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Trouble in Paradise: How the California Drought is Affecting Vineyards and the Wine Industry

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Trouble in Paradise
How the California Drought is Affecting Vineyards and the Wine Industry

Sarah Gonsier
Abstract

The severe and prolonged drought in California throughout the past three years has had significant effects on the state’s agricultural industry. The wine industry is no exception. The long term effects of such a severe drought could be devastating economically for the industry and environmentally for wine-growing regions. This thesis explores both the short-term and long-term effects of the drought on the wine industry in northern California. Quantitative data from the federal government on drought conditions and climate change statistics from the National Academy of Sciences illustrate the depth of the situation. Statistics from the Wine Institute and the National Academy of Sciences provide a complete understanding of the wine industry’s ecological footprint and how grapes are grown. This thesis examines the history of drought and viticulture in California as well as the effect of previous droughts on vineyards compared to the current situation. This thesis outlines the role both environmental and classic economics play in the wine industry. Not to mention the fascinating politics behind water distribution in California as well as the lesser-known politics of the wine industry. This thesis explores the ways in which the wine industry can adapt to the long-term effects of a drought in a sustainable way. The combined historical, economic and political perspectives of the drought provide a comprehensive look at the need for more sustainable viticulture practices in the region.
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Introduction: A World Without Wine

While all agricultural practices are sensitive to climate to some extent, viticulture is especially vulnerable to changes from its preferred climatic conditions. According to the Environmental Defense Fund, wine is the “canary in the coal mine” in terms of an indication of what effect climate change will have on agriculture at large.¹ Wine grapes are fastidious organisms and different varieties demand different yet similarly specific climate ranges. However, due to climate change, famous grape-growing regions around the world are slowly but surely facing warmer temperatures that threaten the feasibility of a continued wine industry. California makes 90% of all U.S. wine and is the 4th leading wine producer in the world.² At the same time, 94.34% of the state of California is currently experiencing severe to exceptional drought.³ California’s wine industry is an important economic boon to the state and the country, not to mention a cultural phenomenon in and of itself. The industry must react to the possibility of further prolonged drought and other climate change induced weather events. This thesis attempts to clarify the current situation by providing historical, economic and political perspectives as well as policy suggestions for how wineries and governments can address prolonged drought.

Chapter one provides quantitative data on the drought in California and on climate change globally as well as data on how wine is made and its ecological footprint. This data illustrates the severity and rapidity of climate change specifically in California but also in other wine producing regions of the world. The description of the wine industry’s ecological footprint reinforces the need for a shift to sustainable viticultural practices.

¹ Sandra Allen, “How Climate Change Will End Wine As We Know It,” BuzzFeed, November 20, 2014.
Chapter two outlines the history of viticulture and agriculture in general in California. The history of agricultural water policy in California and how it changed after the drought in the 1970s will be touched upon here as well although discussed more in depth in the fourth chapter. Chapter three discusses the economics of the wine industry. This includes standard economic data on the importance of the wine industry to both state and local economies as well as a discussion of environmental and ecological economics. The economics of the drought and of viticulture highlight the importance of growing grapes only where the climate allows it and of adopting a closed-ecosystem approach. Chapter four discusses the politics of agricultural water use in California both historically and currently. This chapter will also hone in on how some wineries in Napa County are taking the initiative and formulating their own water policy. Finally, in chapter five, I will synthesize the information from the above chapters into an explanation of the severity of the drought and the imperativeness of the adoption of sustainable viticulture by wineries. The vineyard management practices of other countries like France and Australia will be compared and contrasted as possibilities to be adopted by California wineries. A case study of Sonoma county wineries Scribe and Benziger will be discussed in order to illustrate the economic and environmental benefits of sustainable and biodynamic viticulture practices. The case study is coupled with the policy recommendations so as to reinforce the importance of widespread adoption of sustainable viticulture.

Chapter 1 Drought and Viticulture Statistics

Globally, climate change is having a now subtle but potentially major effect on the world’s foremost viticultural regions. Namely, it is threatening to make some of the most
venerated and ubiquitous wine regions unsuitable for grape growing. The Proceedings of the National Academy of Sciences did a study on climate change and wine as a “test case for measuring indirect impacts mediated by changes in agriculture”. The study uses Representative Concentration Pathways (RCPs), the possible models of climate change identified by the IPCC, as models in order to estimate the decreases in suitable land for viticulture by 2050. Figure 1 below shows that “area suitable for viticulture decreases 25%-73% in major wine producing regions by 2050 in the RCP 8.5 concentration pathway”.

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Figure 1

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5 Ibid
6 Ibid
7 Ibid
The world’s wine regions are, for the most part, situated in Mediterranean climates “in between the 30th and 50th parallels”. Climate change is slowly but surely warming these areas and making weather events like drought and flood more common. In France’s Burgundy region hailstorms have devastated crops for three years in a row. And in the Languedoc region, an extreme flood submerged entire vineyards in 2014. However, as some regions become less suitable others may emerge as new wine growing hubs. Both England and states in the Pacific Northwest like Oregon and Washington, once thought to be too cold to produce fine wines are beginning to become players in the international wine scene. While it is too soon to say that France and California are going to be completely boxed out of the wine industry by new players introduced to the scene by climate change, it is conceivable to believe that old regions will need to adapt to increased unsuitability in their own regions and thus, competition from others.

The specific weather event threatening California’s wine industry is drought. A drought refers to a “deficiency of precipitation over an extended period of time...usually evaluated relative to some long-term average condition, or balance, between precipitation, evaporation, and transpiration by plants”. The drought in California has been worsening since 2012. In 2014 California experienced the third driest January and sixth driest December since 1895. The most up to date information from the National Drought

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8 Allen, “How Climate Change.”
11 Allen, “How Climate Change.”
Mitigation Center states that 100% of the state of California has been in some degree of drought since early 2014 while in December of 2011, before the drought began, only 28.42% of the state was suffering any degree of drought. 2014 was the warmest year on record in California and the hot temperatures only served to intensify the effect of the drought. Figure 2 shows the percent area of the Western US that is and has been in some degree of drought from 2000-2014.

![West Percent Area](image)

**Figure 2**

Because California is such a big state, the drought is felt differently in different regions. Some areas of northern California may be getting more rain than an area of central or southern California but if there is not enough snowpack in the mountains, the entire state is in a drought. The Sierra Nevada Mountains are California’s “largest and most

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14 “Drought-March 2015.”

effective ‘reservoir,’ slowly releasing its water in spring and summer”\textsuperscript{16}. Thus, not only is the amount of snow important, the type of snow is equally critical. When it is below 32 degrees F, the snow that falls contains less water than snowfall at slightly warmer temperatures. For example, “…one cubic foot of the powdery snow that falls at 14 degrees F may only produce .05 cubic foot of water, but at 32 degrees, a cubic foot of snow may contain four times as much.”\textsuperscript{17}

Droughts are felt most acutely by those who are most dependent on consistent annual rainfall and temperatures like grape growers. During a prolonged drought there is a positive feedback loop in agriculture as water use increases as warming increases, effectively exacerbating the drought. In viticulture water is used for two purposes—frost protection and watering the vines themselves. Large sprinklers are often used during budburst stages to prevent cold temperatures from damaging the buds and reducing yield.\textsuperscript{18} The relationship between yield, flavor and water in wine grapes is an important one. The vintner is always striving to strike the perfect balance between quantity and quality of grapes. Too much water leads to an abundance of fruit but less vigorous flavor. Likewise too little water can lead to too few grapes with overpowering vigor. In order to manage a vineyard effectively and provide vines with the correct amount at water at the right time, the grape grower must have a keen understanding of the viticultural cycle.

The viticultural cycle refers to the five stages of the grapevine’s development—“budburst to flowering, flowering to fruit-set, fruit-set to veraison, veraison to harvest and harvest to leaf-fall”—and the grape growth events that occur throughout these phases.

\textsuperscript{16} Ibid., 26.
\textsuperscript{17} Ibid.
\textsuperscript{18} Mark Couchman, interview by author, February 23, 2015.
Every stage of the cycle relies on some degree of water although the amount varies from stage to stage. Figure 3 outlines the percent of water needed in each stage with the majority of water being used during fruit set to veraison and veraison to harvest.

![Graph showing water requirements per stage](image)

**Figure 3**

During the first two stages of budburst to flowering and flowering to fruit-set, it is important for the vines to get enough water in order to maintain sufficient root growth and “establishing the canopy, and potential yield for the current and following season”. Although this stage uses relatively little of the overall water requirement, it is important to irrigate at this point if there is not enough natural rainfall. Water stress during these stages will result in an underdeveloped leaf canopy which will have an adverse effect on grape production as well as inadequate fruit set leading to smaller yield. During the next stage, fruit set to veraison (a French word meaning the onset of ripening), grape growers can

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20 Ibid.

21 Chalmers, ”Insights”.
begin to get creative with their irrigation strategies. While severe water stress can affect fruitfulness, some water deficits reduce berry size and increase the sugar concentration to actually improve the quality of the grape. During veraison to harvest the berries start to accumulate sugars, and water is imperative to this accumulation. Once the berries are ready to be harvested, however, water deficits can be allowed. Finally, during harvest to leaf-fall, water is needed to “ensure that the vine is able to build up sufficient reserves for the subsequent season before going into dormancy” from May to August.\textsuperscript{22} Simply by understanding this cycle grape growers can avoid wasting water on irrigating vines when it is not necessary to do so. Figure 4 shows that there is an irrigation threshold when it comes to grape vines. The vine will take up all the water it is given regardless of whether or not it needs it, resulting in “excessive vegetative growth, nutrient leaching, pest and disease problems, and poorer fruit quality”.\textsuperscript{23} Thus it is important to water little by little, until the vine has sequestered all the water it needs.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure4.png}
\caption{Figure 4\textsuperscript{24}}
\end{figure}

\textsuperscript{22} Ibid.
\textsuperscript{23} Ibid.
\textsuperscript{24} Ibid.
Chapter 2 The History of Agriculture, Viticulture and Drought

The history of viticulture and drought in California is intertwined with the history of agriculture and water management more broadly in the state. The current drought is not the first one that has had a devastating effect on crop yields in the state. This drought is preceded by the similarly dry years of 1929-1934, 1975-1977, and 1987-1993.25 The drought in the 1970s “made life very difficult for...farmers and businesses” and spurred on the adoption of more environmentally friendly farming techniques like drip irrigation.2627 However, now that California is once again embroiled in a serious drought, winemakers and other agriculture professionals can look back at how California water management got to this point in order to create informed decisions about what the future should look like.

California is a large and geographically diverse state and precipitation varies throughout the state depending on the topography of a given area. California has both “the tallest mountain ranges in the 48 contiguous states and desert basins that lie hundreds of feet below sea level”.28 The entire state gets “200 million acre-feet” of precipitation per year but rainfall tends to be concentrated in the northern part of the state and decreases the further south you go.29 The naturally unequal distribution of precipitation in California necessitates a system of bringing water from one part of the state to another. This need has been exacerbated over time, as California has become the top agricultural state in the nation as well as one of the most densely populated. Ironically, most of the state’s agricultural activity is situated in the Central Valley and further south despite the fact that

27 Couchman.
29 Carle, Introduction to Water, 8.
those are the areas of the state that receive the least precipitation. In fact, “75 percent of
the demand for water originates south of Sacramento, although 75 percent of the water
supply in the state comes from north of the capital city.”

During the initial settling of California the land belonged to the federal government. In
an effort to spur western migration and settlement the government “tolerated and later
encouraged settlers...[to] take and use water for mining, agricultural and domestic
purposes”. Federal presence, however, was lacking and eventually the Supreme Court
decided, “that it was the states’ prerogative to allocate water on public lands by any system
they chose.” In 1928, the California Constitution declared the public trust doctrine or that
“all water within California is owned by the state on behalf of the people”. However, most
water development decisions were still made by the federal government. The state’s
water laws were relatively lame in comparison to the large-scale dams the federal
government was building. In the 1900s the state created water agencies to act as
mediators between conflicting claims of property rights in an effort to standardize water
distribution. State water laws were largely administrative and ineffective especially in
terms of addressing environmental issues. Change was slow to occur and even into the
1990s the only “interesting legislation and court decisions of the 1990s...were provoked by
some threat or crisis,” like “urban growth and the threat of enforcement of federal

30 Carle, Introduction to Water, 90.
31 David H. Getches, "Constraints of Law and Policy on the Management of Western Water", in Water
and Climate in the Western United States, ed. William M. Lewis Jr. (Boulder: University Press of
Colorado, 2003), 184.
32 Ibid., 184.
33 Carle, Introduction to Water, 181.
34 Carle, Introduction to Water, 191.
environmental regulations”.\textsuperscript{36} Although water is part of a public trust, in California there is a saying that “water flows uphill toward money”.\textsuperscript{37} Because of this uncomfortable truth, farmers have started to partner with urban areas in order to retain their water rights. In 2001, the Metropolitan Water District of Southern California paid farmers to set aside farmland so the water could be diverted to urban areas.

Today, California has thousands of water agencies and districts and “with so many agencies and many layers of decision making, coordination (or the lack of it) can be an obstacle to wise management of the resource”.\textsuperscript{38} Water agencies are also practically incapable of instigating change because they “can only seek to optimize the services that they deliver under the specific sets of competing objectives and constraints imposed by parent institutions”.\textsuperscript{39} Water is delivered throughout the state via six major systems of aqueducts—“the State Water Project, the Central Valley Project, a number of Colorado river delivery systems, the Los Angeles aqueduct, the Tuolumne River/Hetch-Hetchy system, and the Mokelumne Aqueduct to the East Bay”.\textsuperscript{40} There are 1,400 dams sprinkled throughout the state turning “rivers and streams into reservoirs” and “600 river-miles have been flooded” in the Sierra Nevada.\textsuperscript{41}

Historically, agriculture has been known as both an extremely inefficient user of water and a cause of environmental degradation. During the late 1800s and early 1900s agricultural expansion in California converted “worthless’ mosquito-infested wetlands into

\textsuperscript{36} Getches, “Constraints of Law,” 194.
\textsuperscript{37} Carle, Introduction to Water, 205.
\textsuperscript{38} Ibid., 126.
\textsuperscript{40} Ibid., 90.
\textsuperscript{41} Carle, Introduction to Water, 135.
productive farmland” resulting in wetland habitat loss.\textsuperscript{42} From 1870 to 1902, the amount of irrigated farmland in California jumped from 60,000 acres to 2.6 million acres and between 1870 and 1930 the state’s population skyrocketed from 560,000 to 5.5 million. These corresponding trends in agricultural expansion and population growth contributed to increased water use and habitat degradation. This trend continues today. Farmers have always had generous land and water rights and so as the population of California grows agricultural property becomes increasingly more attractive to urban developers. When urban suppliers purchase agricultural water, farms are taken out of production and agricultural land is developed for the overcrowded population.\textsuperscript{43} Today, 80 percent of California’s water goes to agriculture.\textsuperscript{44}

California’s previous experiences with drought can provide some insight on the current situation. The drought in the 1970s was a wake-up call for California. For the first time during a drought, the state had a population of close to 22 million to feed and provide water for.\textsuperscript{45} Although the drought was much shorter than previous dry spells “its hydrology was severe” and water agencies were unprepared to address it.\textsuperscript{46} Water contractors responded to the drought by exchanging water from the San Joaquin Valley to the San Francisco Bay Area. Drought response methods caused California’s major reservoirs to deplete to unhealthy levels.\textsuperscript{47} However, the drought mostly affected rural areas and

\textsuperscript{42} Carle, \textit{Introduction to Water}, 149.
\textsuperscript{43} Ibid., 147.
\textsuperscript{44} Ibid., 147.
\textsuperscript{46} Ibid.
\textsuperscript{47} Ibid.
“agricultural production losses in 1977 were estimated at $566.5 million.”\textsuperscript{48} The severity of the drought made some people realize that the state should start preparing in advance for future dry spells. Local governments implemented more stringent environmental regulations and new technological advancements were introduced in agriculture.\textsuperscript{49} Some of these environmental regulations included requiring cities and communities to develop drought contingency plans and it was at this time that most vineyards switched to drip irrigation.

Viticulture has been practiced in California as long as any other kind of agriculture, since the 1700s, however, it did not gain popularity until the latter half of the 20\textsuperscript{th} century. The first settlers to bring wine grapes to California were the Spanish missionaries who were interested in viticulture strictly “for production of sacramental wine” at the Catholic missions throughout the state.\textsuperscript{50} However, it was not until the mid-19\textsuperscript{th} century that other Europeans started settling down in the Napa and Sonoma areas and making wine more seriously. In 1857, Agoston Haraszthy, the “Father of California Wine Industry,” brought cuttings from Europe to Sonoma.\textsuperscript{51} The next year Charles Krug moved to Napa and opened the “first commercial winery in Napa Valley.”\textsuperscript{52} The wine industry flourished throughout the late 1800s and it attracted businessmen who “had already made their initial fortunes elsewhere.”\textsuperscript{53} One such man was Gustave Niebaum who was instrumental is introducing

\textsuperscript{48} Ibid.
\textsuperscript{49} Couchman.
\textsuperscript{50} Geralyn Brostrom and Jack Brostrum, eds., The Business of Wine: An Encyclopedia, (Westport, Conn.: Greenwood Press, 2009), 42.
\textsuperscript{51} Ibid., 218.
\textsuperscript{53} Ibid.
Bordeaux grapes to Napa.\textsuperscript{54} The California wine scene cemented its burgeoning reputation by winning several awards at the 1889 World's Fair in Paris.\textsuperscript{55}

The end of the 19\textsuperscript{th} century and beginning of the 20\textsuperscript{th} century brought with it new challenges to the California wine industry. In the 1890s, the root louse, phylloxera, ravaged California vineyards twice and by 1900 “the acreage under grapes has fallen to one-fifth of the levels seen in the 1880s”.\textsuperscript{56} The next challenge came from the federal government in the form of the Eighteenth Amendment mandating Prohibition. Prohibition lasted until 1933 and during this time many wineries stopped production. During the Great Depression and the Second World War, land in Napa and Sonoma counties was used for agricultural purposes to feed people at home and abroad. Finally, mid-way through the 20\textsuperscript{th} century, the California wine industry got back on track and “since 1966, the acreage in grape cultivation has grown steadily to its present level”.\textsuperscript{57} Once again, in 1976, the California wine industry demonstrated its staying power and high quality of wine making at the Paris Wine Tasting, where in a “blind tasting, two California wines...won first place”.\textsuperscript{58} Figure 5 shows how the total wine harvested in California has increased steadily from 1921 to 2012. Napa and Sonoma Counties are the high-quality wine epicenters of California, however, wine grapes are grown throughout the state. The Central Valley “produces two-thirds of the state’s wine grapes...most of this production goes into the large amount of inexpensive generic wines.”\textsuperscript{59} Medium quality wines generally come from the Central Coast of California, an

\textsuperscript{54} Brostrum, \textit{The Business of Wine}, 42.
\textsuperscript{55} Mohan, “Viticulture’s Promised Land”.
\textsuperscript{56} Ibid.
\textsuperscript{57} Ibid.
\textsuperscript{58} Ibid.
\textsuperscript{59} Brostrum, \textit{The Business of Wine}, 43.
area ranging down the coast south of San Mateo county and northwest of Los Angeles county.  

![Graph showing wine harvest in California from 1971 to 2012.](image)

**Figure 5**

Inspired by France's AOC system of defining “strict, specific, appellation characteristics to help guide the consumer, promote minimum levels of quality, and energize growers into producing better wines,” California has broken its wine country into 107 recognized American Viticultural Areas (AVAs). There has also been a movement in winemaking

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60 Couchman
recently towards terroir and winemakers are “fine-tuning their grape growing and vinification to their specific vineyard conditions.” Terroir is a French word referring to the “total natural environment of any viticultural site” with an emphasis on the unique soil of a given area, which “may have distinctive wine-style characteristics which cannot be precisely duplicated elsewhere.” At Benziger Winery, vintner Jeffrey Landolt told me that “soil is proprietary” and a direct reflection of how a given winery cares for its soil.

Due to viticulture’s European origins and concepts of terroir, vintners in general tend to be more responsible stewards of the land than other agricultural professionals. This theory has been proved by a variety of sources. The California Energy Commission’s Climate Change Center report on the “Vulnerability and Adaptation to Climate Change in California Agriculture” did a case study of winery Fetzer Vineyards. In the study they mentioned that wine companies tend to be agricultural environmental leaders because “they are managing their vineyard lands and adjoining forests that maximize biomass on the landscape and balance the emissions generated in their production processes.” In an Australian study on the relevancy of climate change to the wine business the researchers found that many wineries were “taking action to protect the natural environment...whether directly aimed at climate change or not...which may reflect that a respect for nature is a widely held value

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63 Brostrum, The Business of Wine, 43.
64 Ibid.
in this [the wine] industry.”67 Viticulture, more than other forms of agriculture, is “...seen as environmentally beneficial.” 68

Chapter 3 The Wine Industry’s Economic Importance and the Economic Tradeoffs of Sustainability

The wine industry, above all, is a profit-driven industry. Further than that, it is an industry that has always evoked a sense of wealth and culture and thus it is a very profitable industry to get into. Not only is it profitable to the individual wine business, it is economically important to the state of California. This importance is evident simply by looking at the numbers. The wine industry employs 330,000 people in California, creates $61.5 billion in state economic impact, and pays $12.3 billion in state wages.69 Not to mention that the industry creates tourism hotspot out of the towns it inhabits. In 2009 alone, 20.7 million tourists visited California wine regions and they spent $2.1 billion during their visits. In 2012, “three of every five bottles sold in the U.S.” were from California and the value of California wine sales nationwide was valued at $23.1 billion.70 In a state that grows a large percentage of the nation’s food, wine grapes are “one of California’s top five agricultural commodities by value.”71

However, there are economic tradeoffs involved in growing grapes, especially if a winery is looking to practice viticulture sustainably. An Australian researcher did a survey on the relevancy of climate change to business in the Margaret River wine region of

68 Tyler Colman, Wine Politics: How Governments, Environmentalists, Mobsters, and Critics Influence the Wines We Drink. (Berkeley: University of California Press, 2008),141.
69 “California Wine Profile 2013.”
70 Ibid.
71 Ibid.
Australia and found that “economic merits strongly influence whether or not a specific action is implemented” in terms of responding to changes in climate.\textsuperscript{72} One participant in the study summed up the economic tradeoff discussion well by saying:

“A lot of this stuff is driven by economics eventually. Can we justify doubling our power bills by purchasing expensive green energy? What benefit would we get from it? We’re not going to be going down a full life-cycle analysis and calling our products carbon neutral, and hoping that we can get a premium in the marketplace for it. So in the end, it’s a profit/loss driven exercise I think.”\textsuperscript{73}

Many wineries are not willing to implement potentially sustainable practices if they do not see an economic incentive to do so. Economics is also a driver behind whether or not wineries choose mitigative or adaptive practices as a response to climate events and climate change in general.

The Australian study found that mitigative actions are often chosen over adaptive ones because of economic tradeoffs perceived as not worth it. Often, adaptive actions are more expensive than mitigative ones. For example, few wineries are interested in uprooting vines and replacing them with varieties more suited to hotter temperatures or in purchasing land in colder climates. These kinds of actions are more drastic than mitigating ones like eliminating pesticide and chemical use or using insectaries to enhance natural biodiversity. Differing beliefs about climate change also affect whether or not a winery will invest in adaptive solutions. The study found that “in the absence of market demand, participants seemed hesitant to spend scarce resources to adapt to climate change... not only because of their uncertainty about climate change and lack of experiences of climate

\textsuperscript{72} Galbreath, “On the Relevancy,” 17.
\textsuperscript{73} Galbreath, “On the Relevancy,” 17.
change effects, but because they did not see clear economic benefits in doing so.”

Adaptive measures are more expensive but in such an uncertain climate they “should be considered part of good risk management.” It is more expensive to practice viticulture sustainably and with an eye to the inevitable future, but in the long run, being better stewards of the land pays off in both wine quality and disaster preparedness, for example, during a drought.

A drought is capable of causing irrevocable economic damage to any agricultural enterprise depending on its length and severity. Most of the droughts that California has experienced over the past two centuries have inflicted some kind of economic damage on agriculture. The drought of 1863-1864 was particularly disastrous for agriculture because it occurred before the widespread adoption of irrigation when there was little to no water infrastructure. In 1977, long after irrigation technology was employed throughout the state, the drought caused agricultural production losses of “$565.5 million, composed of $414.5 million in livestock, $112 million in field crops, and $40 million in fruit and nut crops.” Most recently, in 2009, at the end of the 2007-09 drought, the governor of California released an Emergency proclamation on water shortage stating that “...agricultural revenue losses exceed $300 million to date and could exceed $2 billion in the coming season with a total economic loss of nearly $3 billion in 2009.” One lesson that can be drawn from these historical examples of the effect of drought is that the importance of preparedness cannot be emphasized enough. Vineyards are especially susceptible to

74 Ibid., 23.
75 Ibid., 24.
76 Jones, “California’s Most Significant Droughts,” 32.
77 Ibid., 52.
78 Ibid., 102.
changes in water availability because they rely on irrigation water. Since the 1987 drought “increased acreage [has been] devoted to permanent plantings of orchard and vineyard crops that require reliable water supplies during dry conditions.”79

An evaluation of the traditional economic effects of the drought is important for the wine industry, as it is a profit-driven venture. However, it is important to also consider environmental economics as a factor, especially in terms of sustainable viticulture. The ecosystem services provided by a well-managed sustainable vineyard cannot be underestimated. In the “Vulnerability and Adaptation to Climate Change in California Agriculture” report’s case study on Fetzer Vineyards, the various techniques the winery uses to capture ecosystem services are outlined. According to the study, Fetzer is one of a “number of wine companies that are managing their vineyard lands and adjoining forests that maximize biomass on the landscape and balance the emissions generated in their production processes.”80 After purchasing land in Mendocino County, Fetzer collected data on the carbon stocks on the property.81 In this way vintners were able to “prioritize non-vineyard land for carbon storage, biodiversity and habitat conservation, and eventually other types of ecosystem services, such as keeping steep slopes and stream corridors forested to protect against erosion and sediment loading in waterways.”82

Scribe winery in Sonoma County is another sustainable winery taking advantage of ecosystem services. Scribe uses its natural position on a hill as well as insectaries planted with native grasses as a means of erosion control. The winery also utilizes cover cropping on the vineyard to increase the nutrient content of the soil, decrease the vigor of the grapes,

79 Ibid., 69.
80 Jackson, “Vulnerability and Adaptation,” 76.
81 Ibid.
82 Ibid., 77.
and combat soil erosion. Scribe believes that by utilizing the strengths of the ecosystem around them, they are able to create a more stable vineyard and thus, produce better wine.

There are economic trade-offs in sustainable viticulture, as the products used tend to be more expensive than traditional ones. Scribe’s Adam Mariani mentions that although “round-up is basically free,” Scribe chooses to use organic products. However, Scribe does not consider the economic trade-off a negative because the organic products they are using are “that much better”. Benziger winery is of the same mind. Jeffrey Landolt, a vintner at Benziger, says that you “can’t fake quality, time and effort” in the wine industry. This idea is reiterated at Scribe. Mariani emphasizes the importance of direct interaction with the land or as he puts it spending “more time sitting on a tractor”. Good wine derives from good farming practices and an intimate relationship with the land, not luck.83

The negative externalities caused by using chemicals, pesticides and excess nitrogen in the vineyard outweigh the cheaper costs of these products. In Tyler Colman’s book Wine Politics, he writes that the “components of conventional viticulture” are “chemical fertilizers and herbicides in the field [and] lab-manufactured yeasts and enzymes for wine-making.”84 These products, while initially effective, can encourage the pest to become resistant “forcing the vineyard manager to resort to more expensive and harsher chemical treatments.”85 It is ultimately much cheaper to go the way of sustainability and decrease farmer reliance on suppliers of these products.86 The researchers behind the Fetzer case study write that “integration of forest, other natural habitat and vegetation types, and agricultural ecosystems into complex landscapes is increasingly viewed as a way to

83 Jeffrey Landolt, interview by author, February 24, 2015.
84 Colman, Wine Politics, 136.
85 Ibid.
86 Ibid.
increase the provision of multiple ecosystem services, including carbon storage, pest management, nutrient retention, erosion control, and water quality." While more expensive initially, sustainable vineyard management practices make a vineyard more adaptable to crises like prolonged drought. This adaptability saves money in the long run. The economic importance of the wine industry in the traditional sense of dollars and cents cannot be denied. However it is important to realize that in terms of environmental economics, a sustainably run winery can provide ecosystem services not only for itself but also for the environment in which it inhabits. A healthier winery ecosystem ensures a healthier natural ecosystem for the winery's neighbors both corporate and residential. From an economic perspective, sustainable viticulture is a wise choice and the politics behind the choice to go sustainable further explain why.

Chapter 4 Water Politics and Wine Politics

The tension between the state and federal government in the arena of water policy mentioned in Chapter 2 has been a point of contention in California since settlement. Despite an apparent concession to the power of the state via Supreme Court decisions, the federal government retained supremacy over water in the Western United States. The state was generally in charge of allocating private water rights while the federal government subsidized large-scale water projects in the West.

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87 Jackson, “Vulnerability and Adaptation,” 81.
89 Ibid., 186.
In the 1900s, the state tried to standardize the water distribution process by creating water agencies to “mediate conflicting competing claims.” Nowadays, state water rights in California are broken into two classifications, riparian and prior appropriation. The riparian doctrine refers to right of “a person who owns land that borders a watercourse” to use the water on his or her land. The prior appropriation doctrine allows a person who has obtained permission through the state to divert water from a source for “reasonable and beneficial use of the water.” Between the two, riparian rights are superior to appropriative rights. All riparian rights users are on the same level; no one user’s rights are superior to another’s. However, within appropriative rights “the person’s right that was appropriated first is considered superior to later appropriators’ rights.” The hierarchy generally boils down to water going first to riparians and then to appropriators based on “the order in which they secured the right to water.” During a drought this system of priority can cause problems in water distribution. During a drought, different levels of rights’ owners have their shares of water cut by different amounts. For example, while some “…senior contractors are allocated 75% of their contract amounts…more junior contractors might be allocated as little as 0% of their contracted supplies.” These restrictions on allocations are reached in order to protect habitats for fish, however the amount of water doled out to different rights holders can seem unfair, not to mention pose an issue in food security for California’s growing population.

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90 Ibid.  
92 Ibid.  
93 Ibid., 20.  
94 Ibid.  
96 Ibid., 24.
Since 1957, California has been releasing the California Water Plan every five years. Originally the plan “focused on how to fully develop the state's water resources” but today the focus is on water management. According to the California Department of Water Resources’ website the plan “evaluates different combinations of regional and statewide resource management strategies to reduce water demand, increase water supply, reduce flood risk, improve water quality, and enhance environmental and resource stewardship”. The latest update to the California Water Plan was completed in 2013. In it the Director of the Department of Water Resources counsels that the current drought is a reminder of the “value of integrated water management”. The water plan highlights the increasing difficulties of transporting water “great distances due to declining ecosystems (and related regulatory requirements), rising energy costs and aging infrastructure”. This echoes the 2014 IPCC report’s judgment that “Water management infrastructure in most areas of North America is in need of repair, replacement, or expansion.” The plan also addresses the issue of further reliance on groundwater during a drought. In February of 2014 “estimated water deliveries from the State and federal water projects were expected to be zero” for the first time in history. When surface water is not available, water agencies rely on groundwater to fulfill demand, putting aquifers around the state under an enormous amount of stress. The California Water Plan suggests regional solutions supported by state incentives in order to adequately respond to the needs of all Californians.

The federal government has always had the last word in water policy because it often subsidizes most of the water management infrastructure in the state. In 1965 the federal government passed a law to “promote better, more integrated planning at the river basin

98 “IPCC report 2014,” Intergovernmental Panel on Climate Change, 1456.
level” and California complied in order to take advantage of the federal funding. However, the funding only lasted until the 1980s at which point states lost interest in water resource planning. The environmental consequences of these federal water projects, however, were not assessed until the 1970s when “the National environmental Policy Act required federal agencies to prepare...environmental impact statement[s]...” Towards the end of the twentieth century the federal government made more of a commitment to environmental regulations on water. This “expansion of federal environmental laws late in the century and the increasing scarcity of water for all uses...made conflicts [with the state] more frequent and sometimes bitter.”

The U.S. Army Corps of Engineers is one government agency that was used to fund water development projects. The Water Resources Development Act of 1986 authorized the Corps to do a variety of projects throughout the country and it contained several environmental provisions as well. In the late 1990s, the federal government continued to pass more legislation aimed to “emphasize preparedness, mitigation and risk management rather than crisis management.” The Clean Water Action Plan of 1998 had the express goal of “restoring and protecting the Nation’s waters” while the National Drought Policy Act, passed in the same year, worked to improve coordination at the federal level on drought response policies. The federal and state governments are the most common paths to go through to effect change in water management; however, they are not

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99 Getches, “Constraints of Law,” 188.
100 Ibid.
101 Ibid., 185.
104 Ibid.
the only ones. While institutional changes “...can be achieved only by federal, state and local governments...other significant changes must come directly from the individual.”

Solutions for water management issues have been achieved, however, outside of the legislative realm, usually through the cooperation of various stakeholders. One example of this is the creation of CALFED or what is now known as the Delta Stewardship Council. In the 1990s, the delta of the Sacramento and San Joaquin Rivers at the San Francisco Bay was degraded by “environmental and supply problems and operations of water-diversion facilities.” The health of the delta is incredibly important, as it is the “hub of the state’s water delivery system.” The state government was not able to deal effectively with the “related problems of water quality, watershed protection, ecosystem restoration, water-use efficiency, water transfers, and facilities for water storage...” all at once. Thus, CALFED was created to fill a void in the capacity of state legislatures. CALFED brought together “representatives of agriculture, business, the environment, and cities in efforts to solve problems growing out of the...Bay-Delta dispute.” Smaller local efforts can also be effective in solving problems that are too niche and seemingly small for any level of government.

In Napa County, several wine organizations came together to provide the initial funding for a recycled water pipeline “that will deliver 700 acre feet...annually from Napa Sanitation District to the groundwater-deficient area that drains Milliken, Sarco and

\[105\] Ibid., 133.
\[106\] Getches, “Constraints of Law,” 203.
Tulocay creeks” known locally as the MST area. The wine organizations will pay for and receive the bulk of the recycled irrigation water. However, more and more residents and property owners are catching on and beginning to sign up for some of the water and in turn, some of the cost. The project is also funded in part by the federal government and has a loan from the state government. Through the recycled water pipeline, Napa County wineries are making real progress in ensuring a source of irrigation water even in a prolonged drought.

Now that the state is embroiled in such a serious drought, the long history of the complicated and ineffectual nature of California water politics shows no signs of changing. Governor Brown is being pressured to address the drought in a timely way and to finally take on the water management infrastructure issues that have plagued the state for so many decades. David Getches writes that only the threat of “a perceived crisis [could] move the western states to significant action in reforming water policy” and California stakeholders are hoping that this drought is that crisis. Governor Brown is considering a plan to “build twin tunnels...to make it easier to pump water from the Sacramento River to Central Valley farms and Southern California cities.” The plan will cost a purported $25 billion and take 10-15 years to complete. The plan is receiving a lot of backlash from environmental groups and Bay Area politicians who argue that the tunnels will put the Bay-

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111 Couchman.
112 Jensen, “Officials Celebrate.”
113 Williams, “California Water Politics.”
114 Getches, “Constraints of Law,” 212.
115 Williams, “California Water Politics.”
Delta at risk. The drought is a reminder that California’s water management infrastructure desperately needs to be addressed. However, federal, state and local governments are far from reaching a consensus on how to do so.

While the politics behind the global wine industry is the not the focus of this thesis, it is beneficial to include a brief explanation in order to understand the role of politics in the sustainable winemaking movement. According to Tyler Colman, author of Wine Politics, almost everything the consumer knows about wine comes from a political decision—“Politics determines not only which grapes grow where...and how much wine costs, but perhaps most important, it also affects the quality of the wine in the bottle.” Even the decision to become sustainable can sometimes be a political one. In Napa in the 1990s, environmental activists joined forces with disgruntled residents to fight the growth of the wine industry, which they saw as degrading the once pastoral landscape into “'alcohol farms.'” Environmentalists created a “watershed task force” to assess the damage wineries were doing to the Napa River. The environmental issues associated with the wine industry included habitat loss, chemical runoff, and sedimentation. In 1999, Environmentalists showed their strength when the Napa chapter of the Sierra Club sued Napa County for not properly enforcing the “California Environmental Quality Act standards for farmland developments.”

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117 Colman, Wine Politics, 2.
118 Ibid., 129.
119 Ibid., 130.
120 Colman, Wine Politics, 130.
121 Ibid.
Since then, most wine affiliated businesses have started to focus more on environmental communications and community relations in order to avoid lawsuits and controversy. According to Colman, the “...increasing prevalence of ‘natural’ winemaking” has been “prompted in part by environmental activists and in part by a blend of beliefs and marketing research.” It is in a wine business’s best interest to at least try to acknowledge environmental concerns before it is attacked for not expressly addressing them. This is the same reasoning behind the creation of the California Sustainable Winegrowing Alliance (CSWA) to promote sustainable viticulture by the Wine Institute and the California Association of Winegrape Growers in 2003.

The politics of wine and water make it difficult to create real change at the federal or state government level. Local governments and cooperative efforts among businesses seem to be the most effective ways to address drought induced water shortages. Because grapes can be grown with minimal water inputs, the wine industry can afford to use less water and thus, act as a model for agriculture at large. Wine politics have made sustainability an important part of winemaking and a perceived advantage, making sustainable water use a wise economic decision for any wine organization. Localized water policy coupled with the forward-thinking policies of individual wine organizations can keep the wine industry sustainable for years to come.

122 Ibid., 131.
123 Ibid., 5.
Ch. 5 The Path to Sustainable Viticulture and Case Studies

I. The Path to Sustainable Viticulture

In terms of agricultural water use wine grapes use nowhere near the water that almonds, walnuts or even table grapes need. However, when viticulture is practiced unsustainably the waste of agricultural water is still significant. In Mendocino County, 25% of all agricultural water goes to viticulture.\textsuperscript{125} The climate in Mendocino County is colder than other parts of the state so vineyards there have to use more water on frost protection than in Sonoma or Napa Counties. In Sonoma County, the 2014 wine industry insider reports that, “Unless rainfall picks up sufficiently to end this third consecutive year of drought, allocations for agricultural water will be curtailed.”\textsuperscript{126} Although the whole state is being affected in someway by the drought, different regions of California are facing different rainfall realities. Sonoma and Napa counties are receiving more rain than counties in Southern California or in the Central Valley. Therefore, localized policy is very important as no region of the state can be treated the same. There are a variety of ways to accomplish policy to ensure more sustainable viticultural practices and water use but they have to either be implemented via local governments or through the wine industry itself.

As mentioned in the previous chapter, the Delta Stewardship Council model is a good way for agriculture professionals to gain a better understanding of where their water comes from and how to manage it effectively. In David Getches’ essay “Constraint of Law and Policy on the Management of Western Water” the author writes, “Solutions to water problems must be based on access to sound technical and scientific information and

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\textsuperscript{125} "Agricultural Water Issues Meeting Winter 2014,” Mendocino Winegrowers Inc., February 27, 2014.
\textsuperscript{126} “Industry Sector Report.”
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judgment. Scientific experts...can bring essential information and valuable insights to water-policy discussions. Yet these experts rarely have participated in formulating policy or even advising those who create policy...Climate experts in particular have been consulted infrequently...127" Creating councils comprised of several experts from business, agriculture, science and technology, and local government creates an environment in which every stakeholder is heard. However, it is also important that these councils be more than just an educational resource because “the key to crisis-driven opportunities for water reform is to engage people who can influence policy.”128 The most obvious choices of “well-established interests with great influence in state politics, such as special districts and state agencies” are not the most willing to work with other stakeholders.129 Therefore it is important to get as many different people involved in the process as possible in order to convince those more traditional interests of the importance of a council’s goal.

Sustainable viticulture refers to the practice of growing wine grapes with a focus on not degrading the surrounding environment or needlessly depleting natural resources. As mentioned in the previous chapter, the CSWA provides a workbook and occasional workshops for vintners and grape growers to self-assess their sustainability and offer sustainable viticulture solutions. The CSWA is a step in the right direction but it is not as effective as it could be because it is a voluntary service. The workbook also lacks a section addressing the specific issues caused by a drought. California grape growers and vintners can, however, look to Australian winemakers for water management inspiration. Australia suffered a drought, dubbed the “Millennium” drought from 1997-2009. Winemakers in

129 Ibid.
southern Australia had to make adjustments towards more sustainable viticulture. According to the 2014 IPCC report “The 1997-2009 drought in southeastern Australia and projected declines in future water resources in southern Australia are already stimulating adaptation [through water resources policy and management].”

Three water management techniques Australian winemakers and the Australian government support using are regulated deficit irrigation (RDI), partial rootzone drying (PRD) and sustained deficit irrigation (SDI). Before implementing any irrigation system it is important for vintners to really understand their soil and to keep it in good condition because “maintenance of good soil condition is vital for vine health and fruit production.”

RDI, PRD and SDI are all deficit irrigation strategies that revolve around a “reduction in available soil water, but how the water is applied is fundamentally different.” RDI simply refers to some schedule of deficit irrigation, to save water without reducing fruit yield. PRD refers to alternating drip irrigation “about every 2 weeks on either side of the vine row” thus controlling canopy growth and producing quality wine grapes. SDI differs from RDI in that the water deficit “increases progressively as the season advances” allowing for water stress to develop more slowly. These techniques work very well with vines because “they are not sensitive to water deprivation at some developmental

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130 IPCC source
132 Chalmers, “Insights”.
134 Ibid., 155.
135 Ibid., 151.
stages.” Vintners can take advantage of the natural adaptability of their crop and save water without losing fruit or flavor.

While Australia’s water management techniques were a reaction to extreme drought, France has long had very strict rules on water use for vineyards that have little to do with drought or climate change. France’s winemaking authority, the National Institute of Appellations of Origin (INAO), has banned irrigation in the country except in the case of very young vines. The principle behind the irrigation ban in France and other countries in Europe can be linked to the concept of terroir. Many countries in Europe have resisted technological advancements like drip irrigation in an effort to retain the terroir characteristics that set wines apart from each other. While this kind of dry farming, or strict reliance on natural rainfall, may seem like an ideal water management technique in a drought it is unlikely to ever be adopted by California wineries. California simply does not receive the same amount of rainfall per year as France does and while putting the vine under a little bit of water stress can make for good wines, it is not a sustainable approach to viticulture. Due to climate change and warming temperatures irrigation will become more and more important, not less. It makes more sense for vintners to get better at irrigating smarter rather than abandoning irrigation altogether. RDI, PRD, and SDI are all ways for vintners to get more in touch with the needs of the land and start irrigating appropriately.

Scribe and Benziger’s commitment to sustainability reflects a matter of both principle and necessity. However, if the drought continues, it will not be enough to just be a

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136 Ibid., 153.
sustainable winery on your own, wineries needs to start forming coalitions to further promote sustainable initiatives from the inside out. For example, wineries came together in Napa County to get a recycled water pipeline installed in the Milliken-Sarco-Tulocay (MST) area. As some of the largest water users in the area, vineyards and wineries provided the initial funding to get the recycled pipeline project approved. Coalitions of vineyard interests and councils of various water stakeholders are effective ways to address water management issues and prolonged drought. If the state continues to take water away from agricultural interests, wine organizations will need to address their water needs some other way and a recycled pipeline project is a great way to do so.

There is also a place for agricultural water cutbacks for vineyards through local government policy. A logical policy for local governments to impose is to create a threshold amount of agricultural water allotted to vineyards in their part of California. This threshold will be lower in areas of more reliable rainfall in northern California and higher in areas of less reliable rainfall in southern California. This solution also allows more agricultural water to be diverted to crops that provide California’s overpopulated cities and towns with more food. If the drought worsens and climate change continues to make southern California climates drier and warmer there will be more parts of California where it will no longer be economically or environmentally feasible to grow wine grapes. More sustainable policies like this may have the effect of discouraging those who are in the wine industry simply for profit. However, those that understand how important the wine industry is to California’s economy and environment can adopt biodynamic and sustainable viticultural practices that enhance both the economy and the environment of California.
The wine industry can cement its reputation as the most environmentally friendly agriculture in California by working together and with local governments. The wine industry in California is large enough that if it makes an effort as a whole to be more sustainable it will have a positive effect on the environment of the winemaking regions of the state. Making the choice to be sustainable has never been more clearly necessary than now in a time of extreme drought. The California wine industry has an opportunity to set itself apart from the competition at the same time as being more responsible stewards of the land and creating the best wine possible. Change often occurs from the inside out, so as the industry reinvents itself local policy will follow.

II. Case Studies

To get a sense of how wineries in California are thinking about and addressing climate change in general and the drought in particular, I met with two Sonoma county wineries. While both Scribe winery and Benziger winery have included sustainability in their mission from inception, the wineries have different points of view on climate change and the drought. These differences, I believe, derive from the differences in size between the two wineries. Benziger is a large-scale co-op of a winery that has been around since the 1980s while Scribe is a small, boutique winery started in 2009. Benziger’s biodynamic practices are scientifically driven and research based while Scribe’s similar practices are less scientific and more holistic, driven by a keen understanding of farming and a devotion to the land. These differences can even be discerned from the names each winery uses to describe its philosophy—at Benziger it’s biodynamic, at Scribe “forever wild”. However,
both wineries have adopted a closed ecosystem approach to viticulture in order to achieve sustainability and some degree of control in an increasingly uncontrollable climate.

Benziger acts a research center not only for its own growers but also for the wine consumer. The winery offers a biodynamic tram tour (which I took) for visitors and wine drinkers to gain an understanding of Benziger’s sustainable approach to viticulture. During the tour the guide reminds visitors of the drought and mentions some of the winery’s mitigating activities including cover cropping, dry farming, and water reclamation ponds. Jeffrey Landolt, a vintner at Benziger, made it clear that Benziger is concerned about the drought and about climate change in general. The winery puts a lot of time and money into long-term weather forecasting. Landolt told me that this forecasting is “60% accurate in predicting rain events and 80% accurate in predicting heat events”. They also use soil moisture probes and leaf porometers to see how stressed the vine is for water as well as soil pits to check root health and soil biology. To mitigate the effect of the drought they use an extensive cover crop, drive the roots system down deeper into the soil, and compost. Using these approaches, Benziger had been able to reduce water use by 50% since 2012. They also work hard to harness the rainfall they manage to get. There are three ponds and a system of constructed wetlands on the Benziger property in order to filter water naturally so it can be reused in the vineyard. The winery has also begun to self regulate its own wells because there are no county well restrictions.

Benziger is about as sustainable as they come regardless of whether or not there is a drought. Benziger is a biodynamic winery meaning that they are as sustainable and self-regulating as they can be in every aspect of their winemaking. They use biodynamic sprays on the vines and only two pounds of nitrogen per acre as opposed to the 20-25 pounds
used in traditional farming. They keep sheep and cattle on the premises to provide manure and grazing. They have an insectary where they grow organic fruits and vegetables that provides a habitat for bugs that are important to vine health. Landolt told me that, at Benziger, they use the forest as inspiration of a self-regulating ecosystem and that “everything put into the farm and the vineyard is grown here”. Landolt was very clear in his belief that this scientifically driven, entirely biodynamic approach is the best, and maybe only, way to make quality wines.

Scribe is Benziger’s new-age younger sibling with less of an emphasis on hard science and more on the relationship between a farmer and his land. The winery’s view of the drought and climate change was also more nuanced than what I heard at Benziger. I spoke with Scribe’s Adam Mariani, who told me he was not particularly worried about the drought considering the amount of rain Sonoma County had been receiving, reminding me that, in comparison to many crops, wine grapes need very little water. Mariani called them the “most resilient plant on the planet”. When asked about his thoughts on a prolonged drought and climate change, Mariani took a big picture approach arguing that it doesn’t make sense to take water away from agriculture because of overpopulation and the number of people we need to feed. He did not seem worried about his own vineyard’s future viability both agriculturally and economically. However, like Benziger, Scribe is dedicated to sustainability regardless of drought or climate change, it is simply part of the winery’s DNA. According to Mariani “we have more water than we need, we make the decision to use as little as possible”.

Scribe’s priority is to be in tune with the land and the vineyard. In order to do this, they spend as much time as possible with the land. Scribe’s approach is “forever wild”
farming meaning that they rely on the strength of the farm’s ecosystem to create a stable vineyard. They use cover cropping to combat soil erosion and increase the nutrient content of the soil and they plant insectaries with native grasses to strengthen the ecosystem. Scribe grows its own food and puts the compost back into the soil. They don't kill anything on the farm, Mariani says that they act as “participants in a natural ecosystem”. Rather than imposing their will on the land, Scribe reacts to the land itself remaining flexible in terms of planning and avoiding “quick-fixes”. Mariani does mention however, that they no longer keep sheep on the property to graze because the drought has made native grasses too scarce. In terms of addressing prolonged drought, Mariani focuses on improved farming techniques rather than scientific research. Instead of using sprinklers or wind machines for frost protection, Scribe relies on pruning the vines late after bud break. They also irrigate the bare minimum and in the case of prolonged drought they could start reducing the amount of water used for irrigation especially for older, more established vines.

Both Benziger and Scribe demonstrate a sense of stewardship over their land despite the differences in their approaches to sustainability. These case studies illustrate that wineries that include sustainability in everything they do are better situated to confront challenges presented by climate change. Benziger is confident in its preparedness and scientific data. Because they are so conscious about their water use and informed about weather patterns, Benziger has the ability to either embrace an early season (like the one we are in this year) or start adding water to delay bud break. Landolt told me that they mimic spring and winter rain with irrigation if there isn’t any naturally. Benziger has the freedom to be flexible because of their sustainable collection and use of the rainfall they do receive. Similarly, although Scribe is ostensibly less concerned about the drought, their
philosophy of being in tune with the vineyard and creating a closed eco-system protects it to some degree against climate change events. Scribe's reliance on farming tools rather than “quick-fixes,” allows it to respond more quickly and correctly to the needs of its vineyard.
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