A WINEGROWERS’ GUIDE TO NAVIGATING RISKS

CALIFORNIA SUSTAINABLE WINEGROWING ALLIANCE

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INTRODUCTION

Farming is risky by nature. Winegrape growers and vintners in California often confront significant challenges from unpredictable natural physical conditions and market factors. Moreover, unprecedented changes in local and global climate, as well as increased regulatory and economic pressures, have exacerbated risks. These and other concerns often create stress for growers and vintners.

Top risks include water shortages and impairments, damaging pests (especially exotics), weather extremes (e.g., frost, heat, heavy rain/flooding, or drought), labor concerns (e.g., employee retention, labor shortages, safety, or legal issues), increasing energy costs, unexpected market variability (e.g., intensifying global market competition and price fluctuations), and increasingly, natural disasters such as wildfires and earthquakes. Many growers experience losses from these factors. In 2015, the estimated reported losses in California's grape crop in terms of total indemnities paid to insured growers totaled $49,826,204. About 15% of the state's grape growers are uninsured, positioning them at greater risk (USDA-RMA, Davis Region Office, 2016). Crop insurance alone, however, does not fully buffer risks and guarantee business success.

The good news is that growers can adopt methods to reduce liability and risk by implementing sustainable winegrowing practices. “Sustainable winegrowing” is an integrated systems approach to producing grapes and wine that balances the three E's or principles of sustainability – Environmentally Sound, Socially Equitable, and Economically Feasible – as defined in the California Code of Sustainable Winegrowing Workbook (Code Workbook), the centerpiece of the California Sustainable Winegrowing Program (SWP) (see Box A).

This Winegrowers’ Guide focuses on the relationship between sustainability and risk reduction by highlighting key practices from the Code Workbook, an important risk management tool itself, and from other sources that reduce risks to growers and vintners. The intent is to demonstrate that adoption of sustainable practices to drive continuous improvement can be an effective risk-management strategy and enhance the long-term viability of vineyards and wineries. The following risks and corresponding sustainable practices for minimizing risks are addressed in this guide.
The California Sustainable Winegrowing Program (SWP), launched in 2002, provides tools and resources to promote the adoption of practices that are sensitive to the environment, responsive to societal needs and interests, and economically feasible to implement. The SWP promotes sustainable practices in all aspects of grape and wine production, enhances peer-to-peer education about these practices, and demonstrates positive results. A comprehensive, self-assessment workbook known as, the California Code of Sustainable Winegrowing, educational workshops, reporting, and other activities are used to facilitate the adoption of sustainable practices by growers and vintners. This set of self-assessment and educational tools and resources enables a cycle of continuous improvement for increasing sustainability. The SWP collaborates with many partners, including industry groups, regional grower associations, government agencies, scientists, environmental organizations, insurance companies, and other agricultural commodity groups. Visit www.sustainablewinegrowing.org for additional information or to download a copy of the Code Workbook.

RISKS TO CALIFORNIA WINEGRAPE PRODUCTION

- Water scarcity
- Impaired quality of water
- Decreased quality of soil
- Diminished air quality and climate change
- Outbreaks of pests
- Rising cost of energy
- Increased cost of labor and labor shortages
- Aberrant weather and natural disasters
- Unexpected market challenges
- Inadequate planning for succession

CORRESPONDING MITIGATION (SUSTAINABLE PRACTICES)

- Water conservation and efficiency
- Water quality protection
- Soil conservation and management
- Air quality protection
- Integrated pest management
- Energy conservation and efficiency
- Human resource management
- Weather monitoring and preventive planning
- Selection of appropriate insurance policies and tools
- Proactive business planning and management

The application of these recommended practices, which incorporate sound science and technology, and effective financial tools, constitutes an integrated systems approach that greatly reduces risk and associated stress. This guide addresses economic, environmental, and social risks; and reveals that these risks are often interrelated (e.g., environmental risks in farming often have financial implications for individual producers and/or to society). Effectively navigating the complexity of risks helps producers ensure their long-term business success by simultaneously achieving financial goals while benefiting human and natural resources.

Box A

THE CALIFORNIA SUSTAINABLE WINEGROWING PROGRAM
Water is an increasingly precious resource. Its limited availability is a critical concern for some agricultural producers, creating serious risks to and losses in production. Over time, decreases in the amount of water for farming have become commonplace in California. This can be attributed to increased demand by many sectors of the economy, expanding human populations, changes in water policies, drought, and/or climate fluctuations. As a result, the conservation and efficient use of water is crucial to minimize the risk of decreased supply and to sustain viable farming operations.

Some key practices for efficiently using water in a vineyard are summarized below. They include: conserving water with a well-maintained drip irrigation system; water monitoring tools to guide irrigation decisions; vineyard design for efficient water use; and other methods to conserve water. See the California Code of Sustainable Winegrowing (Code Workbook), Vineyard Water Management Chapter for a comprehensive overview of these practices.

**CONSERVING WATER WITH A WELL-MAINTAINED DRIP IRRIGATION SYSTEM**

Most winegrape growers in California rely on drip irrigation. Properly maintained and operated drip systems, in contrast to furrow and sprinkler irrigation, allow the precise delivery of minimally required water to specific zones of active roots. Besides conserving water, the more efficient use of water enabled by drip irrigation may improve wine quality. Despite these advantages, many drip systems are designed and/or operated inefficiently. There are many ways to improve the efficiency of drip irrigation to avoid overuse and depletion of water supplies (Code Workbook, Vineyard Water Management Chapter, Page 1).

To function optimally, drip irrigation systems require updated and efficient features and frequent inspection and maintenance. It is important that growers diligently monitor and maintain their irrigation systems. Problems such as clogged or leaky emitters can reduce efficiency and result in uneven distribution. The following list details important components that should be established, monitored, and adjusted as needed.
Regular maintenance of your pump and other components of your irrigation system is crucial to your water efficiency strategy.

Preventive Maintenance: Regular maintenance of the components of irrigation and pumping systems is crucial to maximize efficiency and minimize water losses. The schedule in Table 1.1 has been recommended by experts.

### Table 1.1: Preventive Maintenance Schedule

<table>
<thead>
<tr>
<th>Inspection Item</th>
<th>Startup</th>
<th>Daily</th>
<th>Weekly</th>
<th>Biweekly</th>
<th>Monthly</th>
<th>Winterization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleaning filters</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Read flow meter</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check field pressures</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riser hose screens</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flush hose lateral</td>
<td></td>
<td></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flush mains</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Inspect emitters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Inspect valves/pressure regulators</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Inspect chemical injection system</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Pumping plant</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Irrigation controller</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Filter winterization</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Always have the manufacturer’s maintenance and operation manuals available and follow recommendations.
WATER MONITORING TOOLS TO GUIDE IRRIGATION DECISIONS

The main advantage of drip irrigation is the control it gives growers in deciding exactly how much water to apply and when. Along with this flexibility comes the responsibility to efficiently schedule and deliver only necessary amounts of water. Numerous methods for monitoring water use and irrigation scheduling are available. Irrigation decisions should be supported by soil and vine monitoring, not the calendar. Measurements of soil and vine water status help determine appropriate irrigation timing. Accordingly and if insufficient supply, soil water reserves are used first and then replenished (Prichard, et al., 2004). Various tools are available for measuring soil and plant water status, as summarized in Table 1.2. Sometimes, patterns of water status over time are more revealing than time-specific indicators. For measurements of vine water status, logs should be kept throughout the season regardless of the tool(s) used. Visual indicators, especially for shoot tips during early season, should be recorded and used to inform decisions about irrigation timing (Greenspan, 2007).

### Table 1.2 Tools for Monitoring Water/Moisture Conditions in Vineyards

<table>
<thead>
<tr>
<th>Tool or Method</th>
<th>Function</th>
<th>EST. 2016 Purchase Price (Per Tool)</th>
<th>Comments: Pro &amp; Con</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil Measurement Tools</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moisture Block</td>
<td>Measures soil water potential</td>
<td>$50 per sensor plus logging / telemetry costs</td>
<td>Inexpensive and may be monitored continuously. Requires good soil contact. May not measure the drier portion of the desirable water content range. Single depth measurement.</td>
</tr>
<tr>
<td>Tensiometer</td>
<td>Measures soil water potential</td>
<td>$200 dial readout or add logging/telemetry at additional cost</td>
<td>Inexpensive technology, but requires frequent maintenance and is not effective in the drier soil range. Single depth measurement.</td>
</tr>
<tr>
<td>TDR, Dielectric, sensors - permanent</td>
<td>Measures soil water content</td>
<td>$100-$300 per sensor plus logging / telemetry costs</td>
<td>Some require no soil contact. May be monitored continuously. Higher sensor costs. Multiple depth measurement.</td>
</tr>
<tr>
<td>Dielectric constant(capacitance) probe – portable</td>
<td>Measures soil water content</td>
<td>$2,500-$6,000, with logging device</td>
<td>Less expensive and not regulated like neutron probe, but water content can be measured only occasionally. Multiple depth measurement.</td>
</tr>
<tr>
<td>Dielectric constant(capacitance) probe – fixed</td>
<td>Measures soil water content</td>
<td>$850 - $1,100 for multi-sensor probe</td>
<td>Measures water content continuously, providing dynamic information about water content. Multiple depth measurement.</td>
</tr>
<tr>
<td>Neutron Probe</td>
<td>Measures soil water content</td>
<td>$10,000</td>
<td>Large measurement volume provides very good representation. But, can practically be measured only occasionally and safety regulations are strict. Multiple depth measurement.</td>
</tr>
</tbody>
</table>

*Table continued on next page.*
Note that neither soil- nor plant-based measures provide sufficient information to effectively schedule irrigation. Rather, growers should use these water status measures as feedback as to whether they are irrigating excessively or insufficiently. Various tools for determining soil and plant water status are described in Table 1.2. New technology is available that enables some measurements to be automatically captured and delivered electronically to the user via radio telemetry, internet, or cellular data.

### Table 1.2 (Continued)

#### Tools for Monitoring Water/Moisture Conditions in Vineyards

<table>
<thead>
<tr>
<th>Tool or Method</th>
<th>Function</th>
<th>Est. 2016 Purchase Price (Per Tool)</th>
<th>Comments: Pro &amp; Con</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vine Measurement Tools</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Porometer</td>
<td>Measures vine response to water stress – stomatal conductance</td>
<td>$2,700</td>
<td>Highly portable. Vine water status is valuable information and stomatal conductance is a measurement of the vine's response to stress. Instrument is more fragile than the pressure chamber and sample area is smaller.</td>
</tr>
<tr>
<td>Pressure chamber</td>
<td>Measures leaf water potential</td>
<td>$2,900</td>
<td>Highly portable and durable. Vine water status is valuable information. But, leaf water potential can sometimes be misleading.</td>
</tr>
<tr>
<td>Dendrometry</td>
<td>Measures shrinking and swelling of plant tissues</td>
<td>$1,000 plus logging / telemetry costs</td>
<td>Indirect measurement of plant water status. Sensitive measurement, but automatable. Difficult to correlate to other methods.</td>
</tr>
<tr>
<td>Sap Flow</td>
<td>Measures flow of xylem sap in trunk, or other plant stem</td>
<td>$1,000 to $5,000 plus logging / telemetry costs</td>
<td>Automatable measurement. Expensive devices that require expertise in installation and maintenance.</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automated Weather Station</td>
<td>Measures weather parameters for ETo and may be used to deliver and log soil moisture measurements</td>
<td>$2,500 to $5,000</td>
<td>Evapotranspiration (ETo) may be used to assist irrigation scheduling. Other useful information is also provided and most vendors provide soil moisture connectivity. Some systems provide irrigation control capabilities.</td>
</tr>
<tr>
<td>Surface renewal ET</td>
<td>Measures ET more directly than the ETo model</td>
<td>$1,500 (rental service)</td>
<td>By measuring sensible heat flux and an energy balance model, more directly measures actual ET than the more common ETo-type equipment.</td>
</tr>
</tbody>
</table>

Source: Mark Greenspan, Advanced Viticulture, personal communication, 2016
over 4 inches on the North Coast or 6 inches on the Central Coast can likely reduce irrigation by 1-2 inches. Likewise, North Coast growers irrigating with over 7 inches or Central Coast growers irrigating with over 9 inches can consider reducing rates by 2-3 inches without adverse consequences. Central Valley vineyards generally require more irrigation, due to the more demanding climate and to the economic necessity of higher yields. Central Valley wine grape vineyards are typically irrigated with 18 to 30 acre-inches per acre. Growers in the northern Central Valley applying 18 or more inches can consider reducing their application by 4-6 inches. Growers in the southern Central Valley applying 24 or more inches can likely reduce their applications by 6-12 inches without detriment.

Limiting unnecessary irrigation benefits growers, the public, and the environment by reducing energy use and costs, air emissions, and demand for water. Water conservation in winegrapes can provide additional benefits by decreasing expensive cultural operations and increasing fruit value. Note that reducing water inputs does not automatically mean reduced yields. In fact, reductions in vine vigor can lead to more open canopies in fruit zones and more fruitful, dormant buds.

Regulated Deficit Irrigation (RDI) refers to an approach to irrigation that enables water conservation and also results in other desired effects. In vineyards, RDI means applying less than the full potential vine water requirement, usually with a drip irrigation system, to achieve properly timed mild water stress. Successful RDI irrigation strategies typically use 50-60% of full vine water use (Prichard, et al., 2006). This approach reduces vegetative vigor and can limit (or eliminate) the need for cane cutting and/or leaf removal. It can also increase grape quality and thus market value. (For more information on RDI, see Code Workbook, Water Management Chapter, Pages 20-21, and http://ucmanageddrought.ucdavis.edu/Agriculture/Crop_Irrigation_Strategies/Winegrapes/.)

The amount of season-long irrigation applied to California coastal vineyards ranges from none (dry-farmed) to about 8 (North Coast) and 12 (Central Coast) acre-inches per acre. On average, North Coast vineyards are irrigated with approximately 4 inches. About 2-4 additional inches are required for the Central Coast because of lower winter rainfall. Growers irrigating with close planting on high-vigor prone soils is not advisable. Avoid high-vigor, drought-prone rootstocks, such as 5BB, and O39-16. On the other hand, high-vigor, drought-tolerant rootstocks such as 110R and 140Ru can be counterproductive, except on very poor (i.e. shallow, low fertility) soils because of their propensity to create excessively large canopies. On deeper, more fertile, soils, wider vine spacing may be used, but low or moderate-vigor rootstocks are recommended. Very deep soils may need little or no irrigation after vines reach mature stages of development. Shallow soils generally refer to soils from 10 to 24 inches deep, and deep soils generally exceed 28 inches; however, the available water holding capacity in the soils, whether shallow or deep, may also be a significant factor affecting water needs. (Glenn McGourty, UCCE, personal communication, 2008.)

Understanding soil moisture dynamics in conjunction with plant stress measurements is another way to schedule irrigation precisely and without the use of models. Tracking water content at several depths allows irrigation to be controlled, such that water does not percolate below the active root zone, unless desired. Tracking the water content of the profile as a whole
allows growers to determine when the applied water has been depleted and a subsequent irrigation is required. Measures of plant moisture provide the needed feedback for achieving or avoiding a target level of plant stress. Monitoring both soil and plant water status provides the full picture of water status in the soil-plant-atmosphere continuum of water movement.

**COMMON DROUGHT-TOLERANT ROOTSTOCKS:**

1103 Paulsen (V. berlandieri x V. rupestris): Excellent phylloxera resistance. Excellent drought tolerance. Moderate vigor when deficit irrigated, high vigor otherwise. May have some root knot nematode tolerance. May be more susceptible to dagger nematode than other rootstocks. Also has some tolerance to salinity.

140 Ruggeri (V. berlandieri x V. rupestris): Excellent phylloxera resistance. Excellent drought tolerance. High vigor. Late ripening. Well-suited to gravelly or low vigor sites. Good lime tolerance. Has some salinity tolerance, but tends to be quite vigorous. Poor tolerance to wet soils.

110 Richter (V. berlandieri x V. rupestris): Excellent phylloxera resistance. Good drought tolerance. Moderate vigor when deficit irrigated, high vigor otherwise in some regions but low vigor in Central Coast region. Can produce vegetative, high pH wines on fertile, deep soil. Well-suited to gravelly or low vigor sites. Poor tolerance to wet soils.


420A (V. berlandieri x V. riparia): Not as drought tolerant as the above, but has moderate drought tolerance and low vigor, which is a good combination for higher-density plantings. Good lime tolerance. Poor tolerance to dagger nematode.

**TAKE ACTION:**

For more information and details on specific rootstock recommendations visit: [http://goo.gl/nCoJcr](http://goo.gl/nCoJcr) or [http://goo.gl/nDZL1E](http://goo.gl/nDZL1E).

**OTHER METHODS FOR WATER CONSERVATION**

**COVER CROP MANAGEMENT:**

Some cover crops such as native perennial grasses and other grasses create potentially high competition for water. In water-shortage situations, disking of the cover crop is one effective way to reduce competition, while providing long-term benefits for soil health. Another approach is to aggressively mow or disk alternate rows of cover crops when water is becoming scarce.

**WAIT AS LONG AS POSSIBLE BEFORE STARTING TO IRRIGATE:**

Irrigating too early in the season is a common problem; it wastes water and causes excess vine growth. Furthermore, in the North Coast, early irrigation reduces the motivation for the vines to “reach” more deeply for stored water. Therefore, early irrigation may prevent the development of a deeper, more extensive root system. You can decide when to begin the irrigation season by looking at the shoot tip growth. Usually, vines do not require irrigation if shoots are actively growing.
However, if vine growth begins to slow down before vines have achieved the proper shoot length (3-4 feet or about 18-22 nodes), irrigation must be applied to maintain continued, but slow, shoot elongation.

**SHORT AND FREQUENT IRRIGATION:**
Irrigating with small volumes and short periods of time between applications has several benefits. For example, instead of irrigating for 5-6 hours once or twice a week, 2.5-3 hours 2-4 times a week may be more effective. This is especially true for vineyards with heterogeneous soil water holding capacities. Shorter irrigations tend to irrigate only a portion of the rootzone, thereby tricking vines into “thinking” they are stressed. As a result, the vines partially close their stomata to conserve moisture. Often, growers irrigating in this manner find that they can further reduce the overall volume of water applied. The downside to this approach is that it is less efficient to apply only small amounts of water, since more water is lost by evaporation. This may be mitigated by avoiding irrigations during the heat of the day. Hillside applications may exacerbate this effect, though a well-designed irrigation system may mitigate the problem of uphill versus downhill irrigation system charge and discharge.

**CHANGES IN EMITTER SPACING:**
You can also use a greater number of emitters per vine (or per unit length) with smaller discharge rates rather than fewer emitters with higher rates. Laying out irrigation blocks based on patterns of soil uniformity is another wise move. These decisions are primarily made during vineyard design.

**ADJUST WATER VOLUME AND FLOW IN DIFFERENT PARTS OF THE VINEYARD:**
You can apply different water volumes in different sections of the vineyard. Figure out how much water can be applied without causing much change in water content over a period of time using the soil moisture devices. Continuous measurement of soil moisture is especially useful for this purpose. If you don’t know the depth of your root zone, use a backhoe to examine the soil profile in different portions of the vineyard. The use of sensitive soil moisture probes can also reveal what depths root activity is occurring.

**USE LOW-VOLUME SPRINKLERS AND MISTER UNITS FOR VINEYARD COOLING DURING HEAT WAVES:**
Some growers use overhead impact-type sprinklers to wet their vineyards during periods of high heat. This uses water at a high rate. Using low-volume cooling units may save many inches of water during a typical summer weather season. If impact sprinklers are used, cycle the system on and off during operation, allowing water to evaporate from the vines and soil between cycles. Use these systems only on heat-sensitive varieties.
Canopy management that maintains a light foliar shading the fruit zone may reduce or eliminate the need for evaporative cooling during heat waves. Overall, water-cooling of vineyards should be avoided, if possible.

**DRY FARMING:**
In some situations in California, particularly where deep soils exist, winegrape growers practice dry farming, the ultimate agricultural approach to water conservation. Dry farming relies on conserving and retaining the moisture held in soils from winter rains. While there are many benefits to dry farming, it can result in lower-than-desired yields and other trade-offs so most winegrowers in California use some form of irrigation. The Community Alliance with Family Farmers developed a comprehensive guide to dry farming that covers site selection considerations, vineyard setup, cultural practices and more. To determine if dry farming is possible for your vineyard, download the guide: Dry Farming Wine Grapes: A Best Management Practice Guide for California Growers at: http://www.caff.org/wp-content/uploads/2011/08/CAFF-Dry-Farming-BMP-Guide_web.pdf.

**PERFORMANCE METRICS FOR TRACKING WATER USE**
Performance metrics are the measurable outcomes of business practices. Sustainability performance metrics consider measurable outcomes of environmental (e.g., use of natural resources) and social (e.g., employee safety) practices. Performance metrics can help growers measure, track, and manage production inputs (e.g., water, energy, and nutrients) and greenhouse gases (GHGs) to optimize operational efficiency, decrease costs, and minimize adverse environmental impacts.

**TAKE ACTION:**
To track your water use per acre or ton, visit http://www.sustainablewinegrowing.org/metrics.php or click on the “Metrics” tab within the SWP Online System.

**REFERENCES**


Check with your local RCD for assistance with evaluating the distribution uniformity of your irrigation system with their mobile irrigation lab. Several RCDs in California offer this service (sometimes for low or no cost). To find your local RCD, visit: http://www.carcd.org/rcd_directory0.aspx.
Impaired water quality is a key risk to successful winegrape farming in terms of production losses, reduced environmental quality, and liability to regulatory action. Ramifications of decreased water quality can be categorized as on- or off-farm impacts.

**CHAPTER 2: ASSURING WATER QUALITY**

1) **ON-FARM IMPACTS FROM POOR WATER QUALITY ON GRAPE PRODUCTION:**
- Plugged irrigation lines, pumps, pipes, and emitters from water contaminants (salts, sediments, etc.).
- Decreased soil fertility from excess salinity.
- Reduced grape, and subsequently wine, quality due to salt or sediment residues or suboptimal pH levels.

2) **OFF-FARM IMPACTS FROM POLLUTANTS TRANSPORTED BY WATER RUNOFF, LEACHING, OR WIND:**
- Decreased quality of surface water from sediment, pesticides, or fertilizers.
- Decreased quality of ground water from pesticides or fertilizers.

There may be important regional issues about the quality of irrigation water. For example, high levels of iron can lead to the formation of precipitates in irrigation lines that can plug emitters. Contact local experts such as an appropriate UC Farm Advisor, irrigation company, or analytical laboratory for more information.

**PRACTICES TO REDUCE RISKS OF WATER QUALITY IMPAIRMENT**

Listed below are sustainable practices that growers can use to protect and improve irrigation water quality:

- Regularly monitor the quality of irrigation water: test wells and reservoirs for nitrates, pH, bicarbonate, salinity, total dissolved solids (electrical conductivity), suspended solids, and nitrate. Testing may need to occur often where water quality (e.g., nitrate or salinity levels) fluctuates over time.
- Amend water, if needed, to address water quality concerns or needs (with gypsum, sulfuric acid, polymers, root zone leaching, or other appropriate means).
- Flush irrigation lines and emitters regularly with diluted acid solution or another appropriate product when water has a high pH. Simple water flushing is valuable to prevent sediment build-up. Organic production systems do not allow use of acid, but other organically-approved products are available.
Filter or buffer strips typically are planted with diverse annual or perennial vegetation, based on climate and topography, in non-cropped areas next to vineyards. These strips improve water penetration and infiltration; slow water movement; mitigate erosion and water runoff; and extract sediment, nutrients, and pesticides.

A hedgerow is a ‘living fence’ planted with perennial trees, shrubs, or grass. Hedgerow vegetation is diverse and is typically selected subject to its suitability to the local climate and topography. Hedgerows have different functions including decreasing water runoff, increasing water penetration and infiltration, reducing erosion by water and wind, attracting beneficial insects, and beautifying the landscape. Wind protection by hedgerows also may increase productivity. In addition, hedgerows may attract arthropod and vertebrate pests (Tourte, et al., 2003).

TAKE ACTION:

SUPPORT FOR IMPLEMENTING WATER QUALITY PROTECTION METHODS: EQIP COST-SHARING

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) offers cost-share assistance through its Environmental Quality Incentives Program (EQIP) to support eligible landowners wanting to implement practices for protecting water, soil, air, and wildlife resources. Through its regional staff and programs, NRCS supports the adoption of sustainable practices by winegrape and other producers or landowners. Table 2.1 is a select list of practices and approximate payment rates potentially funded through EQIP. Growers should contact their local NRCS office for updated cost-share opportunities for these and other practices.

<table>
<thead>
<tr>
<th>PRACTICE CODE</th>
<th>PRACTICE/ACTIVITY NAME</th>
<th>PRACTICE/ACTIVITY TYPE</th>
<th>UNIT TYPE</th>
<th>PAYMENT RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>327</td>
<td>Conservation Cover (Ac.)</td>
<td>Native Species</td>
<td>Acre</td>
<td>$172.92</td>
</tr>
<tr>
<td>340</td>
<td>Cover Crop (Ac.)</td>
<td>General Purpose</td>
<td>Acre</td>
<td>$102.48</td>
</tr>
<tr>
<td>329</td>
<td>Residue and Tillage Management, No-Till</td>
<td>No-Till</td>
<td>Acre</td>
<td>$15.62</td>
</tr>
<tr>
<td>390</td>
<td>Riparian Herbaceous Cover (Ac.)</td>
<td>Riparian Broadcast Seeding</td>
<td>Acre</td>
<td>$1047.39</td>
</tr>
<tr>
<td>393</td>
<td>Filter Strip (Ac.)</td>
<td>Introduced Species</td>
<td>Acre</td>
<td>$123.33</td>
</tr>
<tr>
<td>393</td>
<td>Filter Strip (Ac.)</td>
<td>Native Species</td>
<td>Acre</td>
<td>$258.48</td>
</tr>
<tr>
<td>422</td>
<td>Hedgerow Planting (Ft.)</td>
<td>Single Row</td>
<td>Foot</td>
<td>$1.96</td>
</tr>
<tr>
<td>422</td>
<td>Hedgerow Planting (Ft.)</td>
<td>Three Rows for Pollinators, Two Herbaceous</td>
<td>Foot</td>
<td>$2.67</td>
</tr>
<tr>
<td>638</td>
<td>Water and Sediment Control Basin</td>
<td>Embankment</td>
<td>CuYd</td>
<td>$3.42</td>
</tr>
<tr>
<td>638</td>
<td>Water and Sediment Control Basin</td>
<td>Excavated Basin</td>
<td>CuYd</td>
<td>$8.02</td>
</tr>
</tbody>
</table>


TAKE ACTION:
Check with your local NRCS field office for updated information on securing financial assistance. To find your local NRCS office visit: http://offices.sc.egov.usda.gov/locator/app?agency=nrcs.

REFERENCES


CHAPTER 3:
ENSURING SOIL QUALITY

Soil is the foundation of winegrape production. However, growers may face significant risks from problems with soil structure or quality, impacting the soil’s capacity to provide vine roots with water, nutrients, and air. Various management practices prevent or mitigate soil-related risks while ensuring soil health and increasing the overall sustainability of the vineyard. Soil erosion is another risk growers must navigate; Chapter 2, Assuring Water Quality provides detailed information on managing and preventing soil erosion.

GENERAL SOIL MANAGEMENT PRACTICES

- Regularly evaluate the soil properties and nutrient status of the vineyard.
  - Take plant tissue samples (e.g., petioles at bloom) for analysis of nitrogen content.
  - Sample soil at least every 6 years (or 2-3 years if problems or if undergoing a soil amendment program) to evaluate nutrient, mineral, and organic matter content, and other characteristics.
  - Know the soil water-holding capacity and erosion potential (More information: http://soils.usda.gov/).
- Use a database to record results from analyses of plant tissue, soil samples, and soil amendments.
- Discuss nutrient management strategies with the winemaker and other vineyard consultants.
- Adjust soil amendments or strategies according to assessed needs.
  - Apply nitrogen only when vines can best utilize it and avoid excess nitrogen fertilization to ensure nitrogen does not leach below the rooting zone (see Code Workbook, Box 4-F, Sixteen Reasons to Avoid Excess Nitrogen and 4-G, Examples of Good Fertigation Practices).
  - Build organic matter (preferably to 1-3% in most
sites) using tactics such as site-appropriate cover cropping (see below) and additions of compost.

- Avoid compacting soil.
  - Choose or modify equipment to minimize.
  - Avoid operating equipment in the vineyard during very wet soil conditions.
- Minimize the potential for erosion/improve structure.
  - Implement erosion control methods (See Chapter 2, Assuring Water Quality).
  - Plant cover crops, as explained below.
- Conserve soil organic matter to build and maintain desired soil structure and fertility (See Box 3.1).
  - Practice no till or conservation tillage.

**TAKE ACTION:**
For information about soil properties, such as water-holding capacity, infiltration rates and erosion potential, and soil maps for many regions, see the Natural Resources Conservation Service website: [http://soils.usda.gov/](http://soils.usda.gov/).

**CHOOSING METHODS FOR NUTRIENT ANALYSIS: WHY, WHEN, AND HOW MUCH?**

Nutrient analysis is crucial for evaluating vineyard and plant health, timing amendments and other soil-related interventions, and troubleshooting nutritional problems. Accordingly, nutrient analysis is an important activity consistent with the International Plant Nutrition Institute’s 4 R’s framework for safe and cost-effective nutrient management – Right source, Right amount, Right timing, and Right placement (http://www.ipni.net/4r).

Growers who invest in sampling plant tissues and/or soil for nutrients and interpreting results from analyses can make informed choices for soil management, thereby avoiding risks from over- or under-use of amendments. Opinions differ about the most reliable methods for measuring the nutritional status of the vineyard (see Table 3.1). Although petiole (stem) sampling and

**TABLE 3.1**
**METHODS FOR NUTRIENT ANALYSIS**

<table>
<thead>
<tr>
<th>TECHNIQUE</th>
<th>BENEFITS &amp; DISADVANTAGES</th>
<th>SAMPLE TIMING &amp; SIZE</th>
<th>*APPROXIMATE COST FOR ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petiole Analysis</td>
<td>Standard method; must be analyzed immediately after picking; may not be good for nitrogen analysis</td>
<td>At bloom each year; include at least 75 petioles per average-sized block</td>
<td>$35.00 per sample (complete analysis)</td>
</tr>
<tr>
<td>Leaf Blade Analysis</td>
<td>Good for analyzing nitrogen, but not good for other nutrients; controversial</td>
<td>At bloom or verasion each year; include at least 75 leaf blades per average-sized block</td>
<td>$35.00 per sample (complete analysis)</td>
</tr>
<tr>
<td>Soil Sampling</td>
<td>Provides more comprehensive information; may be costly and difficult</td>
<td>Every 5–6 years or more (every 2–3 years if problems); include at least 15–20 cores per 20–40 acre block</td>
<td>$14.00–$35.00 per sample (depending on factors tested)</td>
</tr>
</tbody>
</table>

*Source: A&L Western Laboratories, Inc. Costs will vary by vendor.*

Compost applications can help increase water holding capacity and maintain desired soil structure and fertility.
analysis has been the most widely accepted method, it may be inadequate for determining nitrogen levels. Soil sampling may be preferred for a more thorough analysis. See the Code Workbook (Box 4-B, Soil Sampling and Box 4-C, Interpreting Petiole Test Results) for a short guide on the basic interpretation of soil and plant lab test results. Every grower should make informed decisions about applying fertilizers and soil amendments.

COVER CROPS FOR IMPROVED SOIL HEALTH

MULTIPLE BENEFITS OF COVER CROPS

Planting and maintaining cover crops is a key tool for protecting and enhancing soil quality in vineyards. Cover crops are featured prominently in this chapter since they provide the simplest and most cost-effective means of protecting and improving soil structure. Cover crops provide numerous benefits, including reducing soil erosion, adding nutrients, protecting and improving soil structure, retaining and improving soil moisture, increasing organic matter, improving the availability of nutrients in the soil, sequestering carbon, and providing habitat for beneficial insects (Ingles, et al., 1998). (See Figure 3.1)

Cover crops are usually classified by temporal occurrence, divided into annuals (winter or summer) that last up to one year or perennials that last at least three years. Alternatively, cover crops may be classified by vegetative type, such as legumes (e.g., clovers and vetches), grasses (e.g., barley and fescue), or managed native vegetation. The type of cover crop used should be based on the desired effect(s).

Winter cover crops are planted in late summer or fall to provide soil cover during the winter. To increase soil nutrients, for instance, legumes such as clovers, vetches, medic, or field peas may be mixed with cereals like rye, oats, or wheat. Summer cover crops are typically used as part of crop rotations and for soil enrichment (Sullivan, 2003).

Grasses are considered cost effective for preventing erosion.

Cover crops provide a significant benefit by contributing organic matter to soil (Ingles, et al., 1998; Sullivan, 2003). In addition, some cover crops may prevent leaching of soil nitrate by storing it during the wet season. Other nutrients stored by cover crops include phosphorous, potassium, calcium, magnesium, and sulfur. Cover crops can suppress weeds by competing for

| Prevent erosion |
| Improve soil structure |
| Retain soil moisture |
| Increase organic matter and soil fertility/biodiversity; sequester carbon |
| Attract beneficial insects |
| Increase soil organisms |
| Manage vine vigor |

Grasses are considered cost effective for preventing erosion.

Cover crops provide a significant benefit by contributing organic matter to soil (Ingles, et al., 1998; Sullivan, 2003). In addition, some cover crops may prevent leaching of soil nitrate by storing it during the wet season. Other nutrients stored by cover crops include phosphorous, potassium, calcium, magnesium, and sulfur. Cover crops can suppress weeds by competing for

Organic matter is increased more rapidly when organic material is left on the soil surface, not tilled in. Tillage mixes additional oxygen into the soil, enhancing microbial activity and consumption (i.e., “burning off”) of the organic matter. In untilled soils, the natural process is for organic material to be broken down by soil organisms and transported by water into the soil over time.
light and space. Some varieties of mustards may reduce the development of nematode pests. Finally, cover crops, especially when in bloom, can enhance the appearance vineyards (Ingles, et al., 1998; Sullivan, 2003).

In addition to expected benefits, considerations for selecting cover crops should include geographical location, topography, soil, climate, and water availability.

**POTENTIAL DRAWBACKS OF COVER CROPS**

Possible adverse consequences of cover cropping include undesired competition with vines for water and nutrients – although some competition may be acceptable or desirable. Some cover crops, such as those that grow under-the-vine, can create habitats conducive to increased populations of rodent pests. Other cover crops may reseed in undesired places, essentially becoming weeds. Cover crops can also reduce the solar warming of soil, increasing the risk of frost damage to vines during the spring. This risk can be mitigated by planting cover crops in alternate rows, selectively using overhead irrigation, or timely mowing. In general, the benefits of cover crops outweigh the concerns.

**TAKE ACTION:**

Check with an appropriate UC Farm Advisor or cover crop specialist for site-specific recommendations. For a detailed list of cover crops and more information visit: Overview of Cover Crops and Green Manures. Available at: http://www.attra.org/attra-pub/covercrop.html#economics.

**PERFORMANCE METRICS FOR TRACKING APPLIED NITROGEN**

Performance metrics are the measurable outcomes of business practices. Sustainability performance metrics consider measurable outcomes of environmental (e.g., use of natural resources) and social (e.g., employee safety) practices. Performance metrics can help growers measure, track, and manage production inputs (e.g., water, energy, and nutrients) and greenhouse gases to optimize operational efficiency, decrease costs, and minimize adverse environmental impacts.

You can track your applied nitrogen (from fertilizer applications, compost, manure, and irrigation water) to determine the pounds of nitrogen applied per acre or per ton. To access SWP’s user-friendly online metrics tool visit: http://www.sustainablewinegrowing.org/metrics.php or click on the “Metrics” tab within the SWP Online System.

Cover crops provide numerous benefits, including reducing soil erosion, adding nutrients, protecting and improving soil structure, and maintaining and improving soil moisture.

**REFERENCES**


Risks associated with decreased air quality in California have resulted from expanded human populations and emissions from industrial, transportation, agricultural, and other sectors. A number of regulations have been imposed to curtail problems. Although agriculture is not a leading cause of most problematic air emissions, growers can help resolve problems by proactively limiting air emissions associated with agriculture through the adoption of specific sustainable winegrowing practices.

Two categories of air emissions affected by winegrowing are: 1) the US EPA designated criteria pollutants and 2) greenhouse gases (GHGs). The criteria pollutants of most concern are particulate matter and ozone. Airborne particulate matter 10 microns or less in diameter (PM$_{10}$) is a risk to human health. Emissions of particulate matter result from dust stirred up by wind, vehicles, and equipment, or from the combustion of fossil fuels and wood.
Human activities have been linked to four key GHGs – carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and the halocarbons (includes refrigerants). CO₂ and N₂O are the two key GHGs associated with winegrape production. Unlike criteria air pollutants, GHGs are of concern primarily because of their impacts on climate change, including global warming and ramifications such as glacial melting, rising sea levels, and more intense and frequent weather events (e.g., heat waves, droughts, floods, hurricanes). Global warming could impact California agriculture by decreasing the reliability of water, changing the dynamics of pest populations, and causing variations in crop yield and quality.

Carbon sequestration is the long-term storage of carbon in vegetative structures and soils. Plants are a “sink” for CO₂ because they uptake CO₂ during photosynthesis. Carbon sequestration offsets atmospheric concentration of CO₂, and can be increased by maximizing vegetation in and around the vineyard, such as utilizing cover crops (especially permanent covers) and maintaining or planting hedgerows, trees, and shrubs. The net balance of GHG emissions and carbon sequestration for a vineyard is its “carbon footprint.”

For more information about vineyard management practices and carbon footprints, see http://www.sustainablewinegrowing.org/docs/ghghandout.pdf.

For information about the DNDC (DeNitrification-DeComposition) model and how to use it to quantify vineyard GHG emissions and carbon sequestration, see http://www.sustainablewinegrowing.org/docs/DNDC_Handout.pdf.

Ground-level ozone, another risk to human health, is formed by atmospheric reactions of volatile organic compounds (VOCs) with nitrogen oxides (NOₓ). Like particulate matter, these ozone precursors are associated with use of fossil fuels. VOCs also can be emitted from certain pesticides and other petroleum-derived products.
Climate change resulting from emissions of GHGs poses many risks ranging from adversely affecting crop production to human health concerns. The major GHGs associated with winegrape production are carbon dioxide (CO$_2$) and nitrous oxide (N$_2$O). Emissions in the vineyard come primarily from N$_2$O released from the soil and are related to natural bio-geochemical processes, local climate, soil conditions, and management practices like the application of nitrogen fertilizers. Understanding how natural conditions and management practices affect field emissions may allow growers to further optimize their applied nitrogen use, thereby reducing on-farm N$_2$O emissions. CO$_2$ can be emitted or stored (sequestered) by plants and soils as a result of plant and microbial activities and management practices (see Box 4.1). Additionally, minimizing fossil fuel use for equipment will have positive environmental impacts, while also reducing operating costs (Wine Institute, 2014).

VINEYARD PRACTICES TO REDUCE EMISSIONS OF AIR POLLUTANTS AND GREENHOUSE GASES AND TO INCREASE CARBON SEQUESTRATION

Listed below are selected practices for reducing problematic air emissions in vineyard operations. A comprehensive coverage of these and other practices can found in the California Code of Sustainable Winegrowing (Code Workbook).

VINEYARD FLOORS

| Minimize or eliminate tillage (reduces particulate matter, ozone precursors, and GHGs; increases carbon sequestration). |
| Plant cover crops – especially permanent systems (reduces particulate matter; increases carbon sequestration). |
| Grass alleys (reduces particulate matter). |
| Reduce equipment passes (reduces particulate matter, ozone precursors, and GHGs). |
| Maintain unfarmed natural habitat and consider peripheral plantings of hedgerows, trees, or other vegetation (reduces particulate matter, ozone precursors, and GHGs; increases carbon sequestration). |
| Increase soil organic matter by adding organic material (e.g., green manure, compost, winery wastes) (increases carbon sequestration). |

UNPAVED SURFACES – ROADWAYS AND EQUIPMENT STAGING AREAS

| Reduce speed and travel (reduces particulate matter, ozone precursors, and GHGs). |
| Consider paving, spreading gravel or seeding grasses in these areas for more permanent solutions (reduces particulate matter). |
| Apply water or regulatory compliant anti-dust materials (reduces particulate matter).

ENERGY USE AND EFFICIENCY

| Minimize use of fossil fuels – especially petroleum diesel (reduces particulate matter, ozone precursors, and GHGs). |
| Conserve electricity, and test and improve the energy efficiency of power equipment, especially irrigation pumping plants (reduces particulate matter, ozone precursors, and GHGs). |
| Rely more on renewable energy (e.g., solar, wind, biodiesel) (reduces particulate matter, ozone precursors, and GHGs). |
| Replace or retrofit older diesel engines with cleaner burning technology or install electric motors (reduces particulate matter, ozone precursors, and GHGs). |

PEST MANAGEMENT

| Rely on biological and cultural control tactics to reduce pesticide use (reduces particulate matter, ozone precursors, and GHGs). |
| Base pesticide applications on economic thresholds and/or weather-based decision indices (reduces particulate matter, ozone precursors, and GHGs).
| When pesticides must be used, apply low-VOC products at lowest effective rates and maximize on-target deposition with precision spray technology (reduces ozone precursors).
| Use weed management tactics that minimize dust (reduces particulate matter).

**NITROGEN FERTILIZATION**

| Minimize use and rates of synthetic nitrogen fertilizers (reduces GHGs).
| Time and place necessary applications to ensure maximum plant uptake (reduces GHGs).

**TAKE ACTION:**


**INCENTIVE PROGRAMS TO ASSIST GROWERS WITH AIR QUALITY MEASURES**

The Environmental Quality Incentives Program (EQIP) of the United States Department of Agriculture Natural Resources Conservation Service (NRCS) offers cost-share payments to growers for adoption of technologies and practices that can mitigate air quality impairment. Box 4.2 includes example conservation practices for protecting air quality that the EQIP program covers for growers who apply and qualify for this payment. Always check with your local NRCS field office for updated cost-share information and to get started on securing

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**BOX 4.2**

**EXAMPLE CONSERVATION PRACTICES WITH COST-SHARE OPPORTUNITIES FOR PROTECTING AIR QUALITY IN CALIFORNIA**

**COMBUSTION SYSTEM IMPROVEMENT**

Repowering or replacing old, uncontrollable diesel engines powering irrigation systems or off-road agricultural vehicles with new electric motors or diesel engines meeting the latest EPA and ARB Tier level emissions certification.

**DUST CONTROL ON UNPAVED ROADS AND SURFACES**

Controlling direct particulate matter emissions produced by vehicle and machinery traffic or wind action from unpaved roads and other surfaces by applying dust suppressants on the untreated surface (e.g., petroleum-based road oil or polymer emulsion application).

**AGRICULTURAL BURNING**

Treating residual woody material that is created due to management activities or natural disturbances.

Contact your local NRCS field office for details on cost-share opportunities for these and other conservation practices.

*Source: USDA-NRCS, 2014.*

The use of alternative energy for pumps can help improve air quality by reducing on-farm GHG emissions.
financial assistance. (To find your local NRCS office visit: http://offices.sc.egov.usda.gov/locator.)

Additional programs which provide California winegrowers with financial incentives for improving technologies or practices relevant to air quality include the Carl Moyer Memorial Air Quality Standards Attainment Program, the State Water Efficiency and Enhancement Program (SWEEP), and energy stewardship programs by Pacific Gas & Electric (PG&E) and Southern California Edison (SCE) (See Take Action Box and Code Workbook, Air Quality Chapter, Pages 15 and 16).

PERFORMANCE METRICS FOR TRACKING GREENHOUSE GAS EMISSIONS

Performance metrics are the measurable outcomes of business practices. Sustainability performance metrics consider measurable outcomes of environmental (e.g., use of natural resources) and social (e.g., employee safety) practices. Performance metrics can help growers measure, track, and manage production inputs (e.g., water, energy, and nutrients) and GHGs to optimize operational efficiency, decrease costs, and minimize adverse environmental impacts.

TAKE ACTION:

To track metrics for GHG emissions, water, energy, and nitrogen, visit http://www.sustainablewinegrowing.org/metrics.php or click on the “Metrics” tab within the SWP Online System.

TAKE ACTION:

Carl Moyer Memorial Air Quality Standards Attainment Program is a statewide grants program administered by local air districts to retrofit or replace diesel engines for heavy-duty vehicles and equipment. For more information, visit: http://www.arb.ca.gov/msprog/moyer/moyer.htm.

Pacific Gas & Electric (PG&E) and Southern California Edison (SCE) offer incentive programs relevant to energy stewardship and air quality, including for irrigation pumping and energy efficient equipment. For pump tests, retrofits and repairs, see http://www.pumpefficiency.org for PG&E, and the Pumped and Primed to Save Energy handout at https://www.sce.com for the best SCE resource. Additional rebate and incentive programs for PG&E can be found at: http://www.pge.com/en/mybusiness/save/rebates/bybusiness/agriculture.page. Contact utility representatives for other programs.

State Water Efficiency and Enhancement Program (SWEEP) is a statewide grants program through the California Department of Food and Agriculture (CDFA) for projects to implement on-farm irrigation systems to reduce water and energy use and thereby reduce GHG emissions. For more information, visit: www.cdfa.ca.gov/go/SWEEP.

REFERENCES


Various pests – insects, mites, pathogens, nematodes, vertebrates, and weeds – pose economic risks to the production of winegrapes when pest densities surpass tolerable levels, i.e., exceed economic thresholds. The incidence, frequency, and severity of the risks vary, depending on the vineyard location, climate, ecological conditions, and other factors. A diversity of cost-effective management tactics are generally needed and used to prevent or reduce economic risks from pests and sustain production.

Pest-related risks also include potential impacts to human and environmental health. Some tactics for controlling pests may harm humans or the environment, especially when used improperly. Growers should minimize all pest-related risks (economic, social, and environmental) as part of an overall approach to sustainability and risk management.

“Integrated pest management (IPM) is an integral part of any sustainable farming program,” as explained in the California Code of Sustainable Winegrowing (Code Workbook, Pest Management Chapter). IPM is an approach to managing pests by combining biological, cultural, and chemical tools in a way that minimizes economic, health, and environmental risks. IPM is relevant for all farming systems, including organic and biodynamic systems.

IPM does not provide standardized prescriptions. In fact, the application of IPM changes in time and space, as pest managers adjust to circumstances. Nevertheless, IPM always is a knowledge-based, multi-faceted approach that safely maintains pests at sub-economic levels. IPM programs emphasize preventive, ecologically-based methods first. Good IPM practitioners improve over time, as their knowledge increases.
The California Code of Sustainable Winegrowing Workbook Pest Management Chapter provides a detailed characterization of IPM and its components. This chapter focuses on the following four key elements that are essential for minimizing risks:

- Knowledge of Pests and Their Natural Enemies
- Monitoring Pests and Natural Enemies
- Preventing Environmental and Human Health Risks from Pesticides
- Training for Safe and Sustainable Pest Management

**KNOWLEDGE OF PESTS AND THEIR NATURAL ENEMIES**

The proper identification of pests and natural enemies is an essential starting point for reduced-risk pest management. For effective monitoring and decision making, pest managers must be able to identify the following important species in their vineyard and region:

- Main insect and mite pests associated with the vineyard and region (e.g., leafhoppers, Pacific mites, thrips, leafrollers, mealybugs).
- Naturally occurring beneficial species that predate or parasitize insect and mite pests (e.g., Anagrus wasp, predatory mites, spiders).
- Main diseases associated with the vineyard and region (e.g., powdery mildew, botrytis, eutypa, phomopsis).
- Main vertebrate pests associated with the vineyard and region (e.g., gophers, ground squirrels, voles, deer, finches, rabbits).
- Naturally occurring predators of vertebrate pests (e.g., owls, hawks, kestrels, bats).
- Main weeds associated with the vineyard and region.

For optimal management, pest managers also should be aware of pest and natural enemy life cycles and population dynamics in relation to vine growth. For the growing season in their region, for example, practitioners should know that leafhoppers usually go through 2-3 generations, while associated Anagrus wasps have 3-4 times more generations.

**TAKE ACTION:**

For a list, description and photos of pests found in California vineyards, visit the UC IPM Pest Management Guidelines at: [http://www.ipm.ucdavis.edu/PMG/selectnewpest.grapes.html](http://www.ipm.ucdavis.edu/PMG/selectnewpest.grapes.html). For additional resources about pesticide risk reduction, visit the California Department of Pesticide Regulation Pest Management page: [http://www.cdpr.ca.gov/docs/pestmgmt/ipminov/ipmmenu.htm](http://www.cdpr.ca.gov/docs/pestmgmt/ipminov/ipmmenu.htm).

**MONITORING PESTS AND NATURAL ENEMIES**

The field monitoring of population densities of pests and natural enemies is a fundamental tenet of IPM. Some damage by pests can be tolerable, i.e., when little to no economic losses in yield and quality occur. If pest densities remain below economic thresholds and crop injury is not excessive, remedial control generally is unnecessary, especially if sufficient natural enemies exist. Effective monitoring enables informed decisions about whether pest control is economically justified and about the design of the safest and most cost-effective management tactic(s). The information from monitoring is therefore crucial to avoid or reduce risks. Monitoring should include the following:

- Monitoring of pests (including major insects, mites, and diseases) at least weekly during the growing season and keeping written records of pests found.
- Monitoring of beneficial species (including Anagrus wasps, predatory mites, and others) weekly during the growing season.
- Monitoring of weather conditions in relation to decision support tools to track disease (mildew) susceptibility.
- Monitoring for the presence of exotic pests as appropriate (e.g., glassy-winged sharpshooter, vine

*Habitat for natural predators is an important part of any Integrated Pest Management (IPM) strategy.*
PREVENTING ENVIRONMENTAL AND HUMAN HEALTH RISKS FROM PESTICIDES

Preventing risks to the environment and human health is important to minimizing risk and maximizing sustainability in pest management. The practices below are recommended for limiting environmental and health risks associated with pesticide use. Many of these measures also improve the efficiency and efficacy of applications when pesticides are necessary, therefore reducing economic risks as well.

RISK-REDUCTION MEASURES FOR PESTICIDE APPLICATIONS

| If/when pesticides are required, regulations are followed and lower-risk materials are used when possible. (See Box 5.1 for information about determining lower-risk pesticides). |
| Low-volume electrostatic sprayers (e.g., 20 gal/aces or less) or low-volume conventional sprayers are used. |
| Sprayers are calibrated regularly, especially when soil, terrain, or tractors change. |
| Spray nozzle discharge rates are monitored frequently, and changed if needed. |
| Sprayer components are checked yearly. |
| For optimal spray coverage, air-blast sprayers are driven 3.5 miles or less and nozzles are positioned according to canopy development. |

BOX 5.1
DETERMINING RISKS FROM PESTICIDES

Certain pesticides cause higher risks than others. Many organophosphates and carbamates, for example, have higher risks because of their broad-spectrum toxicity and long persistence. Pyrethroids pose risks to natural enemies, aquatic organisms, and water quality. Moreover, some neonicotinoids have been linked to adverse ecological effects, including water quality, honey-bee colony collapse disorder, and loss of birds due to a reduction in insect populations. Various sources can be used to determine risks. Pesticide labels and recommendations by the UC Statewide IPM Program identify certain risks associated with specific products. Environmental risks include potential impacts to natural enemies or environmental (e.g., surface or ground water) contamination. Also, newer products meeting designated criteria may be registered as “reduced risk” materials by the US Environmental Protection Agency (US EPA); see http://www.epa.gov/pesticide-registration/convention-al-reduced-risk-pesticide-program. Pesticide risk models are increasingly used by wine grape growers to quantify and compare risks. Models include the Pesticide Environmental Assessment System or PEAS developed for Lodi growers (http://www.lodigrowers.com/lodi-rules/certification/), and IPM Institute of North America’s Pesticide Risk Mitigation Engine or PRiME (http://www.ipmprime.org). PEAS calculates non-target risks associated with each application as cumulative environmental impact units (EIUs). PRiME quantifies and categorizes (low, moderate, and high) non-target risks from pesticide applications according to a comprehensive set of indices.

Source: Code Workbook, Box 6-G Pesticide Use and Reducing Risks for Winegrapes
Applicators are trained to ensure maximum on-target deposition, minimizing drift and runoff.
Applications are avoided when winds exceed 7 mph or are less than 2 mph.
Lowest effective rates are used and nozzles are maintained to deliver recommended droplet sizes.
Low-drift spray technology and products with low volatile organic compounds (VOCs) are used.
Sprayers and dusters are shut off at row ends near sensitive areas.
Sign posting and/or other communication are used to ensure that field workers know about relevant environmental and health issues and avoid risks.

**RISK-REDUCTION MEASURES FOR PESTICIDE STORAGE, MIXING, AND LOADING**

- On-site storage of pesticides is minimized.
- When stored on-site, pesticides are separately housed in a place/building designed for maximum safety.
- Personal Protective Equipment (PPE) is provided for all workers who handle or apply pesticides.
- Measures are taken to prevent surface and ground water contamination. An emergency response plan is posted to address accidental spills or handler exposure.

**TAKE ACTION:**

Further information on safety measures can be found in Pesticide Safety by P. O’Connor and S. Cohen, 2006, which can be ordered at [http://www.ipm.ucdavis.edu/IPMPROJECT/ADS/manual_pesticidesafety.html](http://www.ipm.ucdavis.edu/IPMPROJECT/ADS/manual_pesticidesafety.html). Additional vineyard spraying best practices and resources are outlined at [http://web.entomology.cornell.edu/landers/pestapp/grape.htm](http://web.entomology.cornell.edu/landers/pestapp/grape.htm).

**TRAINING FOR SAFE AND SUSTAINABLE PEST MANAGEMENT**

Continuing training and education in IPM is important to ensure growers, pest control advisors, and employees have appropriate knowledge of pests and natural enemies, integrated management options, and the potential environmental and health risks and means to mitigate the risks. Training should include the following:

- Employees are trained to identify the main pests and natural enemies found in vineyards in their region.
- Employees are trained in the basic components of IPM, especially in identification.
- Employees are trained about cultural practices effective for preventing pest problems.
- Employees are regularly trained about health/safety risks related to chemical use, and effective safety methods to prevent risks.
- Employees are provided regular safety training related to equipment operation and the mixing, loading, and application of pesticides.

Appropriate educational programs that ensure safety in pest management can reduce risks and liabilities for both employees and employers, while increasing the effectiveness of pest management.

**REFERENCES**


California Department of Pesticide Regulation. Pest Management Resources. Available at: [http://www.cdpr.ca.gov/docs/pestmgt/ipminov/ipmmenu.htm](http://www.cdpr.ca.gov/docs/pestmgt/ipminov/ipmmenu.htm).


The effective management of human resources can reduce risks and cut costs. It benefits vineyard and winery operations through improved employee morale, attitudes, and productivity. This not only helps with employee retention and recruiting, but can positively impact the economic bottom line and overall sustainability of your business.

This chapter summarizes key recommended practices for the optimal management of human resources for vineyard operations. Practices are categorized by: Workforce Planning and Recruiting, Employee Safety and Training, Communication and Employee Relations, and Employee Incentive Programs. For a more comprehensive overview of best practices see the California Code of Sustainable Winegrowing Workbook (Code Workbook), Human Resources Chapter.

**WORKFORCE PLANNING AND RECRUITING**

Most vineyard and winery operations in California have a combination of full-time, part-time, and seasonal workers. It is important to create a workforce plan and recruiting process that ensures that sufficiently trained and motivated employees are available when needed, especially for increasingly hard-to-find seasonal workers.

**WORKFORCE PLANNING**

- After each harvest, develop a workforce plan for the next 12 months that documents:
  - Estimated number of acres to be managed.
  - Types of work to be performed and the percentage of each that will be mechanized.
  - Number of full-time, part-time and seasonal workers needed.
  - Include a written job description for each job or job family to clarify the roles/responsibility of each position.
  - Employees who may be retiring, leaving, or promoted.
Identify discrepancies between the number of workers needed and the number available. Use this information as the basis for preparing an annual recruitment plan (see Table 6.1). Moreover, consider developing a long-term staffing strategy that analyzes staffing needs for the future.

<table>
<thead>
<tr>
<th>TABLE 6.1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CREATING A WORKFORCE PLAN</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cost:</th>
<th>Management time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits:</td>
<td>Early identification of potential gaps in employment and time to resolve</td>
</tr>
<tr>
<td>Get Started:</td>
<td><a href="https://www.calhr.ca.gov/state-hr-professionals/Pages/Workforce-Planning-Toolkit.aspx">https://www.calhr.ca.gov/state-hr-professionals/Pages/Workforce-Planning-Toolkit.aspx</a></td>
</tr>
</tbody>
</table>

**RECRUITING PLAN AND PROCESS**

Create a recruitment plan, as part of a broader workforce plan, to:

- Identify your preferred recruitment method(s), e.g., referrals, newspapers, college recruiting, internet, wine journals/publications, community outreach, radio, etc.
- Create an associated recruiting budget.
- Develop provisions for emergency recruitment, e.g., unexpected employee turnover.
- Identify individual(s) responsible for recruiting and ensure they are trained on legally mandated hiring practices.
- Ensure that your recruiting process complies with state and federal requirements.

**EMPLOYEE SAFETY AND TRAINING**

Developing and applying effective safety and training programs can increase employees’ morale, performance, and job satisfaction. Training can be done in various formats and should include safety, orientation, professional, and supervisory/management training. Certain safety policies and training are legally mandated, and all businesses should be aware of and implement legal requirements.

**IMPORTANT NOTE ON LANGUAGE FOR HUMAN RESOURCE ISSUES:**

If there are employees who do not effectively speak or comprehend English, it is highly recommended that HR interactions, such as interviewing, training, and other HR communications, be conducted in the primary language of those employees, or that a translator is present.

**SAFETY PLANNING**

- Develop an Illness and Injury Prevention Plan (IIPP) that documents steps to prevent workforce injury and illness. (The IIPP must be in writing for businesses with over 10 employees). For details, see [http://www.dir.ca.gov/dosh/dosh_publications/IIPP.html](http://www.dir.ca.gov/dosh/dosh_publications/IIPP.html).
- Identify and plan measures to prevent heat stress (see Box 6.2).
- Develop a plan for emergencies, including fire, which should be documented in an Emergency Action Plan (EAP). For details, see [http://www.dir.ca.gov/Title8/3220.html](http://www.dir.ca.gov/Title8/3220.html).
| Create a Hazard Communication (HAZCOM) program that identifies workplace hazards, including hazardous substances employees may handle or be exposed to during work. Determine which substances require employees to wear protective gear when handling; and specify postings, training, and other methods to effectively communicate hazards. |
| Create a Job Safety Hazard Analysis (JSHA) which is a safety management tool to identify the hazards associated with each job. Once hazards are identified, steps to eliminate or control them are documented and posted to guide workers in safe performance on the job. |
| Ensure that Materials Safety Data Sheets (MSDSs) for hazardous chemicals or materials are readily available. |
| Conduct an ergonomics assessment for repetitive tasks and identify and communicate safety standards for doing work without injury. |

**SAFETY AND HEALTH TRAINING AND MONITORING**

| Develop a safety training program that addresses IIPP, EAP, HAZCOM, ergonomics, and heat stress prevention. Employees who handle dangerous substances, such as pesticides, or operate hazardous equipment should receive additional training and be provided with necessary protective gear (See Boxes 6.1 and 6.2). |
| Develop methods for ongoing safety communication and document all safety training; documentation should include employee signatures. |
| Implement a regular safety inspection process. |
| Consider adopting a safety bonus system to award positive behavior. |
| Comply with Cal/OSHA reporting and documentation requirements, including recording and reporting workplace injuries. |
| If there are Spanish speaking employees in your operation, translate safety communications, documents, and training for them. |
| Ensure all employees have access to worker’s compensation insurance. |

Note: Research has confirmed that the positive recognition of employees for demonstrating safe practices and for contributing to safety policies and safety awareness programs is more effective than merely implementing a safety bonus program.

**ORIENTATION TRAINING**

| Schedule at least one hour with new employees during their first day of work (or at least within the first week) to review company history, policies and procedures, the employee handbook, employee benefits, safety elements, employment forms, etc. |
| Consider providing new employees with a tour of company facilities and operations. |

**BOX 6.1**

<table>
<thead>
<tr>
<th>Key Safety Issues to Address During Employee Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe use and handling of pesticides (and other chemicals) and pesticide notification procedures</td>
</tr>
<tr>
<td>Availability and interpretation of Materials Safety Data Sheets (MSDSs)</td>
</tr>
<tr>
<td>Prevention of heat stress</td>
</tr>
<tr>
<td>Importance of personal hygiene and daily changes into clean clothing</td>
</tr>
<tr>
<td>Solid waste handling</td>
</tr>
<tr>
<td>Equipment operation and confined space safety</td>
</tr>
<tr>
<td>First aid</td>
</tr>
<tr>
<td>Hazardous materials handling</td>
</tr>
<tr>
<td>Procedure for reporting workplace injuries</td>
</tr>
<tr>
<td>Preventing machinery related accidents</td>
</tr>
<tr>
<td>Personal Protection Equipment (e.g., to protect hearing, eyes, and hands)</td>
</tr>
<tr>
<td>Avoiding field sanitation hazards</td>
</tr>
<tr>
<td>Office safety</td>
</tr>
<tr>
<td>Confined spaces</td>
</tr>
<tr>
<td>Hazard communication</td>
</tr>
<tr>
<td>Emergency Action Plan</td>
</tr>
<tr>
<td>Fall protection</td>
</tr>
<tr>
<td>Injury Illness and Prevention Program</td>
</tr>
<tr>
<td>Bloodborne pathogens</td>
</tr>
<tr>
<td>Avoiding dangerous snakes, spiders, and related hazards in the vineyard</td>
</tr>
</tbody>
</table>

Note: Providers of worker’s compensation insurance generally offer free or low-cost safety training and audits; contact them to determine if they can assist in this area.
TRAINING FOR PROFESSIONAL SKILLS AND MANAGEMENT

- Complete a needs assessment to determine if employees require training for professional skills, such as specific technical capacities, office/computer skills or management skills.
- Identify and develop methods for delivering necessary training, e.g., training manuals, self-study, online courses, or hiring a consultant.
- Document all training in employee records.
- Evaluate how well the training was received.

Provide harassment prevention training for employees in supervisory positions. In California, harassment prevention training should include bullying prevention as well.

Ensure that employees newly promoted to supervisory or management positions undergo appropriate training in workforce management.

Consider establishing a mentoring or coaching system.

TABLE 6.3
CREATING A SAFETY AND TRAINING PROCESS

| Cost: | Consultant/trainer costs and costs associated with materials, facilities, and employee salary/benefits while away from the job. (Standard trainer/consulting costs range from $125 to $350 per hour; safety brochures, postings, and material costs vary.) |
| Benefit: | Employees gain skills to safely and efficiently manage vineyard operations and personnel, and the business is in compliance with federal and state laws |
| Get Started: | http://www.dir.ca.gov/dosh/EmployerInformation.htm |

COMMUNICATION AND EMPLOYEE RELATIONS

Clear communication reduces risks and costs by ensuring that employees understand the policies and procedures associated with operations. Furthermore, clarity of communication improves employee relations through common understanding about company goals and work rules. Motivational activities such as teambuilding, special events, and harvest or holiday parties also can significantly enhance employee relations.

Defining expectations and using clear communication are vital to maintaining a productive and motivated workforce. Given that the replacement cost of an employee can be more costly than their annual salary (when considering the costs associated with recruiting a new employee, potential overtime or temporary employees, management time to interview candidates, orienting and training a new employee, and potential unemployment),
investing time into clearly communicating with employees pays off in numerous ways.

CLEAR EMPLOYEE COMMUNICATION AND POSITIVE RELATIONS

| Document and communicate workplace policies and procedures in a handout or employee handbook, provide written job descriptions that define the expectations for the position, and post the key policies (including the Equal Employment Opportunity Statement (EEO), Unlawful Harassment Policy, and the Workplace Conduct Statement).
| Review company policies, procedures, and job expectations with employees during orientation or whenever a change in policy/procedure occurs.
| Hold regular meetings to update employees on progress and issues within the company and industry.
| Consider developing an “Open Door Policy” so employees are encouraged to talk to supervisors or managers about their concerns.
| Consider installing a mechanism for employees to anonymously make suggestions.
| Encourage teamwork and respect among all individuals.
| Consider holding annual performance evaluations so that each employee meets with his or her supervisor at the beginning of the year to set goals, evaluate performance, and provide constructive feedback.
| Consider holding teambuilding and other events where employees are recognized for their efforts and for being a valued member of the company.

TABLE 6.4

IMPLEMENTING POSITIVE COMMUNICATION AND EMPLOYEE RELATIONS PROCESSES

| Costs: | Costs associated with management time to meet with employees, developing and updating the employee handbook, and teambuilding motivational events. |
| Benefits: | More motivated and efficient workforce because they understand company policies, procedures, and their job expectations and feel valued by management, i.e., less risk of employee dissatisfaction. |
EMPLOYEE INCENTIVE PROGRAMS

Vineyard and winery employee incentive programs can include both financial and non-financial rewards. Financial rewards may include salary increases, bonuses, long-term incentives, and benefits. Non-financial rewards include positive feedback, public recognition, a pleasant work environment, motivational supervisors, supportive co-workers, and the satisfaction of being valued. Research in the US and Australia indicates that vineyard and winery businesses with established reward systems have higher profitability than those that do not (Thacht and Kidwell, 2009).

ESTABLISHING INCENTIVE PROGRAMS

| Identify clear performance standards for the specific job type. |
| Create a reward system, with specific incentives that may vary by job type. |
  • Make sure the reward system is fair, does not discriminate, and complies with applicable laws. |
  • When establishing bonuses, consider what types are being offered by similar companies, e.g., bonuses for harvest, holidays, safety, etc. |
| Foster a work environment where positive feedback is encouraged for outstanding work-related behavior or performance. |
| Implement two or more employee recognition programs and hold at least one formal meeting or ceremony in which an employee is recognized publicly, e.g., a staff lunch or picnic. Employee recognition may or may not include a monetary bonus. |

TIMELY AND APPROPRIATE DISCIPLINE

Incentive programs are only effective in motivating the workforce if unacceptable behavior is adequately addressed. A robust incentive program will not have the desired effect if the workforce believes that any behavior is acceptable and tolerated by supervisors. It is important to encourage timely and appropriate discipline to keep up the morale of the entire team.

| Ensure supervisors are trained to identify and deal with unacceptable behavior. |
| Ensure consistent and timely responses to unacceptable behavior. |
| Maintain neutrality, disciplining unacceptable behavior is not personal. |

TABLE 6.5

IMPLEMENTING AN INCENTIVE PROGRAM

| Costs: |
| Costs include those for bonus or salary increases and for management time and possibly for consulting to setup incentive program. |
| Benefits: |
| More motivated and efficient workforce because employees better understand performance goals and targets. Research shows positive impact on company profitability. |
| Getting Started: |
| http://www.amazon.ca/1001-Ways-Reward-Employees-Revised/dp/0761136819 |

REFERENCES


Wolfe, A. (2016). Maintaining a Productive and Motivated Workforce, AgSafe [PowerPoint slides].
Energy costs and availability have become risk factors creating financial stress and vulnerability for vineyard and winery operations, and for companies throughout agricultural supply chains. The combination of fluctuating energy prices, uncertain fuel supplies, aging grid infrastructure and the drive to save money by conserving natural resources have compelled many growers and vintners to invest in energy efficiency and conservation.

Moreover, conventional patterns of energy use are contributing to increasing public concerns about greenhouse gas (GHG) emissions and associated societal risks tied to global climate change. Accordingly, government regulations in California are placing restrictions on and requiring companies to improve their energy efficiency and adopt other practices that reduce GHG emissions and mitigate climate change (see Box 7.1).

These trends underscore the need for vineyard and winery operations to develop or update their energy management plans. More than ever, it is essential to have a comprehensive energy management plan and to implement practices that increase energy conservation, efficiency, and use of alternative energy sources when possible. These actions will help companies reduce costs and risks, mitigate and adapt to climate change, and increase the sustainability of their business.
PRACTICES TO REDUCE RISK & IMPROVE ENERGY EFFICIENCY

PLANNING, MONITORING, AND ACHIEVING RESULTS

Good energy management starts with measuring and knowing your energy use, and implementing a comprehensive plan.

|  | Monitor and record total energy used year round. |
|  | Get a detailed energy audit. (Take advantage of free or subsidized audit services if your energy provider offers them - see Box 7.2.) |
|  | Review the rate schedule for the cost of electricity to see if you are on the correct rate. |
|  | Identify usage patterns, inefficiencies, opportunities, and priorities in your business. |
|  | Develop an integrated energy management plan for all aspects of the operation (lighting, pumps, tanks, refrigeration, motors, drives, etc.). |
|  | Determine energy metrics per unit of product (kWhs per ton of grapes or case of wine) and set yearly goals for overall energy use, according to baseline monitoring data. |
|  | Include contingency options in the plan, in order to meet energy needs at critical times, such as on-site generation capabilities during crush. |
|  | Implement the plan(s), focused on priorities, and demonstrate a measurable reduction in energy metrics per ton and/or per gallon production each year. |
|  | Incorporate energy use and conservation in a comprehensive training program for employees. |
|  | Network with other winery operations to learn what does and does not work. |

MOTORS, DRIVES AND PUMPS

|  | Carry out an efficiency evaluation of vineyard water pumps. (Find out if you qualify for subsidized pumping audit service or retrofit incentives offered by the Advanced Pump Efficiency Program at: www.pumpefficiency.org.) |
|  | Install a Time-of-Use (TOU) meter on your well that allows you to pay a reduced rate for “off-peak” pumping hours. Generally off-peak hours are between 6 pm and 12 pm. Pumping off-peak will reduce electric charges by approximately 60%. A special meter is required so contact your electricity provider to get the right one. |
|  | Select and purchase new equipment made for optimal energy performance and results, such as variable frequency drives, multi-speed motors, and “right sized” pumps. |
|  | Use energy efficient technologies and designs, such as stacking tanks, installing solar aerators, utilizing smaller diameter pipes, and installing software for etc.), while providing the necessary guidance to report domestic emissions at the local level. To download the protocol visit: www.wineinstitute.org/ghgprotocol. |

BOX 7.1

CLIMATE CHANGE CONCERNS AND LEGISLATION AFFECTING CALIFORNIA’S WINE INDUSTRY

Since climatic shifts can dramatically affect the production and quality of grapes and wine, global climate change has generated major concerns and risks for winegrowers across California. Scientific projections indicate variable impacts from climate change across the major winegrowing regions, which have initiated efforts to mitigate and adapt to climate change.

California passed a law, known as AB32, in 2006, establishing the first-in-the-world comprehensive program using regulatory and market mechanisms to achieve quantifiable cost-effective GHG reductions. The Wine Institute and International Partners revised and updated the FIVS International Wine GHG Protocol, first released in 2008 and updated in 2015, to offer a common framework for calculating and communicating about carbon emissions that is in step with international standards and practices. Further, it is tailored for use at the international level by all segments of the wine industry (growers, wineries, contract bottlers, etc.), while providing the necessary guidance to report domestic emissions at the local level. To download the protocol visit: www.wineinstitute.org/ghgprotocol.

To learn more about climate change adaptation for California specialty crops, including winegrapes, see the California Department of Food and Agriculture’s report “Climate Change Consortium for Specialty Crops: Impacts and Strategies for Resilience” at: https://www.cdfa.ca.gov/environmentalstewardship/pdfs/ccc-report.pdf.
monitoring equipment performance, where appropriate.

| If you use diesel pumps, consider switching to electric or natural gas pumps or powering them with renewable energy such as solar or wind.

HEATING VENTILATION AND AIR CONDITIONING (HVAC)

| Regularly schedule and record maintenance of the HVAC system by checking insulation, weather stripping, and using window film.
| Reduce heating and cooling loads for the facility by increasing the R-value of insulation, passive ventilation, louvered roof panels, timed automatic door openers, and lighter shades of paint on buildings.
| Use energy efficient technologies and designs throughout the facilities.

LIGHTING FOR ALL FACILITIES

| Inspect and clean light fixtures annually.
| Install motion detectors throughout the facility.
| Train employees to turn off lights when leaving areas.
| Use compact fluorescent lights or LEDs in all appropriate locations.
| Design lighting to illuminate areas needed at the time (task lighting) and use natural light if possible. Disconnect unnecessary lamps and fluorescent ballasts.
| Use energy efficient internal and external lighting technologies and designs, such as automatic room lighting controls, mercury vapor, sodium and sulfur lamps, skylights, and natural light tubes.
| For outdoor lighting, install sodium and/or sulfur lamps, and design lighting to illuminate key security areas or with motion detectors, as appropriate.
| Train security guards to turn off lights as they go on their rounds.

TRANSPORT

| Ensure your vehicles are running at high fuel-efficiency; make sure oil changes and maintenance are undertaken regularly to increase efficiency.
| Provide training to employees about measures to save fuel, such as lowering speeds, avoiding idling motors, checking tire pressure, etc.
| Consider purchasing high-efficiency or hybrid vehicles.

---

**CHECK YOUR ELECTRICITY RATE TO SAVE MONEY:**

The amount you pay for electricity changes over time and the only way to ensure the most cost-effective rate for your usage patterns is to get a rate analysis done every year. You may be able to save money by selecting an alternate electric rate schedule. Contact your utility account representative to check your rate schedule. PG&E customers can call 1-877-311-FARM (3276) to access your account representative.

**INCENTIVE PROGRAMS AND REBATES FOR ENERGY EFFICIENCY**

**ENERGY AUDITS:**

- Many utilities offer energy audit assistance, including free or subsidized audit services – check with your local provider for available services.
- To find out about subsidized pump efficiency tests in your area, visit: www.pumpefficiency.org/.
- The Natural Resources Conservation Service (NRCS) provides technical information and financial assistance for energy audits through the EQIP On-Farm Energy Initiative – contact your local NRCS office for more information.
- A detailed winery energy audit checklist is available in the Code Workbook, Chapter 9 Box 9-B Winery Energy Audit Checklist.

**REBATES:**

- PG&E offers many standard rebates for the purchase of approved energy-efficient products. Check the online rebates catalogue for a complete list of rebate opportunities, including lighting fixtures and controls, HVAC, motors, strip curtains, and much more at: http://www.pge.com/en/mybusiness/save/rebates/index.page?

**SAVINGS BY DESIGN:**

- Learn about the many ways you can get free technical assistance and take advantage of the rebates and incentives for new construction or renovation/remodeling projects at: www.savingsbydesign.com/.
Avoid extra travel by all employees; hold conference calls or video conferencing when possible.

Establish carpools or other means for group transport of employees. Provide incentives for carpooling.

Consider using biodiesel for vehicles that run on diesel.

Coordinate trips to stores through the individual in charge of purchasing.

**OFFICE EQUIPMENT**

- Turn off office equipment when not in use.
- Consider energy consumption when office equipment is upgraded or replaced, and get Energy Star® certified equipment, when possible.
- Install power strips with timers/motion detectors in offices to turn off equipment at end of day.

**REFRIGERATION SYSTEM (FOR WINERIES)**

- Select and maintain technologies for optimal performance.
- Reduce chiller loads by building insulation, insulating tanks (both inside and outside), incorporating night air cooling, and using off-peak energy for evaporative cooling and/or ice making.
- Use energy efficient technologies, such as evaporative condensers, extra heat exchange surfaces, condensers fitted with flow-control values to reduce pressure and temperature, chillers that can operate at moderate or high-cooling stages, and variable-speed fans for cooling towers.

**TANKS AND LINES (FOR WINERIES)**

- Install insulated jackets on tanks.
- Install insulation on glycol lines.
- Locate tanks in places that reduce cooling and heating needs such as in shady or covered areas or indoors (if appropriate/possible).
- If tanks are located in a building, insulate and enclose the building.

**BOX 7.3**

**COSTS AND BENEFITS OF VARIOUS FUELS**

<table>
<thead>
<tr>
<th>FUEL TYPE</th>
<th>ADVANTAGES</th>
<th>DISADVANTAGES AND OTHER COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>Currently available widely at commercial pumps</td>
<td>Volatile pricing; unstable supplies; high GHG emissions</td>
</tr>
<tr>
<td>Diesel</td>
<td>Currently available at commercial pumps</td>
<td>Volatile pricing; unstable supplies; high GHG emissions</td>
</tr>
<tr>
<td>Biodiesel</td>
<td>Reduces dependency on oil; renewable source; lower GHG emissions</td>
<td>More difficult to access; higher costs</td>
</tr>
<tr>
<td>Ethanol</td>
<td>Reduces dependency on oil; Low GHG emissions; renewable source</td>
<td>Difficult to access in CA; problems using corn as stock; raises food prices</td>
</tr>
<tr>
<td>Straight Vegetable Oil</td>
<td>Lower GHG emissions; renewable; often available from oil waste products</td>
<td>Conversion of vehicle engines is necessary; sometimes difficult to source</td>
</tr>
</tbody>
</table>
TAKE ACTION:
Pacific Gas and Electric Company (PG&E) provides many services and information to wineries and vineyards, including low or no cost winery energy audits, visit: www.pge.com/wineries. Southern California Edison customers can find information about vineyard services at: https://www.sce.com/wps/portal/home/business/ems/agriculture and winery information at: https://www.sce.com/wps/portal/home/business/ems/food-processing.

For more information on no-cost and low-cost energy efficiency options, go to: http://energy.gov/energysaver/energy-saver. A good source for information on certified energy efficient products is available on the Energy Star website at: https://www.energystar.gov/products.

Learn about what other California vineyards and wineries are doing to save energy and money by viewing a short video or reading a written case study at: http://www.sustainablewinegrowing.org/educational-videos.php. Topics covered include self-generation fuel cells, improving pump efficiency, solar hot water systems, saving energy with high-speed roll up doors, variable frequency drives, and more.

PERFORMANCE METRICS FOR TRACKING ENERGY AND GREENHOUSE GAS EMISSIONS
Performance metrics are the measurable outcomes of business practices. Performance metrics can help growers measure, track, and manage production inputs (e.g., water, energy, and nutrients) and GHGs to optimize operational efficiency, decrease costs, and minimize adverse environmental impacts. Calculating the performance metric for energy use gives growers and vintners the ability to monitor and record energy use by production unit (e.g., acre/tons of grapes per kilowatt hour and/or gallons/cases of wine per kilowatt hour). By tracking this information, growers and vintners can set targets based on measurements, monitor fluctuations in use and make necessary improvements, and get additional feedback about their operation.

TAKE ACTION:
To track your metrics for energy, GHG emissions, water, and nitrogen, visit: http://www.sustainablewinegrowing.org/metrics.php or click on the “Metrics” tab within the SWP Online System.

ALTERNATIVE SOURCES OF POWER – VINEYARDS AND WINERIES

| Do an energy audit and implement energy efficiency measures before considering and installing an alternative source of power (do not “solarize your inefficiencies”). |
| Prepare a financial analysis to evaluate the use of renewable energy, including solar, wind, fuel cells, and geothermal, in your vineyard or winery operations. Consider the value of incentive programs or RECS (renewable energy credits). |
| Install solar photovoltaic panels or passive solar hot water systems, if feasible. |
| Design or retrofit buildings to maximize potential use of passive solar for heating, if feasible. |
| Install a system(s) using another alternative energy source, such as wind, methane digesters, fuel cells, or geothermal, if feasible. |
| Monitor the energy use and savings from on-site renewable energy technologies to compare results to your previous approach. |
| If you use alternative energy, offer your operation as an example or demonstration for other growers or wineries exploring energy alternatives. |
| Some counties have the option of choosing 100% renewable electricity from their utility provider through a Community Choice Aggregation program. Contact your utility provider to see if this option is available in your area. |

TAKE ACTION:
For additional information on incentive programs for renewable energy, see the Database of State Incentives for Renewables and Efficiency at: http://www.dsireusa.org/.

REFERENCES
Although California generally has an excellent climate for growing grapes, severe weather conditions occasionally take a toll on vineyards and other agricultural production systems. Major risks that confront grape growers include extremes of both heat and cold – including untimely frost in the spring and fall, heavy rain storms and potential erosion, excessive heat, and drought. As California continues to cope with long-term and more frequent droughts, growers can benefit from drought management planning and drought-related resources offered by federal and state agencies. In recent years, wildfires and earthquakes have also caused major damage in several California wine regions, highlighting the need to be prepared for many types of natural disasters to reduce risk. Although most of these problems do not occur annually, and can be somewhat rare, they can cause major anxieties for growers and vintners.
MANAGING SEVERE WEATHER

Some growers may feel that they are victims of extreme weather events, and that there is nothing they can do to avoid such risks. However, as noted in Table 8.1, there are ways for growers to prepare for extreme weather events, and to prevent certain weather-related losses, or at least reduce their anxiety and stress. Buying crop insurance is also an important tool to offset losses, as discussed in detail in Chapter 9.

<table>
<thead>
<tr>
<th>RISK</th>
<th>METHOD TO MITIGATE/ PREVENT RISKS</th>
<th>COMMENTS AND INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme or unusual weather conditions</td>
<td>Be prepared: keep track of weather through Online Weather monitoring service and forecasting</td>
<td>Information available online from NOAA, other climate data and services*</td>
</tr>
<tr>
<td>Humidity and rain storms</td>
<td>Adcon weather stations and similar weather monitoring technologies</td>
<td>See Chapter 1 of this guide (weather stations for disease monitoring)</td>
</tr>
<tr>
<td>Frost</td>
<td>Temperature monitoring and alarm system – warning for frost danger</td>
<td>This is crucial in any area that has frost risk</td>
</tr>
<tr>
<td>Frost</td>
<td>Frost protection: installing overhead sprinklers (ensure adequate coverage &amp; regularly maintain the system)</td>
<td>Good option, if water is abundant in your area</td>
</tr>
<tr>
<td>Frost</td>
<td>Frost protection: wind system</td>
<td>Second option, especially if water is limited</td>
</tr>
<tr>
<td>Flooding</td>
<td>Improved drainage system and/or watershed restoration</td>
<td>Code Workbook, Vineyard Water Management and Ecosystem Management Chapters</td>
</tr>
<tr>
<td>Flooding</td>
<td>Erosion control practices (straw wattles, filter strips, cover crops, etc.)</td>
<td>See Chapter 3 of this guide</td>
</tr>
<tr>
<td>Extreme heat</td>
<td>Heat “cooling” with sprinklers</td>
<td>Possible during extreme heat, if water is available</td>
</tr>
<tr>
<td>Extreme heat</td>
<td>Increase drip irrigation volume if possible</td>
<td>See Chapter 1 of this guide</td>
</tr>
<tr>
<td>Frost, Flooding, Heat, Drought</td>
<td>Crop insurance policies</td>
<td>See Chapter 9 of this guide</td>
</tr>
</tbody>
</table>


DROUGHT RESPONSE

In 2015, California growers contended with the fourth year of a severe drought, declared a drought emergency by Governor Brown. Prolonged periods of drought present particular challenges and risks for farmers. Creating a drought management strategy is one way growers can evaluate how to effectively respond to limited water availability. There are also numerous support programs offered by federal and state agencies to assist farmers in minimizing the negative long-term impacts that result from sustained drought and other disasters.

DROUGHT MANAGEMENT STRATEGY:

Making the best use of limited irrigation supplies is important for responding to drought situations. Having a drought management strategy in place is increasingly important in California, due to the state’s ever-increasing water quality and quantity issues. While always important to conserve water, drought management goes beyond business as usual and includes proactive measures for addressing limited water supplies.

A drought management strategy can include:

- Methods for maximizing irrigation water efficiency through use of weather, soil, and plant monitoring for irrigation scheduling and irrigation system maintenance, among others. (See Chapter 1 for more information on maximizing irrigation efficiency.)
- Appropriate use of regulated deficit irrigation (RDI) in situations where water availability is limited. (For more information on integrating RDI into an irrigation strategy visit: http://ucmanageddrought.ucdavis.edu/Agriculture.)
Monitoring water resources is important for an effective drought management strategy and can include:

- **Groundwater fluctuations**: survey wells to know how deep the water is being pulled from.
- **Surface water conditions**: check the levels of creeks by accessing the USGS water data for surface water at http://waterdata.usgs.gov/nwis.
- **Water quality fluctuations**: drought conditions can impact water quality and checking the quality of irrigation water is important.

Ensuring adequate crop insurance coverage. See Chapter 9 for more information on crop insurance.

**TAKE ACTION:**

To help monitor drought conditions, a weekly map of drought conditions is provided by U.S. Drought Monitor and can be found at: http://droughtmonitor.unl.edu.

**FEDERAL & STATE ASSISTANCE PROGRAMS:**

Below are two of the key drought-related assistance programs offered by federal and state agencies available for winegrape growers. (For a complete list of federal and state assistance programs for drought visit: https://www.cdfa.ca.gov/drought/.)

**USDA Natural Resources Conservation Service (NRCS) EQIP** – Nearly $40 million is being made available in programs to help drought-impacted farmers. Through the Environmental Quality Incentives Program (EQIP) farmers are typically reimbursed for about half the cost of the practices they identify and implement through conservation plans developed with assistance from NRCS conservation planners. The three priorities for the drought funding are: protecting soils made vulnerable due to water cut backs; protecting drought-impacted rangeland; and stretching every drop of irrigation water using improved hardware and management. All California county offices are taking drought applications. Locate your office at: http://offices.sc.egov.usda.gov/locator/app?state=CA. For more details visit: http://www.nrcs.usda.gov/wps/portal/nrcs/main/ca/newsroom/features/.

**State Water Efficiency and Enhancement Program (SWEEP)** – California Department of Food and Agriculture’s (CDFA) SWEEP program provides financial incentives for California agricultural operations to invest in water irrigation and treatment and/or distribution systems that save water and reduce greenhouse gases (energy use). More information is available on the program website: https://www.cdfa.ca.gov/EnvironmentalStewardship/WEEP.html.

**FIRE READINESS**

Climate change and drought have significantly increased the risk of wild and forest fires in California. In the fall of 2015, areas of northern California, especially Lake County and some areas of Calaveras County, suffered significant loss from fires that raged over several weeks. In light of fire risks in and near winegrowing regions, it is important for winegrowers and wineries to be prepared for fire.

On the following page is a checklist of key steps to ensure that your property and staff are prepared for a fire, based on guidance from CAL FIRE Battalion Chief Scott McLean and Gregory Slugocki of National Storage Tank and the Insurance Institute for Business & Home Safety (Slugocki, 2015 and IBHS, 2015).
STEP ONE: SPEAK WITH YOUR LOCAL FIRE DEPARTMENT

| Find out who your local responder is, how long it would take them to get to your location, and how much water the trucks will be carrying. You can also ask for your local responder to come to your property and assess fire preparedness. Contact CAL FIRE for more information on “pre planning” (see: http://www.fire.ca.gov/).
| Ask your local responder if they have on hand all equipment needed to fight fire at your property, and determine if there is specific equipment you must have on site. (For example, to use water from a pond on your property the fire responder must be equipped with materials such as folding tanks, float dock strainers, hoses, and supply line holders.)

STEP TWO: PREPARE EMPLOYEES

| Determine where all access points to water on your property are located, and ensure that they are well-marked, illustrated on a map, and known to all employees.
| Develop an emergency disaster plan for fire (including an evacuation plan), and conduct drills with your staff on what to do.
| If any employees do not speak English, ensure there is information and training in their primary language.
| Check with your insurance provider if your staff is allowed to begin fire counter-measures prior to the arrival of the local fire responder. If so, ensure that your staff is adequately trained and prepared to fight fires with the correct equipment (e.g., hoses, pumps, and water trucks).

STEP THREE: PREPARE YOUR PROPERTY/FACILITY

| Ensure that you have a 100-foot defensible zone around your structures, and clear any dead plants, trees, branches, or debris from your property. Clear any branches that extend over the roof or within six feet of your structure. (To learn more about creating a defensible zone, go to: http://www.readyforwildfire.org/defensible_space/)
| If you have an older facility, consider installing a sprinkler system if your winery does not already have one.
| If not installed already, consider installing a water tank (used for fire prevention and irrigation) in order to supplement water on fire trucks. Dispersing several smaller tanks dedicated as fire water around the property can be effective in containing widespread fire.
| Regularly monitor the amount of water in your tank(s).

TAKE ACTION:
For more information, see CAL FIRE’s Fire Prevention resources at: http://calfire.ca.gov/fire_prevention/fire_prevention.

EARTHQUAKE PREPAREDNESS

The West Coast is known to be the center of seismic activity in the US, and many of California’s winegrowing regions are situated near major fault lines. Earthquakes can hit without warning, and can destroy or severely damage winery assets such as barrels, tanks, and bottles, as South Napa businesses learned from the aftermath of the 2014 6.0 earthquake. It is critical that wine making, storing, and distributing facilities and staff are adequately prepared for earthquakes.

After the major 8.8 earthquake hit Chile and its winegrowing regions in 2010, Chilean wine producers shared key lessons learned about earthquake preparedness with writer Deborah Grossman. The following checklist for earthquake preparedness is based on their guidance (Grossman, 2010).

STEP ONE: PREPARE FACILITY INFRASTRUCTURE

| Review geography, soil and structural foundations in construction, and evaluate tolerance levels for a massive earthquake. Seek the guidance of structural engineers to review earthquake hazards (see for more
| Do not be lured by cost-cutting shortcuts in materials or construction. |
| Consider purchase of generators with surge protection or solar panels, and have local staff trained in their use. |
| For irrigation systems, use earthquake resistant pipes. Consider having generators to provide backup power. |
| Consider a backup plan – informal or formal – if facilities are unusable during critical operational times such as harvest. |

**STEP TWO:**
**PREPARE TANKS, BARRELS, AND BOTTLES**

| Use earthquake-resistant stainless steel vats. Purchase tanks with the thickest gauge possible. |
| Purchase tanks with five legs rather than four legs. Consider diagonal leg supports and braces on large tanks. Use as many smaller tanks with a larger diameter-to-height ratio as possible. Bolt to concrete as appropriate. |
| If tanks are not bolted or fixed, evaluate for stability. Avoid placement of stainless steel tanks directly on the ground without bolts. |
| Consider the evolution of tank construction, and evaluate new and older designs for thickness/stability. |
| Use cradle-type or stainless steel “tree” arms for stacking barrels. Avoid the “solera” direct-stacking method. Consider metal stacking with secure linking brackets between lines of barrels. |
| Store bottled wine shrink-wrapped in cardboard boxes. |
| Limit the height at which pallets of bottled wines and barrels are stacked. |

**STEP THREE:**
**EDUCATE EMPLOYEES**

| Develop and drill everyone on an evacuation plan, with secure places to stay during and after the quake. Train employees in the barrel room to jump inside the closest available canopied forklift. Forklifts with canopies are designed to withstand direct hits form barrels. |
| Create contingency plan for duty-staff to arrive quickly to inspect the facility and start the generator. Communicate structural damage and well-being of employees. |
| Implement a backup communication plan if cell phones fail and electricity is unavailable for computers. Some wineries found that e-mail via mobile devices was the only means of communication during the first days and hours. |
| Prepare for employee needs in case of housing and medical issues – both physical and mental. |
| Prepare press releases about winery status for broad dissemination as quickly as possible. Keep employees informed of overall impact on winery. |

**STEP FOUR:**
**CONSIDER INSURANCE AND FINANCIAL PREPAREDNESS**

| Consider a standalone stock-throughput insurance policy for the wine, separate from insurance for buildings. The policy covers goods in all phases of production from the vine and cellar to the customer. |
| Look into preventative insurance. Some insurance companies support clients with preventative measures from engineering firms that specialize in evaluating earthquake hazards. |

**TAKE ACTION:**


**REFERENCES**


Growers have several options for addressing risks through the purchase of crop insurance, an important sustainability tool. If you choose to buy crop insurance, it is recommended to thoroughly investigate options for what to include in the coverage you select. In addition, establishing overall business management plans – including succession plans – can help considerably in reducing risks and assuring your future success. This chapter gives an overview of insurance options as well as key business planning aspects that can help vineyard owners/managers prevent or reduce risks while ensuring sustainability over time.

**INSURANCE OPTIONS**

Crop insurance policies provide several options to growers who seek protection against risks. Depending on the level of coverage, the government subsidizes 38% to 67% of the premium, making crop insurance an affordable and key risk management tool. A grower can insure their grape tonnage at the lower of their contract price or the maximum of two times the established price election. As California growers continue to contend with drought and potential losses from weather-related damage, more growers are seeking coverage and increasing their premiums to cover potential loss.

Some main options for crop insurance include the following (RMA, USDA, 2016):

**Whole-Farm Revenue Protection (WFRP)** provides a risk management safety net for all commodities on the farm under one insurance policy and is available in all counties nationwide. This insurance plan is tailored for any farm with up to $8.5 million in insured revenue, including farms with specialty or organic commodities (both crops and livestock), or those marketing to local, regional, farm-identity preserved, specialty, or direct markets. It is available in all 50 states.
Supplemental Coverage Option (SCO) is a county-level crop insurance option that provides additional coverage for a portion of your underlying crop insurance policy deductible. First available for grapes in 2016, it must be purchased as an endorsement to the Actual Production History policy.

Multi-Peril Crop Insurance Policy (MPCI) provides comprehensive protection against weather-related causes of loss and certain unavoidable perils (including adverse weather conditions, earthquake, failure of irrigation water supply (if caused by an insured peril during the insurance year), fire, insects or plant disease (but not damage due to insufficient or improper application of control measures), volcanic eruption, or wildlife). Coverage is available on over 76 crops through the U.S. including winegrapes at 50% to 85% of the Actual Production History for the farm. MCPI coverage provides protection against low yields and poor quality.

Catastrophic Risk Protection Endorsement (CAT Coverage) pays 55% of the established price of the commodity on crop losses in excess of 50%. The premium on CAT coverage is paid by the Federal Government; however, producers must pay a $300 administrative fee for each crop insured in each county. CAT coverage is not available on all types of policies; contact a crop insurance agent for more information.

The choice of an insurance policy depends on the objectives of the grower. Growers should determine their objectives for obtaining crop insurance and compare them to the options for insurance packages (see examples of possible objectives below). Contact a crop insurance agent to assist in determining which insurance package is most appropriate for your needs. To find a list of crop insurance agents, visit the Risk Management Agency website at: http://www.rma.usda.gov/tools/agent.html.

POSSIBLE OBJECTIVES OF PURCHASING INSURANCE:

What do I want my crop insurance to do in a bad year? For example, it could:
- Cover production costs
- Give security to make marketing decisions even with low/no crop to harvest
- Provide peace of mind

What do I want my crop insurance to do in a good year? For example, it could:
- Guarantee loan collateral
- Provide security to make marketing decisions
- Add confidence to my farming decisions
- Increase my opportunity for profit

TAKE ACTION:


BUSINESS PLANNING TO REDUCE RISK AND ENSURE SUSTAINABILITY

Business planning is an important part of owning and/or managing a vineyard operation. It is an on-going problem-solving process that can be used to identify challenges and opportunities. New and experienced business owners and managers, regardless of their history or current status, can benefit from business planning. Producers generally prepare business plans to: evaluate production alternatives; identify new market opportunities; and communicate their ideas to lenders, business partners, employees, and family (SARE/MISA,
It is important for both growers and vintners to understand the fluctuation and cycles in market conditions. Turrentine Brokerage has developed a helpful infographic to illustrate these fluctuations. These cycles are influenced by supply and demand of grapes and wine, and other economic and climate-related factors. These changing conditions can create significant risks in the market for growers and wine buyers. At the same time, recognizing this cyclical situation can help people create effective marketing plans and mitigate risks. To view this helpful infographic, see: https://www.turrentinebrokerage.com/wine-wheels/.

2003). Business planning can also help ensure that potential risks are understood and practices are in place to reduce risks.

Before starting to develop a business plan, it is helpful to determine what you want to accomplish from the planning process, and also who will be involved. Generally, business planning is done by a team of key people involved in the operation. A team approach can enrich the effort and garner collective support. People involved in developing business plans often include family members, partners, employees (especially managers or directors), board members, lenders, and/or other experts – who may be seen collectively as stakeholders.

The planning process for an agricultural operation involves five major tasks which are summarized below (SAN/MISA, 2003). All of these business planning tasks are also important for managing risk and ensuring sustainability in vineyard operations.

1. **IDENTIFY VALUES – WHAT IS IMPORTANT TO YOU?**
   - What does it mean for you to be successful?
   - What community, financial, and environmental values are important to you?

2. **REVIEW HISTORY AND ASSESS YOUR CURRENT SITUATION – WHAT DO YOU HAVE?**
   - Market situation (your products, customers, unique features, pricing, promotion, etc.); cycles and fluctuations in the wine and winegrape market which affect pricing and sales opportunities (see Figure 9.1).
   - Operations situation (physical resources, production systems, management and information systems, etc.).
   - Natural resources (your land/soil, water, air, energy sources, habitat, etc.).
   - Human resources situation (current work force, skills, and expected changes).
   - Financial situation (financial needs, performance, and risks).
   - Identify current Strengths, Weaknesses, Opportunities, and Threats (SWOT).

3. **IDENTIFY YOUR VISION, MISSION, AND GOALS – WHERE DO YOU WANT TO GO?**
   - Develop a vision, mission statement, and goals.
   - Set and prioritize goals.
4. DEVELOP AND COMMUNICATE YOUR STRATEGIC BUSINESS PLAN – WHAT ROUTES WILL YOU TAKE TO REACH YOUR GOALS?

| Develop a marketing strategy: identify markets, products, competition, pricing, and promotion. |
| Develop an operations strategy for production, management, regulations, natural resource management, resource needs, etc. |
| Develop a human resources strategy (see Chapter 6 of this guide). |
| Develop a financial strategy, including financial risk management, organizational structure, means of achieving financial requirements, long-term financial plans, contingency plans, etc. |
| Communicate the plan and strategies to others in your operation and to others who work closely with you (such as lenders). |

5. ENSURE EFFECTIVE IMPLEMENTATION OF THE STRATEGIC PLAN AND EVALUATION

| Develop steps for implementing the plan. |
| Establish monitoring methods and record keeping. |
| Review your plan annually, and evaluate progress, strengths, weaknesses, risks, and opportunities, and adjust practices and plans as needed. |

This list of tasks provides only a general overview of business planning for a farming operation. Carrying out these basic steps in business planning can contribute to a successful and sustainable business, and can also help manage and reduce risks to your business in the future.

TAKE ACTION:

SUCCESSION PLANNING

To avoid financial risks to your winery or vineyard business and/or to your family, and to help ensure sustainability and success of your business, it is important to develop a clear plan for succession. Lack of succession planning can be a major problem – contributing to significant uncertainties, frictions among family members, and/or financial losses for a business. Although many people avoid planning and instead adopt a “wait and see” attitude, this type of unplanned approach can lead to many difficulties and unnecessary stress. Succession plans have proven to be helpful to avoid such concerns – whether you intend to keep the business in the family, or sell it to a third party.

The development of an effective succession plan usually includes the following elements or steps (Silicon Valley Bank, 2008):

| Agree on a formal or informal timeline for succession. |
| Establish a strategic plan that includes financial plans and guidelines for the transition. |
| Complete an exit strategy, including estate and tax planning; ensure sufficient liquidity to pay taxes and other expenses. |
| Establish an advisory board or board of directors, and successor(s), if appropriate, and identify their roles in the current business, and for the succession process (see Box 9.2). |
  • Concentrating on developing the competencies of potential successors in a way that best fits their strengths is key to ensuring a smooth transition. |
| Identify and/or hire advisors to help with the succession process (such as a CPA, attorney, M&A advisor, banker, or family business advisor), if needed (including professionals in the succession planning is an excellent investment). |
| Develop family continuity plans and define family business policies. |
| Review, identify, and disclose clear roles and responsibilities in the succession plan, including roles of spouses and members of the family who are not involved in the business; and, if needed, develop contracts that define those roles. |

TAKE ACTION:
Start your succession planning by reviewing the Farm Journal Legacy Project’s Succession Planning Tools at: http://www.farmjournallegacyproject.com/tools/#getstarted. The online toolkit includes a checklist of steps to guide you through the planning process, family meeting agenda topics, templates and self-assessments for financial management, tax and legal issues, and much more.
If you plan to sell your winery or vineyard, the additional factors identified below need to be analyzed and planned carefully as part of your succession plan, to enable a successful sale with the highest possible return (Silicon Valley Bank, 2008):

- Clean up financial records, such as separating family cash flow from business.
- Realign strategic and non-strategic assets (for example, some business assets may be separated from the assets for sale; some may be set up to be kept in the family).
- Solidify key relationships (e.g. grape contracts, distribution, consultants, and management team).
- Clarify and plan banking arrangements (loan agreements, covenants, prepayment fees, and due on sale clauses).
- Plan tax arrangements (such as estate plan, deal structuring, positioning other owners’ assets for the best after-tax return).
- Plan licensing (e.g. Alcohol and Tobacco Tax and Trade Bureau (TTB), bounty, zoning ordinances, and changes not grandfathered to the next owner).
- Address problematic real estate issues (such as vineyards near the end of useful life, not planted to newer clones, inadequately positioned, etc.).

A winery might choose to have a relatively informal board consisting of a few key advisors who address business issues, or create a more formal traditional board with legal, advisory, and fiduciary responsibility. In succession planning processes, a board may be able to assist in successor selection, equity discussions among family members and generations, setting policies about family member compensation, performance reviews, and career development. The board may also help to select a bridge CEO in the event of the sudden incapacitation of a key family employee, dispute resolution, and provide guidance and support. It is helpful to establish board oversight early in the succession planning process.

**FIGURE 9.2**

**ADVISORY BOARDS, BOARDS OF DIRECTORS AND THEIR ROLES IN SUCCESSION PLANNING**

Professionals with experience in succession planning often advise creating a board of directors, or a formal advisory board for family businesses, which can help provide a forum for communication, strategic planning, and can help solve problems or build stability. The roles of boards vary in different businesses; there is not a “one size fits all” for board responsibilities.

**TAKE ACTION:**

Learn more about the succession planning process, including some of the key success factors by reviewing the US Office of Personal Management’s Succession Planning Process guide at: [http://www.opm.gov/hcaaf_resource_center/assets/Lead_tool1.pdf](http://www.opm.gov/hcaaf_resource_center/assets/Lead_tool1.pdf).

**REFERENCES**


GET INVOLVED

CERTIFIED CALIFORNIA SUSTAINABLE WINEGROWING (CCSW-CERTIFIED)

California growers and vintners - learn more about ccsw-certified, a program that enhances transparency, encourages statewide participation, and advances the entire california wine industry towards best practices in environmental stewardship, conservation of natural resources, and socially equitable business practices.

LEARN MORE:
www.sustainablewinegrowing.org/CCSW-certificationguidelines.php

PARTICIPATE IN THE SUSTAINABLE WINEGROWING PROGRAM

California growers and vintners - take the sustainable winegrowing program’s latest self-assessment (3rd edition code) and learn about new practices to help continuously improve your sustainability practices.

LEARN HOW:
www.sustainablewinegrowing.org/online_participant_form.php