GROWING
GOOD
Almond Sustainability 2017
Defining Sustainability for California Almonds

Sustainability requires balancing the needs of people, profit and the planet—something farmers know is essential to the long-term viability of their operations. While there is no one-size-fits-all approach to sustainability, California Almond farmers are committed to using research to evolve their practices and continuously challenging themselves to do more.

In 2005, California Almond farmers and processors created and adopted a formal definition of sustainability specific to almonds based on the three pillars of sustainability.

SUSTAINABILITY (səˈstā-nə-ˈbi-lə-tē) NOUN
Sustainable almond farming utilizes production practices that are economically viable and based upon scientific research, common sense and a respect for the environment, neighbors and employees. The result is a plentiful, healthy and safe food product.

Socially Equitable
Economically Viable
Ecologically Sound

1. United States Department of Agriculture. 2012 Agricultural Census. 2. Almond Board of California, Almond Board of Australia and INC.
Committed to Continuous Improvement

Sustainability for California Almonds is interconnected and crosses all aspects of the almond lifecycle, inside the orchard and beyond. In addition to growing a healthy food that is good for people, California Almond farmers are working to continuously improve their practices in a way that’s good for communities and the planet.

A Solid Foundation

Underlying the advancement and innovation in each of the categories above is nearly $70 million in Almond Board of California-funded research spanning more than 40 years. This has built a foundation for continuous improvement that is helping almonds to be an economically, environmentally and socially responsible crop for California.

TO LEARN MORE ABOUT HOW THE CALIFORNIA ALMOND COMMUNITY IS CONTINUOUSLY IMPROVING IN EACH OF THE CATEGORIES ABOVE, VISIT ALMONDSUSTAINABILITY.ORG

Our Heritage of Sustainability

Sustainability is a journey—always improving and, where possible, seeing how the latest science and technology can be taken to the next level. The California Almond community is on a sustainability journey of its own and the following are important milestones we have achieved along the way.

1843 First known ALMOND ORCHARD planted in California
1950 FEDERAL MARKETING ORDER ESTABLISHED for almonds at the request of California Almond farmers, now known as Almond Board of California (ABC)
1973 ABC LAUNCHES RESEARCH FUNDING PROGRAM focusing on orchard health, pests, and food quality and safety
1976 POLLINATION ADDED TO ABC RESEARCH PRIORITIES to better understand the important role honey bees play in growing almonds
1977 ABC BEGINS FUNDING RESEARCH TO EXPLORE HOW ALMOND COPRODUCTS (HULLS, SHELLS, WOODY MATERIAL) CAN BE PUT TO BENEFICIAL USES, like livestock feed and creating alternative energy through cogeneration
1982 ABC BEGINS INVESTIGATING IRRIGATION IMPROVEMENT and other water-related research
1995 ABC FORMS BEE TASK FORCE to increase research focus and collaboration related to honey bee health
2007 CALIFORNIA ALMOND FARMERS AND PROCESSORS ADOPT STATE-OF-THE-ART FOOD SAFETY PROGRAM to ensure a wholesome, safe product
2009 CALIFORNIA ALMOND SUSTAINABILITY PROGRAM LAUNCHED to support almond farmer continuous improvement and adoption of sustainable practices
2014 OCTOBER ABC PUBLISHES HONEY BEES BEST PRACTICES for California Almonds, a tool for all involved in almond pollination to protect honey bees
2015 FEBRUARY ABC UNVEILS NITROGEN CALCULATOR, which helps almond farmers feed their trees while reducing environmental impacts
APRIL ABC LAUNCHES EDUCATIONAL TOOLKITS, VIDEOS and more for all involved in almond harvest to reduce air quality impacts
JULY LIFECYCLE ASSESSMENT (LCA) of growing almonds shows that more than 50% of emissions are offset by current practices and the almonds trees themselves
SEPTEMBER ABC AND ENVIROMENTAL DEFENSE FUND receive a USDA grant to explore how almond farmers can quantify greenhouse gas reductions to access California’s cap-and-trade market
OCTOBER ABC FUND RESEARCH TO EXPLORE USING ALMOND ORCHARDS TO RECHARGE GROUNDWATER AQUIFERS with partners at University of California, Davis; Sustainable Conservation; Land IQ and Lawrence Berkeley National Laboratory
DECEMBER SPATIAL ANALYSIS OF ALMOND PROCESSORS finds 50% are utilizing solar energy at their facilities

Nimbler than ABC’s traditional research program and featuring bold new partnerships, Accelerated Innovation Management (AIM) is designed to help meet the future needs of California Almond farmers and processors while benefiting local communities and the environment. Since its launch in 2015, AIM has funded 24 research projects across four initiative areas.

- **Water Management + Efficiency**: accelerating adoption of irrigation practices and technology that maximize crop per drop
- **Sustainable Water Resources**: exploring on-farm groundwater recharge and diversifying California’s water supply
- **Air Quality**: understanding farming-related air quality impacts and how to decrease emissions
- **22nd Century Agronomics**: focusing on new technologies and out-of-the-box solutions to create the almond farm of the future

RESEARCH PROGRAM

Launched in 1973, ABC’s research program funds expert researchers from prestigious universities and institutions. Their findings provide the foundation for increased understanding and improved practices.

**Focus Areas:**
- Orchard, tree and rootstock improvement
- Irrigation and nutrient management
- Insect, disease and weed management
- Food safety
- Pollination and honey bee health
- Almond coproducts and biomass
- Air and water quality

Each funded research project shares findings through a midyear summary, poster and/or full report. These are available at Almonds.com/researchdatabase, onsite at The Almond Conference and within ABC’s annual Research Update print publication.

ACCELERATED INNOVATION MANAGEMENT

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EDUCATIONAL RESOURCES

While research provides the scientific basis for improved practices, ABC translates those findings into actionable and field-ready recommendations shared through a variety of resources and educational opportunities. Information from the California Almond Sustainability Program helps to prioritize what materials and tools get created.

To share these resources and recommendations, ABC’s robust communications program leverages newsletters, magazines, workshops, social media and more to reach all involved in growing and processing almonds.

CALIFORNIA ALMOND SUSTAINABILITY PROGRAM

A sustainability program tailor-made for California Almond farmers and processors, the California Almond Sustainability Program was established in 2009 to educate participants about sustainable farming practices and facilitate continuous improvement. Through self-assessments, participants learn about best practices and share information about their own sustainability practices to help tell the story of how California Almonds are grown. To date, 4,022 modules have been completed, assessing 23% of California’s productive almond acreage.

THIS YEAR ABC INVESTED IN 64 NEW RESEARCH PROJECTS TOTALING $4.8M TO IMPROVE ALMOND FARMING PRACTICES ACROSS WATER EFFICIENCY, HONEY BEE HEALTH, COPRODUCT UTILIZATION AND MORE. THIS BUILD ON ABC’S MORE THAN 40-YEAR AND $70 MILLION COMMITMENT TO CONTINUOUSLY IMPROVING THE CALIFORNIA ALMOND COMMUNITY THROUGH SCIENTIFIC RESEARCH.

THE AMMOND CONFERENCE HAS BEEN HELD ANNUALLY SINCE 1973 TO SHARE FINDINGS FROM ABC’S RESEARCH PROGRAMS AND MORE. IN 2018, THE AMMOND CONFERENCE INCLUDED 3,600 ATTENDEES // 50 SYMPOSIUMS // 260 EXHIBITORS // 120 RESEARCH POSTERS // $27,000 RAISED FOR AG SCHOLARSHIPS

TO LEARN MORE ABOUT THE CALIFORNIA ALMOND SUSTAINABILITY PROGRAM, SEE PAGES 6–7.
Through the California Almond Sustainability Program (CASP) we can share key milestones and information about how California’s 6,800 almond farmers grow their crops. This helps the public better understand the responsible practices used to put food on their tables, while farmers who participate learn about opportunities for improvement. Nearly a quarter of California’s productive almond acreage has been assessed to date through CASP. The data gathered through farmer self-assessments provides statistically significant information about the use of distinct management techniques and practices across the California Almond growing region.

CASP offers participants a variety of tools to facilitate improvement in the orchard and beyond.

**CALCULATORS**

*IRRIGATION SCHEDULING:* Uses farmer-submitted data about their orchard and irrigation system setup, with local weather data and other inputs to generate irrigation schedules, providing farmers with details about the optimal amount and timing of irrigation.

*NITROGEN BUDGETING:* Advises how much and when to apply nitrogen fertilizer based on orchard-specific yield estimates, tissue sampling and nitrogen available from other sources, helping farmers provide their trees with the nutrients they need while protecting water and air quality.

**WORKSHOPS AND EVENTS**

On-farm demonstrations, expert lectures and peer-to-peer sharing provides participants with opportunities for learning, collaboration and networking.

New this year, Almond Board’s expert staff brought CASP directly to the orchard, meeting individually with more than 50 almond farmers. Visits served to familiarize farmers with CASP tools and provide farm-specific guidance, a service available to any California Almond farmer.

“The biggest benefit for me of participating in CASP is seeing what other farmers are doing in the industry and how we can improve and incorporate new strategies into our operation. It has made me a better farmer.”

— Eric Genzoli, fourth-generation almond farmer

Turlock, California

**FARM PROFILE:** almonds

**ACRES OF ALMONDS:** 300
Almond farmers are ahead of the curve for efficient irrigation adoption

Almond farmers representing 2,200 acres have been recruited to host on-farm recharge demonstration trials.

675,000 acres of California almond orchards have moderately good or better soil suitability for groundwater recharge.

Almond Board has funded over 200 water research projects since 1982.

ON-FARM RECHARGE

Groundwater is a vital resource in California, held in underground aquifers that are collectively California’s largest water storage system. In addition to surface water, which is moved around the state via rivers, aqueducts, reservoirs and canals, groundwater plays an important role in growing food and providing drinking water for Californians.

Overreliance on groundwater means that many of the state’s aquifers are under pressure. That’s why, in 2015, Almond Board launched an initiative to explore to what extent almond orchards can be used to replenish underground aquifers. A number of orchard research trial sites are being flooded with excess winter storm water to determine how recharge may affect orchard health, water quality and other factors.

Water recharged through this program would benefit all Californians, not just farmers. Research findings will be used to develop best practices for almond farmers to participate in on-farm recharge and promote groundwater sustainability.

SPOTLIGHT ON: Water

LEADERS IN EFFICIENCY

Decades of Almond Board-funded research and innovation has led to impactful on-farm improvements and provides the foundation for continuing advancement.

TRANSFORMATIVE CHANGE

The California Almond community began investing in research in 1982 to determine if a new irrigation method—microirrigation—could work in almond orchards. The results were positive and, by targeting water applications directly to the trees’ roots instead of uniformly across the field, farmers have conserved water and created other operational efficiencies.

Today nearly 80% of California Almond orchards are using microirrigation and, as older orchards are replaced, we expect that number to grow.

A ROADMAP TO CONTINUED IMPROVEMENT

While almond farmers have made strides in irrigation efficiency, there’s more everyone can do, which is why Almond Board and almond irrigation experts developed the Almond Irrigation Improvement Continuum in 2017.

The Continuum provides a path to improvement for every almond farmer across varying stages of irrigation precision using five key management areas.

EFFICIENT ALMOND IRRIGATION REQUIRES:

1. Calculating orchard water requirements
2. Monitoring irrigation system performance
3. Measuring applied water
4. Monitoring soil moisture
5. Monitoring plant water status

“These aquifers are a shared resource between farmers, families and businesses, so the act of replenishing them through recharge brings benefits to a much wider community, including cities and urban areas. My hope is that when the next drought comes, we will have made fundamental changes to our water infrastructure for the better.”

— Nick Blom, second-generation almond farmer
Modesto, California

FARM PROFILE: alfalfa, almonds, grapes, peaches, walnuts
ACRES OF ALMONDS: 650


10% 12%
42% 15%
43% 15% 12%

1LB
33%

87%
SPOTLIGHT ON: Coproducts

California Almond farmers and processors have always taken responsibility for the crops’ coproducts—hulls, shells and the tree itself—ensuring they’re put to beneficial use rather than sent to landfill. A changing market for these materials has led Almond Board of California to focus research investment on new uses.

These innovations will bring value to the California Almond community and the local environment while contributing to zero waste and addressing greater needs across industries such as food, pharmaceuticals and automotive.

MIMICKING MOTHER NATURE

Just like a tree falling in the forest provides nutrients to those around it, researchers are exploring the potential for recycling almond coproducts back into the soil and how that might affect orchard health.

- **WHOLE ORCHARD RECYCLING**, a process in which entire almond orchards are ground up at the end of their lives and the woody materials incorporated into the soil. Preliminary findings indicate this may return nutrients to the soil, increase water infiltration and storage; and slow the release rate of carbon dioxide, a greenhouse gas, into the atmosphere?

- **BIOSOLARIZATION** (anaerobic soil disinfection), which uses almond hulls and shells, water, tarps and the power of the sun to naturally deplete the soil of oxygen, making it inhospitable to key soil pests. Researchers hypothesize that this approach may lead to increases in soil fertility and decreased reliance on traditional soil pest control methods.

A GENUINE BIOECONOMY

ABC is committed to innovative new uses of almond coproducts that can support California in creating a genuine bioeconomy where every byproduct is an input for another valuable product.

Research is underway investigating how components of almond hulls and shells can be transformed to provide value to other industries.

- **EXTRACTING** sugars from almond hulls to serve as fuel or a food ingredient, and the remaining fibrous material has value as an additive for foods, moisturizers, pharmaceuticals or even biochar.

- Through **TORREFACTION** (heating to controlled temperature), almond shells can be transformed to a charcoal-like product ideal for strengthening biodegradable plastics, such as tires, flower pots, garbage cans and more.

IN 2016, CALIFORNIA ALMOND ORCHARDS GREW:

- 130 MILLION TREES
  - Clean the air and, at the end of their lives, are used to create alternative energy or improve soil quality
- 1.492 BILLION POUNDS OF SHELLS
- 4.262 BILLION POUNDS OF HULLS
  - Nutritious feed for dairy cows which reduces water needed to grow other feed crops
- 2.131 BILLION POUNDS OF KERNELS
  - Natural source of livestock bedding and other value-added uses

With further production improvements and policy changes, including new options for coproducts, the CALIFORNIA ALMOND COMMUNITY COULD EVENTUALLY BE CARBON NEUTRAL OR EVEN CARBON NEGATIVE.


“"The Almond Board, in collaboration with our industry partners, are working every day to bring profitable, innovative solutions for coproducts back to growers and hullers/shellers. Having a robust economic outlook while remaining committed to environmental sustainability are not mutually exclusive, which is why I’m excited to be a part of this effort.”"

— Rory Crowley, second-generation almond farmer
Chico, California

FARM PROFILE: almonds, walnuts
ACRES OF ALMONDS: 150
SPOTLIGHT ON:

Bee Health and Pollination

Every almond you eat exists because a honey bee pollinated an almond blossom. And every honey bee who visits an almond orchard gets its first natural food source of the year there, building up reserves of workers and stored food to support a healthy start to their pollination season.1

Because of honey bees’ essential role in almond production, Almond Board of California has invested more into honey bee health research than any other crop group2, and farmers have adopted voluntary measures to protect bees in the orchard and beyond.

HELPING HIVES

The California Almond community is taking action in the orchard to support honey bee health during bloom and beyond.

PROTECTING POLLINATORS

To help almond farmers achieve this goal, Almond Board of California, using research insights and in partnership with universities, government agencies, nonprofits and others, developed the Honey Bee Best Management Practices (BMPs) for California Almonds. The Bee BMPs provide key recommendations to everyone involved in the pollination process to make the orchard a safe and welcoming place for honey bees while balancing the need to protect the developing crop.

GOING THE EXTRA MILE

Working with honey bee research organization Project Apis m. and others, Almond Board encourages farmers to plant bee-friendly forage near almond orchards as additional food sources for honey bees before and after almond bloom. Beyond providing additional nutrition for honey bees and other pollinators, these plantings may help farmers improve soil health, water infiltration and more.

THE BUZZ ON BEES

The decline in bee health has been linked to a variety of complex factors, including those influenced by beekeeping and crop production activities. This chart outlines those factors and how the California Almond community is helping address each area.

1. VARIROA MITE: Investigating treatment options and beekeeper guidance for treating this devastating pest
2. OTHER PESTS + DISEASES: Kickstarting Tech Transfer Teams made up of traveling bee doctors who work with beekeepers to monitor hives and advise on pest and disease treatment as necessary
3. LACK OF GENETIC DIVERSITY: Funding researchers to bring new, foreign genetic material into the U.S. and making it available to U.S. beekeepers for improving breeding stock
4. PESTICIDE EXPOSURE: Understanding if pest control materials used need to protect the almond crop during pollination impacts bees and how these materials can be applied to minimize impacts
5. LACK OF FORAGE AND NUTRITION: Understanding the benefits and best management practices for supplemental forage and supporting the distribution of blooming plant material seed to almond growers for additional bee nutrition before and after almond bloom

35% of the world’s food crops rely on pollinators to some degree

94% of farms coordinate with their beekeepers about what pest control materials may need to be used during bloom and how the beekeepers will be notified in advance

93% of farms provide clean water for bees to drink and cool themselves with while pollinating

THE NUMBER OF U.S. HONEY BEE HIVES IS AT A 20-YEAR HIGH

However, beekeepers still experience significant in-season losses and must work hard to maintain healthy apiaries.

Almond Board has supported 113 RESEARCH PROJECTS across all 5 MAJOR FACTORS impacting honey bees

Just like almonds are a nutritious snack for us, ALMOND POLLEN is very nutritious for honey bees, providing all 9 of the essential amino acids their diets require. Because of this, bee hives routinely leave stronger after visiting during almond bloom.

FARM PROFILE: almonds, beekeeping

ACRES OF ALMONDS: 130

“[I] look at the relationship between beekeepers and almond farmers as symbiotic in many ways. Being a hobbyist beekeeper as well as an almond farmer enables me to see issues from both sides. Over the years, we have changed our farming practices and planted forage to promote bee health and nutrition because, at the end of the day, stronger hives can produce bigger crops.”

— Christine Gemperle, second-generation almond farmer
Ceres, California

MORE ON ALMOND SUSTAINABILITY AT:

- **Almonds.com/blog**
  Regular posts about almond sustainability and more

- **@almondboard**
  The latest sustainability updates in 140 characters or less

- **AlmondSustainability.org**
  Detailed information about all areas of almond sustainability

- **Almonds.com/researchdatabase**
  Reports from 40+ years of almond farming and environmental research

- **Almonds.com/CASP**
  Why farmers and processors should participate in the California Almond Sustainability Program

- **SustainableAlmondGrowing.org**
  Online portal for California Almond Sustainability Program participants

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