Updates to the Lifecycle Modeling of California Almond Production Systems: Enhanced Groundwater Modeling, Scenario Analysis, and New Indicators

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PROJECT SUMMARY

Objectives:

- Commercial orchards in California's Central Valley demand significant energy, chemical, and material inputs throughout their lifespan. In previous projects, we have characterized the life cycle energy, greenhouse gas (GHG) emissions, and criteria air pollutants of California almonds. Due to rapidly changing real-world conditions (e.g. for water, biomass uses, and feed markets), and due to advances in research, we are expanding our previous work by improving spatial modeling to better capture irrigation, water, and climate trends, and by updating our model to reflect current or new trends in practices, co-product value, and resource availability. To achieve this, we will:
  - o model California's surface and groundwater systems for agriculture from a life cycle perspective
  - o develop modeling components for alternative biomass scenarios, including spatially resolved information on biomass availability

Background and Discussion:

California almond growers in running their operations and formulating their business plans, have to take into account such factors as energy use, GHG emissions, and other forms of air pollution in both the short and long run. This project is designed to furnish growers, handlers, and others in the almond industry with a life cycle analysis (LCA) that will enable them to better understand the production processes and practices that contribute to GHG emissions, air pollution, and energy use.

Our LCA study was the first to examine California's surface and groundwater irrigation networks from a life cycle energy and GHG perspective, and accounts for the geospatial variability in California. Based on this research, irrigation is the single largest contributor to energy consumption in almond cultivation, and is second only to fertilizer in GHG emissions (which includes fertilizer production, application, and soil-related emissions). With this project, we are improving our surface water model, which previously included only pumping requirements of the major aqueducts and omitted district-level infrastructure, and improving the modeling of groundwater pumping. In addition, groundwater recharge potentials will also be modeled.

Our LCA model also demonstrated that orchard biomass fate and utilization has the highest potential for changing the life cycle impacts, particularly carbon intensity, of almond production. Recent changes in the bioenergy sector affect current and future uses of orchard biomass co-products, however predictive modeling of the quantity and location of biomass generation has not been done. This work addresses that gap, and analyzes other biomass management practices, such as whole orchard recycling, from an LCA perspective. Very preliminary results show that whole orchard recycling may have the potential to significantly reduce carbon intensity on scale equal to or greater than bioenergy uses.

Project Cooperators and Personnel: Dr. Elias Marvinney, Dept. of Civil and Environmental Engineering, UC Davis; Dr. Edward Spang, Dept. of Food Science and Technology, UC Davis; Dr. Sonja Brodt, Agricultural Sustainability Institute, UC Davis

For More Details, Visit

- Poster location 53, Exhibit Hall A + B during the Almond Conference; or on the web (after January 2018) at Almonds.com/ResearchDatabase
- 2016 - 2017 Annual Reports (13-AIR8-Kendall and 16-17-AIR8-Kendall-AIM) on the web at Almonds.com/ResearchDatabase
- Related Projects: 17-PREC3-Holtz; 16-WATER6-Shilling (Poster 60); Poster 38-Mountjoy