

# SUSTAINABILITY HIGHLIGHTS

January 2022



# A MESSAGE FROM OUR PRESIDENT AND CEO



For 129 years Limoneira Company has contributed to society in many ways by taking care of our employees and their families, being a good neighbor in our local communities, and operating our business in an ethical, environmentally responsible socially inclusive manner. Our progress is not only measured by dollars, but in the lives we touch and the communities we lift.

We are continuing to make both financial and human capital investments relating to sustainability stewardship. It starts with cohesive teams that are collaborative, inclusive, and diverse, and that are aligned around the Limoneira Mission Statement and our philosophy.

More important than setting ambitious goals is achieving them. Leaders are responsible for embedding these targets throughout their operations and are held accountable for progress and ultimately the achievement of our targets including through the annual compensation process.

If 2021 taught us anything, it's that society and our industry will continue to face new challenges. Limoneira is committed to being a catalyst for positive change and we continue to view these challenges as an opportunity to create a better future. In short, we believe we can do well by doing good sustainable things. I hope you enjoy reading about them.

A handwritten signature in black ink, reading "H. S. Edwards". The signature is fluid and cursive, with a large initial "H" and "S".

Harold S. Edwards  
President & CEO

Limoneira Company ("Limoneira" or the "company") recognizes the increased emphasis by stockholders, business partners and other key constituents in recent years on environmental, social and governance ("ESG") sustainability programs. Our commitment to ESG is deeply embedded in our culture and drives value creation for our investors, supply chain, the communities in which we live and work, the environment, our employees and the long-term success of our business. The Company is committed to improved reporting around these and other programs that impact ESG visibility. The Company has an executive-led cross-functional team (the "ESG Committee") that includes representation from our Board of Directors ("Board"). The ESG Committee has been tasked with taking meaningful steps to establish a series of short-term and long-term goals that demonstrate our commitment to further improvement.

## ENVIRONMENT

We are dedicated to practices that strengthen our business while reducing negative environmental impact.

## SOCIAL

We are committed to improving the lives of all our stakeholders by helping to provide access to our products and increasing the diversity of our workforce and Board of Directors.

## GOVERNANCE

We are focused and committed to upholding strong governance practices to protect the interests of and create long-term value for our investors, supply chain, customers, employees and communities.

## MISSION STATEMENT

Limoneira is an agricultural and community development company which, based upon its rich heritage and traditions, seeks to not only maximize value for its customers and shareholders, but to enhance its legacy by employing sustainable practices in all aspects of operations including stewardship of both its natural and human resources.

## OUR PHILOSOPHY

Limoneira's objective is to provide high quality products and services. While in pursuit of that objective we adhere to the highest standards of integrity and fairness in our relationships with employees, customers, stockholders, supply chain, and our community.

Furthermore, it is our obligation to:

- Protect and expand our asset base to assure long-term profitability
- Be responsible trustees in the protection and improvement of our environment
- Provide leadership and resources for the betterment of our community
- Encourage and support the development of our employees

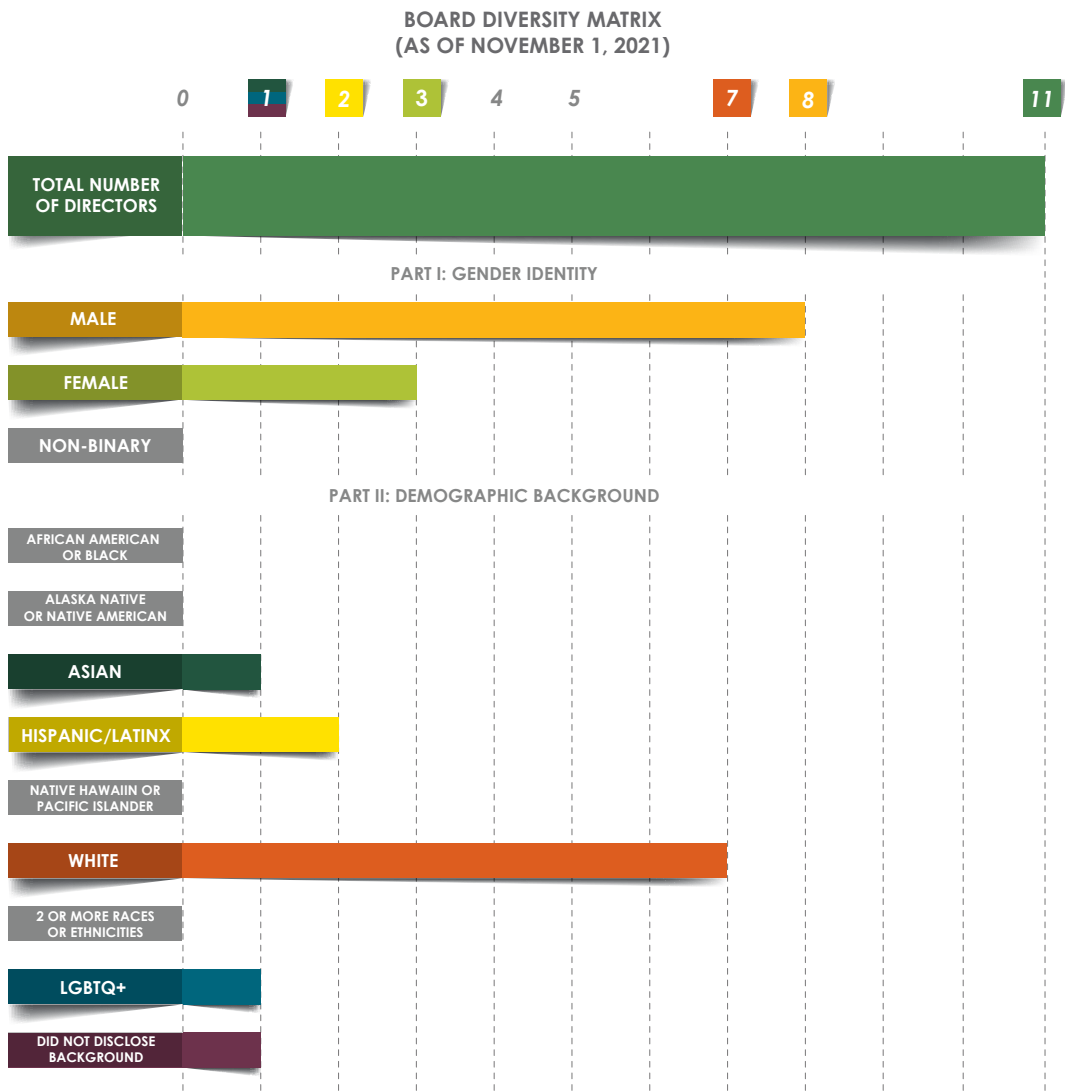
# CORPORATE GOVERNANCE

Effective corporate governance is critical for both our long-term performance and maintaining stakeholder trust. Our Board is responsible for overseeing the governance, strategy and operation of the Company. Our 11 directors come from diverse backgrounds, drawing on their substantial experience in finance, philanthropy, public accounting, law, water rights, compliance, agribusiness, global produce distribution, real estate and education. We comply with California SB 826, requiring a minimum of three female directors for corporations with six or more directors. We also comply with California AB 979, requiring corporations with nine or more directors to have a minimum of three directors from underrepresented communities.

It is the duty of our Board to oversee the management of the Company's business and to serve the best interests of our stockholders, employees, supply chain and communities. As part of its oversight of the Company, our Board oversees an enterprise-wide approach to risk management, which is designed to support achieving the Company's objectives,

including its strategic priorities to improve long-term operational and financial performance and enhance investor interests.

We have a long history of strong commitment to being an ethical and responsible company acting with integrity and respect for each other, our communities, and the environment. Our Board considered such commitment when it approved the charter for the Nominating and Corporate Governance Committee ("NCGC"). Our Board tasked the NCGC with the responsibility for overseeing our ESG and sustainability programs and practices, including considering potential long- and short-term trends and impacts that environmental and social responsibility and sustainability issues may have related to our business. Our Board includes a seasoned ESG professional who provides guidance to our ESG Committee. Our Director of Compliance & Business Development, also a member of our Board, leads our ESG initiatives.



# SOCIAL RESPONSIBILITY

We believe that an environment of diversity, inclusion, and belonging fosters innovation, strengthens our global workforce, and drives our ability to serve customers. Our global presence is strengthened by having a workforce that reflects the diversity of the customers we serve and by maintaining an environment in which such diversity contributes to our mission.

Limoneira is committed to protecting the human rights, safety and dignity of the people who contribute to the success of our business. We also seek to support the welfare of the people who produce, process and harvest the products we sell. Limoneira has a Social Responsibility Committee ("SRC") with representation from our Board, senior management, compliance, human resources and operations.

Limoneira's overall culture emphasizes the health and safety of our employees and the customers we serve. Our Take a Healthy Stand™ campaign showcases the many ways lemons can play a role in helping to alleviate serious health issues and our free Nature's Pharmacy™ app links items found in the produce section of local grocery stores to related health benefits. lifeOur Take A Healthy Stand™ educational campaign is supported by research from the Institute of National Health and other objective organizations. Recipes, tips & tricks are developed for Limoneira by Megan Roosevelt, a registered dietitian nutritionist and founder of Healthy Grocery Girl®. Reputable outside sources are also used for additional recipes, tips & tricks.

Further, Limoneira supports the efforts of the Produce Marketing Association and the United Fresh Produce Association (collectively, the "Association") to create an industry-wide framework for the responsible production and procurement of fresh fruit, vegetables and flowers. This mission is captured by the Association's Ethical Charter on Responsible Labor Practices, of which Limoneira is one of many endorsers representing the fresh produce industry that includes growers, labor agencies, packers, distributors, foodservice operators, marketers and retailers. In addition, Limoneira has adopted its own Ethical Charter on Responsible Labor Practices (the "Charter"). The Charter includes but is not limited to: prohibiting the use of forced labor and child labor; preventing harassment, abuse and violence in the work environment; ensuring a non-discriminatory work environment; ensuring a safe and healthy work environment; permitting freedom of association and collective bargaining; providing at least the minimum wage and benefits required by law in locations where we and our suppliers do business; ensuring working hours do not exceed the maximum set by applicable law; and operating in strict compliance with all applicable laws.

<https://investor.limoneira.com/static-files/917fc179-1df0-4c09-ae1e-9446448e7ac0>





# SUPPLIER CODE OF CONDUCT

Our Charter also serves as our Supplier Code of Conduct ("Supplier Code"). Our Supplier Code was established to protect the human rights and safety of our supply chain. We recognize and respect the cultural and legal differences found worldwide. To this end, Limoneira also has a Policy on Human Rights and Labor ("Policy"). Our Policy and Supplier Code are global in scope, and apply to all companies in our supply chain and their facilities, as well as our facilities and operations.

To align with international standards, our Supplier Code is derived from the policies, standards, and conventions of the United Nations, including the principles related to human rights, labor standards, environment and anti-corruption included in the United Nations Global Compact. Furthermore, Limoneira supports Resolution 64/292 adopted by the United Nations General Assembly explicitly recognizing the human right to water and sanitation. This Resolution calls upon states and international organizations, like Limoneira, to provide safe, clean, assessable and affordable drinking water and sanitation for all.

Limoneira employs a risk-based approach with respect to audits (including environmental, social and governance

audits) and seeking to confirm compliance with the Supplier Code. When such audits disclose the need for improvement, Limoneira requires suppliers to adopt corrective action plans and performs subsequent audits to determine progress. Limoneira also offers other capacity building services that improve management systems to address the root causes of alleged violations. Limoneira works with suppliers and/or their facilities to correct Supplier Code violations. Depending on the severity or lack of remediation of Supplier Code violations, Limoneira reserves the right to terminate our relationship and/or purchase orders with a supplier and/or their facility.

Limoneira continually educates our employees on the importance of our Policy and Charter through updated training and in-person seminars to review the requirements and any changes. Employee and management training takes place annually on the Company's policies related discrimination (age, race, sexual orientation, gender identity, gender expression), ethics, corruption, safety as well as a variety of other factors.

<https://investor.limoneira.com/static-files/1e451570-1911-4a1c-a8e4-8b182d08bf5c>

## SERVING OUR COMMUNITIES

We have deep roots in our communities and each year we collaborate with and devote resources to many worthwhile entities that make our communities special places to live and work. Management and employees volunteer time and resources for various industry, community and non-profit organizations by serving on their boards and committees and staffing events. Our teams work together to raise awareness, generate resources and participate in events that resonate with our local teams, customers and community members. At the local level, some of these initiatives include Santa Paula Chamber of Commerce, Boys and Girls Club of Santa Clara Valley, Ventura County Food Safety Association, Colab – Coalition of Labor Agriculture and Business, Students for Eco Education and Agriculture (SEAAG), California Women for Agriculture (CWA), Canyon Irrigation Company, and California Arizona Lemon Growers Association (CALGA).

As part of our ongoing commitment to our communities, we sponsor many charities and events. We fund children's agricultural education, college scholarships, health and human services, industry, community, cultural events and projects that make our communities more vibrant and sustainable. Limoneira also founded a federal credit union onsite to provide agricultural employees an opportunity to accumulate savings and create a source of credit. Our Harvest at Limoneira master-planned community continues our long history of building, integrating and sustaining community to promote economic, social and cultural vitality in our community

# EMPLOYEE ENGAGEMENT

Culture is the driver of performance at Limoneira. Our employees reside at the heart of everything we do. We strive to be a great place for our employees to work and live. To do that, we are committed to building and maintaining a workforce that is talented, while fostering a fair and inclusive work environment that represents our stakeholders. We offer competitive pay and best-in-class benefits, including a 401k plan with matching contribution opportunities, comprehensive paid healthcare plans, wellness programs, and tuition reimbursement. On October 31, 2021, we had 268 employees, of which 98 were salaried and 104 were hourly. None of our employees is subject to a collective bargaining agreement. We believe that our relations with our employees are good.

It is our practice to continually assess whether we are doing everything we can with respect to employee engagement. We have established several new diversity, inclusion, and belonging efforts and programs to better ensure that we are supporting our employees. In particular, as our employees navigated the challenges of the COVID-19 pandemic, we expanded our existing programs to support employee health and wellness. Working closely with our Human Resources Team and the County of Ventura, we hosted three highly successful on-site mobile vaccination clinics

for our employees. As of October 31, 2021, over 95% of our team members are vaccinated. We have implemented, and continue to improve, appropriate safety measures in all our facilities and locations.

Limoneira is committed to an environment where open and honest communications are the norm, not the exception. We encourage our team members to feel comfortable in approaching supervisors and management. By creating open channels of communication, we promote a positive work environment. An effective reporting system augments our efforts to foster a culture of integrity and ethical decision-making. We selected EthicsPoint, an independent third-party service, to provide us with an anonymous and confidential method for employees to voice their concerns and make reports of alleged misconduct.

Limoneira has an Illness and Injury Prevention Plan (IIPP) and a Safety Guide and conforms to and follows regulations and guidelines set forth by OSHA in our facilities and operations. Where a particular jurisdiction's guidelines, such as Cal OSHA, are different from the OSHA standard, Limoneira adheres to the most extensive guideline. We have excellent results from our safety programs compared to similar companies within our industry.

## WORKFORCE HOUSING

We own and maintain approximately 256 residential housing units located in Ventura and Tulare Counties in California. We lease these housing units to employees, former employees and non-employees. Our residential units provide affordable housing to many of our employees, including our agribusiness employees. Employees live close to their work, which reduces traffic and commuting times. This unique employment benefit helps us maintain a dependable, long-term employee base. We partner with some local schools to provide transportation for residents.



# ENVIRONMENTAL CONSERVATION

We have a long-standing ambition and commitment to environmentally responsible operations and seek to continually improve sustainability throughout the life cycle of our products, including farming, harvest, production, operations, packaging and disposal.

Our business relies on the health of our planet and the well-being of our people for its continued success. Given our interconnectedness and dependency on the land, sustainability has always been integrated into our business strategy. Sustainability involves several complex interactions and relationships, including, but not limited to, our planet, our communities, our employees and our business practices. We are building on our history of quality in all that we do and are continuing to evolve our environmental impact program and reporting/metrics standards.

We engaged Sustainable Environmental Consultants ("SEC"). SEC uses EcoPractices, a third-party verification platform for sustainability risk management. We are working to quantify the impact of actual farm practices by using evidence-based measurements. Having such data will provide more depth to our decision-making. This project focuses on Limoneira's Key Performance Indicators including soil health, nutrient management, use efficiency, biodiversity, water quality and quantity, energy

and carbon. Included, as Appendix A hereto, is our 2020 Sustainability Analysis, prepared by SEC for On-Farm Practices. Included, as Appendix B hereto, is our 2021 Life Cycle Assessment, prepared by SEC.

We are committed to the following guiding principles of our environmental policy: complying with all applicable environmental regulations; training of staff on our environmental programs and empowering them to contribute and participate; preventing pollution whenever and wherever possible; communicating clearly our environmental commitments and efforts to our supply chain, staff, customers, investors and the communities in which we operate; conserving natural resources through careful planning and efficient use of water, energy, and materials; minimizing waste through source reduction, reuse, recycling, and composting; handling and disposing of waste through safe and environmentally sustainable methods; employing environmentally responsible practices when handling and disposing chemicals and hazardous materials, including wastewater and solid water generated from operations; and minimizing the generation of greenhouse gases, and the unintended release of substances that could cause harm to air, water, or land.



RESOURCES				NATURE					PEOPLE			
Water Strategy	Solar Energy	Green Waste Recycling	Waste Water Treatment	Integrated Pest Management	Efficient Use of Inputs	Site Selection	Crop Diversity	Bee Pollination	Work Force Housing	Community	Harvest	Children's Ag Education



## SOLAR

To reduce our energy use and related emissions contributing to climate change, we look for ways to decrease our reliance on fossil fuels and increase our use of renewable energy. Over the past few years, we invested in various renewable energy projects including solar energy.

Our solar program is generating clean energy and savings to the Company. We implemented Tesla's 400kWh scalable

energy storage system, which reduces energy costs and improves reliability for demand charges and shifts energy use from peak to off peak times. This enables us to be 50% off the grid and we have a goal of being 100% off the grid in seven years. Over 2,000 Hanwha Q Peak solar modules have been installed on the roof of Limoneira's new packinghouse, which offsets approximately 680 tons of CO2 and 420lbs of NOX annually.

## LANDFILL & RECYCLING

Landfill gases influence climate change. The major components are CO2 and methane, both of which are greenhouse gasses. In terms of global warming potential, methane is over 25 times more detrimental to the atmosphere than carbon dioxide. We recognize that we have an important role to play in reducing greenhouse gas emissions to protect the health of our planet today and for the benefit of future generations. Our 10-acre facility on Limoneira property receives over 200 tons a day of organic green waste that would otherwise be transported to landfills. The end-product produced at this facility helps us

and other growers to significantly reduce the use of water, herbicides and fertilizers. Our approach not only reduces the environmental impacts of food waste going to landfills and releasing toxins and greenhouse gases, but also helps communities' access healthy fruits and vegetables.

Limoneira instituted a corporate recycling program in the early 2000's. The following items are recycled: cardboard, paper, magazines, newspapers, glass containers, plastic bottles and metal containers.

## WATER

Limoneira is particularly sensitive to water usage, and in connection with our commitment to reducing the harm caused by water over-usage, is committed to actively reducing its impact on the environment by managing water sustainably and reducing its water use, assessing water risks where it operates, implementing water stewardship in all operations, and working with stakeholders in shared watersheds.

We understand the importance of maintaining the balance between water demand and supply. We consider how water scarcity affects our operations, as well as the impact we have on the water resources we share with the communities in which we operate worldwide. Our farms, employees and local communities all depend on safe and clean water to thrive; our growers rely on clean water to produce healthy crops; and our facilities need clean water to prepare our produce for consumption. Limoneira takes important steps to protect this valuable resource. Farming practices at Limoneira leverage innovative technologies to drive water use efficiency and work proactively to

prevent negative potential impacts on community water resources.

Water quality and supply is maintained through rigorous lab testing, filtration systems, and a network of micro sprinklers. Water probes are part of our innovative water management practices. Soil moisture probes measure volumetric water content and are connected to data loggers utilized in the irrigation control system. Soil moisture stations log water data and send it to a main controller. Water with appropriate fertilizer quantity to desired root zone depths is monitored. Moisture sensors can determine when orchards are at full water holding capacity, thus reducing run off and wasted water. Limoneira's new natural wastewater system uses patented technology and is a low carbon footprint project that has a series of gravity fed ponds that circulate and clean 30 million gallons of water annually with natural vegetation, local plants and fine gravels. Ultraviolet (UV) rays remove any bacteria in the water to achieve Title 22 drinking water standards. This water is then used for landscape irrigation.

## INTEGRATED PEST MANAGEMENT

Limoneira was one of the founders of the Integrated Pest Management program in Ventura County. Pesticides, including herbicides, fungicides, and insecticides, are part of our Integrated Pest Management program. Biological, chemical, mechanical, and cultural indicators are also

key components in Integrated Pest Management decision making. We have been working with Associates Insectary since 1928 to minimize the use of pesticides by releasing beneficial insects into orchards to control destructive agricultural pests.

# FOOD SAFETY

Limoneira is committed to providing safe and wholesome produce to our customers. We have adopted and implemented a robust food safety plan that meets or exceeds industry food safety standards as well as adhering to the federally mandated Food Safety Modernization Act (Title 21 CFR Part 112 GAP & Part 117 GMP). Limoneira's food safety commitment is built on a science-based plan offering transparency through an in-depth environmental monitoring program, pest control program, internal inspections, as well as other key programs.

Limoneira is pleased to announce our products are annually certified to a Global Food Safety Initiative (GFSI) recognized Certification Program. We audit using the PrimusGFS scheme for Farming, Harvest Crews, and Packinghouse, as well as Global G.A.P Standards for our international Suppliers. We are proud to continually achieve superior ratings on these audits at our packinghouse facilities and farms, both domestically and internationally. Additionally, we require our suppliers to adhere to the current GFSI standards and support compliance.



Limoneira invests extensive time and resources developing comprehensive training programs for our employees. From the moment an employee is hired, they continue to receive ongoing, current and industry-specific food safety education relevant to job responsibilities. This training includes Hazard Analysis and Critical Control Points (HACCP) Training, pest control monitoring, incoming and outgoing product inspections, and additional job-specific training.

We maintain a robust traceability program. Key operators are trained on systems essential for proper traceability from each of our farms and suppliers. Each of our facilities holds a quarterly unannounced test to assess "real-time" system product traceability capabilities. This process brings visibility into the system and allows us to make continual improvements to the system and overall process. Limoneira believes in continuous improvement and learning from Government and Industry mandates and changes to Food Safety, Quality and Traceability, which is why we are members and active supporters of various produce trade associations.



## IN CLOSING

While we have made significant progress over our 129 year history, the sustainability story begun by our Pioneer forefathers in 1893 is increasingly relevant and important. At Limoneira, our strong commitment to environmental conservation, social responsibility and corporate governance is ongoing. We understand the importance of serving our stakeholders in today's environment while also looking ahead to anticipate future needs. We will continue make improvements in efficiency and reducing our impact on the earth and adjusting as we learn about what works

and what doesn't. Through continued evaluation, research and innovation, we consistently strive for more to help build a better world by focusing on ESG topics that matter most to our business and to our stakeholders.

Should you have questions, comments or recommendations on how we may further our commitment, we invite you to contact us at **(805) 525-5541**, extension 1042 or **esg@limoneira.com**.

# APPENDIX “A”

**2020 Sustainability Analysis,  
prepared by Sustainability Environmental Consultants  
for On-Farm Practices**

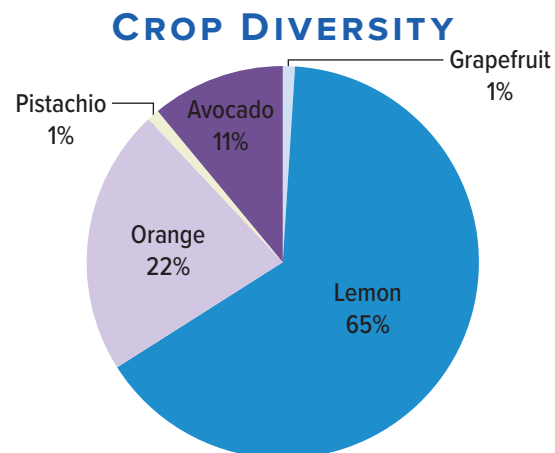
### SUSTAINABILITY ANALYSIS

#### About Limoneira

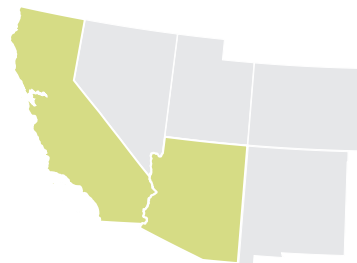
Limoneira is a global company with investments in agribusiness, real estate, and natural resource management. The business is the largest vertically integrated lemon supplier and largest avocado grower in the US. It has succeeded for more than a century, founded by Nathan W. Blanchard and Wallace L. Hardison in 1893 when they purchased 413 acres of land. At that time the primary crops were lemons, Valencia oranges, and walnuts. Since then, the orchards have expanded to a variety of citrus and fruit trees supplying fresh food to the US and around the world. They grow and process in California, Arizona, Chile, and Argentina. Limoneira's focus on citrus starts with their name, meaning "lemon lands" in Portuguese.

#### Quantifying the Impact of Actual Farm Practices

The benefits were determined through EcoPractices' unique process that is able to pinpoint the influence of specific agricultural practices. While agricultural practices have progressed to better care for natural resources, the ability to quantify the influence these practices have on sustainability has not kept pace. Limoneira seeks to put evidence-based measurements to its farm practices. Having such data brings more depth to decision-making. Short- and long-term goals can be based upon more meaningful information.



**7,650** acres on **48** blocks



#### IMPORTANCE OF BEES

Insect pollinators, such as bees, play an important role in orchard systems and help provide an abundant crop. Bees can be brought on farm during pollination or wild bees can also help pollinate the orchard.\*\*\*



#### ORCHARD BIODIVERSITY

**117** acres are planted to shrubs and grasses to draw predators away from the citrus trees and fosters beneficial insect habitat. These areas provide a corridor for pests by providing plant diversity further into the orchard. This draws pests to these areas and diverts them away from impacting the trees themselves.



#### ADDITIONAL CITRUS VARIETIES

- › Blood Orange
- › Cara Cara
- › Minneola
- › Pummelo
- › Sumo
- › Tango

CROP	YIELD
Avocado	3.7 T/ac
Grapefruit	21.7 T/ac
Lemon	16.4 T/ac
Orange	12.2 T/ac





## Weather, Soils, and In-Field Management Practices

influence the following environmental metrics

### ENVIRONMENTAL OUTCOMES

From the management practices at Limoneira, the following environmental outcomes resulted.\*

#### OVERALL FARM

**Soil CO<sub>2</sub>e Emissions** (T/ac)

**0.6**

**Soil Carbon Sequestered** (T/ac)

**0**

**Soil Erosion** (T/ac)

**0.1**

For soil carbon emissions, the lower the value, the better. For soil carbon sequestration, the higher the number, the better. The lower the soil erosion, the more environmental benefit the practices have.

Trees pull carbon out of the atmosphere during their lifespan. Due to tree removal at end-of-life, carbon is therefore not permanently sequestered. While this has a positive environmental impact, these values are not considered in the above soil carbon analysis.



### EROSION AVERAGE

The USDA National Resources Inventory provides estimates on average erosion for different systems across the US.\*\*

CA Non-Cultivated    AZ Non-Cultivated    National Cultivated

**1.7 T/ac**

**0.2 T/ac**

**4.6 T/ac**

### FERTILIZER

An average rate of **179 lbs/acre of nitrogen** and **2 lbs/acre of phosphorus** applied on all fields.

### SOIL CONDITIONING INDEX (SCI)

Soil Conditioning Index (SCI) is a tool from NRCS that shows the trajectory of soil health. A positive SCI means a positive trajectory of soil health and vice versa.

The fields have an overall **+** trajectory for SCI.

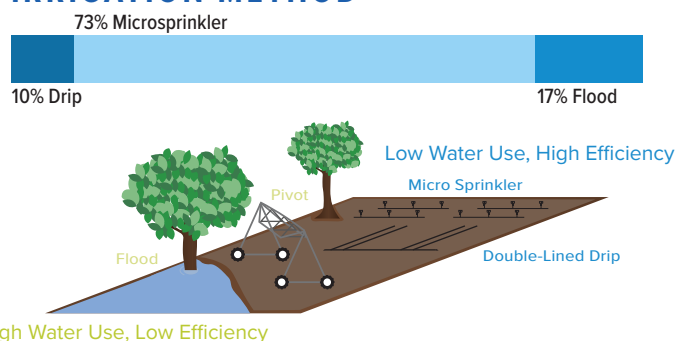
### IRRIGATION

Limoneira utilizes an irrigation program that tracks rainfall, which helps monitor on-farm water usage.



**100%** of acres are irrigated. The range of irrigation used across Northern and Southern California, as well as Arizona, is 1.7 to 14.1 acre-ft/acre. The average amount of water used is **4.53 acre-ft/acre**.

### IRRIGATION METHOD



Flood, microsprinkler, and dual drip hose methods are used across Limoneira's farms. **Flood irrigation** is the most intensive on water use at an average rate of **13.8 acre-ft/acre**. The most judicious type of irrigation is **drip irrigation at 2.4 acre-ft/acre** and **microsprinklers at 2.7 acre-ft/acre** which minimize water losses from evaporation by placing water directly next to the plant within the root zone.

### INTEGRATED PEST MANAGEMENT

**1.8 lbs/acre of active ingredient** applied to the orchard based on:



**63%** of acres applied with a **herbicide**

**100%** of acres applied with a **pesticide**

Pesticides, including herbicides, fungicides, and insecticides, are part of an Integrated Pest Management program. Biological, chemical, mechanical, and cultural indicators are also key components in Integrated Pest Management decision making. **Limoneira was one of the founders of the Integrated Pest Management program in Ventura County. Associates Insectary, a cooperative, has been working with Limoneira since 1917 to provide pest control services to citrus and avocado farmers.**

Data provided by Limoneira for the 2020 growing season.

\* EcoPractices estimates an environmental impact value for reducing greenhouse gas emissions, reducing soil erosion, and reducing nutrient loss due to reduced leaching. These estimates adhere to processes that are documented by the NRCS Technical Guides and publications from the EPA. These values are tailored to a specific location and participant's operation. Models used are supported by USDA, NRCS, other government agencies, and major universities. Modeled results include input data from public resources for weather, soils, and historical crop rotation. Greenhouse gas simulations were produced from the Greenhouse Gas Inventory (GGIT) tool developed by Soil Metrics, LLC (2021) <https://soilmetrics.eco>. The GGIT tool implements the USDA-sanctioned greenhouse gas inventory methods described in Eve et al. (2014) "Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory". The GGIT tool utilizes greenhouse gas modeling technology developed for the COMET-Farm tool, licensed by Colorado State University to Soil Metrics, LLC.

\*\* USDA, NRCS 2017 National Resource Inventory

\*\*\* [Cornell, Wild Pollinators](#)

This summary must not be edited or altered in any way without the involvement and consent of EcoPractices.

**ECO PRACTICES**  
An Evaluation of Actual Performance

# **APPENDIX “B”**

**2021 Life Cycle Analysis,  
Prepared by Sustainability Environmental Consultants**

LIFE CYCLE ASSESSMENT

# Baseline Carbon Footprint

LIMONEIRA

2021

LIMONEIRA®  
SINCE 1893

A Life Cycle Assessment Report by

**ECO**PRACTICES

# BASELINE CARBON FOOTPRINT | LIMONEIRA

## Objective

Limoneira is a fruit production company headquartered in Santa Paula, California. They are the United States' largest supplier of lemons. The company has orchards in California, Arizona and Chile as well as strategic alliances in Argentina, Mexico and South Africa. Limoneira produces a variety of crops, although much of its acreage is devoted to the production of lemons.

Agribusinesses such as Limoneira are under increasing consumer, regulatory and ethical pressure to respond to environmental stresses. According to a 2019 study by the United States Environmental Protection Agency (USEPA), agriculture related activities are responsible for about 10% of the country's greenhouse gas (GHG) emissions. GHG's are a class of gases that have been identified as contributors to climate change. In addition to climate change, many of Limoneira's operations are in parts of the United States that have experienced extreme drought in recent years.

*"According to the United States Environmental Protection Agency (USEPA), agriculture related activities are responsible for about 10% of the country's greenhouse gas (GHG) emissions."*

Citrus crop production presents unique environmental challenges. Citrus crops require high levels of nutrients to produce optimal yields. These needs are often met through the application of synthetic fertilizers. Additionally, the Mediterranean climates where much citrus production occurs experience seasonal rainfall and often, if not always, require irrigation during dry periods. Furthermore, citrus crops are often marketed and sold far from where they are grown. These realities present particular challenges for Limoneira and citrus growers at large as they seek to quantify and understand their contribution to climate change and water use.

In this report prepared by Sustainable Environmental Consultants (SEC), Life Cycle Assessment (LCA) tools will be used to quantify Limoneira's use of water and the GHG dynamics involved in the production of Limoneira's fruit products.





# BASELINE CARBON FOOTPRINT | LIMONEIRA

## Methods

The application of LCA methods to citrus production is a new and exciting field of study. A 2017 literature review completed by the Center of Sustainable Systems at the University of Michigan and distributed by the Oregon Department of Environmental Quality found less than 20 publicly available LCAs for citrus crops, all with varying scopes and boundaries and most studying production in Europe and Asia. While regional and international LCA standards exist for some agricultural products, such as grain and dairy production, similar standards do not exist for citrus crop production. SEC drew from methods developed in primary source literature and extensive experience in sustainable agriculture when identifying GHG sources, quantifying emissions and scaling total emissions.



### Agricultural Inputs

- › Emissions factors for ag inputs (synthetic fertilizers, herbicides, pesticides) were taken from the Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies Model (GREET) produced by Argonne Lab in cooperation with the Environmental Protection Agency. The model estimates lifecycle emissions for the production of fuels including ethanol and biodiesel, where we gathered many of the emissions factors relating to agricultural production. These factors are the standards for the US government. Where emissions factors were not available on GREET, they were taken from other publications produced by the US government and compiled in the document GHG Emissions Factors.



### Gasoline & Diesel/Electricity & Gas

- › Emissions for fuel and energy consumption as well as agricultural inputs were calculated by simply multiplying the quantity of the input or fuel used on an annual basis in the dairy by the appropriate emissions factor. Emissions factors for fuel and energy use were taken from GREET or other government sources.



### Organic Waste

- › The production of orchard crops creates organic waste streams, primarily through fruit spoilage and tree pruning. Emissions factors developed by USEPA and used in their Waste Reduction Model (WARM) were used to quantify emissions produced through the decomposition of pruning, fruit spoilage and the disposal of other waste.



### In-Field Emissions

- › In-field emissions were estimated using COMET-Farm, a whole farm and ranch greenhouse gas accounting system. COMET-Farm uses information on management practices on an operation together with spatially-explicit information on climate and soil conditions from USDA databases (which are provided automatically in the tool) to run a series of models that evaluate sources of greenhouse gas emissions and carbon sequestration.

# BASELINE CARBON FOOTPRINT | LIMONEIRA

## Scope & Boundaries

This LCA seeks to quantify the environmental impact of Limoneira's fruit production and packing facilities, as well as considering the housing and office infrastructure owned by the Limoneira company. The boundary may be referred to as a 'cradle to packing gate'. In addition to these total numbers, GHG emissions will be scaled against a unit of 1 kg lemons produced.

In addition to lemons, Limoneira produces oranges, avocados, pistachios, grapefruit and other specialty citrus crops often times on the same farm. Diesel, gasoline, propane, electricity usage and natural gas are reported at the farm level and not all of these records could be aggregated down to the crop level. These emissions were allocated to lemons based on the mass of the crop at harvest.

## System Boundaries

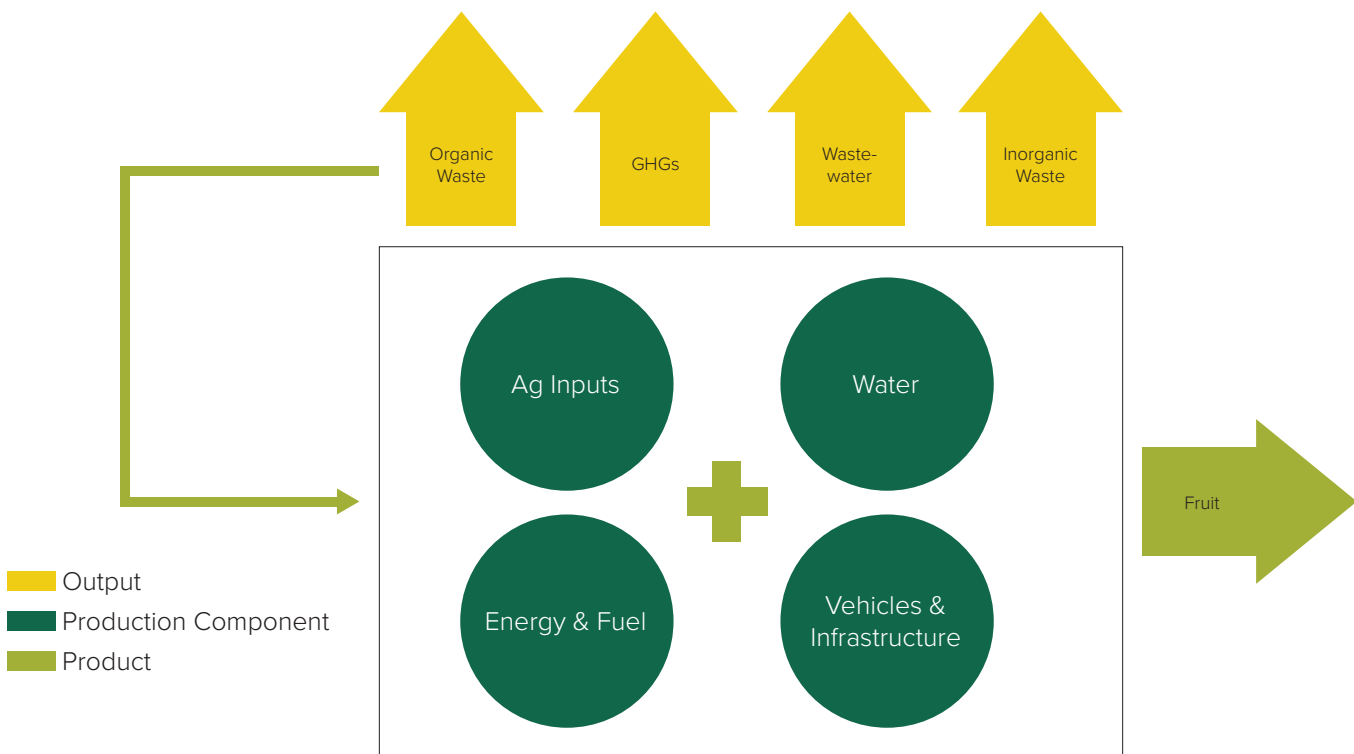


Figure 1: Cradle to Packing Gate Boundary

# BASELINE CARBON FOOTPRINT | LIMONEIRA

## Data Collection & Quality

Data was collected from their operations in Arizona and California for the cash crop growing season of 2020. In-field orchard operations data was collected as part of other ongoing work between SEC and Limoneira.

SEC was allowed access to precise, field-level agronomic data. In addition to in-field data, Limoneira provided records surrounding their purchases of gasoline, diesel, propane, natural gas, waste disposal and water recycling. Below is a list of data inputs and how they were gathered:

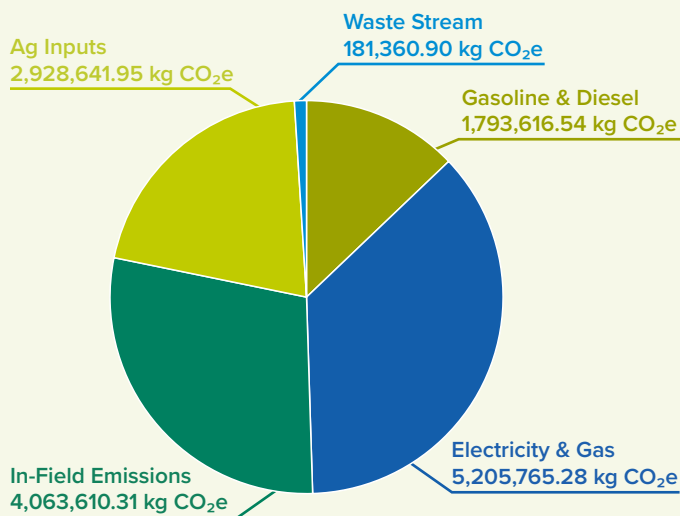
- › Data surrounding fruit production and field management was collected through precision ag software and interviews with the Limoneira team and their farm managers. The data is stored in EcoProducer™, a cloud-based web application that stores all operational data in a structured form.
- › Data surrounding electricity use in the packing house, employee housing and other Limoneira properties was provided by members of the Limoneira team.
- › Bills and invoices were gathered by members of the Limoneira team and used to total gasoline, diesel and propane consumption.
- › In-field water usage for Limoneira was gathered through precision irrigation software. Water used in fruit washing and packing was self reported by the Limoneira team.
- › Recycling and organic waste disposal amounts were taken from annual invoices at the waste disposal sites utilized by the Limoneira company. This amount represents fruit and mixed solid waste leaving Limoneira packinghouses. Limoneira does not produce waste classified as 'hazardous' by the EPA.
- › Building material quantities for infrastructure were estimated by the Limoneira team.

# BASELINE CARBON FOOTPRINT | LIMONEIRA

## Results & Discussion



### Limoneira Percent Emissions



### CARBON BASELINE

Gasoline & Diesel	1,793,616.54 kg CO <sub>2</sub> e	12.5%
Electricity & Gas	5,205,765.28 kg CO <sub>2</sub> e	37%
In-Field Emissions	4,063,610.31 kg CO <sub>2</sub> e	28.5%
Ag Inputs	2,928,641.95 kg CO <sub>2</sub> e	21%
Waste Stream	181,360.90 kg CO <sub>2</sub> e	1%
<b>Total</b>	<b>14,172,994.97 kg CO<sub>2</sub>e</b>	

Figures 2 & 3: LCA results for Limoneira

The largest contributor of Limoneira's emissions comes from the consumption of natural gas and electricity. Limoneira's operations in the United States purchased 16,736.85 kWh of electricity in 2020. Around ~95% of Limoneira's electricity use is associated with packinghouse operations and the operation of irrigation pumps and wind machines. Natural gas was consumed primarily by non-residential holdings. Propane is included in this category. Propane is used primarily by wind machines on orchard, with remaining usage coming from propane powered equipment in the packing house. 2020 data was used when totaling propane usage; it should be noted that wind machine propane usage is highly variable and changes significantly from year to year.

29% of Limoneira's emissions come from in-field emissions. These are GHG emissions that occur following fertilizer application and losses of soil organic carbon. The high rate of nitrogen fertilizer application is the primary driver of these emissions.

Agricultural inputs made up the third largest source of emissions within the Limoneira company. These emissions are largely dominated by the production of nitrogen fertilizer.

Gasoline and diesel make up the fourth largest portion of emissions in the Limoneira supply chain. This is driven by the operation of agricultural equipment and transportation of fruit between the orchard and packinghouse.

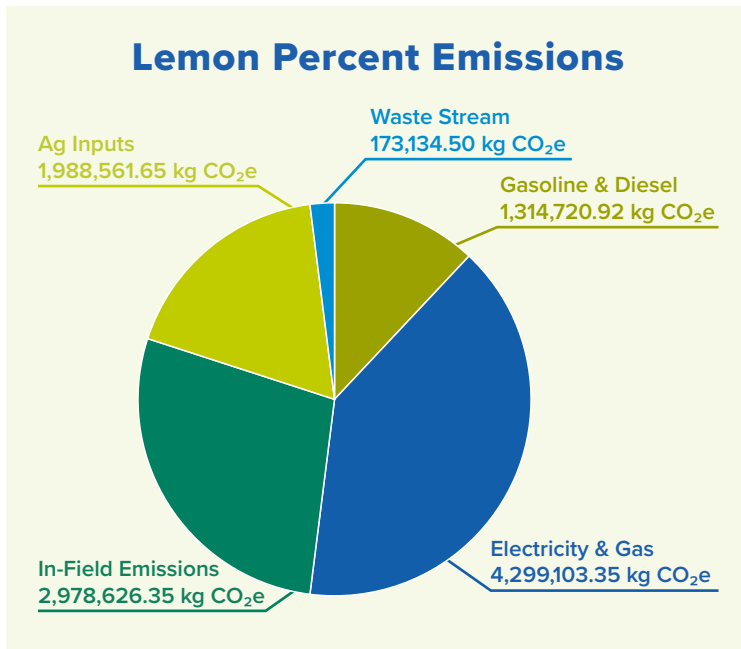
Limoneira disposes of their spoiled fruit at an on site composting center. This organic waste is then incorporated into compost and applied across the orchard system. Organic and solid waste make a relatively small portion of the emissions profile for Limoneira.

When considering electricity, natural gas, propane, gasoline and diesel usage, Limoneira used 4,027,857.16 MMBTUs of energy in 2020. Limoneira's fleet consumed 58,213 gallons of diesel and 100,168 gallons of gasoline in 2020. Additionally, they purchased 16,736.85 kWh of electricity.



# BASELINE CARBON FOOTPRINT | LIMONEIRA

## Focus on Lemons



### LEMON CARBON BASELINE

Gasoline & Diesel	1,314,720.92 kg CO <sub>2</sub> e	12%
Electricity & Gas	4,299,103.35 kg CO <sub>2</sub> e	40%
In-Field Emissions	2,978,626.35 kg CO <sub>2</sub> e	28%
Ag Inputs	1,988,561.65 kg CO <sub>2</sub> e	18%
Waste Stream	173,134.50 kg CO <sub>2</sub> e	2%
<b>Total</b>	<b>10,754,146.78 kg CO<sub>2</sub>e</b>	
<b>Scaled</b>	<b>0.19 kg CO<sub>2</sub>e/kg lemons</b>	

Figures 4 & 5: LCA results for lemons at Limoneira

Crop level data was available for agricultural inputs, waste streams as well as some electricity records. Farm level records were available for propane, diesel, gasoline and remaining electrical records. Emissions from farm level records were allocated to lemons via mass allocation using the weight of the fruit crop at harvest.

A 2017 analysis of 11 citrus LCA's published by the Center of Sustainable Systems at the University of Michigan found the cradle to farm gate GHG footprint to be 0.17 kilograms CO<sub>2</sub>e/kg fruit. A 2013 LCA of Italian orange production (Guidice et al 2013) reported the cradle to packing gate GHG footprint to be ~0.17 kg CO<sub>2</sub>e/kg fruit. In general, one should take care before comparing the results of different LCAs. Methodology, location and time of study can influence final results. Furthermore, none of these studies focused specifically on California citrus production. That said, SEC finds a carbon footprint of 0.19 kg CO<sub>2</sub>e/kg Lemons to be reasonable when compared to these literature values.

The primary drivers of GHG emissions across Limoneira's supply chain were the same as when focusing specifically on lemons production.

Infrastructure across Limoneira's operations included amounts of steel, concrete, asphalt and timber. Using approximate amounts of building materials provided by the Limoneira team, SEC estimates that the production of Limoneira's infrastructure has produced 27,594,319.25 metrics tons CO<sub>2</sub>e. These emissions are not generated on yearly basis, but are historical emissions that have happened over the course of decades.

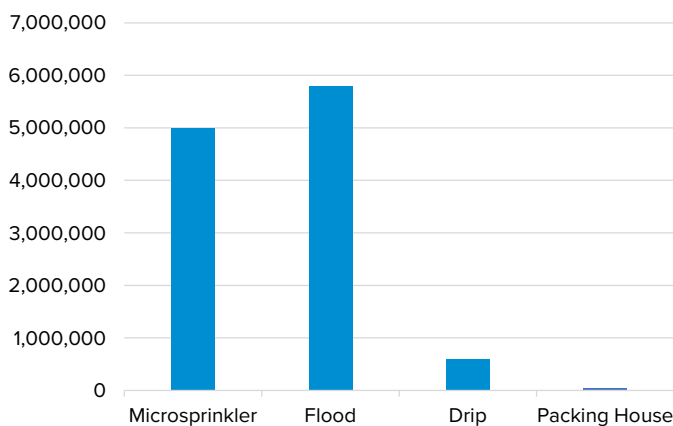
# BASELINE CARBON FOOTPRINT | LIMONEIRA

## Water Usage

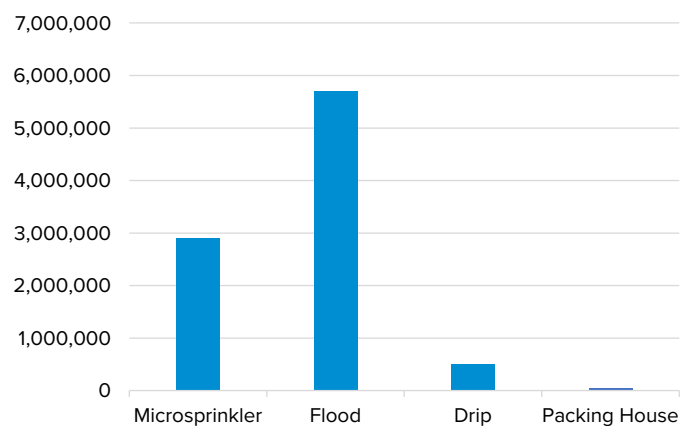
According to the World Resources Institute, 66% of the state's irrigated agriculture faces extremely high levels of baseline water stress. At Limoneira, water is used in the largest capacity to irrigate the orchards. Water is necessary to grow crops in the climate and topography of this region. Many irrigation methods are used at Limoneira including flood, microsprinkler, and dual drip hose. Flood irrigation is the most intensive on water use. Pivot irrigation is often used in row crop situations because the system can travel across the field. A traveling gun can also be used to irrigate but is more common when applying effluent with water. The most judicious type of irrigation is drip irrigation and microsprinklers, both are microirrigation methods. Microirrigation methods minimize water losses from evaporation by placing water directly next to the plant within the root zone. Utilizing this type of irrigation helps maximize water efficiency within the orchards. Flood irrigation utilizes surface water while the remaining irrigation methods draw from wells.

Nearly 31 million gallons of water are used per year in packinghouse processes at Limoneira. This number is marginal compared to water use for irrigation, however, it must be treated after use. Limoneira recycles 98% of this water using gravity fed ponds with natural vegetation, local plants, and fine gravels. Ultraviolet (UV) rays remove any bacteria in the water to achieve Title 22 drinking water standards. This water is then used for landscape irrigation.

**Water Usage Across Operations**  
(1,000 gallons)



**Water Usage Lemons**  
(1,000 gallons)



Figures 6 & 7: Limoneira's water usage across operations vs. strictly lemons

Lemons are the only fruit crop grown that receives water from flood irrigation systems, increasing the average lemon's water footprint. Limoneira lemons use approximately 145,000 gallons of water per ton of packed lemons, or 548 m<sup>3</sup> per ton.

# BASELINE CARBON FOOTPRINT | LIMONEIRA

## References

- Agronne National Laboratory. (2020). Greenhouse gases, Regulated Emissions, and Energy use in Technologies Model (GREET).
- Environmental Protection Agency. (2021). Inventory of United States Greenhouse Gas Emissions and Sinks 1990-2019. Retrieved from <https://www.epa.gov/sites/default/files/2021-04/documents/us-ghg-inventory-2021-main-text.pdf?VersionId=yu89kg1O2qP754CdR8Qmyn4RRWc5iodZ>.
- Guidice, A. (2013). Environmental assessment of the citrus fruit production in Sicily using LCA, 25(2), 202–212. Retrieved from <https://www.proquest.com/docview/1371368707>.
- Heller, M. (2017). Food Product Environmental Footprint Literature Summary: Citrus. State of Oregon: Department of Environmental Quality. Retrieved from <https://www.oregon.gov/deq/FilterDocs/PEF-Citrus-FullReport.pdf>.
- J. Rosenfeld, J. Lewandrowski, T. Hendrickson, K. Jaglo, K. Moffroid, and D. Pape. (2018). A Life-Cycle Analysis of the Greenhouse Gas Emissions from Corn-Based Ethanol. Report prepared by ICF under USDA Contract No. AG-3142-D-17-0161.
- United States Environmental Protection Agency . (2020). Waste Reduction Model (WARM) User's Guide. Retrieved from [https://www.epa.gov/sites/default/files/2020-12/documents/warm-users-guide\\_v15\\_10-29-2020.pdf](https://www.epa.gov/sites/default/files/2020-12/documents/warm-users-guide_v15_10-29-2020.pdf).
- Code of Federal Regulations, 40 CFR Section 261.4(b).

# BASELINE CARBON FOOTPRINT | LIMONEIRA

## Appendix

### EMISSIONS OF FUEL COMBUSTION

FUEL TYPE	KG CH <sub>4</sub> /UNIT FUEL	KG N <sub>2</sub> O/UNIT FUEL	KG CO <sub>2</sub> /UNIT FUEL	KG CO <sub>2</sub> E/UNIT FUEL	TOTAL KG CO <sub>2</sub> E/UNIT FUEL	UNIT FUEL
Diesel	0.001	8.243	10.599	1.683	12.321	gallon
Gasoline	0.000	7.217	8.730	1.983	10.746	gallon
Natural Gas	0.000	0.000	0.054	0.001	0.055	scf
Electricity WECC California	0.015	0.002	205.927		206.826	mwh
Propane	0.000	0.001	565.910	1.282	7.745	gallon
Electricity AZNM	0.031	0.005	433.273		435.4	mwh

### EMISSIONS FERTILIZER PRODUCTION

FERTILIZER NAME	KG CH <sub>4</sub> /TON	KG N <sub>2</sub> O/TON	KG CO <sub>2</sub> /TON	KG CO <sub>2</sub> E/TON	SOURCE
Average Nitrogen Fertilizer	6.84	1.82	2757.18	3470.54	GREET
Phosphate (P <sub>2</sub> O <sub>5</sub> ) Fertilizer				848.546	EPA, GREET
K <sub>2</sub> O Fertilizer				567.25	EPA, GREET

### INFRASTRUCTURE

MATERIAL NAME	KG CH <sub>4</sub> /TON	KG N <sub>2</sub> O/TON	KG CO <sub>2</sub> /TON	KG CO <sub>2</sub> E/TON	SOURCE
Concrete	0.034	0.001	86.2	87.238	GREET
Steel	3.92	0.022	2572.69	2677.118	GREET
Asphalt	3.4	0.004	266.33	352.477	GREET

### WASTE

WASTE TYPE	KG CO <sub>2</sub> E/TON	SOURCE
Mixed Solid Waste	520	EPA WARM Manual
Organic Waste (Compost)	150	EPA GHG Emissions Hub



# BASELINE CARBON FOOTPRINT | LIMONEIRA

---

## **EcoPRACTICES** An Evaluation of Actual Performance

5930 Grand Avenue  
West Des Moines, IA 50266  
info@ecopractices.com

\* EcoPractices estimates an environmental impact value for reducing greenhouse gas emissions, reducing soil erosion, and reducing nutrient loss due to reduced leaching. These estimates adhere to processes that are documented by the NRCS Technical Guides and publications from the EPA. These values are tailored to a specific location and participant's operation. Models used are supported by USDA, NRCS, other government agencies, and major universities. Modeled results include input data from public resources for weather, soils, and historical crop rotation. Greenhouse gas simulations were produced from the Greenhouse Gas Inventory (GGIT) tool developed by Soil Metrics, LLC (2021) <https://soilmetrics.eco>. The GGIT tool implements the USDA-sanctioned greenhouse gas inventory methods described in Eve et al. (2014) "Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory". The GGIT tool utilizes greenhouse gas modeling technology developed for the COMET-Farm tool, licensed by Colorado State University to Soil Metrics, LLC.

\*\* EcoPractices estimates an additional environmental impact for edge of field practices utilizing the data referenced from the Iowa State Nutrient Reduction Strategy by conservation practice based on whole field impact scale.

*This summary must not be edited or altered in any way without the involvement and consent of EcoPractices.*