Cover Cropping in the SGMA ERA

A comprehensive overview of water impacts, policy implications, and recommendations for California's water managers

Executive Summary

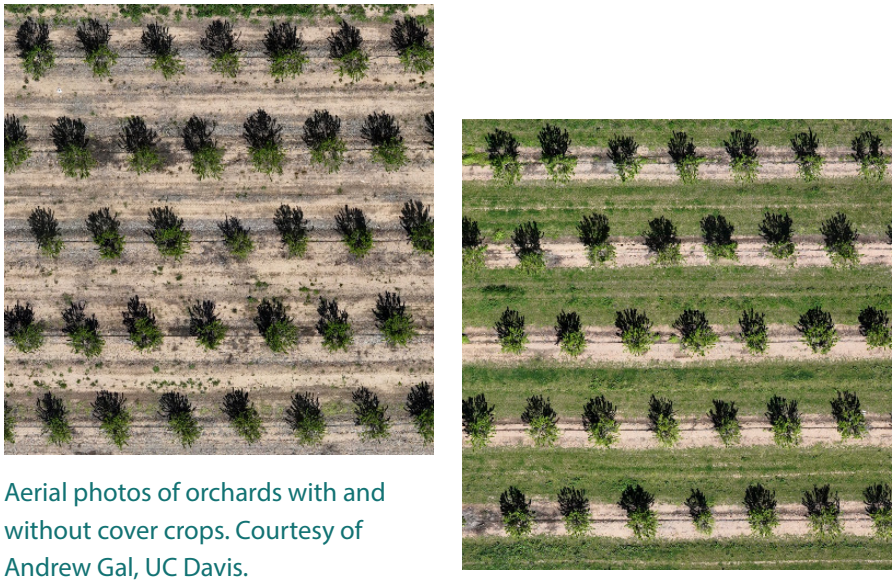
Background

Increasing variability in precipitation, coupled with the rapidly growing demand for irrigation water, is causing a sharp decline in aquifer levels, threatening agricultural productivity, reducing access to clean drinking water, and causing adverse environmental externalities. The Sustainable Groundwater Management Act (SGMA) was designed to address these declines, but the management actions of locally established Groundwater Sustainability Agencies (GSAs) may have unintended consequences for sustainable agricultural practices, such as the adoption of cover crops.

Cover crops are non-income generating crops that are used to protect and improve the soil between regular annual crop production or between rows of perennial tree/vine crops. The benefits of cover cropping include improved pollinator habitat, infiltration, water storage, carbon capture, and soil health, as well as decreased runoff and erosion – all vital factors in California's new "normal" agricultural context. These potential benefits are especially salient in the San Joaquin Valley (SJV), where SGMA implementation is the most restrictive.

To understand the potential of cover cropping under SGMA, a collaborative initiative including more than 100 multidisciplinary experts came together to answer the following questions: 1) what are the impacts of cover crops on water cycles (both benefits and use), 2) how does SGMA management account for cover cropping and is it effective, and 3) how can we ensure that this practice remains available to growers where and when it makes sense?

The full report ***Cover Cropping in the SGMA Era: A comprehensive overview of water impacts, policy implications, and recommendations for California's water managers*** synthesizes the learnings from that collaborative initiative as well as a policy analysis, interviews with GSA staff and consultants, and the expertise contributed by its 30+ authors. This 2024 Report Summary captures the key findings and recommendations of the full report.



Aerial photos of orchards with and without cover crops. Courtesy of Andrew Gal, UC Davis.

Findings: Cover Crops and Water in California

Examining the research literature about cover crops' impact on water-related processes, research in California and Mediterranean climates was prioritized. The key findings are that:

- Cover cropping can improve soil, water, health, and ecological outcomes.
- The water impacts of cover cropping are variable and they depend on many factors: climate, context, management and more.
- Cover crop evapotranspiration (ET) can be negligible compared to bare ground in perennial and annual systems – *wintertime, rain-fed cover cropping does not necessarily significantly increase water losses compared to bare ground in the winter months.*
- The most consistent water-related benefits of cover cropping demonstrated in the *California-based* research literature are increased infiltration of water into the soil (often ≥40%) and the reduction of runoff (often ≥40%).

Findings: GSA Management and Cover Cropping

In order to understand the impacts of GSA management on cover cropping, an analysis of plans, rules and regulations, and methodologies was necessary. Investigating 9 GSAs in the SJV, where plans were most fully developed and include allocation plans, the following were uncovered:

- GSAs are responsible for managing a large workload and considerable complexity. Minimal guidance in a policy based on local control is resulting in varying approaches and degrees of rigor in consequential water management processes.
- Cover crops may be unintentionally disincentivized because GSA approaches tend to account for cover crops' water use but not their water related benefits.
- Some common assumptions in GSA approaches are not reflective of the best

available science and preclude the ability to account for the benefits of certain land management decisions. These are that:
    - Evaporation from bare ground is negligible.
    - Runoff is negligible.
    - The percentage of precipitation that percolates into groundwater is fixed.
- Requirements for bare ground exist in some GSA incentive programs. These requirements are unlikely to meet estimated water savings and are likely to create negative local impacts to air quality, water quality, and human health.
- Some GSA methodologies for incorporating precipitation are likely to result in unintended consequences for cover crop implementation, basin water management, and water use decisions.
- Relative to what is known about the margins of error of satellite ET estimates for common crops, little is known for winter cover crops. In particular, it is not well documented how factors such as increased cloud cover and bare ground could impact the accuracy of ET estimates for cover cropped parcels compared to non-cover cropped parcels.
- GSA methodologies for converting satellite ET data (total consumptive use) or flowmeter data (applied water) into consumptive use of groundwater (CUgw) estimates are variable and not always rigorous.
- An "illusion of precision" may lead GSAs to be less open to enabling multi-benefit practices.
- Current GSA approaches could negatively impact the success of other policies, programs, and efforts in California.

Recommendations

To support SGMA implementation and create a sustainable water future for California, we have created a list of recommendations to address the findings in our analysis. Fundamental to these recommendations is the need to ensure effective adaptive management.

Research: Develop and implement a coordinated effort to increase understanding of net water impacts of cover crops.

- Support, document, and analyze grower experiences implementing cover crops, collecting both quantitative and qualitative data and incentivizing this collection.
- Develop, fund, and implement a coordinated research program that addresses the most important gaps in knowledge.

Cover Crop-Specific Needs: Address cover crop-specific gaps to enable effective integration of cover crops into GSA plans, allocation approaches, and incentive programs.

- Develop and distribute guidance on the characteristics of water-efficient cover cropping, for growers and GSAs who want to implement cover crop-specific programs.

- Develop a spatial dataset of cover crop adoption and update annually.
- Investigate current approaches to "natural lands" within GSAs and identify strategies that may be applicable to the practice of wintertime cover cropping.

GSA Guidance: Provide guidance and support to GSAs on consequential elements of allocations and consumptive use.

- Develop and distribute guidance documents on best practices and methodologies for converting satellite ET and flow meter data into estimates of consumptive use of groundwater.
- Develop and distribute guidance documents on best practices and methodologies for incorporating precipitation into groundwater allocations and consumptive use assessments.
- Provide guidance and technical assistance to GSAs in commonly lacking areas of expertise relevant to ensuring sustainable groundwater management, such as atmospheric science, ecology, and soil science.
- Develop and distribute guidance documents on calculating and incorporating estimates of the margin of error more explicitly into management in ways that increase knowledge about its magnitude and enable the implementation of multibenefit practices.

Data: Improve the quantity, spatial distribution, quality, and use of data necessary to develop approaches and to assess performance.

- Evaluate and invest in the most cost-effective ways to improve distribution and quality of key ET data inputs (e.g., supporting CIMIS, a new Eddy Covariance tower network).
- Identify and spotlight available high-resolution datasets central to GSA management.

Funding: Provide short-term and long-term funding to ensure successful and high-quality implementation of allocation approaches and consumptive use estimates.

- Provide shorter-term funding to support new, one-off initiatives such as the development of guidance documents or research agendas.
- Provide longer-term funding to support ongoing needs such as technical support for GSAs, and the provision of key ET data inputs.
- Identify solutions to ensure GSAs can raise the funding needed to meet the mandates of SGMA.

VISION

To clarify the desired impact of our recommendations and their necessity, a detailed comparison of the current and ideal future states of GSAs and their approaches are included in the table below. The recommendations above aim to support this vision.

		CURRENT STATE *Based on analyzed GSAs*	**FUTURE STATE** *Vision for Effective Management*
OVERARCHING	***Cover Crop Penalties & Incentives***	Within their management approaches, GSAs do not directly penalize cover crops (e.g. with a fine) nor do they incentivize them. However, most current approaches are likely to indirectly disincentivize cover crop use through assumptions and approaches that capture water use but not water benefits.	GSA management systems more accurately account for cover crop water use, their water benefits, and (because they now effectively incorporate precipitation, runoff and infiltration), have the operating space to incentivize this multi-benefit practice if they so choose.
	GSA Guidance and Expertise	GSAs and their consultants have received limited guidance and may lack multi-disciplinary expertise to support the development of the many complex processes necessary to meet their mandates. This has contributed to a wide range not only in approaches, but in the rigor and effectiveness of these approaches.	"Local control" with high-quality outcomes across the state is enabled by the availability of (1) guidance documents for vital processes – including allocations and consumptive use estimates, and (2) multi-disciplinary technical experts who can assist GSAs and their consultants in refining their approaches and methodologies.
	Managing to Margins of Error	GSAs must make many assumptions about complex subbasin-wide processes. They do not publish margins of error resulting from these assumptions nor discuss implications or approaches for operating within it.	GSAs incorporate estimates of the margin of error more explicitly into management, ideally in ways that allow for increasing knowledge about its magnitude and create the space for the implementation of multi-benefit practices.
SPECIFIC	***Fallowing Credit***	Bare ground is sometimes a requirement to receive water credits, increasing the likelihood of negative air, soil, and water quality impacts alongside uncertain water quantity benefits	There are no bare ground requirements. Water-efficient cover cropping is allowed, and incentivized when appropriate, resulting in multiple co-benefits and positive or *de minimis* negative impacts to water budget.
	Infiltration and Runoff	Broad assumptions about infiltration and runoff are common and often don't account for localized factors that can influence the magnitude of impacts, especially in extreme weather years.	GSA assumptions and approaches incorporate a more robust accounting for infiltration and runoff, including methods – such as effective precipitation – that allow for adjustments based on localized factors.
	Precipitation	Precipitation is a central component of allocation and consumptive use schemes and is incorporated inconsistently. Among these approaches, some use assumptions which are especially ill-suited to California's future precipitation regimes.	GSAs have incorporated precipitation in ways that accurately account for the variability over time, while ensuring that growers can plan ahead and are not unfairly penalized in precipitation years that fall well outside of the "average."
	Consumptive Use Methodologies	GSA methodologies for converting satellite ET (e.g. total consumptive use) data or flowmeter (e.g. total water applied) data into consumptive use of groundwater (CUgw) estimates are hard to obtain, variable, and not always rigorous.	GSA methodologies for converting satellite ET data and/or flowmeter data into CUgw estimates is easily accessible, robust, and based on best available science.
	Cover Crop Definitions	There are no clear parameters to define what constitutes water-efficient cover cropping, increasing the perceived risk of developing cover crop-specific approaches or incentives.	Parameters for "water-efficient" cover cropping – including species and management practices – are available and based on best available science. GSAs provide clear parameters that fit their specific context (cropping, climatic, etc.) in any cover crop-specific approaches.

Conclusion

The practice of cover cropping has many benefits that are vital to California's sustainable agricultural future. Cover cropping can improve infiltration and water cycling, increase biodiversity and soil health, and protect air and water quality for local communities, among others. Current patterns in the implementation of SGMA may create unintended barriers to realizing those benefits. However, GSAs are receptive to new data and guidance, and adaptive management is an essential part of SGMA. The report recommendations focus on providing the information and support needed to reduce SGMA-related barriers to the implementation of cover crops. Implementing these recommendations will help enable this management practice to be utilized to its true potential: as one of many tools in a toolkit supporting the health and sustainability of California's agriculture, environment, and communities in a rapidly changing future.

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This 2024 summary document and the full report are the products of a convening process (2022-2023) and both reflect the research, conclusions, and recommendations jointly developed by the Report Author Committee and do not constitute an endorsement by collaborative agencies and organizations. Report Authors participated in the development and drafting of the report's sections based upon their expertise. USDA - NRCS and ARS employees contributed authorship solely to technical aspects of this report and did not contribute to non-technical recommendations. Please see the full report for authorship information. *The full report can be found by scanning the following QR code.*