

# Managing for Climate Change in Agriculture: Farmer Adoption of Practices

Meredith T. Niles<sup>†</sup>, Mark Lubell<sup>†</sup>, V. Ryan Haden<sup>\*</sup>, Louise Jackson<sup>\*</sup>

<sup>†</sup> Department of Environmental Science and Policy, UC Davis

<sup>\*</sup> Department of Land, Air, and Water Resources, UC Davis

## Issue

Agriculture may experience significant impacts from climate change as water availability and temperatures change. Simultaneously, agriculture plays an important role in helping to reduce greenhouse gas (GHG) emissions that contribute to climate change. Agriculture can reduce GHGs through energy and electricity reductions, modified agricultural practices, and carbon sequestration associated with crop and grassland management. Farmers have a suite of practices that may assist them in adapting to these changes and supporting the sustainability of their farming enterprises. However, little is known about farmers' likelihood to change practices in the future and what may influence these decisions. This brief discusses several possible management practices that farmers in Yolo County, CA have already adopted and may adopt in the future for climate change mitigation and adaptation, which are explained in detail in Jackson et al. (2012). Here conservation practices refer to management that utilizes renewable resources with lower non-renewable inputs of fuel, water and/or synthetic nitrogen fertilizer. In general, drip irrigation, conservation tillage, and certified organic production fit these criteria, although exceptions exist.

## Key Findings

- Yolo County farmers have already implemented a number of conservation management practices compared to 1990.
- Overall, drip irrigation has increased nearly 17% since 1990 while conservation tillage and certified organic acreage have increased approximately 12% and 7% respectively.
- High-value specialty groups like grapes and orchards have implemented the largest amount of conservation practices, particularly drip irrigation.
- Nitrogen fertilizer applied per acre has not changed significantly since 1990.
- Farmers are most interested in adaptation practices related to irrigation and less likely to change cropping choices.
- For mitigation, farmers are more likely to adopt practices to reduce energy inputs or increase efficiency than practices with high upfront costs like methane digesters or increased organic acreage.

## Policy & Management Implications

California is currently in the process of implementing a cap and trade program to reduce GHG emissions to 1990 levels by 2020. As part of this process, farmers may be able to participate in carbon offset markets, which will pay farmers to implement practices to reduce GHG emissions. Understanding the types of practices that farmers are most likely to implement can directly assist policymakers in creating policies that are relevant to far-

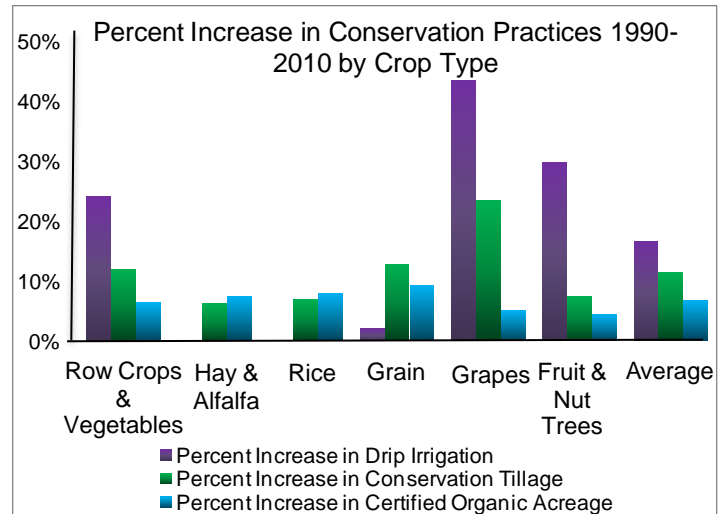


Figure 1. Adoption of Conservation Practices in Yolo County 1990-2010.

mers' interests. From a management perspective, understanding farmer perspectives can enable farmers, scientists, and industry to target new goals for research. Then, outreach and education strategies can be developed to support adaptive capacity through changes in management and markets.

## Methodology

Interviews with 11 farmers and 2 Cooperative Extension farm advisors in Yolo County, CA were conducted in late 2010 to understand farmers' climate change perspectives, management strategies, and potential for adopting new practices in the future. Interviews were used to help design a survey along with input from local agricultural organizations, farmers, and industry. A total of 572 surveys were sent to farmers in Yolo County in February 2011. In total 162 surveys were analyzed (34% response rate). Survey questions asked farmers about their farm characteristics, management strategies, existing practices, climate change perspectives, and likelihood to adopt mitigation and adaptation practices in the future.

## Detailed Results

Figure 1 details the adoption of conservation practices for different crops in Yolo County between 1990 and 2010. Overall, farmers have adopted drip irrigation the most followed by conservation tillage and certified organic agriculture. Grape growers have made the largest increase in drip irrigation and conservation tillage, while grain growers have increased certified organic acreage the most. It should be noted that tradeoffs often exist for mitigation and adaptation. For example, drip irrigation can reduce water use, but not recharge groundwater. Organic agriculture can build soil carbon; however, it may not reduce

overall GHG emissions. Finally, conservation tillage can reduce fuel use, but its ability to increase carbon sequestration is still debated, and it is not feasible for many irrigated crops.

Figure 2 shows that very slight changes in nitrogen fertilizer rates per acre have occurred since 1990 in Yolo County. Figure 3 highlights the overall likelihood of farmers to adopt specific adaptation and mitigation practices. Farmers indicated that they were most likely to adopt adaptation practices related to water including pumping more groundwater, adopting drip irrigation, and concentrating surface water on less acreage. For mitigation practices, farmers were most likely to reduce electricity usage, improve nitrogen use efficiency, and invest in fuel efficient farm equipment.

### Future Research Directions

This study examined the reported farmer adoption of conservation practices and intentions to adopt adaptation and mitigation practices in the future. Further analysis of this data will analyze how farmers' beliefs about climate change, individual characteristics, and operation attributes influence adoption decisions. Additional research in the future could continue to monitor the adoption of these practices to understand whether farmers' stated intentions result in their actual behaviors in the future. There is also a need to link social science and natural science to understand the ecological implications of implementing practices of interest. Finally, there is the need to expand

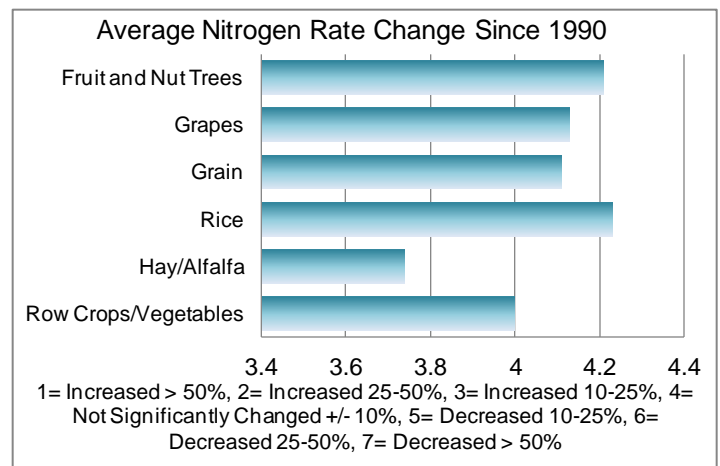


Figure 2. Change in nitrogen fertilization rate (lb/acre) 1990-2010.

studies such as this one to understand whether preferences in Yolo County are similar throughout the rest of California and other regions to best inform policy and research and development.

Citation: Jackson, L.E., V.R. Haden, A.D. Hollander, H. Lee, M. Lubell, V.K. Mehta, A.T. O'Geen, M. Niles, J. Perlman, D. Purkey, W. Salas, D. Sumner, M. Tomuta, M. Dempsey and S.M. Wheeler. Adaptation strategies for agricultural sustainability in Yolo County, California. In press, Report to the California Climate Change Center.

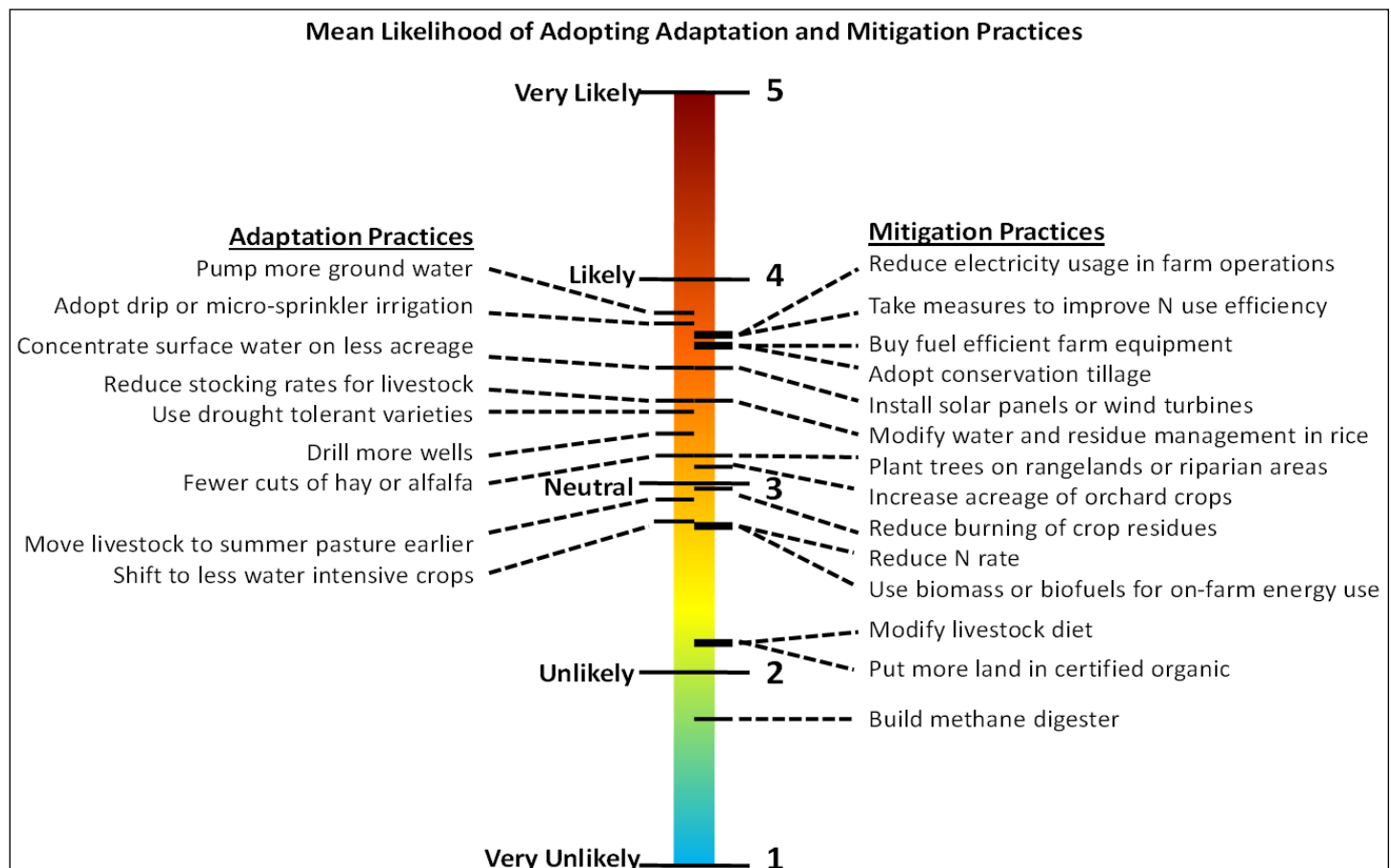


Figure 3. Average likelihood to adopt adaptation and mitigation practices among farmers in Yolo County, CA.