Self-Assessment for Pistachio Production

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Table of Contents

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Project History

Over the last 10 years the field of sustainable agriculture has become more and more important in the eyes of food retailers, buyers and consumers. As is often the case when new concerns arise in relation to food and food production, the spot light shines on the grower. Sustainable agriculture is challenging to define, and once defined it can be challenging for a grower to figure out how to implement it on the farm in an economically viable way. To meet these challenges a group of specialty crop trade associations, NGO's, and other specialty crop stakeholders met to discuss the topic of sustainable agriculture. One outcome of these discussions was an application to the California Department of Food and Agriculture Specialty Crop Block grant program for funds to hire sustainable agriculture professionals to help develop a plan to meet the challenges presented by sustainable agriculture. The Great Valley Center coordinated the grant application and engaged SureHarvest to provide the technical expertise. SureHarvest is a company with extensive experience in sustainable agriculture strategic planning, program design, and program implementation. The grant application was successful and began in September of 2009. The Great Valley Center directed the project and contracted with SureHarvest for project design, facilitation and implementation.

The grant had two primary goals. The first was to develop, through a stakeholder process, a sustainable agriculture strategic plan that each of the participating groups could use internally to help lay the foundation for their own sustainable agriculture program specific to their specialty crop. The second was to develop a tool, or tools, that could be used by their member growers to put the strategic plan into action on the farm.

The following paragraphs contain the sustainable agriculture strategic plan developed by the project leadership team, the members of which are listed in Table 1.

Sustainability Strategic Plan for the Multi-Commodity Project

The sustainability strategic plan for the Multi-Commodity Project is based on SureHarvest's 5 P's of sustainability framework. The 5 P's are: Principles, Processes, Practices, Performance Metrics, and Progress. They are defined as follows:

1. Principles – This is the sustainable vision for the project. It consists of the goals that the participants want to achieve from the design and implementation of the project.
2. Processes – These are the resource areas on the farm that need to be addressed in order to meet the principles or goals of the project. For example, this could be water, energy, and human resources management.
3. Practices – These are the practices that are implemented on the farm that impact the processes or resource areas. They are the on-the-ground actions that are carried out to assure that the principles or goals of the sustainable program are met.
4. Performance Metrics – These are the metrics used to measure the outcomes resulting from the practices implemented on the farm. There are many - examples include crop quality, water use, energy use, and worker satisfaction. Performance Metrics are used to measure the level of success in meeting the principles or goals of the project.

5. Progress – The process used to improve performance over time and communicate the results internally and externally. In other words, tracking the degree of progress one is making towards achieving the goals of the project. Measuring progress will require some kind of system for assessing the farm's performance over time, creating action plans to improve particular areas of performance, and reassessment over time to track progress.

Table 1. Multi-Commodity Project Leadership Team

Organization	Representative
Almond Board of California	Gabriele Ludwig*, Robert Curtis*
Bolthouse Farms	Troy Elliott*, Justin Groves*
California Grape & Tree Fruit League	Chris Valadez*, Barry Bedwell
California Specialty Crop Council	Lori Berger*
California Garlic & Onion Research Advisory Board	Robert Ehn
California Olive Council	Patty Darragh
California Pear Advisory Board	Bob McClain
California Pepper Commission	Glen Fischer*
California Pistachio Board	Robert Klein*
California Raisin Marketing Board	Gary Schultz
California Tomato Farmers	Ed Beckman*
California Tree Fruit Agreement	Gary VanSickle*, Lauren Friedman
California Walnut Board	David Ramos
Del Monte Foods	Pat McCaa
Sun-Maid Growers	Rick Stark*

*Leadership Team Member

Multi-Commodity Project Principles (1st P):

The principles for the Multi-Commodity Project were established by the Project Leadership Team. They are:

1. Create a resource area/practice template that:
    a. Will focus on increasing the economic performance for the participant.
    b. Is scalable and can be used by participating groups to accomplish the goals of their own sustainability programs.
    c. Provides the participant the ability to gauge the state of sustainability of the industry and their farm.
    d. Encourages continual improvement on the farm.
    e. As a whole encourages ecological harmony.
    f. Better defines the 3 E's of sustainability (economic viability, environmental soundness and social equity/responsibility) in a way we can all agree upon.
    g. Is open to and usable by any individual or group in the future that was not involved in the original effort.
    h. Benefit the participants and not result in unintended negative consequences.

2. The program should provide the information/data needed for groups to tell their sustainability story better to all their audiences, e.g. buyers, regulators, consumers, NGO's.
3. The outcomes from the project cause no harm to producers.

The Leadership Team of the Multi-Commodity Project decided the best tool for implementing their sustainability strategic plan was a self-assessment of practices template that stakeholders from specific specialty crops could then fine tune for their own use. The team chose to use the model developed by the California Sustainable Almond Program (CASP), which is a California Almond Board program developed in partnership with SureHarvest. The Leadership Team formed a stakeholder committee to draft the self-assessment template that covered the practice areas listed in the Multi-Commodity Project Strategic Plan. The Stakeholder Committee members are listed in Table 2.

Individual Contact	Title	Expertise
Billy Heller	Grower, Pacific Triple E Farms	Crop management
Bob Giampaoli	Grower, Live Oak Farms	Crop management
Cliff Sadoian	Grower	Crop management
Pat McCaa	Manager, Pest Management, Del Monte Foods	Crop management
Mechel S. Paggi (Mickey)	Director, Center for Agricultural Business, California State University, Fresno	Ag Business & economics
Glen Fischer	Ag Representative, Saticoy Foods Inc.	Crop management
John Trumble	Professor of Entomology, University of California Riverside	Pest management
Jeff Mitchell	Extension Specialist, University of California, Davis	Soils & plant nutrition
Pete Goodell	UC IPM Area Advisor, University of California, Davis	Pest management
Terry Prichard	Extension Specialist, University of California, Davis	Irrigation & crop water relations
Bill Peacock	Representing raisin growers via the Raisin Marketing Board and Tree Fruit Growers	Crop management
Troy Elliott	Director of Agronomy, Bolthouse Farms	Crop management

Table 2. Multi-Commodity Project Stakeholder Committee

The second phase of the Multi-Commodity Project began with SureHarvest obtaining a CDFA Specialty Crop Block Grant to finish the self-assessment template with the Multi-Commodity Leadership Team and Stakeholder Committees and then fine-tune the template into workbooks for individual specialty crops working with willing growers and stakeholders from each specialty crop community. The self-assessment workbook for pistachios which is presented on the following pages was developed using the Multi-Commodity self-assessment template through a series of reviews and edits by growers, other stakeholders and SureHarvest staff. Bob Klein and the Pistachio Marketing Board and Richard Matoain and the American Pistachio Growers were particularly helpful during the review process. The final version was produced by SureHarvest and submitted to CDFA along with their final report in June of 2013.

Air Quality Management

Pressure is being brought to bear on urban and rural industries, including agriculture, to reduce air pollutants in the Great Central Valley of California. This section of the self-assessment will help the grower identify practices that influence air quality, highlight where the grower is doing well, and determine areas that need improvement.

Air Quality Management	**Not Familiar**	**Familiar, not tried**	**Have tried it**	**Currently Use**	**Not applicable**
In Field and Adjacent Land					
1.1 To minimize airborne dust and PM10[5] particles, a reduced tillage program is in place					
1.2 To minimize airborne dust and PM10 particles, a no-till program is in place					
1.3 If tillage is done, moisture content of the soil is taken into consideration to minimize dust					
1.4 To minimize airborne dust and PM10 particles, a cover crop is maintained at least every other row					
1.5 An every row permanent cover crop is maintained in the orchard					
1.6 Vegetation is maintained on non-cropped areas such as headlands, roadsides, and field edges to reduce wind erosion causing airborne dust					
1.7 Prunings are chipped and/or incorporated into the soil or composted rather than burned					
Roads					
2.1 Vehicle speed is restricted on dirt roads around fields to minimize airborne dust					
2.2 Dirt roads are treated with an anti-dust agent that meets the 50% PM10 control for a Fugitive PM10 Management Plan[6] or are graveled, watered, chipped, mulched (crop residues), sanded or seeded					
2.3 Heavily used roads are paved (e.g. main thoroughfares on farm)					
Engines and Fuel Consumption					
3.1 Engines are maintained on a regular schedule to ensure they are					

[5] PM 10 are particles 10 microns in diameter or smaller and pose a health risk because they pass through the throat and nose and penetrate the lungs.

[6] For details see http://www.airquality.nrcs.usda.gov/Documents/files/Dust_Control_Products.htm

running at optimum performance and efficiency so emissions are minimized					
3.2 At least some vehicles are equipped with engines able to use alternative fuels with lower emissions					
3.3 Some off-road farm vehicles are powered by engines that do not burn combustible fuel (e.g. battery-powered golf carts)					
3.4 Vehicle miles are tracked on an annual basis					
3.5 Stationary diesel engines have been replaced (or retrofitted) to Tier 3 or better, or have been replaced (or retrofitted) with technology relying on cleaner burning fuel or replaced with electric pumps					
3.6 Selection of vehicle power plants and stationary engines is in part determined by lower emissions ratings					
3.7 Some of the farm's energy requirements are obtained through renewable sources such as wind or solar					
Pesticide Management and Air Quality					
4.1 When choosing a pesticide to apply, its VOC 'footprint' is considered[7]					
4.2 Practices are implemented that reduce pesticide drift such as use of air induction nozzles, turning sprayers off at turn-arounds , not spraying when a temperature inversion exists in the field, and when wind exceeds 10 mph, or the velocity specified on the label					
Greenhouse Gas Emissions					
5.1 The application of orchard inputs that produce greenhouse gases, such as fertilizers, pesticides and diesel fuel, (e.g. CO_2, NOx) is optimized					

What are VOC's?

VOC stands for volatile organic compound. These are carbon based compounds contained in products used on the farm (such as certain pesticides), that volatilize (evaporate) when exposed to the air. Ground-based ozone is produced by chemical reactions involving VOC's, nitrogen oxides (NOx) and sunlight. While not direct air pollutants themselves, VOC's are important ozone precursors, and considered key targets for reduction in the Central Valley of California in regions where air quality is an issue. The California Department of Pesticide regulation does not know the reactivity of every VOC. Ideally, reactivity should be used to precisely determine VOC emissions. That said, appropriate data and analytical methods do exist at this time to make accurate estimates. The Department does hope to use reactivity at some point in the future. It calculates VOC emissions based on the best available science (Dr. Matt Fossen, pers. comm., Environmental Scientist, Calif. Dept. Pesticide Regulation). Air Quality and greenhouse gas emissions are such important topics in the Central Valley of California it is important to consider the various sources of potential air quality problems.

[7] A VOC calculator is found at: http://apps.cdpr.ca.gov/voc-calculator/

Energy Management

Energy is essential for crop production and it comes in several forms; as sunlight to power photosynthesis, as fuel to power internal combustion motorized vehicles and pumps, and as electricity to power shop and office lights and electronic equipment. Tracking energy is very important because it is getting more and more expensive all the time, increasing the cost of production. Burning of fuel produces GHG that affect air quality and contribute to climate change. So minimizing energy consumption saves money and reduces GHG production. Completing this section should help improve your understanding of energy use in your operation and encourage you to consider some forms of energy conservation.

Energy Management	**Not Familiar**	**Familiar, not tried**	**Have tried it**	**Currently Use**	**Not applicable**
1.1 An energy management plan is being implemented on the farm that includes yearly goals for overall energy use as well as energy used per unit of crop production.[8]					
1.2 The total amount (gallons) of fuel used annually on the farm in all operations is recorded and year to year comparisons are made. Each fuel type is recorded.					
1.3 The total amount of fuel used annually per acre and per unit of crop production is determined and year-to-year comparisons are made[9]					
1.4 The total amount of fuel used annually is calculated for each field and year-to-year comparisons are made. Each fuel type is recorded.					
1.5 Annual fuel consumption and/or electrical use for irrigation pumps are recorded and comparisons made on 4 year running averages.					
1.6 Electrical use for office(s), shop(s), and outdoor security lighting is tracked using energy bills and comparisons are made on 4 year running averages					
1.7 Fuel and electricity used are converted to a common metric such as British Thermal Units (BTU's) so they can be combined to calculate the total amount of energy used annually for crop production and comparisons are made[10] on 4 year running averages.					

[8] Ideally one would convert all energy consumption to BTU's (British Thermal Units) but initial energy management plans could start with using gallons of gasoline and diesel and kilowatt hours for electricity.

[9] This can be a simple calculation of taking the total gallons of fuel used for the year divided by the total amount of crops produced for the year.

[10] Energy conversion calculators for kilowatt hours to BTU's and gas or diesel to BTU's are readily and freely available on the Internet. For example Google 'convert kilowatt hours to BTU's and a link will be provided to a calculator.

1.8 The amount of energy used annually per acre and per unit of crop production is calculated and comparisons are made on 4 year running averages.					
1.9 The amount of energy used annually in each field is calculated and comparisons are made on 4 year running averages.					
1.10 A process is in place to ensure that the most appropriate piece of equipment is used for a given job (e.g. the most appropriate horse power engine for the job).					
1.11 One or more solar energy systems are installed on the property to generate electricity.					
1.12 One or more wind generators are installed on the property to generate electricity.					
1.13 Engines (stationary and mobile) and motors are maintained on a regular schedule to ensure they are running at an optimum fuel efficiency or optimum efficiency.					
1.14 Pumping plant efficiency (energy per acre foot pumped) is checked every 1 to 3 years (based on use) and adjustments are made if necessary (FSU website recommends every 1-3 years based on use).					
1.15 At least some light switches are fitted with motion detectors or photo cells to reduce time of use.					
1.16 At least some office and shop lights have been fitted with low energy consumption compact florescent bulbs or LED lights.					

Indirect Energy Use/Consumption:

Energy is directly expended when driving a vehicle, operating a pump, photocopying, or turning on and using a light bulb. Energy is also expended to manufacture inputs that are used on the farm, such as fertilizers, compost and pesticides. This type of energy consumption is called imbedded energy. If you want to figure out the total amount of energy consumed to produce a crop, then calculations should also be made to determine the amount of embedded energy that was consumed to produce the fertilizers, compost, and pesticides that were used to produce the crop.

Financial Management

The economic E of sustainable farming is literally where the buck stops. If a farm is not profitable, it is not sustainable. People farm not because they want to be accountants. They farm because they want to grow things. However, while financial management may be a challenging part of farming, doing it well is one of the keys to a successful and sustainable farm. This chapter will help the grower recognize strengths in financial management as well as point out areas where improvements are needed.

Financial Management **(The most appropriate person to fill out this section/chapter is the CEO/owner of the farm)**	**Not Familiar**	**Familiar, not tried**	**Have tried it**	**Currently Use**	**Not applicable**
Planning and Risk Management					
1.1 A processing, harvesting and production financial plan has been developed for the farm and seasonal outcomes are compared to these plans					
1.2 A succession[11] plan is in place for the farm					
1.3 I have a written will and estate plan for the farm[12]					
1.4 A business continuation plan has been developed for the farm that addresses disasters, such as extreme weather events or the unexpected death of one or more key personnel					
1.5 A risk management plan has been developed for the farm that addresses factors such as absence of labor, blackouts, or lack of ability to deliver the crop to the processor					
1.6 Key personnel in the company have health insurance					
1.7 Key personnel in the company have disability insurance					
1.8 Key personnel have life or accidental death insurance					
Accounting and Financial Analyses					
2.1 A financial accounting system is used to track and report farm finances and is used to make farm management decisions					
2.2 I understand how to interpret both cash and accrual financial statements, including a balance sheet, income statement, cash flow, and financial ratios					
2.3 A financial advisor is consulted on an annual basis in relation					

[11] A succession plan is one where the change in leadership in the company has been determined, whether it is expected such as the CEO voluntarily stepping down/retiring, or unexpected such as due to illness or accident.

[12] An estate plan is a plan for the financial assets to pass from one generation to the next. It does not deal with the human and intellectual capital and passing that transition to the next generation. That is succession planning.

2.4 Financial profitability analyses for investments are done if investments are made					
2.5 The revenue and returns are tracked for each field/management unit in financial management reports					
2.6 Costs and returns are tracked for all important farming practices					
2.7 Costs and returns are tracked for implementing new sustainability practices and compared to costs and returns of practices they replaced					
2.8 Sensitivity analysis, i.e. change in crop prices over time, is used in production management decisions					
Purchasing and Borrowing					
3.1 More than one quote is obtained for major input purchases such as pesticides and fertilizers					
3.2 Interest rates and services from more than one lending institution are compared before borrowing a significant amount of money					

Food Safety Planning

How do we ensure that fresh food is safe? This is a question that is being debated by everyone all along the supply chain. Compliance with food safety production requirements is becoming a necessary requirement for many specialty crops. This section lists practices that are related to food safety planning.

Food Safety Planning	**Not Familiar**	**Familiar, not tried**	**Have tried it**	**Currently Use**	**Not applicable**
Food Safety Management Planning					
1.1 A written food safety policy is in place for the farm that includes a commitment to food safety, how it is implemented, and how it is communicated to the employees					
1.2 A written food safety plan is on file and implemented on the farm					
1.3 If a food safety plan is in place, the plan meets Global Food Safety Initiative (GFSI) guidelines					
1.4The food safety plan is reviewed and updated at least annually					
1.5 Records are kept to demonstrate the food safety plan is being followed					
1.5 A person has been designated as being responsible for food safety functions on the farm					
1.6 All employees are trained in food safety procedures and practices on the farm					
1.7 My company participates in a third- party food safety certification/verification program (e.g. Agriculture Marketing Service GAP Certified, Scientific Certification Systems, PrimusGFS, GLOBALG.A.P.)					
1.8 If there is participation in a 3rd party food safety program, the program is Global Food Safety Initiative (GFSI) compliant or approved					

Soil Management

Soil is the most complex ecosystem on earth. Gaining a greater understanding of the soil resource in production fields is critical for making informed soil management decisions. Knowing the soil resource gives the grower greater control over yield and crop quality and is especially important in determining the long-term sustainability of the farm.

Soil provides the crop with three vital things: water, nutrients and air. These three things are best provided by a soil with good depth and structure, i.e. a soil in which the particles are bound together into small clumps (aggregates) of varying size. Soil aggregation is a measure of soil structure. Soil organic matter is important in maintaining soil structure by gluing soil minerals together into aggregates. Spaces between large aggregates (measured as millimeters) permit rapid drainage and easy root growth, and spaces between small aggregates (measured as less 1 millimeter down to 0.001 millimeter) trap water for use between irrigation and rain events. One of the more important aspects controlling aggregate stability is the amount of microbial activity and soil organic matter. Stable aggregates occur in varying sizes and are created by the cementing action of microbes and their byproduct and soil organic matter. The assemblage of soil aggregates creates habitat to promote faunal and microbial diversity, an important index of soil quality. Due to the warm to hot California climate, soil organic matter is low in many soils due to rapid breakdown of soil organic matter.

The following self-assessment template will help document the practices producers are using to manage their soil sustainably as well as suggest areas where improvements might be possible.

Soil Management	**Not Familiar**	**Familiar, not tried**	**Have tried it**	**Currently Use**	**Not applicable**
Knowledge of soil properties					
1.1 The soil types in the field has/have been identified using soil samples taken pre-planting (for permanent crops soil pits were dug to establish soil series)					
1.2 Soil properties for each soil type in the field are recorded, including soil moisture holding capacity, texture, and rooting depth					
1.3 A soil sample has been taken in the field within the last 4 years and analyzed for macro and micro nutrients, as well as soil chemistry (e.g. pH, CEC, salts)					
1.4 A soil sample has been taken in the field within the last 2 years and analyzed for macro and micro nutrients, as well as soil chemistry (e.g. pH, CEC, salts)					
1.5 Soil pH is determined and amended if necessary					
Soil properties management					

2.1 If water infiltration is poor (water puddles and runs off when soil is dry underneath) the soil is amended either chemically or physically					
2.2 Cover crops are planted for soil management					
2.3 Resident vegetation is allowed to grow for soil management					
2.4 If soil organic matter is low for the soil series in my field, there is an ongoing program to build soil organic matter, either through additions of compost and/or growing cover crops					
2.5 Equipment is chosen or is modified to minimize soil compaction (e.g. lightest equipment possible, track-layers, wider or bigger diameter tires, tire pressures as low as possible)					
2.6 The soil is never tilled unless a problem develops that requires one pass to alleviate the problem (e.g. soil is too uneven for safe operation of equipment; this does not include aerating the soil with equipment like an Aerway)					
2.7 Tillage is done as necessary to correct orchard floor problems due to things like gopher or ground squirrel activity					
2.8 Tillage is done on a regular schedule					
2.9.1 In order to avoid soil compaction, heavy equipment is never driven on saturated soil					
Soil erosion					
3.1 If soil erosion is an issue, vegetation is maintained along farm roads, on field edges, and along irrigation canals not controlled by the irrigation district					
3.2 The infiltration/run-off rates of the field's soil is known and the rate of irrigation water are applied and adjusted accordingly					
3.3 Culverts are properly sized to accommodate high flows, and inlets and outlets have been hardened to prevent scour or energy dissipaters have been installed					
3.4 An orchard floor management plan is implemented to (1) protect the soil from water droplet impact, (2) enhance aggregate stability, (3) improve water infiltration, and (4) interrupt runoff pathways.[13]					
Crop nutrition management					
4.1 A crop nutrient management plan has been written for the orchard that uses a 'budgeting approach'[14] in determining the nutrient needs of the crop and takes into consideration factors like crop tissue analyses, soil type, time of year, soil moisture, crop load (e.g. alternate bearing), etc. (insert an educational box discussing the 4 R's of nutrient management; see http://www.ipni.net/4r)					

[13] O'Geen, Anthony. Orchard Floor Management Practices to Reduce Erosion & Protect Water Quality, University of California Division of Agriculture & Natural Resources (2006), http://fruitsandnuts.ucdavis.edu/files/103067.pdf.

[14] A budgeting approach means that the amount of nutrients leaving the field in the crop is estimated and the amount of nutrients added back to the field is based on this estimate. A one -to-one replacement is not implied or required since factors such as soil type affect nutrient availability to the crop and these factors must also be taken into account.

4.2 Lab results from the soil samples were used in developing the crop nutrient management plan					
4.3 Plant tissue are taken and analyzed at least once a season and used to help assess crop nutrient needs and assess the impact of the nutrition management program					
4.4 The year-to-year amounts of nitrogen, phosphorus, and potassium applied per acre are recorded and the amounts of N, P, & K applied per unit crop production are calculated					
4.5 Nutrients are applied to the root zone at the time of greatest need					
4.6 Due to the "alternate year" nature of pistachio yields, less fertilizer is applied during "off" years.					
4.7 Fertilizers are applied using Fertigation					
4.8 The total amount of nitrogen needed for the season is applied in a split application(s)					
4.9 Fertilizers are applied using a 'spoon feeding' approach where only the amount of nutrients required by the crop at the time are applied and multiple applications are made throughout the growing season based on crop growth stage and nutrient demand					
4.10 Micro nutrients are applied based on past crop history					
4.11 Micro nutrients are applied based on soil sample test results					
4.12 Micro nutrients are applied based on crop tissue sample test results					
4.13 Long-term records for the orchard are kept of the application program, including applications of fertilizer and soil amendments, results of leaf sampling, and yield.[15]					
4.14 Nutrient management is done using the concept of the 4Rs, i.e. applying the **r**ight rate, at the **r**ight time, in the **r**ight place, and using the **r**ight source.[16]					

The 4 R's of Nutrition and Nutrient Management

The 4 R's of nutrient management is an approach to fertilization developed and promoted by the International Plant Nutrition Institute (IPNI). Whenever nutrients are added to a field or orchard, it should be done at the right time, in the right place, using the right rate and the right source of nutrients. The right time is determined when uptake from the soil occurs. The right place is achieved by ensuring delivery of nutrients to the active roots and managing variability across the orchard. The right rate is applied by matching demand with supply. The right source is ensured by maximizing uptake and minimizing loss potential.

[15] Beede, Robert, Nutrients & Fertilization, Fruit & Nut Research & Information Center, http://fruitsandnuts.ucdavis.edu/pistachiopages/pistachio_nutrients_fertilization/

[16] Brown, Patrick & Siddiqui, Muhammad, *Managing Pistachio Nutrition*, California Pistachios http://fruitsandnuts.ucdavis.edu/files/135347.pdf

Ecosystem Management

An ecosystem is the complex community of living organisms and their physical environment functioning as an ecological unit. Components of an ecosystem are inseparable and interrelated. An ecosystem management approach to growing specialty crops acknowledges that people are a part of and have a significant impact on ecosystem structures and processes, and that people depend on and must assume responsibility for the ecological, economic, and social systems where they live. Ecosystem management is currently being encouraged and implemented by communities, government agencies, businesses, academics and various conservation organizations throughout the world[17].

Ecosystem Management	**Not Familiar**	**Familiar, not tried**	**Have tried it**	**Currently Use**	**Not applicable**
Habitat maintenance and enhancement					
1.1 Hedgerows of trees and/or shrubs are maintained on at least some field edges					
1.2 Vegetation such as grasses, trees or shrubs are maintained along roadsides, ditch-banks and headlands					
1.3 Trees are maintained to provide habitat for wildlife					
1.4 Nesting boxes for owls have been placed around the farm and they are cleaned annually					
1.5 Perches for raptors have been placed around the farm					
1.6 If water courses exist on the farm property, setbacks are in place to minimize disturbance					
1.7 If water courses exist on the farm property, resident vegetation is maintained on the banks					
Whole farm issues					
2.1 I am an active member in the local watershed coalition					
2.2 Invasive pests (e.g. puncture vine, arundo) are monitored for and when found, controlled					
2.3 An environmental survey of the farm has been done noting the presence of sensitive areas, such as vernal pools, swales, oak trees, habitat for endangered species, and other environmental features which affect farming and actual farmable acres					
2.4 Some or all of the natural areas of my property are protected by a conservation easement (see education box below)					

[17] Reeves, K. 2008. Chapter 1. Ecosystem Management *in* Ohmart, C. P., C. P. Storm and S. K. Matthiasson. Lodi Winegrower's Workbook 2nd Edition. Lodi Winegrape Commission. pp. 15- 63.

2.5 Some or all of my property are protected by an agricultural easement program					
2.6 Unfarmed areas are maintained to increase biodiversity on the farm including wildlife, pollinators and/or arthropod natural enemies					

Education box: What is an ecosystem service?

The biological communities in an agricultural ecosystem provide benefits over and above the commercial crops they produce. These benefits are known as ecosystem services. They include removing carbon dioxide from the atmosphere, reducing greenhouse gases, the recycling of nutrients, regulation of microclimate and local hydrological processes. In some cases they result in the suppression of pest plants and animals through the production of pest natural enemies, and detoxification of noxious chemicals that enter the environment.

Education Box: What are Conservation and Agricultural Easements?

Conservation easements for protection of natural resources are legal agreements that allow landowners to donate or sell some "rights" on portions of their land to a public agency, land trust, or conservation organization. In exchange, the owner agrees to restrict development and farming in natural habitat, and assures the easement land remains protected in perpetuity. A 1996 study conducted by the National Wetlands Conservation Alliance indicated that the leading reasons landowners restored wetlands were to provide habitat for wildlife, to leave something to future generations, and to preserve natural beauty. Only 10% of landowners surveyed in the study restored wetlands solely for financial profit. This would also apply to other habitats besides wetlands. A conservation easement can provide you with financial benefits for the protection, enhancement, and restoration efforts for the natural environments on your property. The belief that natural resources such as wildlife, especially sensitive species, will reduce your land value is not true. Many easement programs include some sort of cash payment for a portion of the costs associated with habitat restoration and enhancement.

Agricultural conservation easements are for the explicit purpose of keeping farmland in production. They are similar to natural resource conservation easements, but, specifically protect farmland and maintain the practice of farming. In 1996, the state established the California Farmland Conservancy Program to protect farmland by funding agricultural easements. Based on a study conducted by UC Cooperative Extension and published in 2002, there were 34 local conservation organizations, land trusts, and open space districts that protect farmland through agricultural easements (see – *Agricultural Easements: New Tool for Farmland Protection California Agriculture*, January-February 2002, Volume 56:No. 1). Local opportunities may exist for one or both kinds of conservation easements on your property.

Pest Management

Integrated pest management (IPM) is a fundamental part of any sustainable farming program. It is cost-effective, flexible, and resilient. IPM was developed to respond to some significant pest management challenges that developed in the 1950's and 1960's. Events such as the development of pesticide resistance by many pests, secondary pest outbreaks, and environmental contamination due to the use of certain problematic pesticides, led a forward-looking group of entomologists at the University of California to conclude that agriculture was heading toward a pest management crisis. They realized the fact that pest problems are complex and connected to ecosystem processes was being overlooked. They concluded that the solutions to complex ecological problems must be broad-based and take the farm ecosystem into account. These researchers developed the IPM concept to meet the pest management crisis. Since its inception in 1959, IPM has evolved into the best way to manage pest problems on the farm.

University of California Statewide IPM Program crafted the following as the definition of IPM[18]:
Integrated Pest Management (IPM) is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment.

Farming is carried out within the ecosystem and is a long-term endeavor so the use of management practices that are ecosystem-based and long-term in nature is important. By using a combination of control techniques to manage a pest problem, we develop a broad-based management strategy that will still be successful even if one particular technique does not work. Based on our experience with chemical controls, we know that pest control decisions must take into account not only economic risks, but effects on the environment and people's health well[19].

Pest Management	**Not Familiar**	**Familiar, not tried**	**Have tried it**	**Currently Use**	**Not applicable**
Pest Management Framework for Farm					
1.1 An integrated pest management framework/plan for the farm has been developed that takes into account the landscape within which I farm, an understanding of the cropping system and how it affects the					

[18] http://www.ipm.ucdavis.edu/IPMPROJECT/about.html
[19] Ohmart, C. P. and C. P. Storm. 2008. Chapter 6. Pest Management. *In* Ohmart, C. P., C. P. Storm and S. K. Matthiasson. Lodi Winegrower's Workbook 2nd Edition. Lodi Winegrape Commission. pp. 187- 267.

population levels of key pests, includes monitoring protocols and economic thresholds for key pests, monitoring protocols and important pest natural enemies, and the key biological, cultural and chemical control options available for key pests					
1.2 Each year the pest management framework is reviewed with all those involved in pest management on the farm and adjustments are made according to the goals set forth in the plan and pest management results from the past year					
Risk Assessment					
2.1 Key pests for the farm have been identified in the following groups: diseases, insects, mites, weeds, mammals and birds; and targeted for management					
2.2 Monitoring protocols have been established and are followed for key pests					
2.3 I and/or my Pest Control Advisor (PCA) have established and use economic thresholds for key pests					
2.4 I and/or my PCA keep written spray records containing the information required by California Department of Pesticide Regulation as well as weather conditions and effectiveness					
2.5 Environmentally sensitive areas are known in and near the orchard, such as distance to ground water, surface water, wetlands, vernal pools, swales, houses, schools, public and private roads					
2.6 Environmentally sensitive areas in and near the orchard have been mapped, such as distance to ground water, surface water, wetlands, vernal pools, swales, houses, schools, public and private roads					
Monitoring					
3.1 The UC IPM year round pest management program for pistachios[20] is followed					
3.2 The UC IPM pest management guidelines for pistachios are used[21]					
3.4 I monitor pest populations in the orchard					
3.5 A PCA monitors pest populations in the orchard					
3.6 Monitoring is done for pest natural enemies and their numbers are considered when making pest management decisions					
3.7 Cultural factors, such as time to harvest, preexisting plant damage, plant moisture stress, plant health, and crop load, are considered in pest management decision-making					
3.8 Qualitative (descriptive) written pest monitoring records are kept and are used during the pest management decision making process					
3.9 Quantitative (numeric) written pest monitoring records are kept and are used during the pest management decision making process					
3.10 If pest management recommendations from a PCA are relied upon for pest management decisions, someone from farm management					

[20] http://www.ipm.ucdavis.edu/PMG/selectnewpest.pistachios.html
[21] http://www.ipm.ucdavis.edu/PDF/PMG/pmgpistachio.pdf

reviews with them the pest situation before making a decision to take a management action					
3.11 Crew supervisors and farm managers are encouraged to report any pest problem that is out of the ordinary (e.g. pests they have never seen before) and report it to the appropriate person					
3.12 Pictures of important invasive pests are posted in convenient places so employees can monitor for their presence					
Pesticide Management					
4.1 'Smart'[22] sprayers are used when applying pesticides in the orchard					
4.2 Pesticide drift is minimized by using technologies such as air induction nozzles, or some pesticides are applied using chemigation					
4.3 Pesticides with different modes of action are rotated to minimize development of resistance					
4.4 A written spray drift management plan has been drawn up for each orchard that includes a map of the field and location of sensitive areas and sprayer operators follow the plan					
4.5 Calibration and spray coverage tests are done at least once a season on sprayers and are based on manufacturers' recommendations as well as site characteristics such as crop canopy present					
4.6 Buffer zones have been established for each orchard based on pesticide label specifications as well as adjacent crops and other sensitive sites					
4.7 Sprays are timed such that there is minimal or no human activity in adjacent areas at the time of spraying					
4.8 Sprayer nozzles are shutoff at row ends near environmentally sensitive areas					
4.9 There is a barrier around the wellhead that prevents surface water running to the wellhead					
4.10 Pesticide mixing and loading area is more than 100 feet from the wellhead unless it is protected by a berm or other physical characteristics that prevent surface water running to the wellhead					
4.11 A separate water supply tank is used for pesticide mixing or chemicals are added to the tank at least 100 feet away from the well.					
4.12 Either a double-check valve, reduced pressure principle backflow prevention device or an air gap is in place and maintained between the well pump and sprayer tank[23]					
4.13 Pesticide mixing and loading is done using a closed system or with water soluble pesticide packets when available for the pesticide being applied					
4.14 Spray mixing, loading and calibration is planned so that the tank is empty at the end of the spray job					

[22] A smart sprayer is one equipped with sensors that detect presence or absence of target and shuts off when target is not present.
[23] This is a legal requirement

4.15 The following safe pesticide storage practices are used: dry pesticides stored above liquids, pesticides are stored more than 300 feet from nearest well, storage area has impermeable floor and sump to contain leaks, and only undamaged containers are stored					
4.16 An emergency response plan has been established for pesticide and fertilizer spills and exposure posted in the appropriate places					
4.17 Workers are trained to follow the emergency response plan for pesticide spills or exposure					
4.18 A pesticide risk model such as PRiME[24], WIN PST or UC IPM's Water Tox[25] is used when considering which pesticides to apply					
4.19 The VOC 'footprint' of a pesticide is considered when deciding which pesticides to apply[26]					
4.20 Practices are implemented which reduce the amount of *Aspergillus flavus* inoculum in the orchard.[27, 28]					
Prevention and Cultural Practices					
5.1 Resistance rootstocks are used to manage key root diseases					
5.2 All weeds and grasses are removed from the orchard and around the base of each tree to reduce damage from plant bugs					
5.3 To reduce the incidence of navel orangeworm during the growing season and minimize the need for pesticide use during the growing season, any mummy nuts are removed from the trees and destroyed.[29]					
5.4 Harvest is timed to reduce the incidence of navel orangeworm					
5.5 Ground mummies of navel orangeworms are destroyed by disking or mowing after removing as many nuts as possible from the berm by blowing or raking					
Biological control					
6.1 Conservation of pest natural enemies is considered when choosing a pesticide to use in the orchard					
6.2 Sprays are timed to minimize their impact on pest natural enemies					
Effects of Pest Management on Non-Target Sites & Organisms					
7.1 Effects of a pesticide on non-target organisms existing on the farm, such as birds and small mammals, are considered when selecting pesticides to apply					

[24] PRiME is the Pesticide Risk Mitigation Engine and can be accessed at http://ipmprime.org/cigipm/
[25] The model output is accessible at http://www.ipm.ucdavis.edu by viewing the webpage for the pest in question and clicking on the link labeled 'Water Quality Compare Treatments')
[26] http://apps.cdpr.ca.gov/voc-calculator/
[27] Aflatoxin is a potent carcinogen produced by the fungi *Aspergillus flavus* and associated with liver cancer in humans. Aflatoxin is also an acute toxin for animals that are fed a diet contaminated with aflatoxin. The practices above will reduce the risk of aflatoxin contamination.
[28] California Pistachio Research Board, *Good Agricultural Practices Manual, Guidelines for California Pistachio Growers* (2009), http://ucfoodsafety.ucdavis.edu/files/26477.pdf.
[29] Beede, Robert, Nutrients & Fertilization, Fruit & Nut Research & Information Center, http://fruitsandnuts.ucdavis.edu/pistachiopages/pistachio_nutrients_fertilization/

Social Responsibility

Human Resources Management	**Not Familiar**	**Familiar, not tried**	**Have tried it**	**Currently Use**	**Not applicable**
Staffing and Recruiting Strategy					
1.1 A long term (2-5 years) staffing and recruiting strategy is in place					
1.2 A variety of recruiting methods is used depending on job opening, e.g. word of mouth, newspaper, web recruiting, job fair, temporary or contract services					
1.3 A standard interviewing process is used in recruitment which includes a specific set of review questions					
1.4 A job description exists for each type of job and it is given to the employee and their supervisor					
1.5 Job descriptions are reviewed and updated at least once every two years					
Employee Orientation, Safety Training, and Career Development					
2.1 An orientation program is provided for new non-seasonal employees					
2.2 Safety training is done when employee begins a new job assignment, or any new process, procedure or use of a substance or equipment that creates a new hazard is introduced					
2.3 If labor is contracted, the contractor is licensed, insured, and bonded and they adhere to Cal OSHA standards					
2.4 If labor is contracted, a check is made to ensure contract labor company adheres to all relevant Cal OSHA safety regulations					
2.5 Safety statistics such as time lost due to accidents are tracked and retained for at least 2 years					
2.6 Employees are instructed as necessary to attend training seminars or other educational programs at least once a year that enhance their skills in the workplace					
2.7 Employees are encouraged to attend training seminars or other educational programs at least once a year that enhance their skills in the workplace (e.g. SpraySafe)					
2.8 The company pays for training when required and/or provides tuition reimbursement for work-related college classes					
2.9 A meeting of top management is held annually to discuss company goals and exchange ideas					
Staying Informed					
3.1 Trade journals/appropriate trade literature (including literature on worker issues, safety issues, Farm Bureau, trade association					

literature, etc.) are made available for the farm management team (FMT) to read					
3.2 The FMT has current membership in local grower association(s)					
3.3 The FMT regularly attend regional and/or statewide industry meetings (e.g. irrigation district, Farm Bureau, Water Coalition, etc.), trade shows (e.g. World Ag Expo), and seminars (e.g. UC, CDFA, CSU seminars, research meetings from Commodity Boards)					
3.4 The FMT takes a leadership role in local, regional or state industry associations (e.g. Western Growers, California Grape & Tree Fruit League, Grower-Shipper Association)					
3.5 The company is involved in regional land use planning					
Performance, discipline, grievance process, and employee recognition					
4.1 A job performance process is in place and is linked to pay and promotions					
4.2 A process is in place for employees to comment on job satisfaction					
4.3 The company has a grievance process in place					
4.4 Filed grievances are processed in a timely manner					
4.5 A process is in place by which employees are recognized for good job performance and/or years of service					

Community Support	**Not Familiar**	**Familiar, not tried**	**Have tried it**	**Currently Use**	**Not applicable**
1.1 The company is involved in initiatives, through time commitment and/or donations, that enhance the community such as the Chamber of Commerce, schools/education programs, churches, public health, affordable housing					
1.2 The company is involved in regional water issues such as the regional water quality coalition, irrigation districts, ground water use planning, and/or the irrigated lands waiver program planning					

Waste Management

Sustainable agriculture provides a strategy for managing all aspects of the farming enterprise, including the management of the crop, soil, water, pests and human resources. It also relates to the farm's infrastructure as well, such as offices and shop. While the most interesting part of sustainable farming addresses what happens in the field, it is important not to forget important issues like waste management. In a lot of situations, waste management is one of the most straightforward processes to address on the farm.

Waste Management	**Not Familiar**	**Familiar, not tried**	**Have tried it**	**Currently Use**	**Not applicable**
In field, shop and office					
1.1 A waste management plan for the farm has been written that includes waste reduction goals, recycling goals, hazardous material use reduction goals					
1.2 The farm has an established recycling program					
1.3 The value of recycling is part of the orientation and training of employees					
1.4 All unused or worn out items such as appliances, tractors, ATVs, electrical equipment, are taken to the proper recycling centers for disposal					
1.5 Employees are trained on the proper handling and disposal of hazardous materials (e.g. solvents, cleaning materials, explosives, compressed gases, fuel, acids, and lubricants)					
1.6 Employees are trained on legal requirements related to cleaning of farm equipment with water or steam cleaners and the resulting runoff					
1.7 Hazardous materials no longer used, as well as their containers, are disposed of according to legal requirements					
1.8 The farm participates in the pesticide container recycling program[30]					
1.9 Dumpsters and/or recycling containers are periodically inspected for leaks, spills, and litter. Problems noticed are corrected					
1.10 Bi-lingual signs are posted near the dumpster and/or recycling containers indicating what can or cannot be put in the container					

[30] Use the following link to find out how to participate in an Ag Container recycling program: http://www.acrecycle.org/contact_us.html

Water Management and Water Quality

California is the leading agriculture state in the US by a significant amount. This is due in large part to the high value of the many specialty crops grown in the state. It is also due to the excellent growing conditions such as fertile soils, a Mediterranean climate and the availability of affordable high quality surface and ground water for irrigation. California is also the most populace state in the US, and therefore affordable high quality water is needed to support this population. It is clear that because of the demands for high quality, affordable water, this critical resource needs to be used efficiently and effectively by specialty crop producers. The following template will help document practices producers are using to achieve optimum water quality and use efficiency as well as bring to their attention areas where improvements can possibly be made.

Irrigation Management	**Not Familiar**	**Familiar, not tried**	**Have tried it**	**Currently Use**	**Not applicable**
Pre-plant Planning					
1.1 Pre-plant analyses of the site was done to identify factors that affect quantity of irrigation water delivery and percolation rate such as existence of soil compaction, a root restricting layer, soil type, soil texture, soil chemistry (pH, salinity, etc.) and soil organic matter					
1.2 Ripping, plowing, chiseling, or other practices were implemented if pre-plant soil tests indicated water percolation and/or drainage problems					
1.3 Soil amendments were applied to correct soil chemical or physical issues if sampling identified factors that would affect water percolation					
1.4 The Water source was sampled and evaluated for water quality					
1.5 The irrigation system was designed to deliver the quantity of water required for the crop and accommodate for variation in topography as well as in soil texture that affects water percolation and water holding capacity					
1.6 In order to allow for frequent application and reduce water waste, micro-sprinklers or drip irrigation is used.[i]					
1.7 On newly planted trees, emitters are placed to conserve water while providing adequate water to the newly planted tree					
Irrigation Scheduling & Rates					
2.1 The total amount of water applied to each orchard is measured and recorded every season and the amount of water applied per ton of pistachios is calculated					
2.2 A water management plan for the orchard has been written that includes goals for the growing season and takes into consideration					

annual rainfall, crop variety, crop maturity, water-related pest management issues, soil type, soil preparation, slope, water quality, irrigation efficiency, irrigation uniformity, energy efficiency					
2.3 Irrigation is initiated at the start of the season based on measured soil moisture depletion					
2.4 Irrigation is initiated at the start of the season based on directly measuring plant moisture stress (e.g. with pressure bomb)					
2.5 Irrigation scheduling is influenced by peak energy pricing					
2.6 Water percolation rate and infiltration depth is monitored during the irrigation season					
2.7 Soil moisture depletion is estimated by visual inspection of the trees (e.g. growth or development) that indicates plant water stress					
2.8 Soil moisture depletion is tracked through soil coring					
2.9 Soil moisture depletion is tracked using soil-installed moisture monitoring devices					
2.10 Soil moisture depletion is tracked by directly measuring plant moisture stress (e.g. with a pressure bomb)					
2.11 Amount of irrigation and timing are dictated by the amount and timing of water available through the Irrigation District					
2.12 Amount of irrigation and timing are based on visual cues of the trees					
2.13 Amount of irrigation and timing are based on irrigation history from past growing seasons					
2.14 Amount of irrigation and timing are based on historical crop evapotranspiration (ET)					
2.15 Water demand of the crop is estimated by determining ETo[31] through using data from the nearest CIMIS weather station and used in irrigation rate and scheduling					
2.16 Water demand from the crop is estimated by converting ETo to Etc and using the appropriate crop coefficient factor (Kc) which takes into account crop canopy and used in irrigation rate and scheduling					
2.17 When appropriate less than full water demand is applied to the orchard (deficit irrigation)					
General Irrigation Performance and System Maintenance					
3.1 Pumping plant efficiency has been measured within at least the last 3 years (for areas where water table fluctuates considerably pumping plant efficiency should be checked at least once every 2 years)					
3.2 Pumping plant efficiency has been measured within at least the last 5 years					
3.3 Energy use for irrigation is tracked on an annual basis and related to unit of production					

[31] ETo is the reference evapotranspiration and is calculated using measurements of climatic variables including solar radiation, humidity, temperature and wind speed and is expressed in inches or millimeters of water. It is based on water use for a short mowed full coverage grass crop.

3.4 Electrical irrigation pumps are on time of use metering					
3.5 If pumping efficiency is significantly reduced, I have improved it					
3.6 Diesel irrigation pumps are Tier 2 or higher					
3.7 A flow meter is installed on wells and/or pumps and I monitor and record the flows					
3.8 Pressure check points are installed on key lines from pumps					
3.9 Filters status (and flushing system) is manually checked regularly and corrected if necessary					
3.10 Pressure gauges are installed for measuring pressure drops through filters					
3.11 The irrigation system is monitored for leaks, breaks, and clogging every irrigation					
3.12 Irrigation lines are flushed at the start of the season and then again at mid-season, or more often as needed					
3.13 Fertigation is used to apply most of the fertilizers for the field					
3.14 An interlock system is installed so injection pump shuts down if irrigation pump shuts down to prevent water source contamination					
4.0 Irrigation Performance & System Maintenance – if Drip & Micro-sprinklers, if not go to 5.0					
4.1 Distribution uniformity of the irrigation system is tested regularly					
4.2 The system has pressure compensating emitters to help maintain system distribution uniformity					
5.0 Irrigation Performance & System Maintenance – if Sprinklers, if not go to 6.0					
5.1 Sprinkler head rotation and nozzle clogging have been checked within the last 12 months and repaired if necessary					
5.2 Sprinkler head rotation and nozzle clogging are checked at least every other irrigation and repaired if necessary					
5.3 Sprinkler heads have been checked for wear in the past 5 years and replaced with the correct nozzle size if necessary to maintain distribution uniformity					
6.0 Irrigation Performance & System Maintenance – if Flood & Furrow					
6.1 The field was laser leveled before planting the crop					
6.2 Levee locations in the field are based on observed infiltration rates (i.e. each check is appropriately sized for maximum water application uniformity)					
6.3 Irrigation produces no tail-water					
6.4 Irrigation produces tail-water and a tail-water recovery system is in place					
6.5 Flow meters are installed and flow volumes recorded on lines from pumps or in supply pipelines or ditches (e.g. Weir notch or Parshall flume) or a record of flow volumes is provided by the water district					

Water quality – Source and resource					
7.1 Irrigation water is tested at least every 3 years for quality, including pH, total salt, nitrates, and biological problems. The quality of water in distribution reservoirs is tested if they are present on the farm.					
7.2 If a water quality problem exists it is addressed					
7.3 Resource maps have been examined to determine if the orchard is in a Ground Water Protection Area (GWPA)[32]					
7.4 If a field is in a GWPA, legal requirements for handling restricted use pesticides in GWPA areas have been assessed and are on file in the office					
7.5 Areas on the farm that are potential sites for pesticides and fertilizers to enter the ground water have been identified and mapped					
7.6 The wellhead is situated so no surface water can reach it or a barrier has been placed around the wellhead that prevents surface water from reaching it					
7.7 Return water wells, older wells and abandoned wells are sealed to prevent ground water contamination					
7.8 Irrigation practices create no off-site movement of chemical residues and sediments					
7.9 If storm water run-off occurs one or more of the following mitigation practices are implemented: filter fabric fencing; filter strip; straw bale check dam; straw bale water bars; sediment basin; or other containment system					

[32] http://www.cdpr.ca.gov/docs/emon/grndwtr/gwpamaps.htm