California Climate and Agriculture Network

California's State Water Efficiency and Enhancement Program (SWEEP): A Progress Report

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About CalCAN

The California Climate and Agriculture Network (CalCAN) is a network of sustainable agriculture advocates, farmers, ranchers and agricultural experts that advances policy solutions at the nexus of sustainable agriculture and climate change.

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Executive Summary

California is embarking on potentially transformative climate change policy. Among the new state climate change programs is the State Water Efficiency and Enhancement Program (SWEEP), designed to achieve the dual goal of agricultural water savings and greenhouse gas (GHG) emissions reductions. Programs like SWEEP seek to change the management of California's businesses and ecosystems to reduce our carbon footprint and increase our resilience.

In this progress report, the California Climate and Agriculture Network (CalCAN) reviews SWEEP to better understand how new climate change programs like it are working for farmers and the environment. We review the program's background, discuss the projects funded during the first three application cycles,[a] and highlight SWEEP's successes to date. We also identify remaining opportunities for program improvement that the California Department of Food and Agriculture (CDFA), the administering department, is well-suited to address. Our recommendations describe how future iterations of SWEEP can reach the state's diverse grower populations to incentivize a variety of innovative on-farm water management strategies that meet our climate change goals.

Full details on the methodology used for our data gathering and analysis can be found in Appendix A. A review of the program's application process can be found in Appendix B.

Achievements to Date

SWEEP's significant achievements to date include:

- **Savings.** SWEEP projects funded across Rounds 1, 2, and 3 will save an estimated 37,490 acre-feet of water per year (approximately 12.2 billion gallons/year) and an estimated 11,278 Tonnes CO_2e per year[b] (the equivalent of taking 2,374 passenger vehicles off the road each year).[c]
- **Innovation.** SWEEP has incentivized the installation of many important water and GHG emission savings technologies, with soil moisture sensors as the single most common equipment type. Additional project activities include on-farm water storage, water recycling activities and on-farm solar energy production.
- **Comprehensive projects.** Round 3 featured a higher percentage of projects that combined multiple activity types, demonstrating a move towards more comprehensive—and potentially more transformative—approaches to tackling water savings and GHG emission reductions.
- **Program evolution.** In a fairly short period of time, the program has evolved to further its efficacy and incorporate stakeholder feedback. Promising advancements include a preference for new SWEEP applicants, to encourage more widespread participation, and acknowledgement of the importance of technical assistance and training. See Appendix B for details.

a The Round 4 grant solicitation was available at the time of this report and is included in the analysis, but no projects were awarded at the time of this report.

b Calculation excludes two outlier values of 21,320 and 22,098 Tonnes CO_2e/year.

c Savings are expected to accrue annually over the fifteen-year lifetime of each Round 1 grant and the ten-year lifetime of each Round 2 and 3 grant.

Findings and Recommendations

We consider the following program characteristics key to SWEEP's success:

1. Inclusive participation, accessibility, and reach
2. A clear and fair evaluation process
3. Incorporation of multi-benefit soil management practices
4. Support for farmer training and technical assistance

We conducted our analysis with these program characteristics in mind.

Finding #1: SWEEP's application process may discourage otherwise eligible participants from applying to the program.

Recommendations:

Provide technical assistance for project/application development

Shift GHG emissions and water savings calculations to grant reviewers, not growers

Include expenses (financial and time) for irrigation training services and soil management practices as eligible to count toward the applicant's 50% match

Finding #2: CDFA's process for ranking projects can provide greater clarity and transparency.

Recommendation:

- Provide scoring criteria for SWEEP applications

Finding #3: Multiple grants to single entities and higher maximum project caps limit the program's reach. Water savings and GHG reductions were found to be similar across project sizes.

Recommendations:

- Limit the amount of SWEEP funding an individual entity can receive across rounds
- Use a project cap of $150,000
- Set aside 20% of SWEEP funds each round for 'small' projects of amounts equal to or less than $25,000, administered through a simplified application process

Finding #4: SWEEP funds diverse activities and practices, but a lack of training for system managers may limit water and GHG emission reductions.

Recommendations:

- Fund irrigation management training for grantees to ensure that SWEEP-funded equipment achieves maximum benefit on the ground
- Allow irrigation training expenses to be eligible towards the grantee's 50% match (see Finding #1)

Finding #5: SWEEP does not reward soil management activities with proven benefits.

Recommendation:

Include soil management activities as a primary ranking criterion and provide tools to application reviewers for calculating water and GHG reductions through the use of these practices

Finding #6: Some funded activities appear counter to the program's long-term objectives.

Recommendation:

Convene a meeting of Environmental Farming Act Science Advisory Panel to review the consistency of fertigation, natural gas pumps, and other project activities within SWEEP program goals

Finding #7: SWEEP does not reach some of the regions of the state most impacted by drought.

Recommendation:

Consider using administrative funds to support outreach to farmers by partner organizations that have a demonstrated track record of delivering grower-related programs in under-represented agricultural regions.

Looking Forward

We encourage CDFA to consider further adaptations to the SWEEP program structure to more fully address the issues raised in this report. For example, CDFA may consider alternative program models, such as block grants to local-level technical assistance providers, to address the current lack of funding for SWEEP technical assistance and training or a revolving loan program model to allow for on-going investments, beyond the life of the GGRF. CalCAN believes a robust, long-lasting SWEEP will consider inclusive participation with technical assistance, establish a clear evaluation process, seek synergies with future Healthy Soils Initiative efforts and ensure the longevity of program benefits by supporting on-going farmer training.

A. Introduction

California is embarking on potentially transformative climate change policy. Among the new state climate change programs is the State Water Efficiency and Enhancement Program (SWEEP), designed to achieve the dual goal of agricultural water savings and GHG emissions reductions. Programs like SWEEP seek to change the management of our businesses and ecosystems to reduce our carbon footprint and increase our resilience.

In this progress report, CalCAN reviews SWEEP to better understand how new climate change programs like it are working for farmers and our environment.

We highlight SWEEP's successes to date and identify remaining opportunities for program improvement that CDFA, the administering department, is well-suited to address. These recommendations describe how future iterations of SWEEP can reach the state's diverse grower populations to incentivize a variety of innovative on-farm water management strategies that meet California's climate change goals. We review the program's background, provide a methodology for data gathering and analysis, discuss the funded projects, then present findings and recommendations for the program. Further details on methodology can be found in Appendix A. Our review of the program's application process can be found in Appendix B.

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B. Background

By the end of 2015, California's severe drought had reached epic proportions. Farmers and ranchers experienced the brunt of its impacts, resulting in widespread fallowing of fields, diminished crop yields, and increased reliance on costly and unsustainable groundwater pumping—not to mention the social and economic impacts of drought-related job losses in California's agricultural communities. The drought is just one example of extreme weather events that climate change threatens to exacerbate over the coming years and decades.[1] How California addresses climate change will directly impact the future of the state's agricultural industry and our food security. The state's farmers are well-situated to address both the causes and impacts of climate change.

SWEEP was developed in response to the drought. In 2014, Governor Brown and the state legislature passed emergency drought legislation that created SWEEP with an initial $10 million allocation. A subsequent drought package allocated another $10 million in 2015.

SWEEP is one example of how the state is proactively working with the agricultural community to support both climate change mitigation and adaptation.

Prior to SWEEP, most state efforts to improve agricultural water use efficiency focused primarily on efficiencies at the irrigation district level.[2] But such efforts neglected a critical piece of the water puzzle—grower-implemented, on-farm water conservation efforts. SWEEP aims to fill this gap by focusing exclusively on farm-level projects that achieve water savings and related energy savings and GHG emissions reductions. As a sign of the success of this new approach, the Budget Act of 2015 (SB 101) approved an additional $40 million in SWEEP funding for FY 2015-16 and FY 2016-17.

How are water use and GHGs connected on farms?

Each year, California agricultural irrigation consumes over 10 billion kilowatt hours (kWh) of electricity—nearly enough energy to power 1.5 million residences.[3,4] This electrical consumption has a significant carbon footprint. Many growers run irrigation pumps that consume diesel and other liquid fuels, emitting significant additional GHGs. Optimizing on-farm irrigation efficiency through close monitoring and evaluation can achieve significant water and energy savings, benefiting the agricultural operation and the environment.[5] Efficient irrigation systems can reduce the amount of water applied to fields without diminishing yields, while decreasing the runtime of energy-intensive and costly pumps. Growers can also reduce GHG emissions by installing more efficient pumping equipment and/or transitioning to non-fossil-fuel power sources like solar or wind.


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B.1. Program Basics

SWEEP provides financial incentives to California agricultural operations through a competitive grant program administered by CDFA in coordination with the State Water Resources Control Board (SWRCB) and the Department of Water Resources (DWR). The Environmental Farming Act Science Advisory Panel (EFA SAP), comprised of members appointed by secretaries from CDFA, California Natural Resources Agency (CNRA), and California Environmental Protection Agency (CalEPA), provides additional input on the design and implementation of SWEEP.

SWEEP projects are required to reduce both water usage and GHG emissions. Grantees are expected to maintain their new projects for a minimum of ten years, thereby fostering long-lasting changes in on-farm water- and energy-efficient infrastructure as well as behavioral practices. This focus on long-term project impacts aligns with the state's efforts to promote permanent, transformational changes that result in reduced GHG emissions profiles.

SWEEP is funded entirely through monies from the Greenhouse Gas Reduction Fund (GGRF), the repository for revenues from cap-and-trade allowance auctions conducted pursuant to Assembly Bill (AB) 32, the state's groundbreaking climate change law passed in 2006. As of April 2016, SWEEP had completed three granting rounds, with a fourth round of grant applications under review at the time of this writing. Table 1 summarizes the SWEEP funding rounds conducted to date.

In Appendix B, we discuss project eligibility criteria in greater detail and provide a summary of the evolving changes to the SWEEP request for proposals (RFPs) and related program guidelines. Currently, SWEEP requires that farmer applicants or their consultants calculate their own projected water and GHG emission reduction savings.

Table 1 – Details of each SWEEP funding round

Funding Round	Date Application Released	Funding Source	Funding Amount	Maximum Award Limit	Grants Awarded
Round 1	June 16, 2014	Emergency drought legislation (SB 103)	$10 million	$50,000	62
Round 2	September 29, 2014			$150,000	71
Round 3	May 18, 2015	Emergency drought legislation (AB 91)	$10 million	$150,000	100
Round 4	November 20, 2015	Budget Act of 2015 (SB 101)	$16 million[f]	$200,000	Pending

C. Methodology

To evaluate SWEEP's impact and program effectiveness, CalCAN examined three primary sources of information: (i) CDFA's program guidelines and solicitations/ RFPs for SWEEP funding Rounds 1-4; (ii) applicant-submitted and CDFA-calculated data for SWEEP funding Rounds 1-3; and (iii) descriptions of the projects approved for implementation for Rounds 1-3. Grant awards for the Round 4 solicitation period had not yet been announced at the time of this writing; thus, the analysis of its funded projects is not included here.

Program guidelines and RFPs are important aspects of the analysis, as they both dictate the types of projects considered and impact the ability of farmers to access the program. Data and details on the successfully funded projects further explain SWEEP's impact (e.g., number of acres enrolled in the program, types of new irrigation activities, water and GHG emissions reductions, etc.). Project data also describe demographics of the participating farmers/ranchers (i.e., location, crop type) and overall demand for the program.

Some projects that contained inconsistent and likely erroneous values and data were excluded from our analysis. See Appendix A for a detailed discussion.

We categorized SWEEP's total of 233 grants funded to date in the following ways:

- A **project** is the awarded grant project as a whole.
- **Activities** are categories of action that the grantee proposed to complete as a part of the project. To facilitate analysis, CalCAN created eight activity categories based on the actions described in the project descriptions that applicants provided (see Table 2). Most projects included multiple distinct activities.
- **Practices** are the specific management actions, described in project narratives, that make up each of the activity categories.

  CalCAN created the eight activity categories that are listed in Table 2. Corresponding practices are also listed in Table 2. An example of our categorization process is featured in the sidebar.

Example of methodology for categorizing SWEEP projects:

Using applicants' narrative descriptions of their projects, we identified specific management practices that each project will implement, then coded each of those practices as belonging to a specific activity category.

Sample Project Description:

SDI system on 40 acres of grapes to **replace flood irrigation system**. The **existing well pump and motor will be upgraded** to a more efficient setup and run in conjunction with **new drip system components**, including the use of **ET data based scheduling**. The existing **diesel gear-head will also be converted to an electrical setup** through local PG&E services to substantially reduce emissions. In addition, **a solar grid** will be installed to help combat electrical costs and promote the usage of renewable energy.

Practices:	***Activities:***
Conversion from flood to drip Irrigation	**Conversion to Efficient Irrigation**
Evapotranspiration-based scheduling	**Irrigation Scheduling**
Pump upgrade	
Pump replacement: diesel to electric	**Pump Improvements**
Solar power	

Table 2 – Project activities and practices

Activity Type	Practices
Conversion to Efficient Irrigation	conversion from furrow to drip, conversion from flood to drip, conversion from sprinkler to drip, subsurface drip irrigation (SDI), conversion from flood/furrow to sprinkler, conversion to precision [assumed micro = drip]
Irrigation Monitoring Equipment	in-line pressure sensors, flow meters, soil probes, pump monitoring, weather gauge/station, telemetry systems, irrigation management systems
Irrigation Scheduling	irrigation scheduling, evapotranspiration-based scheduling, automated controls
Leak Fixes	pipeline upgrades (e.g., concrete to PVC; aluminum to PVC), sulfuric acid machines
Pump Improvement	pump upgrades/improvements, pump replacements: diesel to electric, diesel to natural gas, natural gas to electric, solar powered, variable speed drive, variable frequency drive
Soil Management	cover crops, reduced tillage
Water Recycling and Treatment	water recycling system, filters, solution machines, greywater
Water Storage	rainwater harvesting, catchment

Our analysis of project activities and practices was dependent on the project descriptions provided by the grantees, which varied in structure and depth across the rounds. Round 3 project descriptions were more extensive and included more details than the descriptions from Rounds 1 and 2, which may have influenced our analysis. We have no knowledge of 'baseline' farm activities, as these were not described by applicants.

Data used in this report consisted of publicly available information on CDFA's SWEEP website, data obtained through a Public Records Act request by the nonprofit organization TransForm and shared with CalCAN, and additional data provided to CalCAN by CDFA upon request.

More details on the methodology for our data compilation and analysis can be found in Appendix A.

D. Program Demand

Interest in SWEEP increased with each solicitation round. Figures 1 and 2 show the funds requested versus awarded in Rounds 1, 2, and 3, and the number of grants requested versus awarded in Rounds 1, 2, and 3, respectively. For all rounds, applicants requested more than twice the available funds; in Round 2, SWEEP was oversubscribed by 448%. Similarly, for all rounds, the program received more than double the number of project proposals than it was able to award, with a peak interest in Round 3 of 345 applicants (100 of which were awarded).

Figure 1 – Funds requested vs. awarded, Rounds 1, 2, and 3

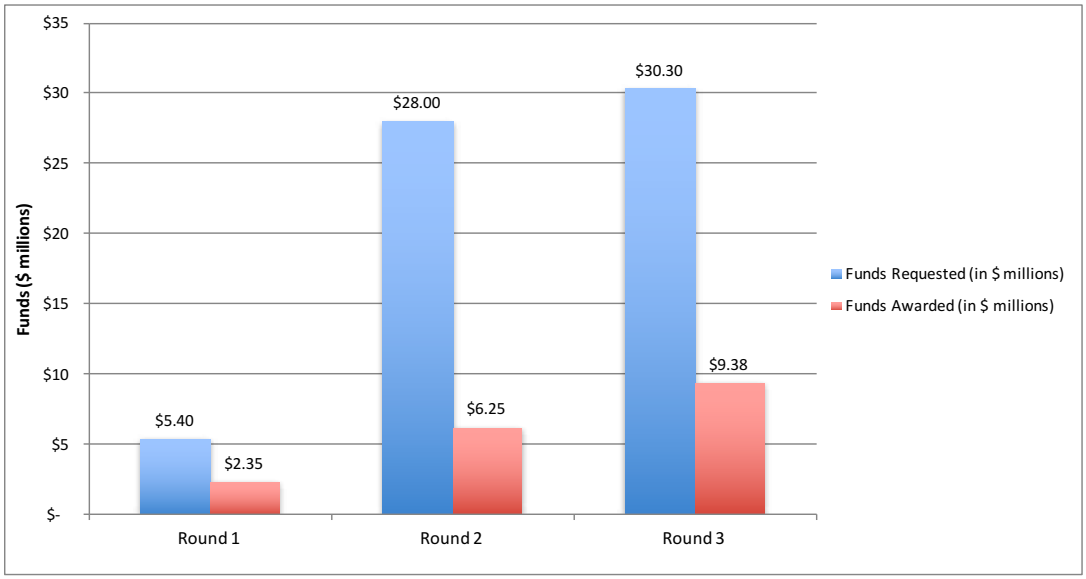
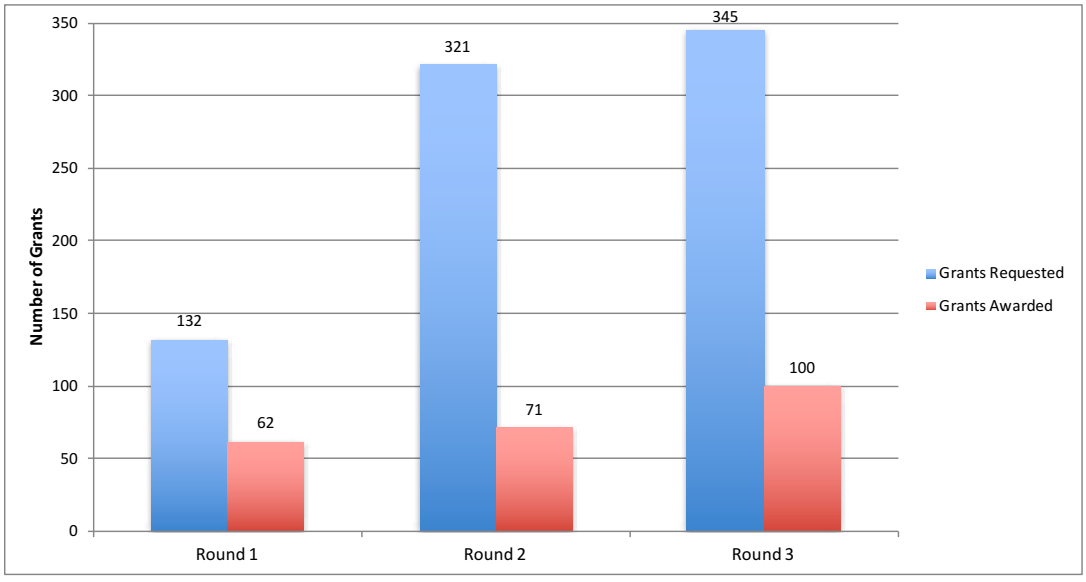


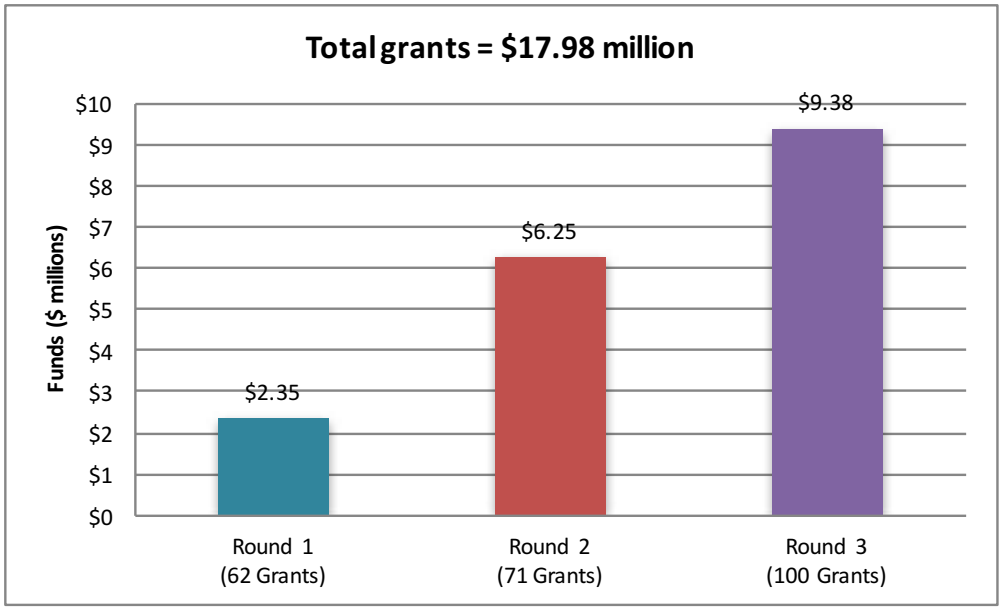
Figure 2 – Grants requested vs. awarded, Rounds 1, 2, and 3



E. Review of Funded Projects

As of January 2015, SWEEP had funded 233 projects[d] totaling $17.98 million, leveraging $10.57 million in matching funds. Figure 3 shows the number of grants and total funding amounts in Rounds 1, 2, and 3. Both the number of grantees receiving funding and the total amount of funds awarded increased with each round.

Figure 3 – Number of grants and total funding amounts, Rounds 1, 2, and 3

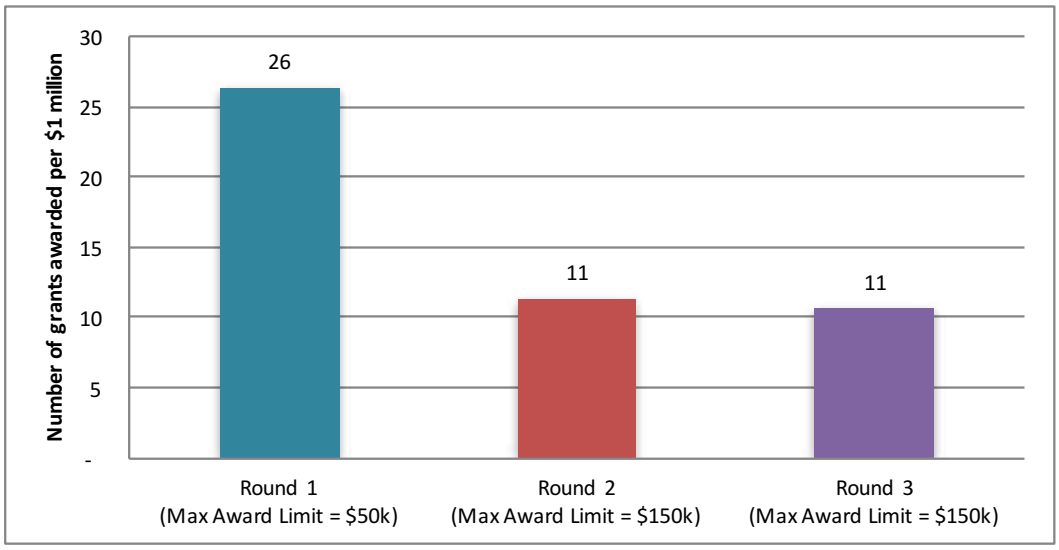


Following the first round of SWEEP grant awards, the Environmental Farming Act Science Advisory Panel (EFA SAP) recommended to CDFA that the maximum award limit be raised to $150,000 in Rounds 2 and 3, up from $50,000 per project in Round 1. CDFA subsequently raised the maximum award limit in Round 4 to $200,000.

Figure 4 shows the number of projects awarded in Rounds 1, 2, and 3. Round 1 supported the greatest number of grants per dollar of funding. The higher maximum award limit appears to correlate with lower numbers of grantees supported by the program in Rounds 2 and 3.

d This does not include 17 offered grants there were declined in Rounds 1 and 2 combined.

Figure 4 – Number of projects awarded per $1 million, Rounds 1, 2, and 3



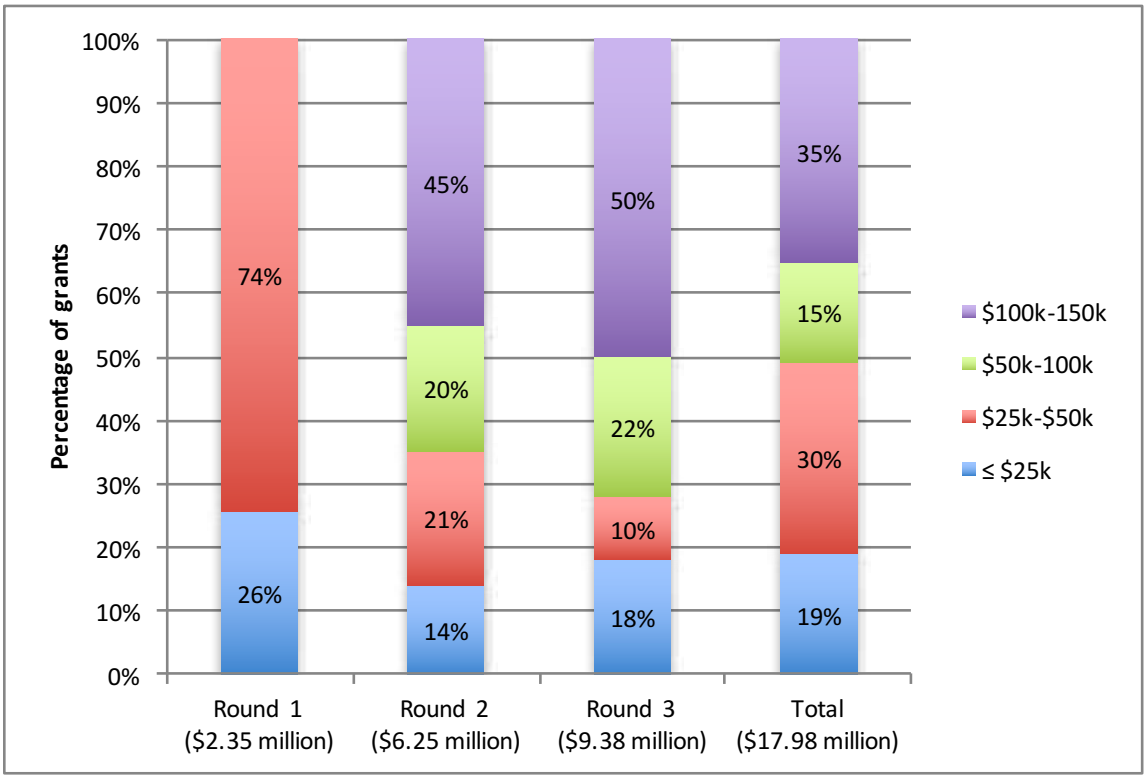
Additionally, with the increased maximum award limit between Rounds 1 and 2, the average grant size increased 232% from $37,870 (in Round 1) to $87,999 (in Round 2). Average grant size increased again to $93,846 in Round 3 despite no change in the maximum award limit.

Further exploring the issue of grant size across rounds, we categorized the funded projects into four funding brackets:

- Less than or equal to $25,000
- Between $25,001 and $50,000
- Between $50,001 and $100,000
- Between $100,001 and $150,000

Figure 5 shows the ranges of grant size by funding round, by four categories. As the project cap size increased so did the number of larger grants. Over half of all funds in Rounds 2 and 3 were granted to projects over $100,000. However, despite the increased project cap, 18% of Round 3 projects were less than or equal to $25,000. Across all three funding rounds, an average of 19% of projects were at or below $25,000.

Figure 5 – Ranges of grant size by funding round, Rounds 1*, 2, 3, and total



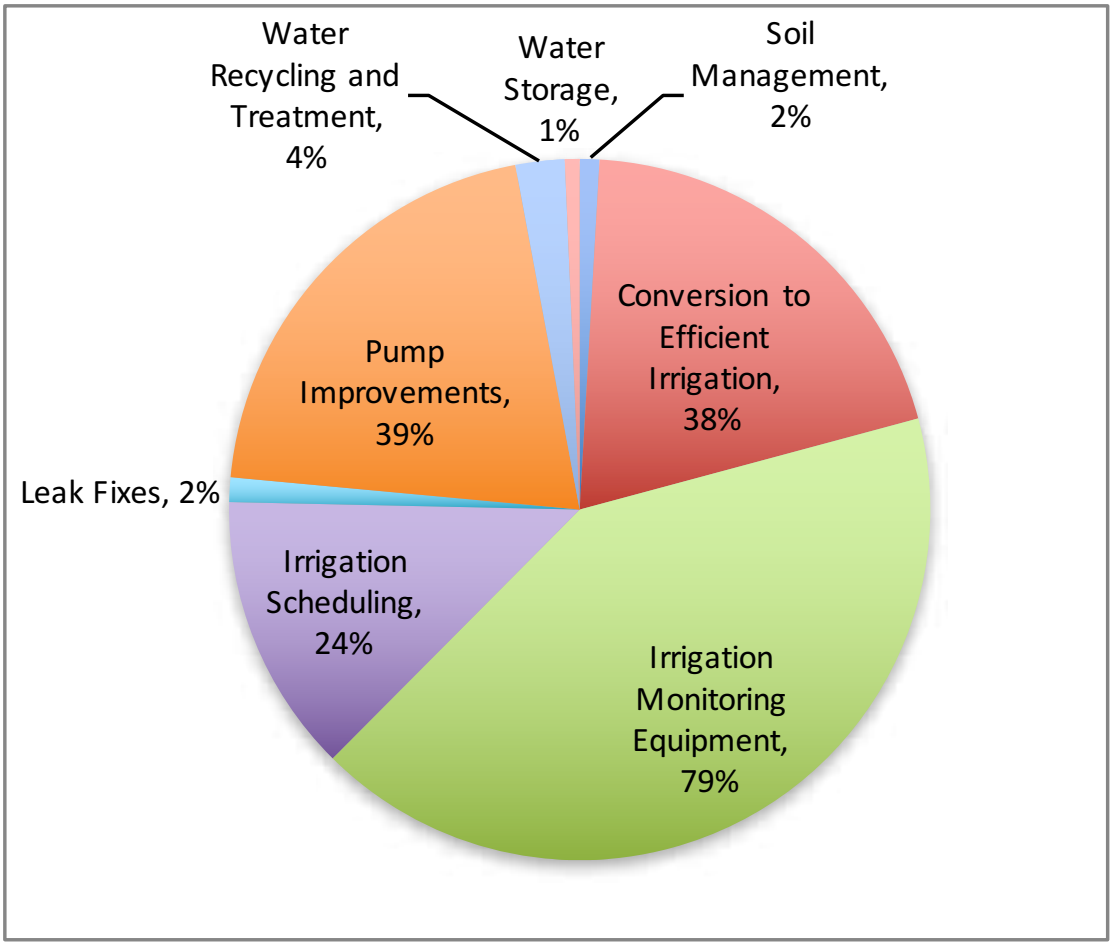
** Note: Round 1 grantees could only receive a maximum of $50,000 in SWEEP funds per project. As such, no projects are represented in the upper two funding brackets for Round 1.*

E.1. Activities and Practices

The 233 SWEEP-funded projects implemented a wide variety of water saving and greenhouse gas emissions reduction practices.

According to our analysis, a total of 442 activities were funded within the 233 SWEEP projects. Installation of Irrigation Monitoring Equipment was the most common activity type, while Water Storage was the least common. Figure 6 shows the percentage of total SWEEP activities, compared across all projects.

Figure 6 – Percentage of total SWEEP activities*, Rounds 1, 2 and 3

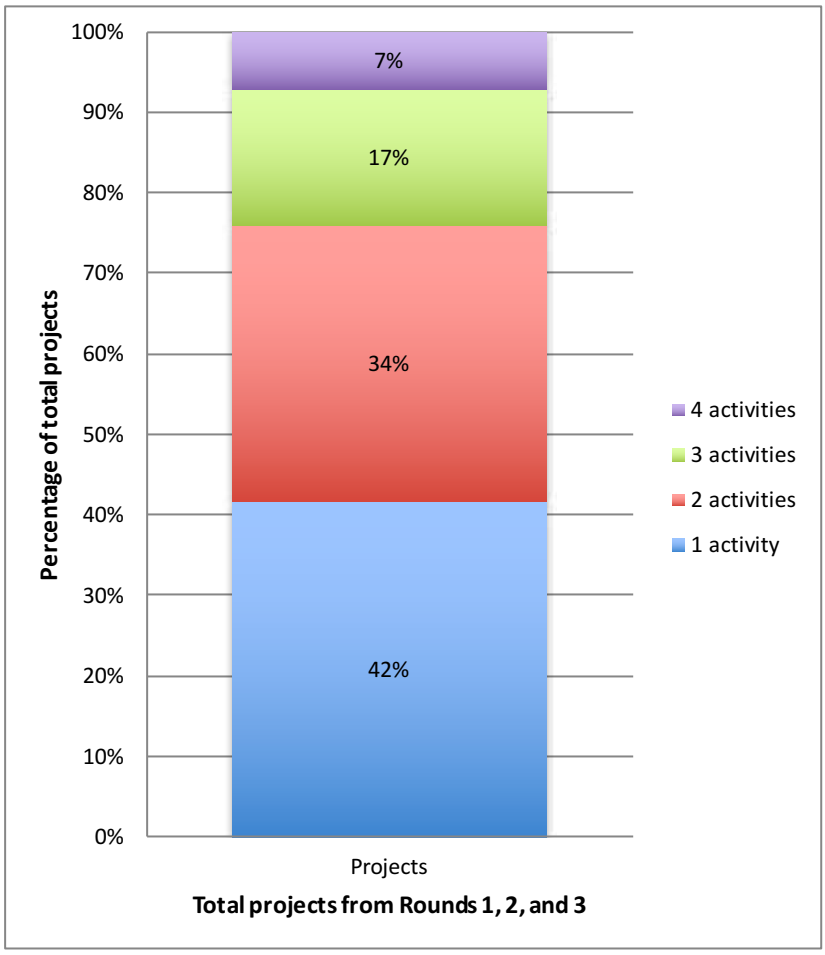


**Note: Percentages are based on the 233 projects funded by SWEEP to date. Many projects involved more than one activity type, therefore percentages add up to more than 100%.*

Applicants to Rounds 1 and 2 were encouraged to address more than one ranking criteria, while Round 3 guidelines made an important change, stating that projects "need to address" multiple ranking criteria. Therefore, we analyzed how many projects included practices that fell into one, two, three, or four of our designated activity type categories.

Figure 7 shows the number of activities involved in selected projects. To date, the majority of SWEEP projects implemented only one or two activity types, with just 7% (17 projects) including four activity types.

Figure 7 – Number of activities per project, Rounds 1, 2 and 3



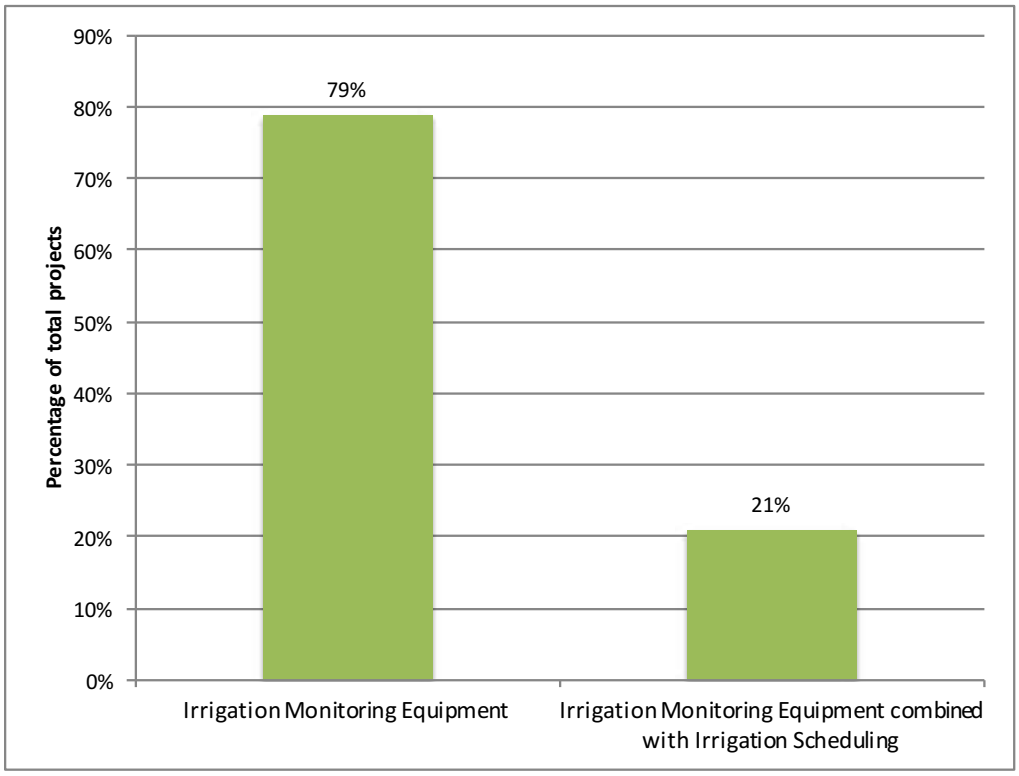
We also compared how many projects coupled Irrigation Monitoring Equipment and Irrigation Scheduling activities since their combined efforts create the greatest water savings benefit (see Sidebar).

Figure 8 shows the percentage of total projects utilizing Irrigation Monitoring Equipment, and the percentage of projects that combine Irrigation Monitoring Equipment with Irrigation Scheduling. Of the 233 funded projects, only 21% implemented Irrigation Scheduling in tandem with Irrigation Monitoring Equipment.

Irrigation Monitoring Equipment Coupled with Irrigation Scheduling

Irrigation Monitoring Equipment (e.g., soil moisture sensors) has the greatest water use efficiency when this equipment is used to inform improved Irrigation Scheduling. For example, irrigation application can be timed/scheduled to align with real-time plant water needs based on data gathered from the Irrigation Monitoring Equipment, potentially reducing irrigation events and application quantities. In some cases, improved irrigation scheduling has been shown to reduce water use by upwards of 20% while also increasing yields.[6] With smart scheduling, growers can often cut down the number and length of irrigation events, thus facilitating fewer pump operating hours among other efficiency benefits.

Figure 8 – Projects using Irrigation Monitoring Equipment; Projects using both Irrigation Monitoring Equipment and Irrigation Scheduling, Rounds 1, 2 and 3

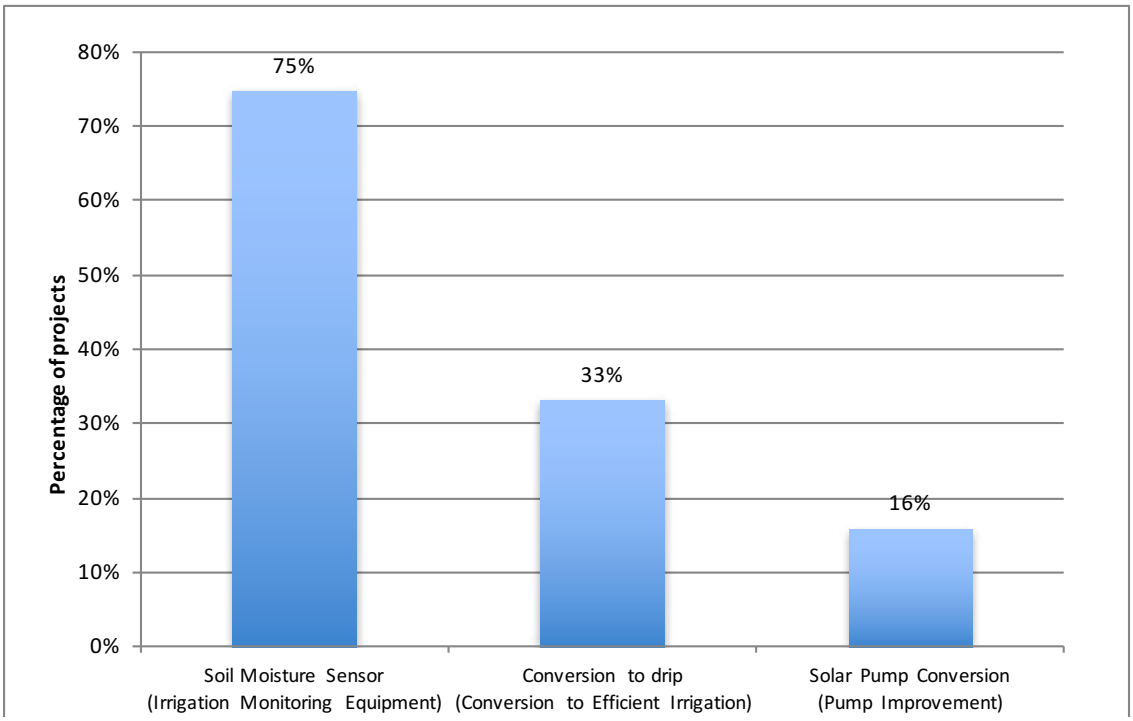


Within the three most common activity types—Irrigation Monitoring Equipment, Conversion to Efficient Irrigation, and Pump Improvements (see Figure 6)—we analyzed the inclusion of three specific practices to further understand the effectiveness of SWEEP grants. Soil moisture sensors (or similar devices), which provide crucial data for irrigation management decision-making, were installed in 75% of the 233 projects. Thirty-three percent of the projects transformed an irrigation application system altogether by converting to drip irrigation, which may decrease water usage. Solar energy generation, which can significantly reduce GHG emissions (especially when replacing a diesel pump engine), was a component in 16% of the projects.[e]

Figure 9 displays the percentages of projects that included soil moisture sensors, conversion to drip irrigation, or conversion to a solar-powered pump.

e Although it was not always explicitly stated in the project descriptions, we assumed that SWEEP-funded solar PV installations were mostly or exclusively intended to power pumping systems.

Figure 9 – Percentage of total projects that included soil moisture sensors, conversion to drip, conversion to solar pump, Rounds 1, 2 and 3



E.2. Greenhouse Gas Emissions Reductions and Water Savings

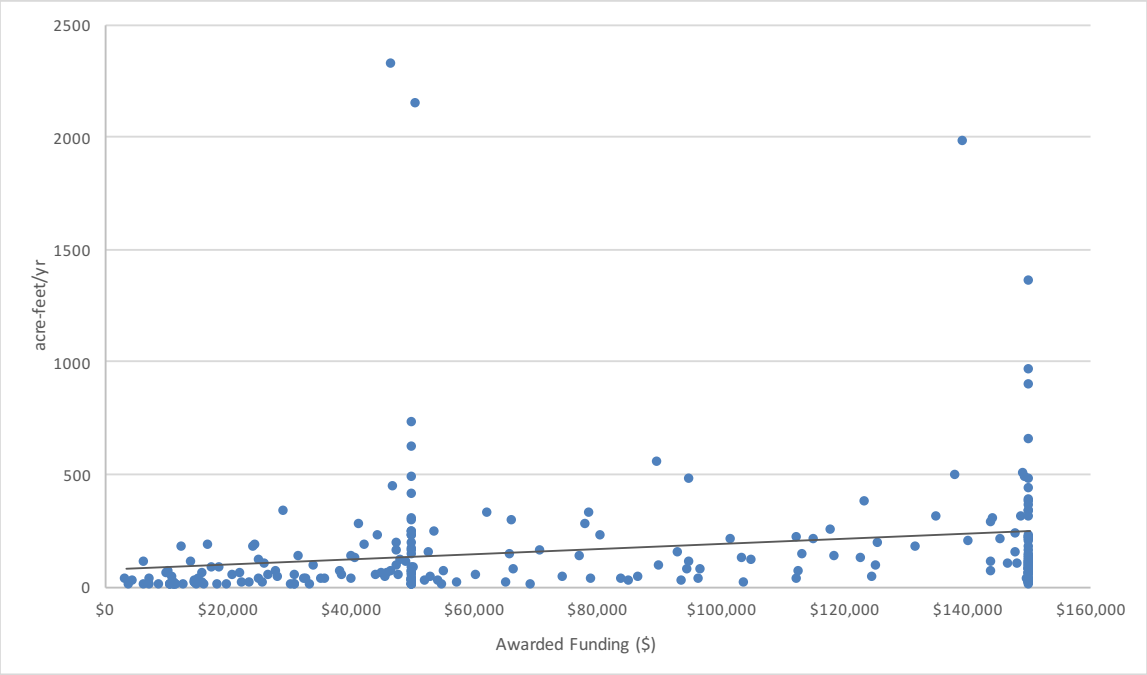
SWEEP projects funded across Rounds 1, 2, and 3 will save an estimated 37,490 acre-feet of water per year (approximately 12.2 billion gallons/year) and an estimated 11,278 Tonnes CO_2e per year[f] (the equivalent of taking 2,374 passenger vehicles off the road each year).[g]

While water savings trend slightly upward with increased grant size, GHG emission reductions remain almost flat with increased grant size. We find that small and large projects have similar GHG emission reduction potential. Figures 10 and 11 show awarded funding in relation to estimated water savings per project and estimated GHG reductions per project, respectively.

f Calculation excludes two outlier values of 21,320 and 22,098 Tonnes CO_2e/year.

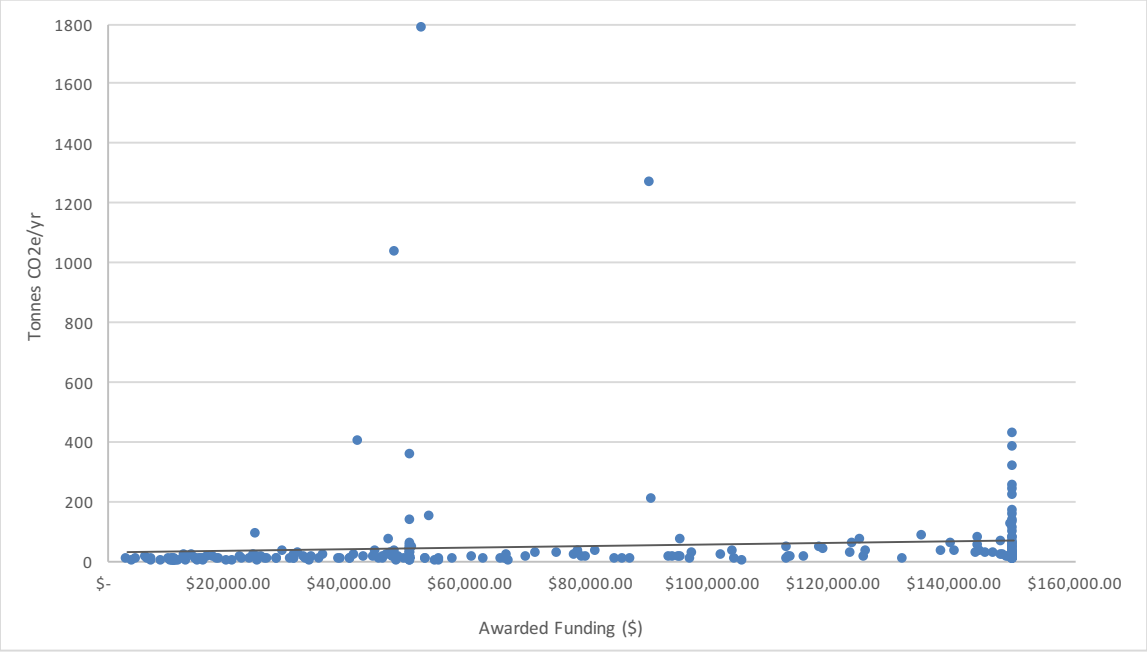
g Savings are expected to accrue annually over the 15-year lifetime of each Round 1 grant and the 10-year lifetime of each Round 2 and 3 grant.

Figure 10 – Awarded funding in relation to estimated water savings per project,* Rounds 1, 2, and 3



*Note: Round 1 projects were not required to have both water savings and GHG emission reductions. Therefore, the one project that reported zero water savings is not included.

Figure 11 – Awarded funding in relation to estimated GHG reductions per project,* Rounds 1, 2, and 3



*Note: Round 1 projects were not required to have both water savings and GHG emission reductions. Therefore, the one project that reported zero GHG emission reductions is not included. The two outlier values of 21,320 and 22,098 Tonnes CO_2e/year are excluded.

E.3. Geography and Agricultural Operations

SWEEP projects were located across 29 of California's 58 counties,[h] with Butte County receiving the most grants (38 out of 233, or 16% of all grants) and grantees in Fresno County receiving the highest combined total grant funds of any county (27 Fresno projects received $2.4 million, or 13% of awarded funds). For context, while Fresno County received $2.4 million for 27 grants, total funds awarded in Round 1 of $2.35 million were able to support more than twice as many projects, at 62 grants (see Figure 3). Of all SWEEP projects, 86 out of 233 (37%) were located in a disadvantaged community.

Table 3 lists the top 10 California counties by total projects awarded, including these counties' state ranking by total irrigated land; Table 4 lists the top 10 counties by total funding received, including these counties' average award amount. For the most part, the top 10 counties receiving the most awards align with the top 10 counties receiving the highest funding. The top three counties with the most irrigated land in the state were also among the counties receiving the highest number of SWEEP grants. Although Butte County received the most individual grants, it placed fifth in total funding awarded because Butte grantees received the smallest financial awards on average.

SWEEP reached 24,088 acres of agricultural land in Rounds 1 and 2.[i] Figure 12 shows the total project acreage per county in Rounds 1 and 2. Fresno County projects covered the greatest total land area at 2,795 acres, closely followed by Butte County at 2,669 acres.

It is notable that some of the state's key agricultural counties most impacted by drought have received zero or minimal SWEEP project funds. For example, San Diego County has only received three SWEEP grants, Riverside County has received one SWEEP grant, and Imperial County has not received any SWEEP grants.

Table 3 – Top 10 counties by total projects awarded, Rounds 1, 2, and 3

County	Number of Awarded Projects*	State Ranking by Total Irrigated Land[7]
Butte	38	14
Fresno	31	1
San Luis Obispo	25	24
Tulare	22	3
Monterey	21	10
Kings	17	7
Kern	11	2
Merced	9	5
Santa Barbara	9	19
Glenn	6	12

**Note: Values include some projects that crossed county lines and were therefore counted towards multiple counties' totals.*

h Counties include: Butte, Colusa, Contra Costa, Fresno, Glenn, Kern, Kings, Los Angeles, Madera, Merced, Monterey, Napa, Riverside, Sacramento, San Benito, San Diego, San Joaquin, San Luis Obispo, Santa Barbara, Santa Clara, Santa Cruz, Solano, Stanislaus, Sutter, Tehama, Tulare, Ventura, Yolo, and Yuba.

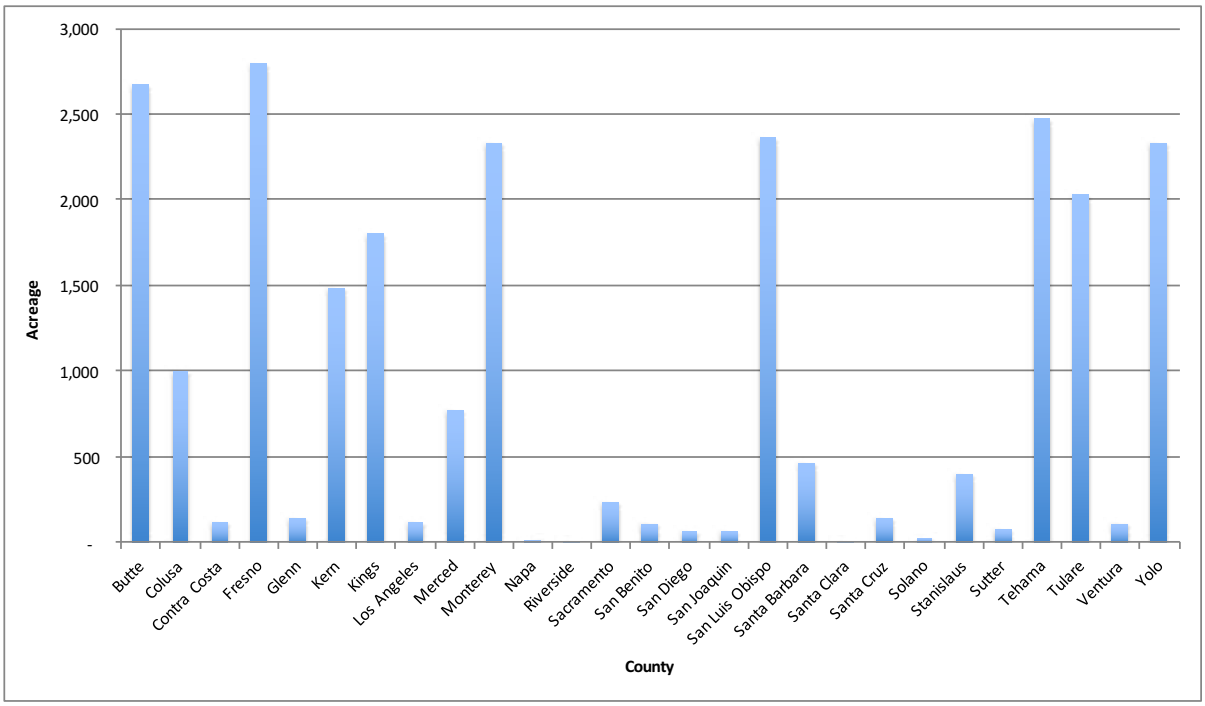
i Round 3 project acreage data was not available.

Table 4 – Top 10 counties by total funding received, including average award amount, Rounds 1, 2, and 3

County	Amount Funded*	Average Award Amount
Fresno	$2,415,146	$89,450
Monterey	$2,087,214	$104,361
San Luis Obispo	$1,795,808	$71,832
Tulare	$1,710,319	$90,017
Butte	$1,695,433	$45,823
Kings	$1,341,027	$95,788
Santa Barbara	$785,665	$87,296
Kern	$727,559	$66,142
Merced	$726,486	$90,811
San Joaquin	$537,420	$89,570

** Note: For projects that took place on operations that stretch across multiple counties, we were unable to determine what dollar amount went to activities in each county. Therefore, multiple-county projects were excluded from Table 4.*

Figure 12 – Total project acreage per county,* Rounds 1 and 2



**Note: Acreage totals include some projects that crossed county lines and were therefore counted towards multiple counties' totals.*

Crop types range from field crops, tree nuts and fruit trees, vegetable and fruit row crops, vineyards, nursery, hay and forage crops (see Appendix A for more information on these categories). Figure 13 shows the percentage of awarded projects by crop type, across Rounds 1 and 2. For comparison, Figure 14 shows the percentage of California irrigated lands by crop type. Tree nuts and fruit trees were the most-funded crop category, at almost half of Round 1 and 2 projects; tree nut and fruit tree crops comprise over a third of the irrigated agricultural acreage in California.

Figure 13 – Percentage of awarded projects by crop type, Rounds 1 and 2

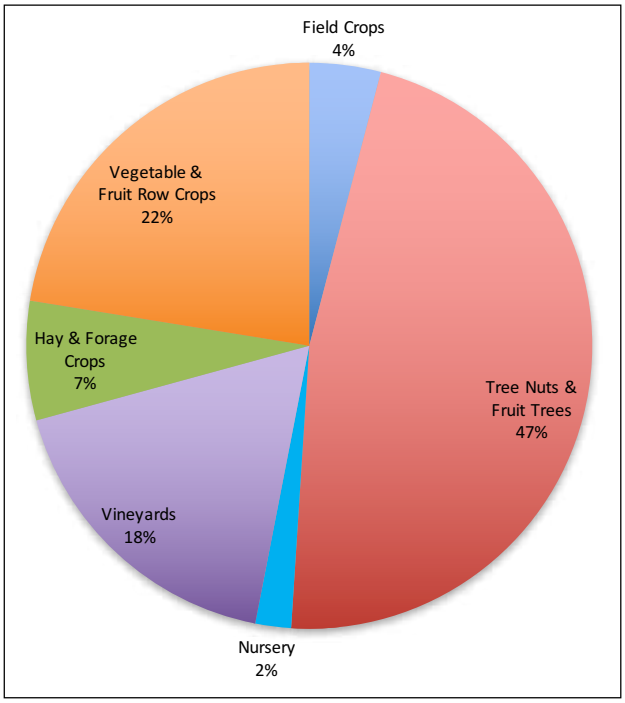
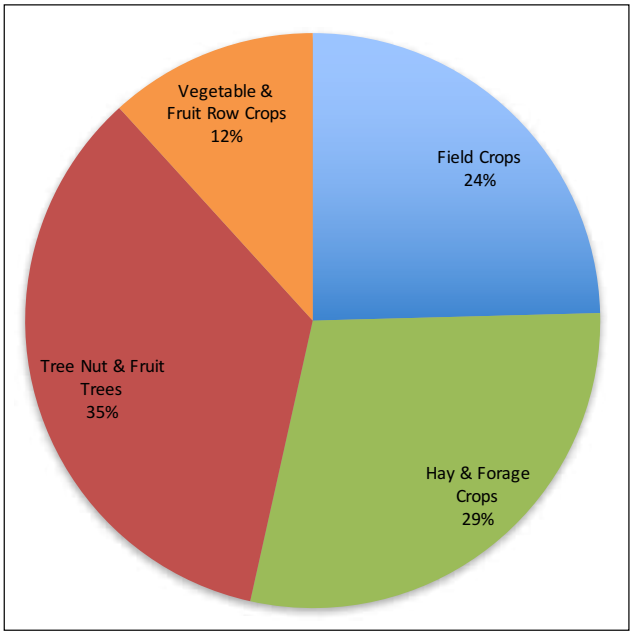


Figure 14 – Percentage of California irrigated lands by crop type[8]



F. Findings and Recommendations

F.1. Achievements to Date

As a drought emergency program, SWEEP was put into action quickly and successfully, with water savings and GHG reductions in place before year's end. The SWEEP efforts funded in 2014 alone (Rounds 1 and 2)[j] will save a significant amount of water and GHG emissions. These reductions—as well as the attendant environmental and public health co-benefits—will continue to accrue throughout the 10-year life[k] of the projects, benefiting the farmer grantees while helping California manage water consumption and meet its climate change goals.

SWEEP has incentivized the installation of many important water and GHG savings technologies, with soil moisture sensors as the most common single equipment type (see Figure 9). In addition to this standard activity, SWEEP funded some unique activities, such as on-farm water storage, water recycling activities, and on-farm solar energy production (see Figure 6). In Round 3 we observed an increase in the percentage of projects that implemented four activity types (see Figure 7), demonstrating a move towards more comprehensive—and potentially more transformative—approaches to tackling agricultural water savings and related GHG reductions.

In a fairly short period of time, the program has evolved to further its reach and efficacy while addressing a set of critical needs and highlighting the all-important water-energy-greenhouse gas nexus. In the Round 4 solicitation, we noted several promising advancements, including a drive to expand participation in the program by adding a preference for new SWEEP applicants; the explicit inclusion of beneficial soil management practices; strong recommendations for both technical assistance and farmer training; and the evolution of project criteria to better encourage comprehensive projects.

F.2. Summary of Recommendations

With its FY 2015-16 allocation of $40 million over two years, SWEEP has transitioned from a temporary, emergency relief program to becoming part of an annual GGRF budget allocation. Its annual budget has also increased approximately four-fold. As SWEEP continues to become more of a fixture in California's efforts to encourage on-farm water use efficiencies, CDFA can ensure its success by assuring the following key program characteristics:

1. Inclusive participation, accessibility, and reach
2. A clear and fair evaluation process
3. Incorporation of soil management practices
4. Support for farmer training and technical assistance

These characteristics will result in maximal impact and will assure the long-term viability of the funded activities and practices while addressing current gaps in existing state and federal outreach efforts.

While the program has clearly accomplished much and has improved during its first two years of operation (see Section F.1.), there remain issues to be addressed and opportunities for continuous improvement. The following section draws conclusions based on the data discussed above, and includes CalCAN's recommendations to CDFA as SWEEP continues to evolve.

j Round 3 estimated water savings and GHG emissions reduction data were not available.
k Round 1 projects were required to have a 15-year lifespan.

Finding #1: SWEEP's application process may discourage otherwise eligible participants from applying to the program.

Requiring a farmer applicant to complete a complex set of water usage and GHG emission calculations is an uncommon procedure for this type of grower-oriented grant program. Most grower applicants are not experts in this type of analysis, and similar programs—notably some offered by USDA's Natural Resources Conservation Service (NRCS), which provide direct grower incentives of hundreds of millions of dollars in California annually—do not require this. Their staff offers hands-on technical assistance for grower applicants, who are required to provide the farm-level data to inform conservation program calculations but are not required to perform the application calculations themselves.

The complex application requirements of SWEEP, coupled with a lack of dedicated technical assistance for growers, may account for some of the inconsistent values that were reported for estimated water savings and GHG reductions. For example, if we compare the grower-calculated estimated water savings and GHG emission reductions to the values calculated by CDFA grant-reviewers, almost half of the projects had their calculations corrected by CDFA. Specifically, 51 out of the 113 grants (combined Rounds 1 and 2) had their water savings calculations corrected and 53 out of the 113 grants had their GHG emission reductions corrected (not including minimal differences of +/- 1.0). In some instances, CDFA grant-reviewers found grower-calculated GHG emission data to be incorrect by values on the order of 1,000 and 10,000 Tonnes CO_2e.

Additionally, project descriptions and anecdotal evidence seem to suggest that applicants have relied heavily on private irrigation specialists, consultants, and product suppliers or manufacturers to help complete their SWEEP applications. CalCAN is aware of several irrigation equipment suppliers that have completed SWEEP applications for multiple growers, and even advertised these services on their website. While these entities provide a valuable service, they may be motivated by the desire to sell their equipment or system type, which can influence the types of projects being proposed for funding. This arrangement may also create a competitive disadvantage for some growers who do not rely on irrigation consultants.

CalCAN is encouraged to see the Round 4 RFP acknowledge the need for technical assistance to growers to support water conservation project development, highlighting Resource Conservation Districts (RCDs) and USDA-NRCS Technical Service Providers as important resources for growers.[l] The RFP specifically states: "The technical assistance of [a] professional irrigation specialist will improve the accuracy of GHG reductions and water savings calculations resulting in a more competitive application."[9]

However, stating that technical assistance is a good idea is not the same as making that assistance available. The state does not offer any financial resources to either support technical providers or grower costs for accessing these services. Without grower outreach and project proposal development by RCDs, UC Cooperative Extension and nonprofit organizations, SWEEP may fail to reach a significant portion of the state's 76,400 farmers. Expanding accessibility to the program will directly improve its effectiveness.

l CDFA had previously indicated a desire to highlight RCDs as an important technical assistance resource. In response to a CalCAN comment letter, Secretary Ross wrote: "As you note in your letter, Resource Conservation Districts are well positioned to assist growers and we intend to include this component in future SWEEP funding opportunities."

Additionally, we note that the current manner in which the 50% recommended matching fund requirement is implemented may be a deterrent to some farms. The applicant's own project expenses appear to only be considered 'matching funds' if spent on equipment, and 'in-kind' if spent on labor involved with the installation of the project. Given that it will take significant time to learn a new irrigation system, implement new soil management practices, and train additional staff, allowing these activities as eligible 'matching' expenses would provide a powerful incentive for growers to invest in the irrigation training and beneficial soil management practices that SWEEP does not itself fund.

Recommendations:

- **Provide technical assistance for project/application development.** Technical assistance is especially needed for those small and mid-scale operations that do not employ irrigation consultants and/or staff who can write grant applications. There are examples of other GGRF programs providing technical assistance for project development, including the Strategic Growth Council's Affordable Housing and Sustainable Communities program that provides technical assistance on grant development to nonprofits and developers in disadvantaged communities. Additionally, a closer look at potential ways to coordinate efforts with California NRCS may yield some creative ways to provide greater technical assistance to potential applicants.
- **Shift GHG emissions and water savings calculations to grant reviewers, not growers.** Growers should provide the farm-level data necessary to establish pre-project baselines, when available. However, they should no longer be required to submit their own GHG and water savings calculations. Since SWEEP administrators do not rely on the grower calculations and instead have the calculations redone by the expert grant reviewers, dropping the requirement of growers to do their own water and GHG savings calculations seems an easy fix that would improve the program's accessibility, especially for those applicants not working with consultants to complete their applications.
- **Include expenses (financial and time) for irrigation training services and soil management practices as eligible to count toward the applicant's 50% match.** This can offer a strong incentive for growers to invest in crucial irrigation training (more in Recommendation #4), which will in turn help to ensure that SWEEP-funded equipment is operated at maximum efficiency and produces the greatest benefit. Allowing expenses related to beneficial soil management practices is also consistent with the intent of CDFA's Round 4 guidelines.

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Finding #2: CDFA's process for ranking projects can provide greater clarity and transparency.

While CDFA provides some helpful guidance to applicants regarding project ranking criteria, examples of eligible activities, and project elements that merit additional consideration (see Appendix B for details), more can be done to inform applicants about how the different components of proposed projects are weighted. For example, it is unclear how 'additional considerations' in the Round 4 RFP—such as location in a disadvantaged community, soil management practices, new SWEEP applicants, etc.—are scored.

Other GGRF programs, and other grower-oriented incentives programs in general, typically provide applicants with scoring information that describes how many points can be earned through adherence to particular suggested criteria. For example, CDFA might indicate that projects will be evaluated on a 100-point scale, and that a certain number of points can be earned by satisfying one or more 'additional considerations.' A clear points-based ranking system could potentially offer applicants a greater incentive to include these additional project characteristics, as they would more clearly understand the importance of these criteria to their project's success.

Recommendation:

- **Provide scoring criteria for SWEEP applications.** Use of this standard granting practice will not only help to guide applicants' decisions as they design their projects, but it will also serve as a useful tool for CDFA to encourage certain project qualities or characteristics across future rounds of the program. Finally, it makes the program selection more transparent, an important principle in any state granting program.

Finding #3: Multiple grants to single entities and higher maximum project caps limit the program's reach. Water savings and GHG reductions were found to be similar across project sizes.

While SWEEP was able to fund 233 unique projects, this number may overstate the breadth of the program's impact. Based on the grant recipients' names and the counties in which projects were located, we estimate that at least 14 agricultural entities received SWEEP funding in two separate rounds (for a total of $2.14 million, or 12% of all funds), while at least three entities received funding in all three rounds (for a total of $941,502).

Additionally, there are multiple sets of projects that were funded within a given round that have identically-worded project descriptions, and in some cases identical water savings and GHG reduction estimates, which may indicate that closely-connected entities are receiving multiple grants. Unfortunately, this is not possible to verify using the available data.

Given that California has a sizable agricultural industry, with over 76,000 farms, it is in the interest of the state to extend the reach of SWEEP. To do so, California cannot afford to fund repeat applicants, but must seek new applicants and new projects.

We also note that the increased maximum award limit from Round 1 to 2 appears to have reduced the number of operations benefiting from SWEEP in subsequent rounds (see Figure 4). If Round 4 follows the same trend, its higher maximum award limit of $200,000—which was raised without input from the program's advisory body, the Environmental Farming Act Science Advisory Panel—may further reduce the number of grant recipients per $1 million spent.

According to CalCAN's analysis, average per-project GHG emission reductions are similar across award funding size (see Figure 11). As such, smaller projects should be understood to hold equitable climate change benefits compared to larger projects. While we observed that the number of projects at or below $25,000 peaked in the first Round at 26% of all funded projects, the percentage of these smaller projects declined in the second Round to 14% of total projects and increased slightly to 18% in the third round of funding (see Figure 5).

Ensuring funding for smaller projects extends SWEEP's reach amongst the 76,000 farms in California. Furthermore, with SWEEP as one of the first on-farm water and energy conservation programs in the state, the program is a prime opportunity to educate farmers about how their farming practices connect to the issue of climate change. In expanding the reach of SWEEP, CDFA can expand awareness of the agriculture-climate change nexus as well.

Recommendations:

- **Limit the amount of SWEEP funding an individual entity can receive across rounds.** SWEEP funding is a limited public resource that should aim to reach the greatest number of growers and achieve the greatest possible long-term water savings and related GHG emissions reductions. Therefore, we recommend that CDFA create guidelines that limit the amount of SWEEP funding any single farm operation can receive within the lifetime of the program and specify that the cap applies to farm operations not individuals (several of whom may have interests in a single entity). This is a common practice in USDA conservation programs, which limit eligibility based on income and limit total payments any grower entity can receive over the life of the current farm bill. We recommend a payment cap of $150,000 for the life of the program.
- **Use a project cap of $150,000.** As vetted by the Environmental Farming Act's Science Advisory Panel, the project cap for SWEEP was $150,000 for Rounds 2 and 3. To spread the program's impact both in terms of the number of funded projects and GHG emissions reductions achieved, we strongly recommend lowering the project cap from its current $200,000 to $150,000. SWEEP should follow the lead of California NRCS, which is moving away from funding expensive irrigation systems, instead focusing on incentivizing improved irrigation and soils management to increase soil water holding capacity (more on this in Finding #5).
- **Set aside 20% of SWEEP funds each round for 'small' projects of amounts equal to or less than $25,000, administered through a simplified application process.** CDFA should make an effort to ensure that at least 20% of projects are awarded in this funding bracket each round. We note that GHG emission reductions are similar across grant award sizes (see Figure 11). Actively encouraging small projects will maintain the program's accessibility, spread the impact of the program funds to more operations, and support less-resourced growers unable to provide a large match. A simplified application process could, for example, eliminate the requirement for excessive project details and project design attachments. Instead, applicants could simply check a box from a list of already-approved project types. These projects would be pre-assigned estimated/average water savings and GHG reductions determined by aggregating the first four rounds of data from this program. This would eliminate grower-required calculations and greatly streamline the application process for smaller projects. This type of process is akin to regional air district permitting for generators, where the district has an expedited application process for already-vetted generators.

Finding #4: SWEEP funds diverse activities and practices, but a lack of training for system managers may limit water and GHG emission reductions.

CDFA has made several attempts to diversify the suite of water and energy saving practices that growers employ, and to encourage truly transformative projects. Most notably, because of CDFA's strong emphasis on monitoring of soil moisture and plant needs, 79% of the 233 projects installed some form of Irrigation Monitoring Equipment (see Figures 6 and 8). However, over half of the funded projects that installed Irrigation Monitoring Equipment do not appear to have coupled it with Irrigation Scheduling activities (see Figure 7).

CDFA has taken steps to address this in the program's Round 4 solicitation by discussing the importance of irrigation training, specifically stating: "Irrigation training is a critical component to irrigation management and agricultural water conservation."[10] While the Round 4 RFP includes irrigation training as a criterion for additional consideration, this activity is not currently funded by SWEEP. This lack of designated funds limit grower access to irrigation management training.

Recommendations:

- **Fund irrigation management training for grantees to ensure that SWEEP-funded equipment achieves maximum benefit on the ground.** CDFA should do whatever it can to provide funds for irrigation training for farmers. Irrigation training could make all the difference in whether or not new irrigation systems are effectively deployed. A number of entities are already well equipped to provide these training opportunities, including RCDs, Cooperative Extension, and some universities (e.g., Cal Poly and Fresno State) along with some community college programs. Improved coordination with NRCS and possible leveraging of NRCS efforts and resources could also be a useful path to pursue.
- **Allow irrigation training expenses to be eligible towards the grantee's 50% match (See Finding #1).**

Irrigation Systems Coupled with Farmer Training

Irrigation system upgrades will only produce the targeted water, energy and GHG savings if operated efficiently by the grower. Growers need greater access to training in order to make proper use of the most up-to-date irrigation technologies;[11] a 2010 survey found that many farmers in the San Joaquin Valley had received no technical assistance on water use and did not know how to implement irrigation scheduling.[12] Both initial and ongoing training for farmers is needed to implement irrigation management practices that work best within the context of each individual operation.

Finding #5: SWEEP does not reward soil management activities with proven benefits.

Soil management activities that increase soil organic matter can offer long-term water and GHG savings with minimal infrastructure. Healthy soil management activities on farms have the unique ability to increase the water holding capacity of soils, lessening their irrigation requirements, while also mitigating the effects of climate change. These activities also align with Governor Brown's Healthy Soils Initiative, which aims to draw down carbon from the atmosphere and store it in agricultural soils, part of the state's plan to reduce GHG emissions 40% by 2030.

However, just 2% of all SWEEP projects implemented soil management practices (i.e., application of mulch and cover crops) to reduce water use and lower GHGs (see Figure 6). CDFA added Other Management Practices as a project option in Round 2 and 3 applications, but this addition did not demonstrably increase the number of projects funded for implementing soil management practices. CDFA's addition of Soil Management Practices as criteria for 'additional consideration' in Round 4 application (see Appendix B) may increase this small percentage.

Our analysis has shown that CDFA's use of ranking criteria that are correlated with specific activities increases the funding of projects that implement those activities. Activities that were included only in the general category of Other Management Practices (i.e., Soil Management, Leak Fixes, Water Storage, and Water Recycling and Treatment), with no related ranking criteria, represent a mere 9% of the implemented activities (see Figure 6).

Recommendation:

- **Include soil management activities as a primary ranking criterion and provide tools to application reviewers for calculating water and GHG reductions through the use of these practices.** CDFA should work with the California Air Resources Board (ARB), the agency that oversees AB 32 implementation and GHG quantification methods, to develop tools that estimate GHG and water use reductions from soil management practices that have been shown to increase water-holding capacity and sequester carbon. This tool will need to account for the long-term benefits of these activities. Two models developed under the direction of USDA-NRCS, COMET-Farm and COMET-Planner, are potential options for fulfilling this need that CDFA should assess and adapt to be incorporated into ARB methodology.

How do soil management practices achieve water use and GHG reductions?

California farmers increasingly employ soil management techniques to retain soil moisture, increase infiltration, and cut down on water use.[13,14] Farming practices with a proven ability to increase soil organic matter (SOM) result in more water being held in the soil where it is plant-available. This relationship between SOM and Available Water Capacity is well established in the scientific literature.[15,16] Cover crops, conservation tillage, compost applications, and other practices can increase SOM.[17,18] NRCS currently incentivizes a number of soil management practices[m] for their ability to increase water-holding capacity.[19] Many of these practices have the added benefit of reducing GHG emissions by sequestering carbon in the soil and diminishing the application of fossil-fuel-derived fertilizer products.[20]

m Conservation practices resulting in available water capacity favorable to soil function include: Conservation Crop Rotation; Cover Crop; Prescribed Grazing; Residue and Tillage Management; Salinity and Sodic Soil Management

Finding #6: Some funded activities appear counter to the program's long-term objectives.

SWEEP has funded some activities that do not seem to fully align with the program's overall goals to reduce water usage and GHG emissions. For example, eight projects included the installation of automated fertigation equipment,[n] which, at best, could potentially maintain on-going nitrous oxide emissions associated with fertilizer or, at worst, increase those emissions. Although many projects with Pump Improvement activities moved away from fossil fuels (see Figure 9), one grant was used to install two new diesel engines, while other projects paid for natural gas-powered engines. These activities seem to be inconsistent with SWEEP's ranking criteria for water pumping, which specifically highlight conversion of pump energy sources from a "fossil fuel pump to solar, wind or electric."[21]

Recommendation:

- **Convene a meeting of EFA SAP to review the consistency of fertigation, natural gas pumps, and other project activities within SWEEP program goals.** We acknowledge that strict funding guidelines for specific activities under SWEEP may unnecessarily limit innovative on-farm water management. We suggest developing criteria to avoid funding projects that do not meet SWEEP's ultimate purpose and intent of shifting away from fossil fuel-intensive management practices.


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n Rounds 1-3 solicitations include "facilitation of nitrogen fertilizer management with irrigation management to reduce the movement of nitrates to groundwater" as an environmental co-benefit.

Finding #7: SWEEP does not reach some of the regions of the state most impacted by drought.

While SWEEP has funded projects across 29 California counties, some of the counties most impacted by the drought are conspicuously under-represented or absent from the list of grant recipients (see Section E.3). Imperial County, for example, ranks sixth in the state for total irrigated land[22] and has been in Severe Drought (according to the U.S. Drought Monitor) for much of the past two years—yet not a single SWEEP project from Rounds 1, 2, and 3 was awarded in this county. Similarly, drought-plagued growers in San Diego County—which has the greatest number of farms of any county in the state—have received only three SWEEP grants to date.

Recommendation:

- **Consider using administrative funds to support outreach to farmers by partner organizations that have a demonstrated track record of delivering grower-related programs in under-represented agricultural regions.**


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G. Looking Forward

In this progress report, we have identified multiple ways to improve SWEEP's delivery to diverse growers across the state. Some of the issues we raise will be relatively easy to address within the current program format; others will prove more intractable and may suggest a need for structural changes to how SWEEP is designed and implemented. As SWEEP continues to evolve, we encourage CDFA to consider further adaptations to the structure of the program.

Competitive grant programs oriented directly to growers can be cumbersome to administer, with a high demand on staff time and resources. They also create an atmosphere in which farmers are pitted against one another to compete for funds, when in actuality the state's climate change goals center around collective action to adapt to and mitigate the effects of a changing climate.

CDFA might consider alternative program models, such as a block grant structure wherein CDFA delivers grants to local-level entities that then identify eligible projects, rather than CDFA delivering each grant directly to the farmer. This model is not unheard of within other GGRF-funded programs. For example, under the Low-Income Weatherization Program, recipients of the weatherization services do not themselves apply for grant funding. Instead, 'program providers' receive the state funding and disperse the funds on a rolling basis until the monies are fully expended. These 'program providers' are responsible for gathering the appropriate project-level data, analyzing it, and reporting it to the Department of Community Services and Development (CSD), which in turn reports to ARB. A similar approach in agriculture is possible. CDFA might allow a 'provider' of technical expertise (such as an RCD, Cooperative Extension farm advisor, or non-profit) to receive funding, and that 'program provider' would then bear the responsibility for gathering and reporting the appropriate project-level data as well as determining project eligibility. Under this format, SWEEP would largely eliminate the onerous grower application process, as well as provide an incentive for 'program providers' to provide technical assistance and training, and it would offer more avenues for improved outreach in those counties and industry segments currently underserved by the program.

SWEEP would also be made more inclusive, as CDFA could select local-level 'program providers' that have relationships with farmers and can better reach the growers currently underserved by the program. The entity administering the funds would be responsible for ensuring the proposed projects meet program eligibility, including conducting calculations. At the same time, these 'program providers' would give technical assistance to project recipients.

Another option to consider, as we look to achieve a program with an even broader reach, is a revolving loan program. Other states offer low-interest revolving loans as a way to encourage new practices. One advantage of a loan program over grants is that as loans are repaid new projects can be funded, allowing the program to continue on past the life of its original funding source—in this case the GGRF, which will cease operations by 2020 unless extended.

H. Conclusion

In its short tenure, SWEEP has incentivized the installation of many efficient technologies. With SWEEP's transition from a temporary to an annual funding source, it is crucial that the program continues to evolve towards emphasizing key program characteristics of inclusive and accessible participation; a clear and fair evaluation process; incorporation of soil management practices; and support for farmer training and technical assistance.

We encourage CDFA to continue pursuing a SWEEP vision that includes alternative on-farm practices such as soil management practices that improve water-holding capacity and build soil health, and techniques like on-farm water ponds that can improve overall water savings.

CalCAN believes a robust, long-lasting SWEEP will consider inclusive participation with technical assistance, establish a clear evaluation process, seek synergies with existing healthy soils incentive programs such as CDFA's new Healthy Soils Initiative, and keep the longevity of practices in mind by supporting on-going farmer training.


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Appendix A: Methodologies

In order to evaluate SWEEP's impact and program effectiveness, CalCAN examined three primary sources of information: (i) CDFA's program guidelines and request for proposals (RFPs) for SWEEP funding Rounds 1 - 4; (ii) applicant-submitted and CDFA-calculated data for SWEEP funding Rounds 1 - 3; and (iii) descriptions of the projects approved for implementation for Rounds 1 - 3. Grant award decisions for the Round 4 solicitation period had not been made at the time of this writing; thus, the analysis of its funded projects is not included in this report.

Program guidelines and RFPs are an important element of the analysis, as they dictate both the types of projects considered and impact the ability of farmers to access the program. Data and details on the successfully funded projects further explain SWEEP's impact—e.g., number of acres enrolled in the program, types of new irrigation activities, water and greenhouse emissions reductions, etc. Funded project information also provides some details on the demographics of the participating farmers/ranchers (i.e., location, crop type) and overall demand for the program.

Data Sources

SWEEP Applications

First, we examined CDFA's solicitation materials for Rounds 1-4 of SWEEP. This data is publicly available on CDFA's SWEEP website.[o] Information gathered from these sources included the following:

- Application timeline
- Project eligibility
- Project ranking criteria and 'additional consideration' characteristics
- Project assistance
- Grant questions specific to farmer/rancher operations and project design
- Water use and GHG emission calculation tools

CDFA's program guidelines and RFPs were not uniform across all four funding rounds. Some of these differences and evolutions are discussed in our analysis.

Additional data sources related to the SWEEP applications included: SWEEP application FAQs, official press releases about the program, and CDFA application workshop presentations.

o SWEEP website: https://www.cdfa.ca.gov/EnvironmentalStewardship/WEEP.html. Round 1 and 2 grant recipient data were dated August 11, 2015; Round 3 grant recipient data was dated December 2015, and Total Funded Projects and Metrics were dated April 8, 2016.

Awarded Projects

A limited set of data on SWEEP-funded projects is publicly available (in PDF format) on CDFA's SWEEP website and included the following information from each SWEEP grant awarded:

- Agriculture operation name
- Qualitative project description
- County (or counties) of awarded project
- Grant award dollar amount
- Cost share in dollars
- Location in a disadvantaged community (yes/no)
- CDFA-calculated estimated annual GHG reductions (MT CO_2e/year)
- CDFA-calculated estimated annual water savings (acre-inches/year and acre-feet/year)

Requested Data

CalCAN requested and received additional data from CDFA. The requested information is listed below:

- Total acreage covered under each funded project
- Acres under cultivation at each granted entity's operation (Note: CDFA did not have this data)
- Information on the type of crop(s) being grown by each grant recipient
- Total applications submitted for each of SWEEP Rounds 1, 2, and 3
- Total grant funds (in $) requested for each of SWEEP Rounds 1, 2, and 3 (accepted + rejected applications)
- Round 1 and 2 SWEEP grants Disadvantaged Communities data (only Round 3 data was publicly available at the time of the request)

Some data on grower-calculated estimated water savings and GHG emission reductions for awarded projects in Rounds 1 and 2 was obtained through a Public Records Act request by the nonprofit organization TransForm, and shared with CalCAN.

Methods for Data Calculations, Interpretation and Assumptions

Grower-calculated Water Savings and GHG Emission Reduction Calculations

CDFA-calculated estimated water savings and GHG emission reduction data was used for our graphs and averages. Grower-calculated data was used to support some of our recommendations.

Grower-calculated estimated water savings and GHG emission reductions data was provided in acre-inches/acre/year and Tonnes CO_2e/acre/year, respectively, for Rounds 1 and 2. Round 3 grower-calculated data was not available. In order to evaluate the total impact of reductions in Rounds 1 and 2, we used Equations A.1 and A.2 to calculate the annual savings for each project.

Equation A.1:

*Estimated yearly water savings (acre-feet/year) = (Projected project water savings (acre-inches/acre/year) * Project acreage (acre)/(12 acre-inches/year)*

Equation A.2:

*Estimated yearly GHG emission reductions (Tonnes CO_2e/year) = Projected project GHG emission reductions (Tonnes CO_2e/acre/year) * Project acreage (acre)*

Round 1 projects were not required to have both water savings and GHG emission reductions. Therefore, projects that reported zero water savings or GHG emission reductions were not included in calculated reduction averages. Two inconsistent values were reported for estimated GHG reductions that did not align with averages, and as such were removed as outliers (21,320 MT CO_2e/year and 22,098 MT CO_2e/year).

Crop Data

Crops were classified into six categories, adapted from USDA's Census of Agriculture crop categories.[23] Table A.1 lists the crop categories and accompanying specific crops. Crop data were provided for Rounds 1 and 2. Round 3 crop data was not available. Many projects included more than one crop type.

Table A.1 Crop Categories

Crop Category	Specific crops
Field Crops	wheat, corn
Nursery	whole sale plants, seeds
Hay & Forage Crops	hay, alfalfa
Tree Nut & Fruit Trees	all nut and fruit trees; includes olives
Vineyards	grapes
Vegetable & Fruit Row Crops	all fruits and vegetables not grown on trees

Projects, Activities, and Practices

We categorized the funded projects by the following:

- A **project** is the awarded grant project as a whole.
- **Activities** are categories of action that the grantee has proposed to complete as a part of the project. To facilitate analysis, CalCAN created eight activity categories based on the actions described in the project descriptions that applicants provided (see Table A.2). Most projects included multiple distinct activities.
- **Practices** are the specific management actions that make up each of the activity categories.

Projects

There were 233 projects awarded and accepted within the first three rounds. Our project-level analysis looks at each grant to an operator as a single distinct action.

Activities and Practices

The 233 SWEEP-funded projects implemented a wide variety of water saving and GHG emissions reduction practices. We categorized these practices by activity type in order to facilitate analysis. Activity type categories were drawn from a survey of the qualitative practices in the project descriptions that were provided by SWEEP applicants. Most projects covered multiple distinct activity categories.

CalCAN created the eight activity categories and corresponding practices that are listed in Table A.2. CalCAN's activity categories were not identical to CDFA's ranking criteria (see Appendix B for additional discussion of ranking criteria). Solar power practices were assumed to be for Pump Improvements, except when explicitly correlated with powering weather stations (classified as Irrigation Monitoring Equipment). Each project had the potential to include more than one activity, and we assigned a maximum of four activities for each project.

Table A.2 – Project activities and practices

Activity Type	Practices
Conversion to Efficient Irrigation	conversion from furrow to drip, conversion from flood to drip, conversion from sprinkler to drip, subsurface drip irrigation (SDI), conversion from flood/furrow to sprinkler, conversion to precision [assumed micro = drip]
Irrigation Monitoring Equipment	in-line pressure sensors, flow meters, soil probes, pump monitoring, weather gauge/station, telemetry systems, irrigation management systems
Irrigation Scheduling	irrigation scheduling, evapotranspiration-based scheduling, automated controls
Leak Fixes	pipeline upgrades (e.g., concrete to PVC; aluminum to PVC), sulfuric acid machines
Pump Improvement	pump upgrades/improvements, pump replacements: diesel to electric, diesel to natural gas, natural gas to electric, solar powered, variable speed drive, variable frequency drive
Soil Management	cover crops, reduced tillage
Water Recycling and Treatment	water recycling system, filters, solution machines, greywater
Water Storage	rainwater harvesting, catchment

Within the three most common Activity types—Irrigation Monitoring Equipment, Conversion to Efficient Irrigation, and Pump Improvements—additional practices were highlighted to further understand the scope of funded SWEEP projects. These practices included soil moisture sensor installation, conversion to drip irrigation, and conversion to solar pump energy. Micro irrigation was assumed to be drip irrigation. Each project was assigned a "yes" or "no" for each of these three practices. Each project was categorized by the activity and practice types featured. Our analysis of project activities and practices was dependent on the project descriptions provided by the grantees, which varied in structure and depth across the rounds. Round 3 project descriptions were more extensive and included more details than the descriptions from Rounds 1 and 2, which may have influenced our analysis. We have no knowledge of existing farm activities, as this was not required in the applications.

Data Review

To ensure accuracy, two CalCAN staff members independently came to agreement on the appropriate categorization(s) for each set of project details (activities, practices, and crops). A third CalCAN staff member arbitrated any disagreements in categorization before the data was analyzed. Water savings and GHG emission calculations were also peer-reviewed.

Appendix B: Evolving Guidelines and RFPs

All four application rounds used the state's online Financial Assistance Application Submittal Tool (FAAST) portal for applicant submittals. CDFA staff review applications to ensure completeness and eligibility. Proposals that pass the administrative screening are then evaluated on their technical merit by external irrigation specialists affiliated with the state of California and the University of California system.

Awarded projects require a follow-up project evaluation to ensure completeness. Starting in Round 2, CDFA has contracted with RCDs to confirm that funded projects have been installed, and that the new irrigation systems and management will achieve water savings and related greenhouse gas reductions. Below we provide more details on the application requirements and process.

Program Eligibility and Criteria

SWEEP is open to California agricultural operations, defined as row, vineyard, field and tree crops, commercial nurseries, nursery stock production and greenhouse operations.[24] The program is not available to dairy and other livestock operations. While grant awardees cannot submit an application for duplicate property locations each round, CDFA encourages them to apply for new projects on different property locations (as documented by Assessor's Parcel Number).[25]

While Round 1 projects were only required to either reduce water use or reduce GHG emissions, Rounds 2, 3, and 4 required applicants to propose how their projects would achieve both benefits.

SWEEP funding can pay for supplies, equipment, and contractors directly related to the awarded project, but cannot support costs associated with project design, maintenance and management. Within the program requirements for Rounds 1 - 3, there was no explicit indication of whether or not training to support efficient irrigation management and technical assistance for growers to complete applications could be a covered cost;[26] however, the Round 4 guidelines clarify that technical assistance and irrigation training courses cannot be covered by SWEEP grant funds.

Project eligibility and criteria for Rounds 1 - 3 closely mirror one another, with some evolution across each round. The Round 4 solicitation features some changes to the nomenclature and content around project eligibility and criteria.

Round 1, 2 and 3:

CDFA established ranking criteria for use in evaluating the merit of proposed projects. CDFA included the following ranking criteria to evaluate SWEEP applications (see Appendix C for definitions of terms):

- Largest water savings (acre-inches/acre/year) and largest GHG savings (Tonnes of CO_2e/acre/year)
    - Round 1 did not require both water savings and GHG savings; Round 3 removed this criterion from the main criteria list but still suggested highest water savings as an intent of SWEEP
- Project is located in identified drought designation area as of April 29, 2014
    - Round 1 only, not included in subsequent funding rounds

Ranking criteria suggested preference for projects that included one or more of the following practices:

- Soil moisture sensors
- Evapotranspiration-based scheduling
- Water pumping
- Micro-irrigation or drip systems
- Low pressure systems
- Variable frequency drives
- Other management practices
    - This criterion added in Rounds 2 and 3

CDFA's ranking criteria also indicated further consideration for projects with additional environmental co-benefits and/or locations within disadvantaged communities, but it is unclear how heavily these criteria are weighted during the application review process.

Application guidelines also recommend a 50% match of the total project cost, but this is not a requirement.

Changes in Round 4:

The Round 4 solicitation removed the ranking criteria, and instead detailed seven project types. These seven project types closely align with the above ranking criteria, but are organized separately into Water Conservation Priorities, Greenhouse Gas Emission Reduction Priorities, and Other Management Practices. One notable change in Round 4 is the requirement that all projects with soil moisture sensors must also include weather or plant based sensors that are explicitly linked to irrigation scheduling. For the first time, all Round 4 projects are required to include flow meters for the purposes of tracking water usage.

Notably, Round 4 guidelines expanded the list of project characteristics warranting 'additional consideration' to include: (i) irrigation training; (ii) location within a critically over-drafted groundwater basin; (iii) soil management practices that increase water-holding capacity (specifically cover cropping, mulching, compost application, and resource conserving crop rotation); (iv) new SWEEP recipients; and (v) location in a disadvantaged community.

Water Savings and GHG Reduction Calculations

Modifications to the SWEEP RFP across rounds have allowed CDFA to gather incrementally more complete data on applicants' 'baseline' operations and the water management projects they propose. The Round 3 application requested information on applicants' crop type(s), irrigation district and water source (i.e., surface or groundwater). The Round 4 application form added total farm size (in acres) to this list.

The SWEEP application form requires growers to calculate their proposed project's estimated water savings and GHG emission reductions. The Round 1 RFP provided a set of online calculators to complete these estimates; RFPs for Rounds 2, 3, and 4 each iteratively attempted to improve the quality and usability of the calculators, but still required the project applicant to assemble the necessary data and complete the calculations. The calculators[p] require specific information for each farm as inputs to calculate baseline water usage and GHG emissions, including utility bill information, crop type, current irrigation management equipment, and soil type, to name a few. Multiple water usage equations are provided and explained. Emission factors are given for various fuel types along with definitions and explanations of general GHG terms.

CDFA has recognized that these calculations can be challenging for growers to use[27] and recommends that applicants work with available experts, such as utility companies, USDA-NRCS, RCDs, and irrigation supply companies, to determine baseline and projected water use and greenhouse gas emissions. However, CDFA has not provided financial support for these consultations.

p GHG and Water Savings Calculators:

USDA NRCS Field Office Technical Guide – Irrigation Water Savings Calculator: https://efotg.sc.egov.usda.gov/references/public/CA/CA_irrigation_water_savings_10-6-14.xls

California Air Resources Interim Quantification Methodology for SWEEP: http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/draftsweepqm.pdf

CDFA GHG Calculation Tool for Fuels: https://apps1.cdfa.ca.gov/emissioncalculator/

COMET-Farm: https://cometfarm.nrel.colostate.edu/Account/LogOn?ReturnUrl=%2fActivityType

COMET-Farm Quick Energy Calculator: http://cometfarm.nrel.colostate.edu/QuickEnergy

National Renewable Energy Laboratory- PVWatts Calculator: http://pvwatts.nrel.gov/

Appendix C: Definitions

Cover crop – Crops including grasses and legumes that are grown for seasonal cover and other conservation purposes, including to reduce soil erosion, increase soil organic matter content, promote biological nitrogen fixation, and manage soil moisture. (NRCS Practice Code 340)

Disadvantaged communities – California census tracts that are considered by the state to be significantly burdened by environmental and socioeconomic issues, as identified in the CalEnviroScreen tool. SB 535 (2012) requires that 25% of moneys allocated from the Greenhouse Gas Reduction Fund must go to projects that provide a benefit to these communities. (More details at http://www.calepa.ca.gov/EnvJustice/GHGInvest)

Drought designation area – Geographic areas classified by the U.S. Drought Monitor as experiencing "a moisture deficit bad enough to have social, environmental or economic effects" ('drought'). Drought Severity Classifications range from D0 ('Abnormally Dry') to D4 ('Exceptional Drought'). (See U.S. Drought Monitor for details)

Evapotranspiration-based irrigation scheduling – The use of localized information on evaporation and plant transpiration rates to more closely predict a crop's water needs and adjust irrigation water use accordingly.

Fertigation – The injection of fertilizers, soil amendments, and other water-soluble products into an irrigation system. (Wikipedia)

Flood/furrow irrigation – 'Low-tech', gravity-based method of irrigating, in which water is allowed to flow over the land surface, often conveyed within small parallel channels along the field length ('furrows'). Some of the water is used by plants, while the rest evaporates, percolates into groundwater, or becomes runoff; flood/furrow methods are generally considered to be a comparatively inefficient use of water.

Flow meter – A device used to measure the flow rate of water within an irrigation system. Can be used to create efficiencies by signaling when a specified amount of water has flowed to fields, or by identifying slowdowns in water flow that can indicate a pipe blockage or other maintenance problems.

Greenhouse Gas Reduction Fund – A depository for proceeds from quarterly auctions and reserve sales at which a portion of GHG emissions permits (allowances) established by California's cap-and-trade program are sold. Investment of these funds is meant to further reduce GHG emissions, provide net GHG sequestration, and support the long-term, transformative efforts needed to improve public and environmental health in the state. (ARB website)

In-line pressure sensor – A device used to measure the water pressure inside irrigation pipes. This information can be used to inform more efficient pumping, adjust irrigation methods, or identify maintenance problems.

Irrigation monitoring – The practice of monitoring the rate, volume and timing of water application, as well as key soil and plant characteristics. Can create efficiencies used to develop an Irrigation Water Management Plan and/or to inform irrigation scheduling. (NRCS Practice Code 449)

Irrigation scheduling – The process of determining when and for how long irrigation occurs, including the amount of water applied.

Micro-irrigation or drip systems – Irrigation systems for frequent application of small quantities of water on or below the soil surface as drops, tiny streams or miniature spray through emitters or

applicators placed along a water delivery line. May be applied to efficiently apply irrigation water and maintain soil moisture for plant growth; establish desired vegetation; reduce energy use. (NRCS Practice Code 441)

Mulch application – The practice of applying plant residues or other suitable materials to the land surface, for purposes including soil moisture conservation, reduced energy use associated with irrigation, erosion control, establishment of vegetative cover, and improved soil health. (NRCS Practice Code 484)

Reduced tillage – Managing the amount, orientation and distribution of crop and other plant residue on the soil surface year round while limiting the soil-disturbing activities used to grow and harvest crops in systems where the field surface is tilled prior to planting. (NRCS Practice Codes 329 and 345)

Resource conserving crop rotation – A crop rotation that: Includes at least one resource conserving crop; Reduces soil erosion; Improves soil fertility and tilth; Interrupts pest cycles; and, in applicable areas, reduces depletion of soil moisture or otherwise reduces the need for irrigation. Resource conserving crops include: a perennial grass; a legume grown for use as a forage, seed for planting, or green manure; a legume-grass mixture; a small grain grown in combination with a grass or legume green manure crop whether inter-seeded or planted in rotation. (NRCS definition)

Soil moisture sensor – A device that measures the volumetric water content in soil, used by farmers to manage irrigation systems more efficiently. Multiple sensors can be linked into a telemetry system for remote data access and analysis.

Subsurface drip irrigation – The irrigation of crops through buried plastic tubes containing emitters, which greatly reduces evaporation from the soil surface, often resulting in substantial water savings when compared with flood irrigation. (California Agricultural Water Stewards Initiative)

Variable frequency drives – Electronic systems that can vary pump motor speed and torque by changing the frequency of the power supply. VFDs can conserve energy by enabling flow and pressure adjustments in response to the dynamic needs of an irrigation system. (NRCS Practice Code 533)

Endnotes

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The California Climate & Agriculture Network

The California Climate and Agriculture Network (CalCAN) is a collaboration of California's leading sustainable agriculture organizations and allies advocating for policy solutions at the nexus of climate change and agriculture. We have come together as a coalition to cultivate farmer leadership to face the challenges of climate change and to serve as the sustainable agriculture voice on climate change policy in California.

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California's State Water Efficiency and Enhancement Program (SWEEP): Round 4 Update

California's State Water Efficiency and Enhancement Program (SWEEP), funded by cap-and-trade auction proceeds, equips agricultural producers to reduce their carbon footprint, save water and energy resources, and increase their resilience to a changing climate.

California Climate and Agriculture Network (CalCAN) reviewed SWEEP to better understand how this two-year old climate change program, administered by the California Department of Food and Agriculture (CDFA), is working for farmers and the environment. Please find complete findings and recommendations in our May 2016 Report.[1] This update expands on our findings and recommendations using data from the recently completed Round 4 grant cycle.[2]

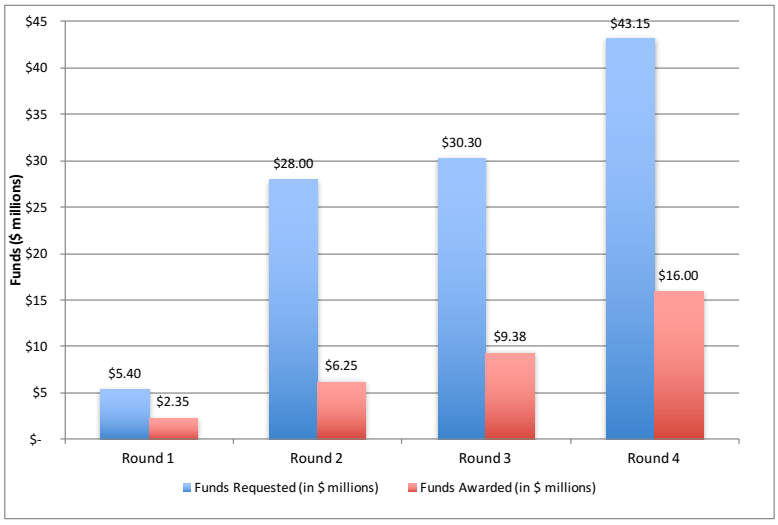
In a fairly short period of time, the program has evolved to further its efficacy and incorporate stakeholder feedback. Program guidelines for this fourth round actively encouraged new applicants, gave additional consideration to water-saving soil management practices, and acknowledged the importance of technical assistance and training to project outcomes.

In Round 4, CDFA awarded 128 projects for a total of $16 million in funding. These projects will save an estimated 22,267 acre-feet of water per year (approximately 7.3 billion gallons/year) and an estimated 5,635 tonnes CO2e per year (the equivalent of taking 1,190 passenger vehicles off the road each year). Across all rounds, SWEEP's 361 funded projects will save an estimated to 59,757 acre-feet of water per year (approximately 19.5 billion gallons/year) and 16,913 tonnes CO2e per year (or taking 3,564 passenger vehicles off the road each year).[3]

Program Basics

As was the case with previous SWEEP solicitations, the fourth funding round was highly oversubscribed. Applicants to the fourth round asked for $43.15 million dollars to implement their projects – the highest amount requested to-date (Figure 1).

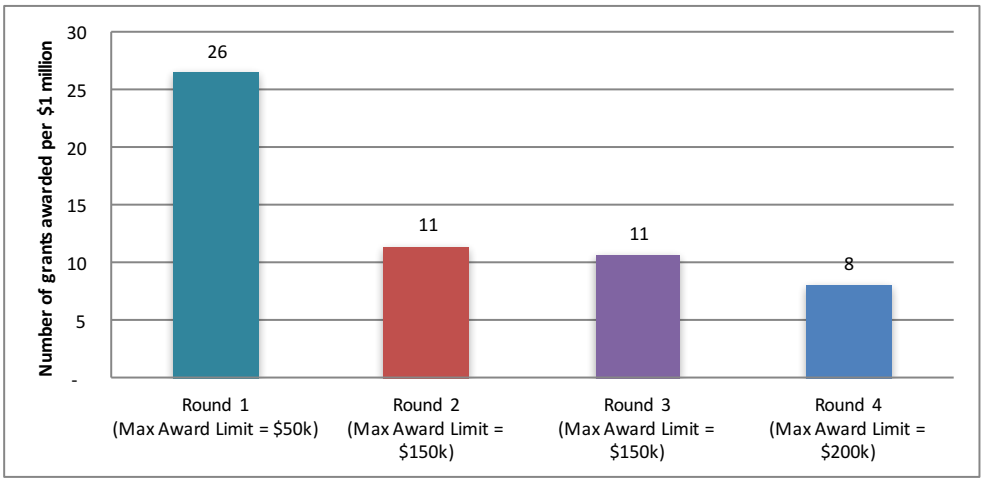
Figure 1- Funds requested vs. awarded, Rounds 1-4



Although Round 4 had the largest budget of the four SWEEP rounds, the number of grants awarded per $1 million of SWEEP funds was the lowest of any round (Figure 2). This downward trend may be in part attributable to Round 4's maximum award size of $200,000, which CDFA increased from the previous two rounds' limit of $150,000.

[1] CalCAN SWEEP Report available here: http://calclimateag.org/sweep-progress-report/
[2] CDFA is currently reviewing applications from the fifth SWEEP solicitation, which closed August 5, 2016.
[3] Calculation excludes two outlier values of 21,320 and 22,098 Tonnes CO2e/year.

Figure 2 - Number of projects awarded per $1 million, Rounds 1-4



Project Activities

Round 4 awardees will implement similar activities to those in previous rounds: installing irrigation monitoring equipment remains the most popular SWEEP activity, followed by pump improvements and conversion to efficient irrigation systems.

Round 4 is the first time SWEEP has given "additional consideration" to applicants that meet certain criteria. A majority of awardees sought additional consideration in each of the categories (Table 1). But how these "additional considerations" are weighted in application scoring is not clear.

While "additional considerations" add value to the program, more can be done to bridge the compatible goals of the CDFA's Healthy Soils Program and SWEEP.

Table 1 - Percentages of projects participating in SWEEP's "additional considerations"

Round 4 Additional Considerations	Percentage of Projects Participating
Soil management practices	53%
Cover Crop	*26%*
Compost	*31%*
Mulch	*34%*
Crop Rotation	*9%*
New SWEEP Recipient	77%
Project in over-drafted water basin	63%
Irrigation Training	81%

Geographical Reach

To-date SWEEP has reached over half of the counties in California (30 out of 58), although a few counties have consistently received the greatest share of awards (Table 2). While Round 4 projects reached 21 counties around the state, many areas in drought-ridden Southern California are still largely missing out. Many farmers and ranchers in southern California have their water delivered to them. Because all pumping occurs off-farm, it is assumed these producers cannot demonstrate GHG emission reductions because they cannot directly account for their water-related energy use.[4] Consequently, these projects are ineligible for funds under the current SWEEP application process. For example, representatives of Rancho California Water District in Temecula have noted to CalCAN that all but a few growers in their district do

[4] CDFA confirms this in "2016 SWEEP Round II FAQs" p. 1: https://www.cdfa.ca.gov/oefi/sweep/docs/2016SWEEP-Rnd2FAQ.pdf

not qualify for SWEEP. This may help explain the low SWEEP participation from most Southern California counties (Table 3). We urge CDFA to look into this issue and possibly reevaluate eligibility criteria to facilitate more equitable participation from this key agricultural region.[5]

Table 2 - Top 6 counties by total projects awarded, Rounds 1-4

County	Number of Awarded Projects*	Amount Funded**
Fresno	50	$4,448,059
Butte	44	$2,259,227
Tulare	40	$4,586,269
San Luis Obispo	34	$3,019,452
Monterey	28	$3,221,962
Kings	25	$2,613,391

Table 3 – Projects awarded in key Southern California counties, Rounds 1-4

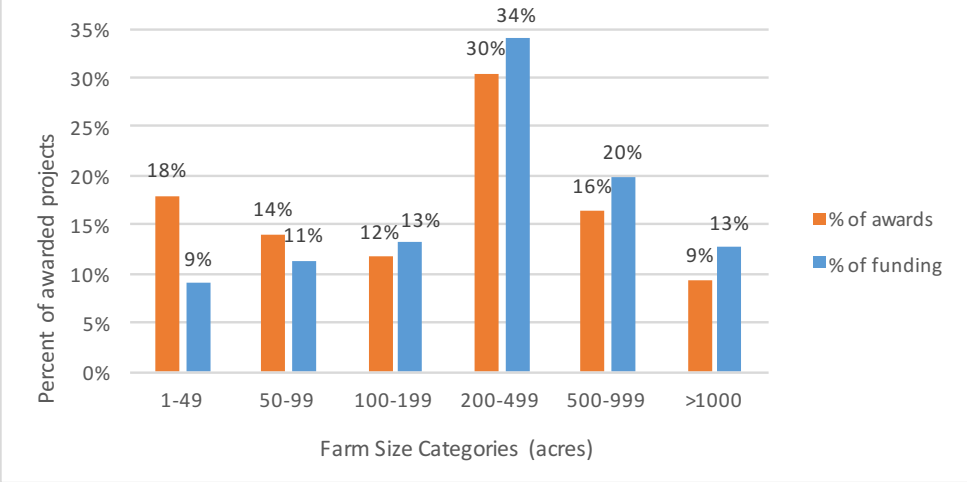
County	Number of Awarded Projects*	Amount Funded**
San Diego	4	$523,709
Los Angeles	2	$50,000
Riverside	1	$8,774
Ventura	1	$103,804
Imperial	0	$0
San Bernardino	0	$0

** Note: Values include some projects that crossed county lines and were therefore counted towards multiple counties' totals.*
*** Note: For projects that took place on operations that stretch across multiple counties, we were unable to determine what dollar amount went to activities in each county. Therefore, multiple-county projects were excluded from total funding amount.*

Farm Size

The Round 4 application was the first to collect farm size data, providing an understanding of the breadth of agriculture operations applying to SWEEP. Figure 3 shows the distribution of awards and funding received across farm size in Round 4, with smaller farm sizes receiving the second highest percentage of awards (out of 6 size categories), but the smallest percent share of funding.

Figure 3 - Distribution of awards and funding by farm size categories (acres), Round 4



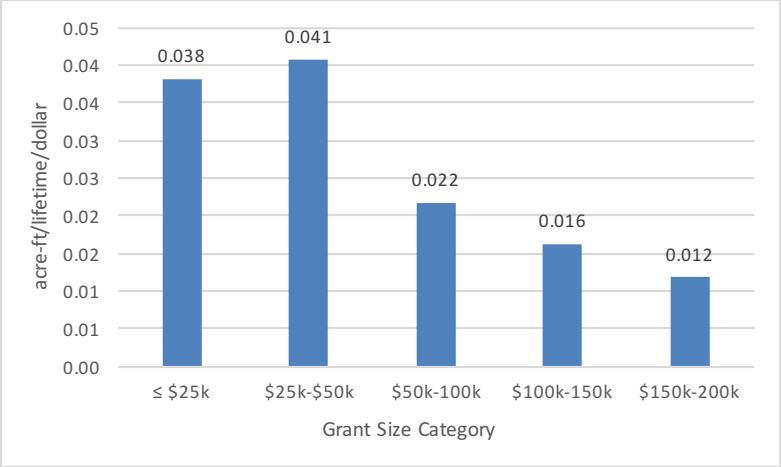
While fewer than one-fifth of the farms in California are 200 acres or larger[6], over two-thirds of Round 4 SWEEP dollars went to farms of this size.

[5] For example, CDFA might consider working with water districts to accurately estimate the GHG benefits from reduced water demand on their customers' operations.
[6] According to the 2012 USDA Census of Agriculture. Data accessed online via USDA Quick Stats 2.0 on August 22, 2016.

Water and GHG emissions benefits

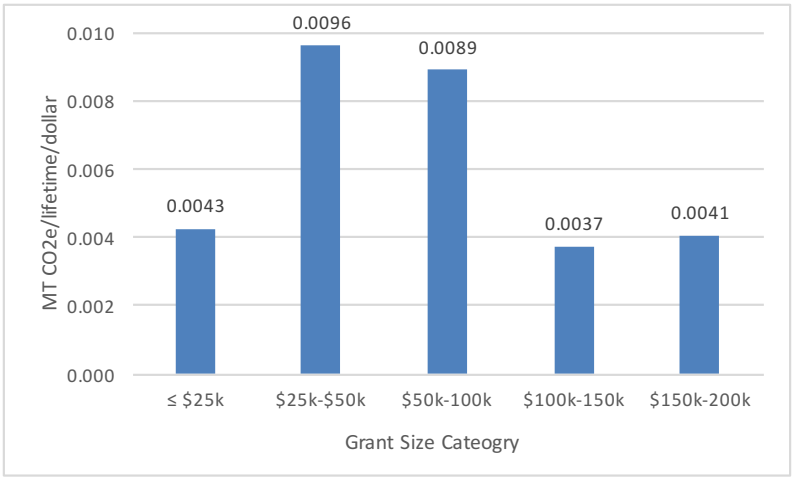
Data from Round 4 continue to demonstrate that higher-funded projects (now with a project cap of $200,000) do not necessarily produce greater water and GHG emission savings per SWEEP dollar spent. Although one might assume that 'larger' projects would yield greater 'bang for the buck', Figure 4 and Figure 5 suggest higher average per-grant-dollar water and GHG benefits in the lower funding tiers rather than the highest ones.

Figure 4 - Average per dollar impact on water savings by grant size category, Rounds 1-4*



**Note: Round 1 projects were not required to have both water savings and GHG emission reductions. Therefore, the one project that reported zero water savings is not included.*

Figure 5 - Average per dollar impact on GHG emissions reductions by grant size category, Rounds 1-4*



**Note: Round 1 projects were not required to have both water savings and GHG emission reductions. Therefore, the one project that reported zero GHG emission reductions is not included. The two outlier values of 21,320 and 22,098 Tonnes CO2e/year are excluded.*

CalCAN
California Climate & Agriculture Network

The California Climate and Agriculture Network (CalCAN) is a statewide coalition that works on state and federal policy to advance the powerful climate solutions of sustainable and organic agriculture.

For more information on our SWEEP analysis, please contact Adam Kotin, Associate Policy Director: adam@calclimateag.org, 916-441-4042

August 2016
For the full SWEEP report see: www.calclimateag.org