cropping for reducing nitrate leaching. **The science on this issue is clear – non-legume winter cover crops can significantly reduce nitrate leaching by approximately 65 to 75% in the Central Coast region** (see reference below). This is why for decades I and other cover crop researchers have advocated for cover crops.

Thank you for considering my perspective. I recognize the challenges with solving the 'wicked' nitrate leaching problem in the Central Coast region, but I am confident that the innovative farmers here can handle this and continue to produce the nutritious food that we all rely on. My research program will continue to support on-going efforts by farmers on this issue to help facilitate the transition to more efficient and sustainable organic and conventional systems that will benefit current and future generations. Please feel free to reach out with any questions regarding my support for the cover crop nitrogen scavenging credits. If possible, I would appreciate the opportunity to provide 10 minutes of verbal comments on these issues before the SWRCB.

Sincerely,



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Cited References (Click links below to access PDF of the cited papers or presentations on YouTube).

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