

Climate Change and Water Management: Non-viability of Freshwater Irrigation in Viticulture



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- **New World** refers to the countries where the *Vitis vinifera* was transported via migration, such as the USA, Chile, Argentina, South Arica, Australia, New Zealand, and Canada.

Definitions

- **Dry farming** (also referred to as dryland farming) is the practice of retaining moisture from winter rainfall in the soil so to sustain the plant during its growing season in arid regions without irrigation.
- **Water footprint** measures the amount of water used to produce a good, service, or crop. It is comprised of **green** (rainfall), **blue** (freshwater, surface and ground), and **gray** (recycled) water. **Terroir** is the term used in the wine industry to denote the taste of a wine's climatic specificity (soil type, exposition (elevation and slope), grape variety).
- ***Vitis vinifera*** is a species of *Vitis*, the common grape vine that is indigenous to Europe and the Mediterranean region, central Europe, and south-western Asia.
- **Old World** refers to the *Vitis vinifera*'s indigenous regions, primarily in Europe.

Introduction

As the world's water wars wage on, it is critical to examine the incidence of irrigation use in wine grape production as a climate change adaptation strategy versus the need for the sector to implement dry farming as its primary mitigation strategy. It is interesting to note that this thirsty \$300 billion industry (Wine: Global Industry Almanac 2012) has escaped scrutiny in the global water competition debate, especially as it is an international sector capable of immediate and significant climate action. "The link between social systems and food production systems in the context of wine production has become a tenuous one. Vineyards are often portrayed as glamorous holiday destinations as opposed to places of agricultural production or as factories implementing highly-advanced technology. The consumer regards wine production as a benign "past-time", heavy with emotional attachments to historical and cultural allegories" (Johnson-Bell 2017). This blurs the causal link between the soil and the bottle. Wine is made from grapes (*Vitis vinifera*) and wine grapes are a luxury fruit crop. Indeed, they are the most

important fruit crop in the world in terms of production and economic importance (Cramer et al. 2006; Vivier and Pretorius 2002) as well as being the fruit crop the most susceptible to climatic changes (Mozell and Thach 2014). History has shown that wine production occurs in relatively narrow geographical and climatic ranges. In addition, “wine grapes have relatively large cultivar differences in climate suitability, further limiting some wine grapes to even smaller areas that are appropriate for their cultivation. These narrow niches for optimum quality and production put the cultivation of wine grapes at greater risk from both short-term climate variability and long-term climate changes than other broader acre crops” (Jones and Alves 2011).

Wine and water use, then, is a relevant and useful test case for establishing sustainable water use in agriculture and water use as a whole. “Water is at the heart of adaptation to climate change, serving as the crucial link between the society and the environment” (United Nations 2018). Any climate action that assists in mitigating its waste is essential. Where “irrigated agriculture remains the largest user of water globally, accounting for 70% of global water abstraction” (OECD 2012), wine’s average global water footprint may not be enormous compared to other crops, or even to other luxury crops, but its blue water (freshwater) use is disproportionate to its overall production values. Where luxury crops such as coffee, chocolate, and tea have among the highest global average embedded water content (blue and green), their water use is predominantly green water, not blue. As stated in the 2018 United Nations World Water Development Report (WWDR), the “key for change will be agriculture, the biggest source of water consumption and pollution.”

In sites where irrigation is legally practiced, this is the greatest use of water in wine production. Eighty-three percent of the surface under vine is irrigated in the New World as opposed to 10% in the Old World (Montpellier.inra.fr). As both the need for irrigation in current planted acreage increases and the additional future acreage will

need irrigation, it is clear that the wine grape can serve as the ideal “poster child” for illustrating the immediate need for drastic water management and for establishing the actions needed to ensure truly sustainable agriculture.

Climate Action in Viticulture: Following the Original French Model

There is one viticultural farming practice that could be coordinated at the international level: dry farming. This is a practice already enshrined in European wine law, where irrigation is banned in the quality wine appellations. However, with the increasing episodes of drought and heat, these irrigation laws are being relaxed, as opposed to being held as a viable mitigation strategy for the rest of the world to emulate. Perversely, the most logical way in which to safeguard both the world’s future quality wine supply and its water supply is to implement dry farming as the sector’s global industry standard: its default position. However, such a legislative move could prove impractical and too political. There exists a mindset among a proportion of producers that would prohibit the curbing of the perceived inalienable right to water. Though, if irrigation were banned internationally, both an economic and an ecological playing field could be created. Wine producers could survive longer, with smaller yields, true, but with better wine, healthier plants and soils, and less water.

This entry will demonstrate how the climatic, economic, legislative, and cultural collision hovering on the horizon will render irrigation impossible in many regions anyway, before international irrigation bans could ever be drafted, enacted, and enforced. It hopes to provide a wider perspective of a highly detailed issue in an industry which impacts numerous other sectors and to open the dialogue regarding the change needed to engender immediate climate action. With today’s wine producers unable to sustain their yields without irrigation, whose soils cannot support further plant life; who cannot afford insurance, water, or water licenses; and who are diversifying or ceasing wine production altogether; it is time to ask the question: Wine or water?

Water into Wine

Wine's Water Footprint

The Water Footprint Network states that it requires 5 l of freshwater to produce a glass of wine without irrigation. Meaning that the 5 l are used in the winery. Add irrigation and that number rises to 110 l of water per 125 ml glass in a temperate climate and to 240 l and rising, in drought-ridden regions. These estimates are challenged, and there is controversy as to how to determine a wine's water footprint in the context of yields (Williams 2001), its end value (Aldaya et al. 2010), and its composition, that is, the proportions used of green, blue, and gray waters and the role of soil type and evapotranspiration rates. Each wine's footprint can be unique from region to region and even from plant to plant.

However, the more critical issue is to determine if any use of freshwater to irrigate a luxury crop for the sake of increased productivity, and hence, profit, is a viable and sustainable goal. The argument that justifies increasing irrigation to achieve higher yields and, thus, greater economic profitability, when higher yields will ultimately lead to lower quality and lower economic profitability, is illogical. Any profit afforded by the greater yields will eventually be consumed by the cost of the water. Irrigation has become adaptation's greatest ally as well as mitigation's greatest foe.

Climate change is redrawing the map of the world's vineyards (Hannah et al. 2013). The *Vitis vinifera* has always been comfortable "moving house." But in the past, the climatic changes have been slower, permitting adaptation. Today, there is an unparalleled rate of change. This is coupled with the fact that never in the history of viticulture has the industry been so firmly and comprehensively entrenched in economic and cultural identities. The changes will have varying effects on the different wine regions that will depend upon their ability to adapt. The relationship between temperature and wine quality is crucial in determining adaptation strategies. But most adaptation techniques, especially irrigation, negatively impact a wine's quality, its soil quality, and hence, its specificity, the hallmark of its luxury status (Johnson-Bell 2017).

Water use in viticulture is essential in every stage of the production process. Irrigation is the largest use, and as temperatures and droughts increase, so does the need for water (Mozell and Thach 2014). The *Vitis vinifera* is indigenous to Europe and Central Asia. When it is grown outside these regions, typically in warmer, drier New World climates, irrigation is used where there is low rainfall during the growing season so to increase yields. In the driest parts of Australia, for example, 99% of the water use is for irrigation, as opposed to uses in the winery (Kilcline 2006).

Initially, commercial, mass-produced wines will continue to adapt via technology. They will continue as long as they can sustain the increasing water prices and are allocated the required water licenses from their local governments. Then, as increased drought and water shortages cause planted acreage to be pulled, it will be the dry farmers who survive. Wines of South Africa, CEO, Siobhan Thompson, recently suggested that the droughts and the move toward dry farming may benefit the Western Cape and force it to "rightsize" itself as the greatest impact from water shortages is being felt in the "bulk producing areas" (Schmitt 2018), confirming that their market is already experiencing this eventuality.

How Vineyards Are Adapting

Climate change is manifesting itself in a myriad of ways. Within the larger warming trend, there are more frequent and more erratic climatic events: unexpected hail storms, flooding, drought, and disease. Adaptation strategies vary depending upon the site-specific issues but can include rootstock and clonal selection, planting in higher altitudes and cooler coastal regions (where physically and legally possible), better canopy management, reduced tillage, trellising techniques, and changing to warmer-climate grape varieties, again, where legally permitted. There is also a groundswell of support for organic and biodynamic farming practices. "Fortunately, *Vitis vinifera* has a wide genetic diversity that can enable such shifts. However, within *Vitis vinifera*, there are few widely planted varieties that can produce quality wine in excessively warm climates" (Difffenbaugh et al. 2011).

“Sustainability” has become a wine trend. It is the new “organic.” There is a plethora of regional accreditations and certifications (mostly voluntary) addressing key adaptation strategies and embracing organic and biodynamic farming practices. The majority of these programs focus on conservation of habitat and biodiversity as well as pest management, soil health, energy efficiency, green buildings, recycling materials, and water and waste reduction. If water management is mentioned at all, it is too often concerned only with water conservation within a system of irrigation. espousing the benefits of drip irrigation, regulated deficit irrigation (RDI), or the need for better water and soil moisture measuring tools. Absence is the acknowledgment that ceasing freshwater irrigation and choosing to dry farm would be the most effective sustainability measure.

It would be inaccurate to categorize dry farming as a strictly Old World farming practice. There are many New World wine producers who are long-time advocates of dry farming, while others are starting the slow and careful process of transitioning. There are wine producers in the most drought-ridden regions who are proving that dry farming works. British Columbia’s Painted Rock Estate is in the midst of weaning their vines off water. Every year, they reduce irrigation levels. Will Bucklin’s Old Hill Ranch in Sonoma, California, has Zinfandel vines that have not been irrigated since 1885. South Africa’s Swartland is famous for its dry-farmed wines, mostly in part to the Swartland Independent Producers (SIP). In Chile, one of the worst irrigation offenders, high-profile producers are now transitioning. For example, Aurelio Montes in the Colchagua Valley has added a premium dry-farmed range to his portfolio. In California, the owner of the Bonny Doon estates in Santa Cruz, Randall Grahm, is an ardent pioneer of dry farming and its ability to translate *terroir*, believing that the best ways are the old ways. Finally, the Deep Roots Coalition in Oregon, USA, is a good example of private-sector action. Their mission is to have the farmers who currently irrigate convert to dry farming and have all new vineyards established without irrigation. As confirms John Paul of the Cameron Winery,

“the ultimate agricultural system is essentially a self-contained order in which everything is recycled and the only significant inputs come in the form of sunlight and precipitation.”

Irrigation as an Adaptation Technique

A Question of Taste and Waste

While irrigation is used to mitigate the reduction of yields due to drought, it also impacts wine quality and damages the soil. The issue is not confined to water conservation alone. “Irrigation” in viticulture is a wide term encompassing a variety of practices according to the amount of water use and the frequency with which the water is applied: from flood, or furrow irrigation, to spray irrigation, and to drip, or trickle irrigation. . . and then from the first day of the growing season and throughout to harvest, or once a week, or once a day, or continuously. It is accepted that irrigation contributes to higher yields, wider leaf area, more vegetative growth, and larger berries. The debate lies in whether or not these responses constitute a negative effect on wine quality. There should not be a debate: it is an established horticultural fact that irrigation reduces flavor in vegetable and fruit crops. Numerous studies have confirmed that reducing irrigation positively affects fruit nutritional quality by increasing anthocyanin and phenolic concentrations (Chaves et al. 2010; Bravdo et al. 1985), whether they be pomegranates, tomatoes, or peaches. Wine grapes are not exempt from the law of nature. On the other hand, too much water stress and the wine quality also suffer, reducing “the relative level of photosynthesis, resulting in lower fruit yields and quality” (Jones et al. 2005). It is a great balancing act. However, using irrigation throughout the growing and ripening seasons so to control moisture stress and yields is increasingly an unaffordable luxury.

Unirrigated vines create root masses that are forced deep into the soil to find moisture, and as they do this, they pick up nutrients through the soil formations. This is what dry farming advocates call “*terroir*”: the taste of the place in which the grapes are grown. The French soil ecologist, Dr. Emmanuel Bourguignon, explains that

irrigated vines often miss out on vital nutrients because their root systems remain on the surface, where the moisture, sun, and fertilizers are. Remaining on the top 30–40 cm of the surface also renders the plants more vulnerable to all climatic events. Bourguignon adds that “irrigation’s increased vigor, or vegetative growth, creates a large canopy, which is particularly problematic in sunny climates because it increases photosynthesis resulting in high sugar and potential alcohol levels. This dilutes the *terroir* but exaggerates the varietal character. If you want to be unique, irrigation will make that very difficult” (Gibb 2013).

Soil salinity is another problem with irrigation (Sidari et al. 2008; Cramer et al. 2006), and the problem is not confined to viticulture. Arid soils are the most susceptible. When salt levels reach high-enough levels in the vine, the leaves start to display “leaf burn” or browning. Salts also change the structure of the soil itself and the way the roots grow, which affects the vines and, thus, the wines. Soil salinity means potentially phytotoxic salt components such as sodium, chloride, and boron, which can cause crippling decreases in vine vigor or even vine death at elevated levels (Teichgraeber 2006). Correcting soil salinity is currently a highly active area of research. The best way to decrease soil salinity is to drench or to flush the soil with freshwater. But if the vineyards suffering from soil salinity had such freshwater reserves at their disposal in the first place, they would not be irrigating. There is also research being conducted on the influence of organic materials on the physical and chemical properties of saline soils with low fertility (Wu et al. 2014). For example, biochar both regenerates soil by replenishing its organic matter and increases its ability to retain moisture, which is essential in dry farming.

Frustratingly, soil salinity research tends to focus on its physiological and metabolic effects, as opposed to its effect on chemical composition, volatile aroma compounds, and sensory characteristics on wine – its *taste*. It has been determined that there may be some grape varieties that are better suited than others to the influence of soil salinity, such as the Nero d’Avola in Sicily

(Scacco et al. 2001). To determine other varieties that perform well in salinized soils would prove a useful adaptation tool for winemakers as they experiment with replanting.

Yields. . . a question of relativity

It is important to insert a discussion on the topic of yields, as low yields are considered the greatest deterrent to the dry farming method. Wine grape yields are measured either in tons per acre, tons per hectare, or hectoliters per hectare. How much volume is produced by a given weight of grapes is determined by a vast set of variables, from site selection (soil composition and exposition), grape variety, rootstock selection, planting density, trellising method, vintage conditions, harvest methods, winemaking methods, wine style, and indeed, the producer’s winemaking ethos. Further, the measurement of land area has its own set of variables and is considered to be an indeterminate unit. To place it into a relevant context, note that premium wines are issued from low yields and lesser quality or mass-produced, commercial wines are those that are from high-yield vineyards. Low yields (for the right reasons) are considered the hallmark of premium wines. It is one of the factors that bestows upon them their luxury status. This is also why much of the discussion in the scientific community regarding crop yields is often skewed when on the topic of viticulture. Those who come to this topic from a general agricultural perspective too often assign to viticulture the same qualitative attributes as other crops and assume that high yields are desirable. In viticulture, low yields, when not due to disease or extreme weather conditions, are preferable.

To place this in a broad context: In the AOC (*Appellation d’Origine Contrôlée*) vineyards of France, for example, the Institut national de l’origine et de la qualité (INAO), as part of the Ministry of Agriculture, sets maximum yields at 60 hl/ha in the Loire’s Sancerre appellation, 40–45 hl/ha in Burgundy’s Meursault (white), and 35–37 hl/ha in Burgundy’s (red) *grands crus* vineyards. In Bordeaux, Saint-Émilion has a maximum yield of 45 hl/ha, while their iconic sweet wines, Sauternes, average 25 hl/ha with the best estates producing yields of only 12–15 hl/ha. These

are considered extremely low yields. And this is not to say that there are wine producers in the less-regulated vineyards in the south of France who produce more mass-produced wines with yields of 80 or 100 hl/ha. The monopoly on high yields is not held by the New World wine producers. However, the New World wine regions are not subject to the same wine laws regarding yields.

It is a highly subjective perspective. In many of the arid New World wine regions, there are premium wine dry farmers who consider their recent yields of 2–3 tons per acre as unviable, when in Europe, that equates to 27–40 hl/ha and would be held to be viable. “The vineyards of Napa Valley are intentionally farmed at lower yields bringing only the very best grape to harvest. Growers here, year-in and year-out, bring an average of 4 tons per acre to crush overall, which is consistently half the California state-wide average” (Napa Valley Vintners’ Association 2018). Four tons per acre is approximately equivalent to 54 hl/ha or more, which is the upper limit of the European AOC yields. So while a producer in Paardebosch, South Africa, laments a yield of 3 tons per acre (50 hl/ha), that is a perfectly viable yield for a Chianti Classico producer in Tuscany. This difference in perspective, and in market forces, is what is partially heeding the progress of dry farming.

Dry Farming

Not Just “Not Irrigating”

Dry farming is an ancient farming practice rooted in antiquity. “In the more or less rainless regions of China, Mesopotamia, Palestine, Egypt, Mexico and Peru, the greatest cities and mightiest people flourished in ancient days” (Widtsøe 1910). In contrast, irrigation was a comparatively modern concept in the context of cultivated food production and was embraced as a method to increase yields and to alleviate the inherent vagaries of annual growing seasons.

Dry farming is not the same as rainfed agriculture. They differ in the annual rainfall of their respective regions. Rainfed agriculture is a form of farming practice wholly dependent on rainwater for irrigation. Dry farming is the practice of

retaining the moisture from winter rainfall in the soil so to sustain the plant during its growing season without irrigation in arid regions that typically receive less than 20 in. (50 cm) of annual precipitation. In ideal vineyard conditions, rainfall is distributed equitably throughout the year. When it falls primarily in the winter and not during the growing season, then this is when dry farming is practiced. In viticulture, dry farming can be practiced with as little as 9 in. of annual rainfall, depending on the actual demand for water of any particular vine and as is determined by vine age, variety, rootstock, soil type and drainage (for both topsoil and subsoil), slope, topsoil depth, day and night temperatures, humidity, wind, depth of water table, crop load, canopy management, vine health, sun and UV exposure, and when the water is applied, among other considerations.

Dry farming is not simply, not irrigating. It works to conserve soil moisture during long, dry periods primarily through a system of tillage, surface protection, and the use of drought-resistant grape varieties. Dry farmers often plant winter cover crops to increase the infiltration rate of winter rains, reduce runoff and erosion, provide nutrients and organic matter for the soil, and increase soil moisture content. They also experiment with tilling and non-tilling methods, as well as disc the soils, use a harrow to create a dust mulch, and use a roller over the mulch to seal it and the subsoil. Soil fertility is increased with compost. And biochar, as stated earlier, is being explored as a remedy to soils that have been salinized by excessive irrigation and enhance water retention. Animals are also introduced into the vineyards, and careful plant pruning and grape cluster thinning are practiced so to keep water use of the vine to a minimum.

Transitioning from Wet to Dry

The principle behind converting a vineyard from irrigation to dry farming is that the irrigation water is slowly and gradually reduced on an annual basis, so as to avoid any shock or damage to the vines. Determining how much reduction in irrigation is required is achieved by assessing the soil information and the use of the same data employed when determining irrigation amounts. The process can take from three to five growing

seasons. For example, areas with greater precipitation and soils with sufficient water-holding capacity and deep rootstocks will require less time to transition, while vineyards with less annual precipitation, planted with riparian rootstocks in shallow, sandy soils with tight planting densities, would be difficult, if not impossible, to transition.

The Impediments: Economic Versus Ecological Viability

The greatest deterrent to adopting or transiting to dry farming, again, is the loss of profit due to the lower yields. Yet these can be greatly offset by the long-term savings afforded by dry farming. Dry-farmed vineyards incur lower costs, both in terms of start-up and maintenance. Irrigated vineyards require the extra costs of the irrigation system, the trellising system, the water, as well as all maintenance. Dry farmers will only have the cost of watering the vines for the first years. CAFF data reports that dry-farmed vineyards average \$6000 per acre as opposed to \$30,000 per acre for an irrigated vineyard (Lambert 2015). How much water is saved due to dry farming is a gray area. There does not exist sufficient quantitative research, and data thus far is on a case-by-case basis. Some Napa Valley dry farming estates estimate that a minimum of 16,000 gal per acre of water is saved when compared to neighboring grape farmers who irrigate lightly (CAWSI 2018).

If a South African dry farmer resorts to irrigation at the end of the growing season, or if a producer in Bordeaux abandons their organic farming methods at the end of a disastrous vintage, they do so to “save their crop.” But this does not mean that their vines were not producing any crop; it means that their vines did not produce enough crop to meet their anticipated yields. It is not an ecological construct but an economic one. Presently, it is only those wine producers who are voluntarily engaging in sustainability practices who are taking the largest risks for the industry. If they are forced to abandon these practices at the final hurdle due to competition from their non-practicing peers, then this poses an enormous inequity and retards the advancement of the adoption of sustainable farming practices. There needs to be a level playing field.

Legislative Restrictions and Consumer Expectations

Water is also a rights issue. “As the global population grows, there is an increasing need to balance all of the competing commercial demands on water resources so that communities have enough for their needs” (United Nations 2018). So, in the same instance that sustainable farming programs are voluntary, water laws are being enacted and enforced on both national and local levels across the globe. Water is being rationed, even if a producer could afford the increasing costs. For example, VinPro, a nonprofit company which represents 2,500 South African wine producers, states that the majority of areas in the Western Cape have seen their water rights cut in half, forcing producers in the north of the region to select which vineyards to save. As a result, estimates for the 2018 harvest volumes are forecasted to be 20% lower in yields on average. The recent water crisis has strained the industry, raising the question of priority for uses not considered essential to fulfilling a human right to water (Larrick 2018).

Over the last decade, grape growers in SE South Australia have had their water entitlements converted to volumetric allocations, have experienced a reduction in annual rainfall, and have seen a rise in the salinity of irrigation groundwater. Most wine producers have shifted from flood and sprinkler irrigation, which was still widely used in the last decade, to precision drip irrigation (Stevens and Pitt 2012). Still, thousands of grape growers have not been able to afford their water bills and have had to cease their production. In Australia’s Riverina wine region, severe drought conditions have forced more than 10,000 families, mostly sheep and wheat farmers, off their land. Wine producers are also having to cease their business activities. The creeks and streams of the Murray-Darling river system are where around 1,300 growers produce more than 400,000 tons of grapes, approximately one quarter of Australia’s total. These vineyards have “relied on highly-regulated irrigation systems flowing from enormous reservoirs in the nearby Snowy Mountains” and can do so no longer. Many vineyards have been abandoned to soil salinity, unable to grow any crop at all (Johnson-Bell

2017). In the recent past, winemakers were faring better than other farmers because their business is deemed so “important to the local economy that it has been guaranteed water” (Mercer 2008). Chardonnay was put before wheat and livestock. This preferential treatment is no longer physically possible.

From this debate over water rights, the role of the educated consumer comes into force. Increasingly, the consumer is making the link between wine and agriculture. Consumers want eggs to be free-range, chicken to be corn-fed, and vegetables to be organic. The provenance of foodstuff is now a key market leader, and there is evidence that this demand has translated into the drinks industry. Unilever claims that “over a third of consumers are now actively seeking out brands and companies based on their social, environmental and ethical impact and behaviour. YouGov puts that figure at 37%” (Unilever 2018). And Nielsen research shows that “75% of millennials are prepared to spend more for a sustainable product, up from 50% in 2014.” Nielsen also recently reported that supermarket sales of organic food and drink in the UK have risen by 4% this year (Nielsen 2015).

A Lack of Incentive and Insurance

Instead of insurance being used as an incentive to farmers to conserve water, it has become an important “last-ditch” adaptation tool: a safety net. The US Congress is presently working on the “Agriculture and Nutrition Act of 2018.” One of its key elements is crop insurance which helps protect farmer income in times of volatile production when crops are damaged by droughts or floods (Agriculture and Nutrition Act of 2018). But “crop insurance is good for farmers, but not always for the environment” (Fullerton et al. 2018). An example of this is the policies offered to South African wine producers. Drought insurance is cost prohibitive and often not issued if the wine producer does not have an irrigation system in place, thus encouraging irrigation as opposed to supporting water conservation. Californian wine producers are encouraged to rely upon their crop insurance policies as their primary backup method of drought management, with such advice as “growers have several options for addressing

risks through the purchase of crop insurance, an important sustainability tool” (California Sustainable Winegrowing Alliance 2018). Authors from the University of Illinois Institute of Government and Public Affairs confer that “while it plays an important role, studies have shown that crop insurance encourages overuse of resources, particularly water, and makes the agricultural system less resilient in the face of climate change. Modifying crop insurance to reduce incentives for unsustainable farming practices could be an effective way to ensure the resilience of our future agricultural system” (Fullerton et al. 2018).

Do the French Have It Right?

Irrigation in European vineyards has always been illegal. This was partially to reduce yields during the 1930s and 1950s when overproduction and low prices were an issue but also in acknowledgment of the qualitative advantage. Now, with the recurring droughts in many parts of France, the INAO and the EU are having to relax irrigation laws in the Mediterranean. The INAO is responsible for the implementation of French policy on official signs of identification of the origin and quality of agricultural and food products and regulates such things as maximum yields (as mentioned above), the maximum vineyard surface allowed, winemaking practices, permitted grape varieties, pH and alcohol levels, vinification processes, etc.

Wine laws in the New World are more lax and are less concerned with associating an appellation with a particular grape or style of wine. For example, white Burgundy must be made from the Chardonnay grape and red Burgundy from Pinot Noir. The New World vineyards do not have the same restrictions. They are permitted to plant whatever variety they wish, wherever they wish. This has both advantages and disadvantages; a discussion thereof is outside of the scope of this entry.

With the décret n° 2006-1527, JORF n°282 of 6 Décembre 2006, irrigation became (very quietly) legal in France. But the most water-efficient method of irrigation, drip, was outlawed in preference for spray irrigation. Further, the period of irrigation was limited to between 15 June and 15 August, which is the flowering and ripening seasons, as opposed to between budburst and

flowering, making it difficult for producers to have any control over their crops, especially as nature's inherent time line keeps shifting. More worrying still is the new project, Aqua Domitia, intent on bringing irrigation water supplies from the Rhône Valley to Béziers and Narbonne. The project was initiated by the region of Languedoc-Roussillon, which today is the most irrigated vineyard in France, with some 23,000 ha or 10% of the region (Martin 2016).

Is allowing more irrigation in France a step backward or forward? Olivier Martin, Président délégué de la Fédération des Vins de Nantes and co-owner of the Domaine Merceron Martin, states that "it is a shame to see people undo all the work Mother Nature has already done. To start irrigating means to invite all the root systems back up to the surface. More and more, with the heat and the irrigation, the traditional French wines will not be French anymore. They will taste like they come from anywhere. But many French winemakers are happy to now have the high yields that can be found in the rest of the world."

More recently, following the décret n° 2017-1327 of 8 September 2017 regarding AOC vineyards, the legislation has had several amendments, allowing irrigation after 15 August and allowing underground drip irrigation systems. Crucially, also, the décret has been revised to ensure that irrigated parcels keep to the original dry farming yields. Only dry farmers are allowed to exceed the traditional maximum yield limits. The French may have found a balance that could be implemented throughout the industry. However, it would be preferable if EU wine laws were to retain their irrigation ban and yield limits but to relax their planting restrictions.

How Much Longer Is Irrigation Viable?

In South Africa's Stellenbosch region, Warren Granat-Mulder, Rust en Vrede's Export Manager, revealed that diversification is already very much part of the South African mindset. "Lots of our neighbors are growing apricots and other crops. Wine is not viable. Dry farming can be a struggle even with the right soils and winter rainfall. Because of the heat. At 40°, the stress is too much and the vines shut down. People will adapt

until they can't anymore. Then they'll diversify, and then they will migrate."

Viticulture is different from other crops. Diversification and migration are not palatable options. It is one exercise to relocate a wheat field or a tea plantation, but it is quite another to do so with a 300-year-old château and its infrastructure or to cease wine production altogether. Yet, wine producers who continue to use irrigation as an adaptation technique will be placed in a holding pattern until "irrigation as an adaptation technique" and "dry farming as a mitigation solution" collide.

Conclusion

For viticulture to survive, to go beyond adaptation, and to become resilient, it must not only take responsibility for its role in water conservation, but it must also protect its soil, its low and healthy yields, and its quality, or its "luxury" status will be lost. This cannot be achieved through irrigation. Many wine producers already understand that the *Vitis vinifera* will 1 day outstay its welcome and will have to migrate to cooler climates. Assisting winemakers to envision this outcome and the ensuing ramifications is part of being resilient to climate change. The winemakers who do not embrace such realities, however unthinkable, risk being the ones who will be destroyed by adversity as opposed to merely being changed by it.

If the European wine laws on irrigation continue to relax until irrigation is used in all appellation levels, while in the New World wine regions irrigation becomes impossible due to water shortages and legislative restraints, an interesting role reversal could ensue. Eventually, only the dry farmers will survive. The New World's mass-produced wines will fall out of the marketplace, despite their initial financial ability to invest in technology and weather the climate storm. But their advantage will not last. At the same time, the Old World will be increasing its yields and taking the previous place of the New World wines. Until, having irrigated itself into dilution, it, too, can no longer adapt. Then again, ironically, those Old World producers who can will return to dry

farming. It will come full circle, albeit with the wine map greatly altered and, perhaps, not so recognizable.

It is time to halt the use of irrigation in viticulture. When an environment is contrived and manipulated to such an extent in order to accommodate a crop's production process, when local government legislation prioritizes viticultural export products in lieu of food crops, and when the very essence of a crop's value and identity is altered beyond recognition, then assisted migration at a forced pace may be the only option.

Climate action in viticulture is a natural fit. The wine industry is a sector possessing a comparatively strong and coherent network between its stakeholders and local and international government. It also possesses an enormous knowledge bank of historical and modern climate data. There is also, comparatively, a strong sustainability mindset as well as strong international marketing and media/communication structures already in place. Wine production also has a long value chain encompassing all adaptation issues; from land use, agriculture, water rights and conservation, transport, energy, employment, and social care to investment and insurance models. Its processes, especially that of European wine law, provide a perfect mitigation "template." We can no longer afford to irrigate a luxury crop. This is a sector that cannot be exempt from climate change adaptation, especially when it has the ability to take the lead in mitigation solutions. The world needs more food, not more wine.

Finally, there is also much to be hopeful about. While there will be many wine producers who will not survive climate change, climate change is also responsible for the creation of the newly emerging, exciting, and sustainable wine regions. How this world map will be configured will depend entirely on the industry's response to the question: wine or water?

Cross-References

- ▶ [Climate Change and Anthropogenic Impacts](#)
- ▶ [Climate Risks/Adaptation to Crop Yield in Pakistan](#)

- ▶ [Desertification](#)
- ▶ [Food and Climate Change: Their Connections and Mitigation Pathways through Education](#)
- ▶ [Take Urgent Action to Combat Climate Change and its Impacts](#)

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