Assessing Nitrate Leaching Hazard from Groundwater Recharge in Almonds

Project Leaders: William R. Horwath[1] and Helen Dahlke[2]
Dept. of Land, Air, and Water Resources, UC Davis, One Shields Ave., Davis, CA 95616
[1] (530) 754-6029; wrhorwath@ucdavis.edu
[2](530) 302-5358; hdahlke@ucdavis.edu

PROJECT SUMMARY

Objectives:

- Determine the risk of increased nitrate leaching into underlying aquifers due to artificial recharge in almond cropping systems on two contrasting soil suitability classes
- Using stable isotopic profiles of nitrogen and oxygen, as well as other biochemical indices, determine the amount of nitrate attenuation by denitrification in the deep vadose zone
- Create a water flow and solute transport model using TOUGH REACT to assess the risk of groundwater banking to exacerbate nitrate contamination of underlying aquifers. Incorporate potential of attenuation of nitrate in the deeper vadose zone via biochemical cycling. Use this model to examine differing management practices and their effect on nitrate transport to groundwater

Background and Discussion:

California has experienced a historically unprecedented four-year drought recently that produced extraordinary reductions of surface water allocations to farmers, especially in the San Joaquin Valley. In response farmers, out of necessity, increasingly turned to groundwater to offset surface water reductions and meet their irrigation needs. In addition to the baseline groundwater overdraft rate of 2 million acre feet per year since 1960, 2014/2015 saw an unprecedented increase in groundwater pumping in the amount of 11 million acre-feet[1].

Climate change forecasts predict increased precipitation variance with expected increases in flood frequency, as well as droughts[2]. Agriculture needs to capitalize on times of water excess in order to persist through times of drought.

Agricultural groundwater recharge presents an innovative climate change adaptation tool for farmers to secure a long-term water supply by recharging the underlying aquifer. However, of particular concern is the potential for groundwater recharge to exacerbate nitrate and salt contamination of already at-risk aquifers. Legacy nitrate below the rooting zone could be pushed further down and ultimately into aquifers used for drinking water wells. Our results suggest significant amounts of legacy nitrates beyond past fertilizer nitrogen application. Groundwater banking could compound the nitrate contamination in soils with leaching of nitrates and salts in surface soils affected by current management practices. If growers were to partake in future, potentially incentivized winter groundwater recharge programs it must be certain that they are in compliance with the water quality discharge requirements established by the Irrigated Lands Regulatory Program. Our project is addressing: 1) What is the nitrate leaching potential in soils used for almond cropping systems? 2) Can in situ biogeochemical processes attenuate nitrate in the deeper soil horizons? This project continues to address these concerns using deep soil coring techniques, stable nitrogen isotope analysis, and groundwater modeling to address potential concerns associated with recharging groundwater.

Project Cooperators and Personnel:
Hannah Waterhouse – PhD student, UC Davis

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[1] Hanak, Ellen and Jeffrey Mount. "Putting California's Latest Drought in Context." ARE Update 18(5):2-5. University of California Giannini Foundation of Agricultural Economics

[2] 'West-Wide Climate Risk Assessments: Bias-Corrected and Spatially Downscaled Surface Water Projections', Technical Memorandum No. 86- 68210-2011-01; Prepared by the U.S. Department of the Interior, Bureau of Reclamation, Technical Services Center: Denver, CO, 20

For More Details, Visit

- Poster location 36, Exhibit Hall A + B during the Almond Conference; or on the web (after January 2018) at Almonds.com/ResearchDatabase
- 2016 - 2017 Annual Reports (16-WATER7-Horwath-Dalhke) on the web at Almonds.com/ResearchDatabase
- Related Projects: 17-PREC7-Volder/Shackel; 17-WATER10-Nico; Poster 38 - Mountjoy