Water Stewardship

Ensuring a Secure Future for California Agriculture

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GARY KRAMER/NRCS

THE VIABILITY OF AGRICULTURE in California is threatened by insecure water supplies – a result of dwindling supply, distribution challenges, and amplified competition among users. In an era of serious and far-reaching environmental, social, and economic issues affecting agriculture and the broader society, win-win solutions that bring multiple benefits must be sought. Agricultural water stewardship is one under-explored arena with the potential for making valuable contributions. Agricultural water stewardship – the careful and responsible management and use of available water resources – can help insulate farmers against future uncertainty in water supply, bolster food security, enhance environmental quality, and contribute to overall appropriate water management in California.

Introduction

AGRICULTURE is a fundamental human activity that serves the public good by providing food, nourishment, and an economic driver for rural areas. Done sustainably, it can also offer environmental benefits such as protecting open space, sequestering carbon, and creating wildlife habitat. Agriculture also has associated costs in terms of inputs, one of which — water use — is the focus of this paper. Agriculture represents the largest human use of water in California, making it a natural focus in times of water scarcity.

The pressures coming to bear on water use in agriculture are intensifying. The cost of both water and the energy needed to deliver it are rising, while water quantity and quality are decreasing. No long-term solutions to chronic aquifer overdraft are forthcoming. Urban development continues to demand more agricultural water transfers and the legal system is increasingly allocating scarce water resources to the environment from agricultural uses. Both sometimes lead to idling or retiring farmland.

It is in the long-term interests of agriculture to be proactive in advocating for policies and projects that benefit farmers and meet the needs of both the urban and environmental sectors. A risk management approach is needed for individual farmers, and the sector as a whole will be better off if it demonstrates leadership in proposing innovative solutions before being forced, through regulations or the courts, to make changes.

Recently, a group of organizations focused on the intersection of agriculture and the environment has been meeting to explore pro-farming solutions to California's water challenges. We have also solicited input from more than thirty experts in water policies and programs representing state government agencies, agriculture organizations, water advocacy groups, producers, and technical experts. The diverse perspectives that informed this document are grounded in practical farming experience and a thorough understanding of agricultural water issues.

Specifically, we have been examining ways in which agriculture can, while remaining profitable, be a better steward of available water resources through improved water management, enhanced on-farm water retention, reduced on-farm demand, and/or improved efficiency. We have identified both the need and the opportunity to develop water stewardship strategies that benefit and protect farming while also sustaining the health of the ecosystems upon which we all depend. It appears increasingly obvious that there can be no economically, agronomically, and ecologically sustainable agriculture system without a sustainable water stewardship strategy.

This document is intended as a starting point for discussions among farmers, supporting organizations, urban water advocacy groups, environmental organizations focused on water issues, and other stakeholders in California's water. It outlines the case for agricultural water stewardship in the current political, environmental, and economic context. It proposes a set of principles to guide ongoing agricultural water stewardship efforts. Finally, this document offers a strategic framework for on-farm practices, policies, and the multi-stakeholder collaborations necessary to implement meaningful solutions.

Why Water Stewardship?

Attempts to grapple with water issues generally fall into one of three categories: improving water quality, increasing supply and improving storage and delivery, and reducing demand. None of these alone provides the solution to California's water woes and all have a role to play.

Of course, one way to increase the quantity of water available for use is to improve water quality by reducing or preventing water pollution. For years after the passage of California's Clean Water Act, agricultural practices were exempt from complying with the regulations resulting from passage of the Act. However, these "agricultural waivers" continue to be challenged in court, and while some gains have been made in curtailing agricultural contributions to poor water quality, there is room for improvement.

On the supply side, proposals to build new water storage and delivery mechanisms continue to be debated and advocated in the legislature and in some sectors of agriculture. The lining of delivery canals is being conducted where appropriate to decrease water loss during transport over long distances to both agricultural and urban customers. One current partnership in this effort is the Metropolitan Water District's agreement to pay for canal lining in the Imperial Irrigation District in exchange for a portion of the rights to the saved water. Options for building large dams are limited, very costly, and can require increasingly expensive energy to pump and deliver water. Though it is outside the scope of this paper, we are interested in exploring water storage solutions (including groundwater storage) that are smaller, regionally oriented, and ecologically sound.

There is clearly a need for a diverse set of coordinated solutions to California's water challenges, including dealing with aging infrastructure, assessing the need for new storage and delivery systems, and improving water quality. This paper focuses on water stewardship — the responsible management and use of water resources — for several reasons:

- A stewardship approach is in keeping with the principles of agricultural sustainability when it comes to limited natural resources availability and supporting environmental goals whenever possible.
- Water conservation is the most economical and efficient way to manage competing needs across sectors in the face of diminishing supply.
- In the face of insecure water resources, reducing reliance on this increasingly scarce resource must be a component of a long-term agricultural strategy.
- Since most of the recent focus on water conservation in agriculture has been on irrigation technology, there is considerable room for new ideas and approaches.
- Water stewardship holds the potential for numerous other benefits, such as lower energy costs and reduced agricultural runoff.

A decrease in water availability — whether due to drought, adjudication, or cost — has already been a great motivator for farmers to take a stewardship approach. As noted by University of California researchers, "[as] water becomes more scarce, farmers act to minimize their losses by adopting water-conserving technologies, shifting from more water-intensive crops to less water-intensive crops, or increasing their reliance on groundwater."[1] Severe water shortages in Australia and Texas, for example, have resulted in the adoption of innovative water conservation solutions.

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While we could wait and let the forces determining water availability play out, agriculture would be well-served by proactively discussing and advancing policies, practices, and programs that encourage better agricultural water stewardship, thereby preserving the long-term viability of agriculture.

Envisioning and implementing successful and sustainable water stewardship strategies will necessitate novel collaborations and win-win solutions. There is great potential in strategies that address more than one problem at the same time. For example, agricultural production methods that conserve water and maximize productivity, build soil health, and provide wildlife habitat should be encouraged. It is possible that on-farm practices that accomplish these goals may soon qualify for carbon sequestration offsets to reduce greenhouse gas emissions, thereby providing a revenue stream to incentivize the shift towards greater water and land stewardship. Another example of "solutions multipliers" is the Nitrate Management Program of Monterey County Water Resources Agency, which educates growers on irrigation management as a means to reduce nitrates in groundwater, increase fertilizer efficiency, reduce erosion, and increase water conservation. In short, ideas that both protect the interests of agriculture, and are responsible beyond these interests, are called for.

> "Water conservation has become a viable long-term supply option because it saves considerable capital and operating costs for utilities and consumers, avoids environmental degradation, and creates multiple benefits."
>
> — *California Water Plan Update 2005*

It is our intention is to use the ideas presented in this paper to open a dialogue and provoke discussion that will move agriculture towards specific proposals that result in sustainable, water-conserving on-farm practices and policies, and better communication and collaboration between stakeholders. This paper is intended as a working document to guide strategy development and action to achieve these goals.

The Opportunity and Need for Agricultural Water Stewardship

California's principal water conveyance systems were built decades ago, and California's population and agricultural production have increased since then, with few improvements to that system. The supply of water has not kept up with the demand, creating serious constraints for agriculture.

Resource limitations are likely to intensify in the foreseeable future, with different forces at play in different regions, due to trends such as increased salinity, changing patterns of precipitation, reduced snow pack, rising sea levels linked to climate change, and groundwater overdraft. Increases in the cost of energy will also play a role in the cost of water since transporting water is one of the state's largest uses of energy. Political and legal constraints are also likely to tighten, including pressure to restore water to the environment and divert agricultural water to urban areas, varying estimations of water availability, mandated reductions in water allocations, contested water rights, and pressure to reduce or eliminate the Agricultural Waiver of the Clean Water Act.

Very recent events serve as warnings and examples underscoring the timeliness of a call for a visionary water stewardship plan:

- In mid-February 2008, researchers at UC San Diego announced that there is a 50 percent chance that Lake Mead will be dry by 2021 if the climate changes as expected and future water usage is not curtailed.[2]
- Also in February 2008, southern California avocado farmers began "stumping" healthy trees in a desperate attempt to take them out of production in order to supply sufficient water for the rest of their orchards. The 2008 water shortage in the Metropolitan Water District of Orange County marks the first time that farmers, who in 1995 agreed to be the first to take water cuts in times of shortage in exchange for discounted rates, have had to take such drastic cuts in supply, in this case making do with 30 percent less water.
- In mid-April 2008, federal officials closed the salmon fishing season along the West Coast from southern California to northern Oregon, citing an "unprecedented collapse" in adult chinook returning to their spawning grounds in the Sacramento River watershed.
- In June 2008, the U.S. Bureau of Reclamation announced it would have to cut water supplied to Central Valley farms to 40 percent of the amount growers contracted for with the federal government.
- On June 5th, 2008, Governor Schwarzenegger issued the first drought declaration since 1991. He also directed the California Department of Water Resources to help speed water transfers to areas with the worst shortages, to help local water districts with conservation efforts and to assist farmers suffering losses from the drought.

The insecurity of agricultural water supplies is clearly a significant issue. In addition to water shortages, case law and legislation will likely continue to further squeeze water availability for agriculture in the future. The remainder of this section outlines the legal context, examines some recent proposed targets for agricultural water use reductions, summarizes major achievements in water use efficiency, and ends by describing opportunities available for further gains from applying a water stewardship approach.

SUZANNE BROWN/CLAYTON COUNTY WATER AUTHORITY

Regional water storage model: Georgia's constructed wetlands

Clayton County in Georgia has developed a series of constructed wetlands that augments traditional wastewater treatment, reclaims the water for use in the county, helps manage stormwater, provides habitat for wildlife, and incorporates stream restoration and public education.[3]

Legal and Legislative Context

Water is typically the topic of dozens of state bills each year, and there is considerable case law on record regarding all aspects of water use in California. The Department of Water Resources (DWR) Water Plan Update 2005 summarizes more than 50 bills over a five-year period that produced regulations to improve water management, flood control, and water supply planning at the local level and also addressed recycling, desalination, and groundwater potential for increasing supplies.[4] A snapshot of the 2007-2008 legislative sessions shows dozens of water bills, the majority dealing with water quality, flood control, urban water conservation, or storage and delivery systems. The State of California has committed to significantly reducing its global warming emissions in AB 32, the California Global Warming Solutions Act of 2006. As yet, the implications of AB 32 for agricultural water users are unclear, but will likely contribute to increasing pressure on water resources.

While there are many legal and legislative indicators of the constraints facing agriculture, the following four landmark examples illustrate the kind of decisions that stand to affect agriculture in the long-term.

Central Valley Project Improvement Act (1992) — This landmark legislation marked a fundamental shift in the balance between the competing water needs of agriculture versus ecosystems, dictating that significant Central Valley water must be reallocated from farming to the environment. The CVPIA identified fish and wildlife protection and restoration as primary purposes of the Central Valley Project (CVP), which also irrigates 3 million acres of California farmland. It ordered a reallocation of 800,000 acre-feet of CVP water (600,000 in dry years) from farmers to the environment. The CVPIA also limited agricultural water contract renewals to 25 years, and set up an environmental restoration fund of $30 to $60 million, funded primarily by CVP customers.

Mono Lake Decision (1994) — This historic decision found that Los Angeles' long-held water rights had to be balanced with environmental protection, and required a reduction in the city's water diversions. This case has broad implications for both agriculture and urban water users, bringing into play the competing needs of the environment. According to a legal brief for the case, it "brings together for the first time two systems of legal thought: the appropriative water rights system which since the days of the gold rush has dominated California water law, and the public trust doctrine."[5]

Friant Dam Decision (2004) — This court case and subsequent legislation established environmental priorities for water in a specific river system and decreased the water available for agriculture. The decision in a lawsuit brought by the Natural Resources Defense Council (NRDC) required the release of water from Friant Dam near Fresno for the first time in 55 years. Since the dam was built, nearly 95 percent of the San Joaquin River's flow had been diverted for irrigation, with significant impacts to fish and wildlife, as well as water quality, for the nearly two-thirds of California's citizens who depend on the river. Two years after the legal decision, a settlement agreement was reached to "restore water flows and salmon to the San Joaquin River below Friant Dam while undertaking one of the West's largest river restoration efforts."[7] Most recently, the San Joaquin River Restoration Settlement Act (still under consideration by federal legislators) would enact the agreement as law and also authorize federal monies to match funds from water user payments to cover the costs of river restoration, salmon reintroduction, and water management.

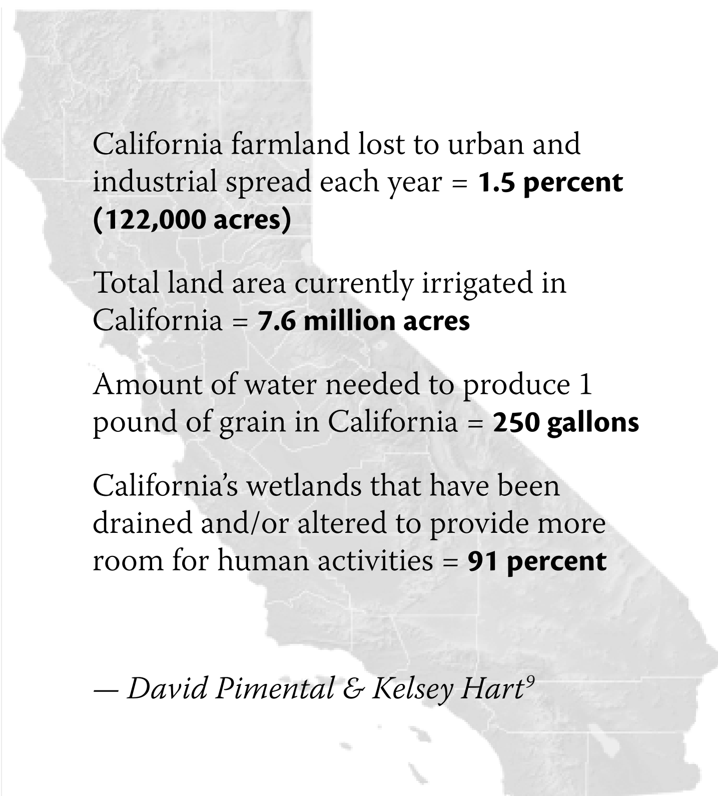
Public Trust Doctrine

"Since 1928, the California Constitution has required that water be put to the highest beneficial use, and has prohibited waste or unreasonable uses…[In the Mono Lake decision] the doctrine recognizes that government has a legal responsibility to protect resources with environmental and aesthetic values; such resources are held "in trust" for the public…"

— David Carle[6]

North Coast Instream Flow Policy — As mandated in 2004 by AB 2121, this policy is targeted for adoption by the State Water Resources Control Board (SWRCB) by the end of 2008. It has potential widespread impacts, primarily for agricultural and rural water users on the North Coast (and across California if it serves as a precedent) because it will subject new water permit applications and changes to existing permits to increased scrutiny and regulation. As excerpted from the SWRCB website, "the draft policy contains guidelines for evaluating whether a proposed water diversion, in combination with existing diversions in a watershed, may affect instream flows needed for the protection of fishery resources. The draft policy establishes principles and guidelines for maintaining instream flows for the protection of fishery resources… [It] provides for a watershed-based approach to evaluate the effects of multiple diversions on instream flows within a watershed as an alternative to evaluating water diversion projects on an individual basis."[8]

Developments such as these in the legal and legislative arena will continue to be a factor for agriculture. They are blunt instruments for responding to the problem, and can unfairly impact farmers who have taken measures to conserve water. Conversely, a widely endorsed water stewardship policy platform developed by agriculture has the potential to influence the direction of state policies in a way that rewards and supports stewardship practices and sustains farmers and farming in California.



California farmland lost to urban and industrial spread each year = **1.5 percent (122,000 acres)**

Total land area currently irrigated in California = **7.6 million acres**

Amount of water needed to produce 1 pound of grain in California = **250 gallons**

California's wetlands that have been drained and/or altered to provide more room for human activities = **91 percent**

— David Pimental & Kelsey Hart[9]

Water Conservation Strategies & Targets

Water conservation targets can serve as a rallying cry and a benchmark for evaluating success. In an era of constricted water availability and increasing demand, we believe that an ambitious target for agriculture (as well as urban and industrial sectors) is both necessary and possible, and in the long-term self-interests of farmers.

Projections for water use reductions forecast in the DWR Water Plan Update 2005[10] were conservative even on the high end of their range. They projected a 5 to 10 percent (1.9 to 3.5 million acre feet) decrease in agricultural water use by 2030 without the need for adoption of any new practices, programs, or policies, plus an additional 0.6 to 2.6 percent (0.2 to 0.9 maf), achievable through a modest set of water efficiency improvements. The Plan's recommendations for facilitating a wide range of stewardship practices call on the state to collaborate with local Resource Conservation Districts, create a directory to aid in state and federal coordination, direct federal funds to on-farm efforts, and conduct better assessments of the efficacy and benefits of stewardship practices. The Plan's water use efficiency recommendations include calls for more funding and technical assistance for various programs and techniques, as well as the collection of water use data for various crops, encouraging rate structures that bill by volume of water delivered, fostering better partnerships, and conducting outreach and education.

A more ambitious "high efficiency" scenario has been presented by the Pacific Institute in their 2005 report, California Water: 2030: An Efficient Future.[11] It lays out a general scenario for savings of up to 23 percent, or 8 maf, by 2030, achievable primarily through more widespread adoption of existing irrigation technologies and other on-farm practices encouraged in part through changes in agricultural water prices. As noted in their report, the difference between their scenario and those of the DWR "are the result of making different assumptions about a range of water-use efficiency options, policies, technologies, and decisions."[12]

We believe that even the Pacific Institute's high efficiency scenario is conservative in that it focuses on broad adoption of already-existing technologies. One purpose of our call for developing water stewardship strategies is to provide savings in addition to those acquired through existing practices and technology.

In the political realm, on February 28th, 2008, Governor Schwarzenegger called for a 20 percent reduction in water use per capita by 2020, effectively issuing a political mandate for the equivalent of a Global Warming Solutions Act (AB

32) for water conservation. While this proclamation is wide open to interpretation, it creates an opportunity to represent the interests of farmers, influence the many responses likely to ensue, and move towards a sustainable agricultural future. We believe that agriculture has the resources, capacity, expertise, and self-interest to rise to the challenge of ambitious water use reduction goals and strategies, without undermining profitability.

Achievements in Agricultural Water Use Reduction

Significant gains in water use efficiency and conservation have been achieved in recent decades in both California agriculture and in urban use. In 32 important California crops between 1980 and 2000, a 38 percent larger volume of crop was produced with every acre-foot of water.[13] Such improvements encourage ancillary economic and environmental benefits such as more precise harvest dates for peak pricing, improved yields, better utilization of agronomic inputs, and improved water quality through reduced runoff.

To be clear, irrigation efficiency improvements allow for larger crop yields per unit of water (more “crop per drop”) and greater economic return, but do not necessarily reduce the volume of water used by agriculture. The efficiency results from better control of water losses, while maintaining or even increasing actual water consumption by crops. As water and its associated energy costs increase, farmers will need to consider whether increased yields are economically feasible, and the emphasis on maximizing yields will need to be balanced with other considerations.

The greatest improvements in irrigation efficiency to date can be grouped into two general categories: irrigation infrastructure and irrigation scheduling or management. Water suppliers play a major role in both categories by reducing losses in delivery systems and allowing more flexibility in water access to growers.

Precision and uniformity of in-field water distribution comprise some of the most significant on-farm water efficiency gains to date. Water districts across the state report ongoing transition by growers from furrow irrigation to sprinkler and ultimately drip irrigation systems, with associated improvements in water use efficiency. Strawberries, many vineyards,[14] and most orchards are examples of crops that are now almost exclusively irrigated by drip or micro-sprinkler methods. Flow and pressure regulation equipment, tailwater recovery, and improved conveyance systems also lend to the gains in water conservation. Among the barriers to more widespread adoption are the capital costs of new infrastructure, logistical conflicts with field operations, education and training for skilled workers, and potential increased energy demands of drip and sprinkler systems.

An efficient irrigation system requires not only good design and infrastructure, but also good management. Pressurized irrigation systems require rigorous maintenance practices to operate at maximal efficiency. Decisions of when, how much, and for how long to irrigate comprise the art and science of irrigation scheduling in response to soil qualities, climate, and crop demand. Techniques range from the direct observation of soil moisture to automated soil and climate sensors and computerized scheduling tools. Both the low-tech and high-tech approaches can be similarly effective depending on a grower’s preference and means of implementation.

A particularly valuable resource is the California Irrigation Management Information System (CIMIS), a statewide network of nearly 125 weather stations, accessed by over 6,000 agricultural users. CIMIS data can be used directly, or input into automated irrigation scheduling tools such as the on-line Wateright program from the Center for Irrigation Technology at California State University Fresno (which had over 30,000 discrete visitors to its website in 2007). One independent study found that growers using CIMIS reduced water use by an average of 13 percent and increased yields by 8 percent.[16]

> “Delaying action on water-conservation and efficiency increases the pressure to find, build, or buy new expensive and environmentally damaging sources of water supply… Such sources of supply are increasingly scarce or controversial. While we do not believe a highly efficient future is necessarily easy to achieve, we think it will be easier, faster, and cheaper than any other option facing us.”
>
> — *Pacific Institute*[15]

Guiding Principles for a Water Stewardship Strategy

As illustrated in the previous section, important gains have been made in water use efficiency. There is an opportunity for additional water savings in each of the areas summarized above, and we support and encourage this work.

In addition, we face a need for new strategies that augment and complement existing strategies such as improved irrigation technology or new infrastructure. For small and mid-size farmers in particular, the sometimes costly investments associated with technology-based solutions may not be feasible or practical. Additional strategies that are "solutions multipliers" with economic, social, and environmental benefits are called for. In short, there is a need for more advanced research, education, policies, and collaborations that focus on sustainable or ecological farming techniques that conserve water.

According to the University of California Sustainable Agriculture Research and Education Program (UC SAREP), sustainable agriculture is characterized by the following:

Sustainable agriculture integrates three main goals — environmental health, economic profitability, and social and economic equity. Sustainability rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs.

A systems perspective is essential to understanding sustainability. The system is envisioned in its broadest sense, from the individual farm, to the local ecosystem, and to communities affected by this farming system both locally and globally.[17]

Arising from our commitment to assuring an economically, environmentally, and socially sustainable agriculture system, we have applied these general concepts to the challenge of water stewardship. We propose that the following set of principles guide ongoing development of an action plan for on-farm practices, collaborations, and policy.

1.

Founded in an ecological, not strictly a technological, framework

Does the initiative provide multiple benefits, and can it be implemented without undue reliance on expensive technology or infrastructure?

In a whole systems approach, solutions are designed to solve more than one problem. In the case of water stewardship, maximizing soil organic matter, for example, improves water retention, thereby conserving water. It also supports the growth of healthier, more pest- and disease-resistant crops. Over time, this also has the potential to reduce reliance on inputs such as energy and fertilizer, offering cost savings and environmental benefits.

2.

Financially feasible for farmers

Does the proposed initiative consider the economic viability of all scales of farms and/or provide financial incentive for existing and new farmers to adopt water stewardship practices?

Farmers are under considerable economic pressure from all directions, and cannot be expected to adopt water conserving practices just because it is "the right thing to do." There must be economic incentives, subsidies, and other supports to facilitate the transition to improved water stewardship practices.

3.

Preserves farmland and a sustainable economic base for rural areas

Does the initiative protect farmland from becoming idle or developed? Does it protect against a reduction in rural employment opportunities? Does it improve agricultural productivity?

Too often, policies put in place for the benefit of the environment or urban development have had the unintended consequence of making farming so unprofitable that farmers idle land or move it out of production altogether. This has been a particular risk of water marketing rules that have made water sales more profitable than farming for some farmers.

4.

Results in measurable water savings

Is the initiative expected to enhance and improve water quality and/or quantity?

While we understand that the quantification of improvements in water usage is challenging and subject to variability over time and place, we believe that it is important to attempt to estimate the impact that a given solution or initiative is expected to make on water use patterns in order to evaluate the most efficacious options.

5.

Regionally appropriate and flexible

Can the proposed initiative be adapted and modified for application to various diverse regions and circumstances across California?

California's agricultural context is extraordinarily diverse in terms of geography, crop patterns, water availability and cost, and other factors. For instance, water availability, management practices, and needs are considerably different along California's north coast than in the southern Central Valley. Water stewardship solutions must necessarily be adaptable to various conditions, and must avoid a one-size-fits-all approach. We believe that the watershed scale is the most appropriate organizational unit to use in organizing, collaborating, and planning most water stewardship initiatives.

6.

Benefits to agriculture, the environment, and urban constituents outweigh the costs

Does the proposed initiative address the needs and constraints of multiple sectors such that the aggregate benefits exceed the costs?

None of these sectors can be considered in isolation when it comes to water needs; they are all interrelated and interdependent. As water needs increase and water supply diminishes, we must assure that competition between the sectors is reduced in favor of initiatives that are cooperative and mutually beneficial.

7.

Protects water quality for rural communities

Does the initiative protect agricultural worker health and safety and ensure access to safe and adequate supplies of drinking water for farms and farm worker communities? Does it ensure that marginalized and low-income communities are not disproportionately impacted?

For farm workers and other rural residents, agricultural pollutants, such as nitrates, frequently exceed safe limits in drinking water, with potentially significant health and economic impacts. Central Valley farm workers report spending up to 10 percent of their household income on bottled water when nitrate levels exceed legal limits.[18] Water stewardship initiatives should ameliorate existing unsafe conditions for farm workers and guard against creating new problems.

8.

Wise reallocation of conserved water

Is the water saved by agriculture wisely reallocated to benefit the highest needs of the environment, farmers, and urban constituents?

It is important that water use reductions in agriculture are not reallocated to enable either unsustainable urban sprawl or unsustainable agricultural production.

9.

Strategic and achievable

Is the proposed initiative likely to garner significant support and engagement among farmers and other stakeholders, inspiring them to implement it?

Agricultural water management strategies and initiatives must strike a balance between realism and ambitiousness. Given the limitations of time, focus, and finances, they must also be prioritized in terms of which initiatives are most likely to succeed and have the greatest impact. We would also like to see a complementary application of strategies that are achievable in the short, mid, and long term.

"For years, finding enough water for people meant finding more water to use. Today, and into the future, we need to find ways to use water in a more sustainable manner through a paradigm shift that stresses increased water use efficiency across all sectors. Agriculture, as the single greatest water consumer in the world and controlling the greatest volumes in the United States, has a unique, mandated responsibility to manage in a sustainable manner national and global water resources.

...Of the 147 countries ranked for water efficiency by the World Water Council, the United States ranked last."

– Cooperative State Research, Education, and Extension Service[19]

Toward a Water Stewardship Framework for California Agriculture

In this section, we propose a multi-faceted framework to guide the development of a bold yet realistic water stewardship strategy. The framework is organized into three interrelated and interdependent categories:

A. On-farm sustainable practices
B. Collaboration and communication
C. Policy

For each of these categories, we suggest an outline for research, evaluation, and assessment, as well as some ideas for advancing specific projects and initiatives. All of the ideas here are grounded in the current context of constraints and opportunities and informed by the guiding principles identified above.

Meaningful attention should be given to each category. While individual innovation on farms is valuable as a model, it must be communicated for greater impact and sometimes encouraged by incentives and technical support to replicate it. Conversely, policy that is not grounded in on-farm realities and constraints runs the risk of being minimally effective or producing negative unintended consequences. Finally, collaboration and communication is the necessary underpinning of successful efforts in both policy and on-farm practices.

Given the diversity that characterizes California agriculture, the framework presented here requires a flexible and regionally appropriate approach. We believe that the most appropriate scale for developing and implementing a water stewardship plan of action is within watershed boundaries, either those of California's nine water districts or perhaps smaller subsets within those districts. While this document has focused on the "demand reduction" side of the equation, a comprehensive watershed-based water stewardship plan would necessarily also address issues of water quality and water storage and delivery. The same guiding principles laid out above could be applied to water quality and supply to develop a sustainable water stewardship approach.

These ideas are presented in an attempt to foster dialogue and partnerships towards an eventual strategic action plan for advancing water stewardship in California agriculture. We do not intend to imply that what follows is a comprehensive outline of what is possible and needed, and we look forward to an evolution and maturation of this framework as the conversation is broadened and deepened with various stakeholders.

A. On-Farm Sustainable Practices

Many farming techniques falling under the broad category of sustainable agriculture have the potential to reduce water use while achieving other benefits. We know that economic drivers are the motivators for most behavior change, so cost-benefit analyses must be applied to all proposed practices to test for the likelihood of widespread adoption and impact. We must prioritize solutions that move farmers away from a reactive, short-term cost minimization approach to a proactive model that encourages investments in long-term sustainability.

We propose that as a first step for advancing sustainable on-farm water stewardship practices, a strategic research agenda (and a proposal for funding it) be created that answers a series of questions. Care must be taken to come up with answers appropriate to farms of different scales, income levels, cultural contexts, and diverse regional contexts. Some of the first questions should include:

- Which currently available sustainable or ecological farming techniques fit the guiding principles for water stewardship, and should therefore be considered in a toolkit of on-farm practices? Is it possible to quantify the water efficiencies of each practice, as well as other benefits such as improved yields?
- What lessons can we learn from other regions or countries that are further down the road of water stewardship (e.g., Australia, Israel, Texas, Arizona)?
- What are the financial and technical barriers to adoption of water-conserving techniques (including, but not limited to, irrigation technologies)?
- Which California crops could most benefit from improved water use efficiency? Which crops are best suited to the available water supply in various regions of the state? How can we achieve the greatest cost-benefit balance by growing high value crops while minimizing water use?

Based on the research currently available and any that arises out of the proposed research agenda, useful products could include best management practices documents, regional or crop-specific guidebooks for developing a farm water plan, or web-based resources.

We encourage research on, communication and promotion of, and incentive-generation for, the water-conserving potential of a blend of diverse strategies that include, but are not limited to, the following:

Manage soil for maximum moisture retention. Soil organic matter, conservation tillage, and soil surface protection all increase the function of the soil as an on-farm reservoir of water to help reduce runoff, increase flexibility in irrigation scheduling, and improve drought resistance. To what extent can water demand be met by such soil conservation practices?

Capture and retain available water on the farm. Depending on site characteristics, surface water can be retained by ponds, keyline systems,[20] swales, and structures, or infiltrated within wetlands, basins, and riparian zones. How do such on-farm and regional projects, when applied widely across the landscape, compare against large, centralized infrastructure projects?

Utilize sources of water other than surface and groundwater. These could include processing and treating local agricultural runoff, and reusing water on-farm (though food safety issues may have to be addressed in some cases). Furthermore, brackish groundwater holds the promise of wellhead treatment and on-farm use.

Favor crops that complement available water supply. Crop rotation and diversification strategies such as those encouraged in permaculture[22] attempt to match crop selection with seasonal and landscape variations in water availability. To what degree can a scaling up of such strategies reduce the water demand of California agriculture?

Consider innovative irrigation regimes that reduce actual consumptive use in appropriate settings. Regulated deficit irrigation, partial root zone drying,[23] no-till, and dry farming are currently practiced with success in specific crops and under specific conditions. To what extent can these practices be more widely adopted within California's vineyards, orchards, and other crops?

Closely monitor soils and climate to inform irrigation decisions. Irrigation scheduling can be refined with feedback from several levels, including direct observation in the field, automated soil moisture sensors, and climate-based modeling tools. Can greater involvement of farm management across the board help to refine irrigation management in significant ways?

Adopt precision water delivery technologies to the extent practical. Existing technologies allow for very specific control of water pressure, flow, timing, and location. Which of these technologies are at the same time most accessible and least extensively adopted among growers, and why?

Encourage water measurement and water use accounting. Quantification of irrigation as inches of applied water

JOHN O'NEILL

Case Study: Integrated Watershed Management Program
Murray Darling River Basin, Australia

As in California, parts of Australia have struggled for decades with water scarcity, over-allocation of water, drought, increasing salinity, and impaired aquatic and riparian species and habitat. Australia has adopted an integrated catchment (watershed) management approach that has a strong emphasis on decentralization and participatory decision-making. The Murray Darling River Basin, covering over one million square kilometers, is a particularly successful management model that addresses water supply allocation, water conservation, arresting and reversing water quality degradation, and ecological restoration and protection. Though there are some significant differences between agriculture in Australia (with its large acreage of less diverse farmlands) and California, there may be some important lessons to be learned.[21]

CIRS

Case Study: Minimum Till Technique
American Farms, Salinas, California

Israel Morales farms many specialty crops on over 2000 acres using 80-inch semi-permanent raised beds, reduced tillage, and solid set sprinklers. The wider beds hold moisture longer allowing him to irrigate less frequently. The goal of reduced tillage is to minimize soil compaction and keep the organic matter and nutrients near the surface to support the plants and microbes that combat plant disease. His farms have almost no runoff because the soil effectively absorbs the water, and he conserves fuel and labor by using fewer tilling passes as well as reducing greenhouse gas emissions. The advantages of set sprinklers is the ability to precisely schedule water applications based on soil moisture needs rather than scheduling and labor demands, minimized soil compaction and reduced leakages caused by moving irrigation equipment, and the additional benefit of lower labor costs.[23]

provides a more precise measure in comparison to more common metrics such as the numbers of hours a system operates. How can water usage data best be collected and reported to growers in a format that helps them to make adjustments that can save costs and maintain or improve yields?

Getting "water stewardship toolkits" based on practices such as these into the hands of farmers, and providing the necessary technical and financial support for implementation, will quite likely rely on the collaboration and communication of ideas that evolve in the following section. Public policies, described in section (C) below, may also be needed to facilitate the adoption of some of the tools.

B. Collaboration and Communication

A truly successful model of agricultural water stewardship will require a foundation of real cooperation among actors. There are several areas that could benefit from enhanced cooperation and better communication in the shared interest of the goals of water stewardship. The growth of the local food and watershed restoration movements, for example, bring with them the potential (and challenge) of incorporating diverse perspectives and uncovering new allies for agriculture.

The watershed is a well-defined unit of organization appropriate for developing water stewardship plans, sometimes known as Integrated Regional Water Management Plans. The development of agricultural water budgets at the watershed scale is a necessary tool for guiding and implementing such plans, and collaboration is required to establish realistic and meaningful budgets and targets for water use reduction.

We suggest using defined watershed boundaries to implement the following set of tactics for improving regional collaboration:

- Explore existing organizational and decision-making models for watershed basins.
- Identify the stakeholders in the watershed that are, or could be, involved in developing a regional water stewardship plan.
- Identify the context, opportunities, and barriers facing the watershed region relevant to agriculture and long-term water resource sustainability.
- Thoroughly map the organizations, academic institutions and researchers, associations, and leaders throughout the state that could be resources for water stewardship solutions.
- Organize a series of roundtable "listening sessions" with diverse agriculture stakeholders in the watershed to explore the ideas represented in this paper and further develop the strategic framework. Some of the categories of stakeholders could include farmers, water district managers, researchers, Cooperative Extension agents, allied trade groups, family farm and minority farmer representatives, citizen watershed groups, food systems advocates, urban water conservation groups, etc.
- Identify funding opportunities to enhance the ability of existing entities (as identified in the mapping exercise) to provide technical assistance and advance the dissemination of the on-farm practices identified in the previous section.
- Establish a web site to provide information on existing web-based resources, water stewardship technologies, including promising research, innovations, and needs, and relevant resources for the watershed.

We see the need for enhanced collaboration and communication particularly in the following four categories:

- Among all sectors of agriculture
- Between farmers and environmental advocates
- Between farmers and urban constituents
- Between various researchers, institutions, and agencies (e.g., Cooperative Extension, California State Universities, California Department of Water Resources, and others) and farmers seeking tools to achieve their water stewardship goals.

ALBA

Case Study: Watershed Collaboration

Agriculture Water Quality Alliance (AWQA)

AWQA is an innovative collaboration of agriculture, resource conservation agencies, researchers, and environmental organizations working to protect both the Monterey Bay watershed ecosystem and agriculture. AWQA is working to improve water quality using agricultural industry-led networks to reduce nonpoint-source pollution, improve technical assistance and outreach, raise awareness, streamline regulatory coordination, identify funding mechanisms and incentives, and improve the maintenance of public lands and rural roads.

- In addition to enhancing collaboration and communication regionally, it will be important to strengthen statewide alliances to develop and advocate for state policies that develop from a policy platform such as the one proposed in the following section.

C. Policy

While a great deal can be, and has been, accomplished on an individual or institutional level to implement water use reduction practices, public policy changes are required to provide incentives, multiply successes, and institutionalize programs. Viable policy options will identify multiple benefits (e.g., water, energy, and environmental benefits) that assure the long-term sustainability of water resources.

We propose the development of a policy platform that advances the goals of a sustainable agriculture approach to water stewardship, and that is framed by the guiding principles outlined previously. We suggest the following steps to move towards a policy platform:

- Assess the current policy context and political obstacles, including issues of water rights and permitting, water rates and water marketing, and identify gaps.
- Evaluate public policy models in other states and countries that have grappled with agricultural water issues.
- Using the guiding principles in the previous section of this document, develop a specific set of parameters for the elements of the policy platform.
- Develop a policy platform and prioritize the elements.

Some early concepts for elements of the policy platform that warrant further discussion and exploration include:

- Establish or improve incentives, subsidies, and funding for research that support the adoption of on-farm water stewardship practices identified in section (A) above, and support the types of watershed basin networks outlined in section (B). One potential source of revenue may be carbon offsets that may become available to farmers employing carbon sequestration practices, many of which would also reduce water usage.
- Describe the relationship between smart agriculture, smart urban growth, and environmental demands that link water stewardship policies to matching urban water conservation efforts.
- Balance the needs of growers for certainty about their access to water with the need for adaptability to unforeseen circumstances leading to shortages.
- Explore ways that farmers could benefit financially from conserving water.
- Identify acceptable and unacceptable agricultural uses and practices of water conservation and management.
- Propose incentives for a systems approach to on-farm infrastructure such as on-site energy generation systems (e.g., solar power net-metering systems) that can offset the capital and operating costs of irrigation systems.

SUNLIGHT ELECTRIC

Case Study: Dry Farming

Frog's Leap Vineyard, Napa Valley

Dry farming is the practice of growing crops without irrigation under a comparatively small annual rainfall. Frank Leeds at Frog's Leap estimates that their dry farming operation saves an estimated 16,000 gallons of water annually per acre. Ancillary benefits include more concentrated, balanced fruit, increased vine longevity and reduced weed growth, mildew pressure and susceptibility to nematodes and gophers. In addition, though production and labor costs are equivalent to conventional vineyards, the cost of establishing dry farm vines is lower.

LISA KRESGE/CIRS

Case Study: Water Recycling

Straus Family Creamery, Marshall, California

At this dairy farm, most of the approximately 5,000 gallons per day of water used to clean their milking barns is recycled. They combine the water used to clean the milking and free-stall barns with wastewater from the creamery, and process it in a series of ponds. This water is then recycled to clean the free-stall barn. The methane gas from the wastewater storage ponds is captured and used to generate 90 percent of the dairy's electricity.

An Invitation to Participate

Tackling the current and projected water issues in California requires a multitude of complementary solutions and the collaboration of many stakeholders in the agricultural arena, which will continue to be significantly impacted by water shortages and competition. These solutions must necessarily address and integrate economically and ecologically sustainable and cost effective proposals for surface storage, groundwater recharge, salt management, conveyance, and improvement of water quality.

One under-explored area with the potential for making valuable contributions is what we have called water stewardship — ecologically, economically, and socially sustainable on-farm practices, collaboration, and policies appropriate for implementation at the scale of watershed basins across California.

This document is intended to launch a conversation to inspire strategic action and implementation of policies, programs, and farming practices founded in a water stewardship framework. Developing a meaningful, realistic, and ambitious action plan will require the participation of diverse perspectives and sectors, and we invite you to become involved.

For more information, background, and resources, and to stay in touch as this initiative progresses, please refer to the following web site: www.agwaterstewards.org.

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COURTESY HEDGEROW FARMS

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