# Sustainability of Maine's Emerging Wine Industry

by Michaela A. Murray, Mark Haggerty, and Stephanie Welcomer

## Abstract

Consumers, businesses and business sectors, and policymakers are increasingly concerned with sustainability, and the global wine industry has long acknowledged concerns about the social, environmental, and economic sustainability of their industry. Several wine regions, including France, Australia, and South Africa, have developed workbooks and policies for sustainable wine production, but Maine's emerging wine industry has yet to explore the concept of sustainability as it relates to its operations. In this project, designed in collaboration with the Maine Winery Guild, we interviewed the owners of 10 Maine wineries and analyzed how they define and enact sustainability along with the obstacles they face in sustainability efforts. This research aims to provide baseline information that will help the guild and policymakers formulate actions that enable Maine's wine industry to grow and compete with other sustainability-conscious wine regions.

## INTRODUCTION

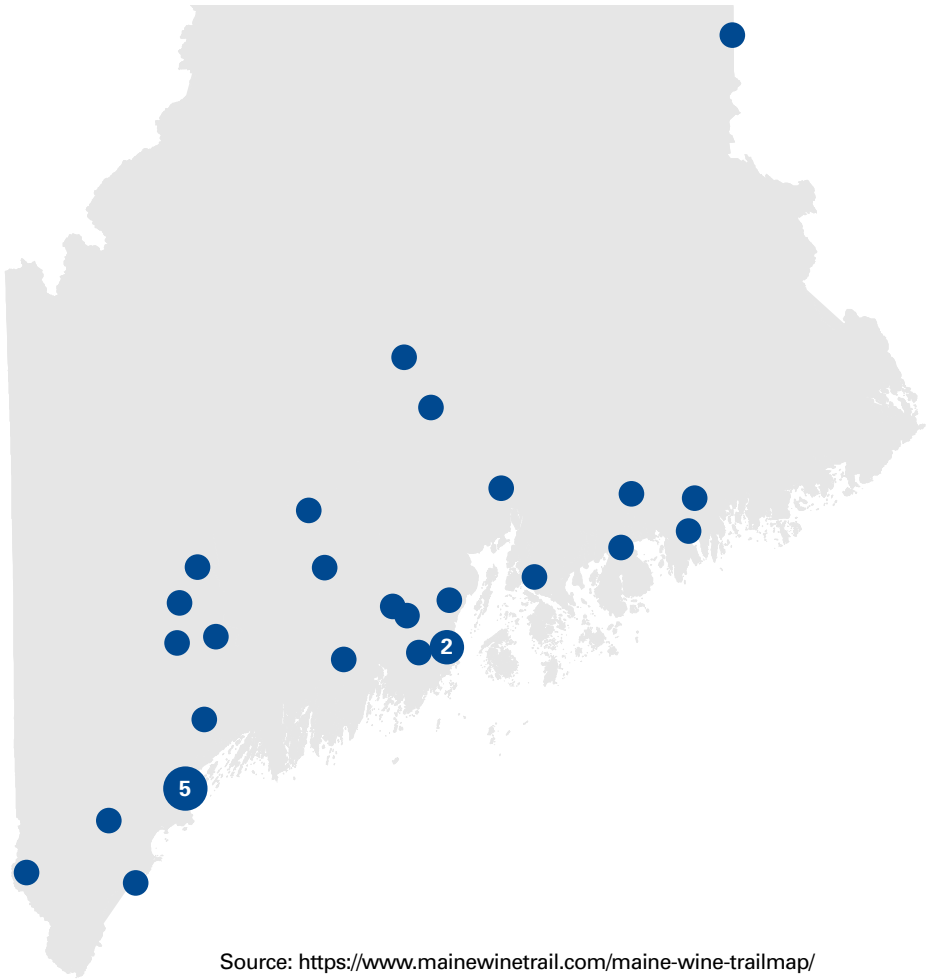
Over the past 20 years, wine consumption in the United States has increased from just over two gallons to close to three gallons per person per year (Wine Institute 2019), and by 2017, US wine sales had reached $62.2 billion (Wine Institute 2018). There are now more than 10,000 wineries in the United States, with California as the top wine-producing state, home to more than half of all US wineries.[1] Currently 13 states have more than 100 wineries operating within their borders. Washington and Oregon follow California, with 689 and 566 wineries, respectively. The remaining top wine-producing states are New York (395), Texas (319), Virginia (276), Pennsylvania (261), Ohio (208), Michigan (184), North Carolina (165), Missouri (149), Colorado (127), and Illinois (115) (UWR 2018). These emerging wine regions are spread out across the country, with successful wineries becoming more common across the entire country and not limited to the Pacific Coast region. While the mid-Atlantic and western regions of the United States are seeing the most growth (UWR 2018), New England has also seen an increase in the number of wineries. New Englanders have been producing wine for centuries, but within the last few decades, many areas have experienced a surge in vineyards and wineries. Despite challenges with climate and soil types, New England wineries have had success with creating wines from cold-hardy grape varietals as well as orchard and bush fruits such as apples and blueberries.[2]

The first Maine winery, Bartlett Estates, opened in 1983 in Gouldsboro. There are now more than 50 federally licensed wineries in Maine, and the number is continuing to increase. In 2007, the Maine Winery Guild was created to support the new industry. The guild now includes 31 members (see Figure 1) who collectively serve to "advance the prosperity of the Maine wine industries, the farms that support them, and the community they serve" through promotion and industry development.[3]

As we learned from our interviews, some Maine winemakers produce fruit wines such as blueberry, apple, strawberry, and pear; others follow a more traditional approach and use grapes; while some produce both grape and fruit wines. Many Maine wineries have upwards of 10 varietals on their product list. Maine winemakers obtain their fruit in different ways: fruits may be grown by the winemaker, sourced locally, or sourced from afar. Only a handful of Maine winemakers are viticulturists since growing grapes in the state is challenging given the climate and topography. A few wineries, however, do grow cold-hardy hybrid grape varietals such as Frontenac and Marquette and create distinctive Maine-grown wines.

As the wine industry has expanded across the United States, concerns regarding sustainable production have increased. California is considered a pioneer of sustainable winemaking. In 1992, the Lodi Winegrape Commission launched an integrated pest

FIGURE 1: **Location of Maine Wine Guild Wineries**




Source: https://www.mainewinetrail.com/maine-wine-trailmap/

management (IPM) program (Ross and Golino 2008) for California wineries. Over the next decade, the commission released the *Lodi Winegrower's Workbook* (Ohmart et al. 2008) containing voluntary practices for vineyard and winery sustainability and established a certification scheme now widely known as the *Code of Sustainable Winegrowing Practices.* The California Sustainable Winegrowing Alliance (CSWA) monitors sustainability practices of participating wineries. Their mission involves a set of practices that are environmentally sound, socially equitable, and economically viable, a mission that is consistent with what is known as the triple bottom line of sustainability.[4] Between the program's start in 2002 and 2015, more than 2000 vineyards and wineries have participated in the program, representing nearly 70 percent of California's wine grape acreage and 79 percent of case production. Furthermore, between 2017 and 2018, the CSWA saw a 44 percent increase in the number of certified sustainable vineyards, bringing the total to 1,398, while the number of certified wineries increased by 13 percent, to 143 wineries. In total, 25 percent of California winegrape acres and 70 percent of the state's wine cases are certified sustainable (CSWA 2018).

Sustainability is a growing concern for wine, retailers, wholesalers, and consumers as well. A 2016 survey of 457 US wine retailers and wholesalers found that most retailers consider a winery's sustainability practices as part of their purchase decision, with 21 percent saying they frequently do, and 52 percent saying they occasionally do (Wine Institute 2017). A 2018 Nielsen global survey found 81 percent of respondents said that it's extremely or very important that companies implement programs to improve the environment. When it comes to action, 73 percent said they would either definitely or probably change their consumption habits to reduce their impact on the environment. And we see the impact of these sentiments at the register. (Nielsen 2018)

Maine's growing wine industry must compete with other global and especially national sectors such as California, Oregon, Washington, New York, and Michigan. These regions are taking sustainability seriously, codifying policies and procedures that enhance fruit growing and winemaking by focusing on key economic, environmental, and social sustainability issues. These sustainability practices have positive benefits for the environment, communities, and workers, and also aim to foster long-term economic benefits.

A wine producer's sustainability practices often make the difference in consumers' decisions to purchase the wine and can strengthen a producer's brand. Additionally, regions benefit from sustainable production practices as pollution and waste is reduced; wineries earn social capital as good citizens; and a network of stakeholders is strengthened.

Maine's wine industry has not yet unified around best practices for sustainability, leaving it in a potentially weak competitive position relative to other winemaking regions. Understanding current sustainability practices and perceptions helps Maine's winemakers and policymakers take first steps towards articulating desired practices, barriers to those practices, and policies that can aide winemakers in triple-bottom-line approaches.

## SUSTAINABILITY AND THE TRIPLE BOTTOM LINE

According to the United Nations' Brundtland Commission report, sustainability "meets the needs of the present without compromising the ability of future generations to meet their own needs" (UNWCED 1987). Perhaps the most commonly used business model is Elkington's (1997) triple-bottom-line framework, which posits that businesses have the responsibility to not only remain economically viable, but also to consider acting in a socially and environmentally responsible manner, sometimes called the "three pillars" of sustainability.

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Economic sustainability "focuses on the economic value provided by the organization to the surrounding system in a way that prospers it and promotes for its capability to support future generations" (Alhaddi 2015: 8). Simply put, economic sustainability is the ability for a business to remain profitable over the long run, and it can be accomplished in many ways, including cost savings, investments, financial planning, establishing competitive advantages, increasing scale, or mechanization.

Social sustainability refers to the ability of a business or individual to "provide value to the society and 'give back' to the community" (Alhaddi 2015: 8). Based on Elkington's (1994) call for a life cycle perspective of sustainability, Gimenez and colleagues suggest that for a business to achieve or work towards social sustainability they should "provide equitable opportunities, encourage diversity, promote connectedness within and outside the community, ensure the quality of life and provide democratic processes and accountable governance structures" (Gimenez et al. 2012: 150).

Environmental sustainability refers to the enhancement and preservation of the natural environment (Shrivastava and Hart 1992). Additionally, Alhaddi (2015) states that it is the ability of a business to engage in practices that do not compromise environmental resources for future generations. Sustainable environmental practices may include waste reduction, pollution control, reduction of greenhouse gas emissions, reduced ecological footprints, increased energy efficiency, lowered use of hazardous materials, and decreased frequency and severity of environmental accidents (Gimenez et al. 2012; Goel 2010).

Sustainable winemaking is supported by the International Organization of Vine and Wine, which developed definitions, guidelines, and general principles for sustainability (OIV 2004, 2008). Specific wine regions have constructed their own frameworks for sustainability. California's aforementioned *Lodi Winegrower's Workbook* pioneered sustainable winemaking practices, and several other wine regions followed, including New York, Michigan, Washington, New Zealand, South Africa, France, Chile, and Australia (Flores 2018; Szolnoki 2013). The comprehensive nature of both the global standards for wine production and the programs developed by several mature and successful wine regions illustrates the relevance of the triple-bottom-line framework as a tool for studying sustainability within Maine's wine sector.

As an agricultural commodity, there are inherent concerns about the environmental sustainability of wine products. For vineyards, the largest concerns relate to inputs such as pesticides, herbicides, fertilizer, water, and energy. For wineries, energy use, chemicals, water, and packaging materials are the most profound problems. All these inputs generate waste materials that have potentially adverse effects on surrounding habitats and biodiversity (Silverman et al 2005). While the magnitude of environmental issues differs across individual

wineries, it is clear that there is a host of problems relevant to the industry as a whole.

In regard to economic sustainability, wineries face impediments to both creating and maintaining financial success such as high capital costs and fluctuating product sales. However, internal capabilities such as leadership, social and environmental responsibility, and organizational size can create greater efficiency, competitive advantages, and financial benefits that would contribute to a winery's economic sustainability by generating cost savings and improving business operations (Alonso and Liu 2010; Dodds et al. 2013).

Wineries often seek to minimize the negative impacts on surrounding communities and maximize the positive, which Alonso and Bressan (2013) suggest involves at least one of four potential roles: provider, guardian, sponsor, or promoter. As a provider, wineries generate employment and give donations to local businesses or events. When a winery acts to preserve the wine culture or tradition of its region, safeguard the physical landscape, and provide housing to local community members, it is considered a guardian. Acting as a sponsor may come from sponsoring local events and buying local inputs for vineyard and winery operations. Lastly, a winery that enhances sustainable tourism within a region is categorized as a promoter (Alonso and Bressan 2013). Fulfilling any or all of these roles in addition to mitigating adverse operational impacts on the surrounding community can increase a winery's social sustainability.

Beyond knowledge, infrastructure, time, and money, some wineries have expressed concerns that implementing sustainable practices may diminish product quality. Certain environmental practices such as organic growing techniques have been thought to reduce wine quality (Dodds et al. 2013). This concern is heightened because many wineries find it difficult to inform their consumers about the benefits of sustainability practices (Szolnoki 2013). A better understanding of the barriers that impede the integration of sustainability within a winery business helps construct policies that diminish their impact.

## INVESTIGATING THE SUSTAINABILITY OF MAINE'S WINE INDUSTRY

To continue developing their market and competing with other regions, Maine wineries need to transition towards more sustainable operations. Using a triple-bottom-line framework, this project establishes a baseline understanding of the sustainability practices currently used by Maine's wine industry and will help develop strategies for moving the industry forward.

For this study, we interviewed Maine winery owners using a semistructured interview questionnaire and recruited participants based upon suggestions from the Maine Winery Guild. Based on scale, geographic location, and years in business, we chose 10 wineries—30 percent of the guild's members—that are representative of the Maine wine industry's diversity. The Maine Winery Guild secretary sent an email to potential participants to introduce the project and the guild's role as a community partner. A more detailed introduction of the first author and explanation of the project was attached to that email. We then scheduled interviews with interested wineries; nine of the ten wineries originally suggested by the guild were interviewed; the guild suggested a substitute for the tenth winery whom we interviewed later.

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Interview questions were designed to capture information about our main research questions:

- How do Maine winery owners in conceptualize sustainability?
- How do Maine winery owners operationalize sustainability?
- What are the internal and external factors driving sustainability conceptualizations and practices in the state of Maine?
- What challenges do Maine winery owners face when practicing sustainability?

The interview's first nine questions (see Appendix on MPR's Digital Commons site) related to winery logistics, such as number of years in business, varieties and quantities of products sold, and level of profitability.

We gathered this information to identify any recurring themes related to sustainability across wineries with similar logistical variables. We used seven open-ended questions to ascertain winemakers' conceptualizations of sustainability, their sustainable practices, and the challenges they face concerning sustainability. Most of the conversations spanned between one and one and a half hours.

Interview transcriptions were the only source of data analyzed in this study. We analyzed transcriptions with a multiround inductive coding process in which data are analyzed to reveal emergent themes (Charmaz 2006). We read transcripts and marked them with descriptive codes, which are words or short phrases that summarize a passage (Saldaña 2013). To ensure validity, codes were developed by the first two authors, and a draft codebook was built and subsequently revised and finalized. We analyzed the remainder of the interview transcripts using this codebook. After each of the transcripts was coded, a second researcher analyzed the data to measure intercoder reliability by coding a sample of the dataset using the same codebook. Our intercoder reliability was 70 percent, which meets the traditional standards for qualitative research (Strauss 1987).

## RESULTS

### *Sustainability Conceptualizations*

Our results showed that Maine winery owners conceptualize sustainability around the economic viability of their businesses. One participant articulated this as, "we are a business and it's important not to lose focus of that because without that, you don't get the other two." From this center of economic viability, winery owners conceptualized social and environmental sustainability in one of three ways: as intrinsic to their businesses, as instrumental to their businesses, or as irrelevant to their businesses.

Winery owners who expressed an intrinsic conceptualization of social and environmental sustainability perceive these concepts to matter wholly on their own. In other words, the owners feel that environmental and social aspects are important to consider despite the impact they have on the profitability of the business. Four of the winery owners interviewed shared this point of view. For example, one participant's vision for the winery was "to try to make the land here connected to what we do." The owner took pride in preserving a family farm. Another participant illustrated an intrinsic perception by saying that the winery aligned itself with environmental practices and that employees were the most important thing for the business. Similarly, a third interviewee expressed a desire to be a strong mentor to the employees of the business and introduced a new technology to reduce the environmental impact of the business. In each of these discussions, the winery owner made no indication that these decisions were made with the objective to improve the bottom line of their businesses.

Three other winery owners considered social and environmental sustainability to be a necessary component of their businesses' economic viability; that is, the practices had instrumental value. One participant stated, "if you're screwing up the soil, you're not gonna continue to get the crop return, so that's not sustainable," indicating that the business's land stewardship practices were motivated by ensuring a good crop yield rather than an innate desire to protect the land. Another winery owner stated, "sustainability to me means you're in it for the long haul…you need to continue to grow your business, but you need that solid base of things that you've relied on." This suggests that the winery's social and environmental practices were inspired by the desire to promote its economic longevity. Lastly, a third interviewee stated that "a lot of what we do is on the economic sustainability side." Recognizing that this statement sounded materialistic, the interviewee explained that one has to be focused on the economic side of a business to remain operable.

The remaining winery owners felt that social and environmental sustainability were irrelevant to their businesses. Although they identified goals to sustain their businesses, these owners felt that environmental and social practices were not necessary for attaining those goals. For example, one owner stated, "I'm so young right now that [sustainability] is not even in my vocabulary yet" and that they did not know "what environmentally [they] could even do." These statements suggests that this winery owner perceived a need to increase the scale of the business before integrating sustainability practices, and thus the concept was not currently relevant to the business. Another participant stated, "I don't really see quite how [sustainability] pertains to what I'm doing" and did not know "what [to] do to contribute to sustainability." A third winery owner was "not sure there's anything else I can do" with respect to environmental and social sustainability, voicing a perception that the business' small scale

limited its capacity to be sustainable. In each of these three discussions, winery owners depict sustainability as extraneous to their business models.

### *Sustainability Practices*

All winery owners discussed practices of sustainability though sometimes it was apparent that the interviewee was not actively linking their practices with sustainability. Regardless of the winery's conceptualizations, sustainability practices were categorized as either being economic, social, or environmental. Practices that were mentioned by multiple participants were used as subsequent coding categories under each of the three tiers (economic, social, environmental). Eight of the wineries incorporated at least a few practices in each component of the triple bottom line, while two others had economic and social sustainability practices, but no environmental sustainability practices.

Marketing, diversification, and cost mitigation strategies were the three economic sustainability practices most discussed by participants; each winery mentioned at least one of these strategies (Figure 2). Nine winery owners emphasized the importance of marketing their businesses, and in some cases particular products, to bolster consumer interest. For example, one interviewee stated, "we're trying to just sort of increase the marketing pressure on the things that are more profitable"; while another said, "we've spent a lot of money on free stuff and free shows to build interest." Many research participants had diversified their business income by having multiple products, incorporating business activities outside of winemaking, or using multiple modes of distribution. For example, one winery owner suggested that "the retail part is really important. The wholesale part, even more so." Another stated that event concerts are "almost a way of limiting risk because if [they] produced a whole lot more wine, [they're] not sure whether [they] would be able to sell it." Many of the winery owners had strategies to help mitigate the costs of running a business. One winery owner buys used barrels and refurbishes them, saving hundreds of dollars on infrastructure costs. Another purchases a majority of the grapes rather than growing them because it was a much cheaper option. Similarly, one participant buys juice to make his products because the cost of new grape presses was too high.

A smaller number of winery owners mentioned other economic sustainability practices such as establishing competitive advantages, strategizing levels of scale, and incorporating technology/automation.

A variety of social sustainability practices was evident across the participating wineries (Figure 3). Many winery owners support their surrounding communities in multiple ways, both economically and relationally. Eight out of the ten winery owners interviewed bought at least some of their inputs locally. For five of those eight participants, local purchasing was an important part of their business plans. One winery owner said, "we definitely pride ourselves in working with local farmers," and another stated, "we'll take basically anything we can buy that's in the state of Maine." Additionally, those five winery owners also mentioned employing local people, supporting other local businesses, or the belief that their businesses created a positive economic impact in the surrounding communities. Many participants believed that money spent locally stays local, and thus took initiative to provide positive economic support to their communities. Community support was also relational; all ten winery owners interviewed articulated having at least one practice that contributed to community relationships distinct from monetary impact.

FIGURE 2: **Economic Sustainability Practices of Maine Wineries**

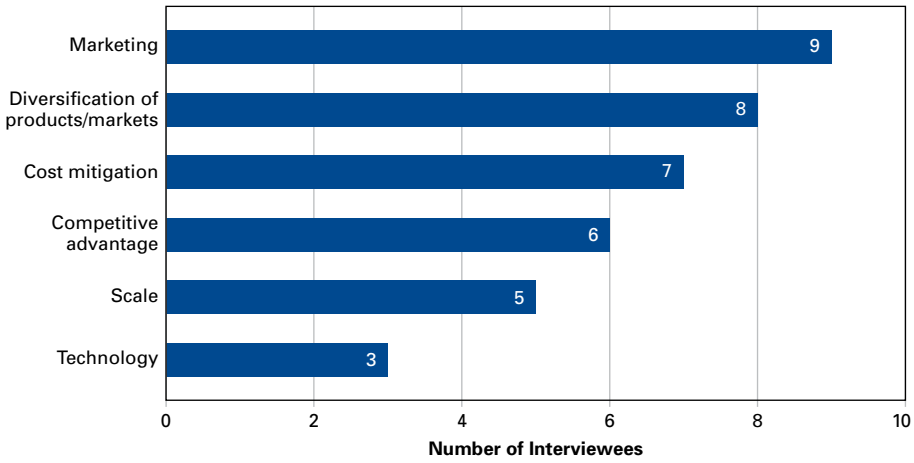
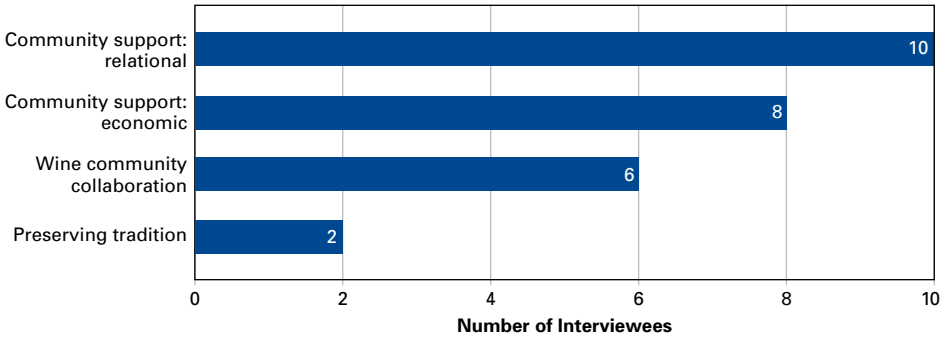


FIGURE 3: **Social Sustainability Practices of Maine Wineries**

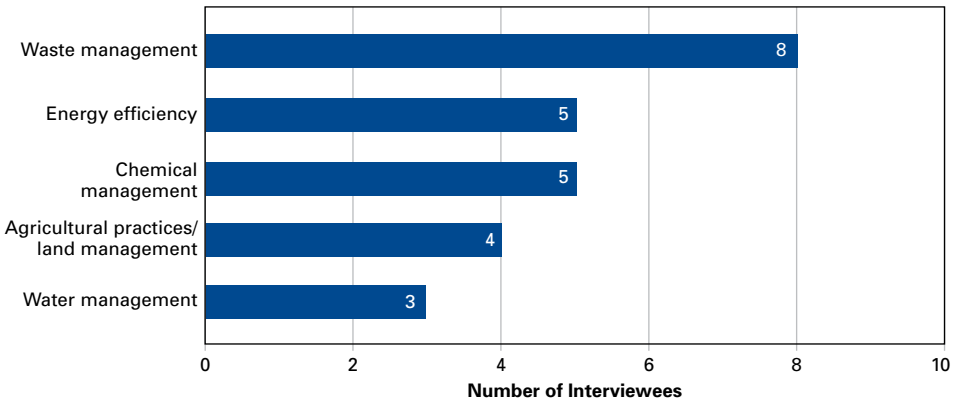



These practices included participating in or sponsoring local festivals, free training sessions, donating to local organizations, and volunteering. Relational community support was also demonstrated through the care that wineries have for their employees; three winery owners explicitly mentioned the value of their employees in business operations. All the winery owners interviewed sought to make their businesses be a positive aspect of the local communities. One owner said, "we want to be good members of the community and help out these organizations that need help," and another stated, "we want to be good to our neighbors."

Six of the participants also collaborated with fellow winemakers in the state. There was a strong sense of community among the network, with one participant saying the winemakers are "all out to help each other," and another stating that no one wants to "compete against one another." More than half the research participants identified a strong sense of communal sustainability in Maine's wine industry. Two of the winery owners interviewed stated their desire to preserve the tradition of their community. One said, "we feel that we've preserved a family farm [and that] we've been able to sustain something that would have probably been broken up and sold a long time ago." Similarly, another owner stated the business "is more about preserving the family farm and enjoying life." The desire to protect cultural heritage is another practice of social sustainability exemplified by Maine winemakers.

Environmental sustainability practices were less commonly identified by study participants than economic and social practices were (Figure 4). In fact, two of the winery owners interviewed did not identify any environmental practices within their businesses. The remaining eight winery owners, however, described strategies for waste management. Seven of these owners compost waste products on site or provide waste materials to local farmers for livestock feed. Additionally, two wineries use biodegradable products, for example, bottle corks and tasting-room utensils. Another two participants had wastewater management plans, one of which consisted of an elaborate bio-barrier system to ensure the water leaving their facilities has "zero toxins." Winery owners also discussed chemical management in both agricultural practices and wine production. Four wineries minimize the amount of sprays used on their fruit, and three of them also use environment-friendly cleaning products. With respect to energy efficiency, two wineries had solar panels that generated most of their businesses' electricity needs, and another winery experienced a 90 percent reduction in energy requirements because of a specialized production process. One respondent also reported consolidating input shipments to cut

FIGURE 4: **Environmental Sustainability Practices of Maine Wineries**



down on transportation emissions. A smaller number of winery owners also discussed methods to reduce water use, strategies for land management, and using IPM or organic agricultural practices.

### *Sustainability Barriers*

Winery owners described a number challenges in achieving economic, social, or environmental sustainability. Costs were the top challenge for economic sustainability (Figure 5). Nine winery owners identified costs such as capital investment in land and technology, labor, and distribution markets as barriers to remaining profitable. One owner suggested, "you have to invest a minimum of probably $50,000 just to have the semblance of equipment you would need." Three winery owners working with distributors articulated specific cost concerns. For one winery owner, the cost of using a distributor reduced profits per bottle of wine by 22 percent. The other two wineries reported the cost of a personal sales representative and the expense of entering out-of-state distribution markets as challenges associated with the use of distribution services.

Seven winery owners discussed the challenges that state laws pose for the economic sustainability of their wineries. For example, winery owners were frustrated that state laws "will let you sell at farmers markets, but [not at] festivals." Participants also reported that wineries are more regulated than breweries or distilleries: "a brewery can have a license to sell by the glass, and a distillery can have a license to sell by the glass, but it's never spelled out for a winery." Other legislative issues include difficulties in entering out-of-state distribution markets and retail prices that are set by the state.

More than half the participants mentioned lack of consumer demand as an economic challenge. Of the six winery owners who talked about this issue, most thought consumer demand was low because many consumers do not perceive Maine as a winemaking region. One winery owner said, "there's never gonna be a huge market for Maine wines, I don't think. The reason is that, at least right now, people don't believe you can make wine in Maine." Another winery owner said, "the northern [winemaking] regions have fallen into this backwater kind of class." One winery owner, however, thought that consumers are just unfamiliar with the Maine products: "I think we're still in the education phase…we're just trying to get people to try it and buy it."

Four of the respondents mentioned challenges with scale. Two of the small wineries need more supply to meet consumer demand for popular products. The other two need to increase production to mitigate losing some profits to distributors. One winery owner said, "a distributor would want another 35 percent, so now we're not making much money on a bottle of wine. That means we just have to produce more."

Three wineries were concerned with marketing. These participants felt it was difficult to compete with other wines: according to one participant, "there's no cheerleader section [for our wines]. It's just there on its own…with 75 other wines." Other marketing challenges included marketing at festivals and introducing and marketing new products without overwhelming previously successful ones.

Winery owners also experience several barriers to social sustainability (Figure 6). State-wide infrastructure—primarily the inability to source enough local inputs for wine products—was the most commonly cited social sustainability challenge. Half of the winery owners reported being constrained by the limited availability of local supplies. For example, "I wish we could buy more things locally for the winemaking business, but that's just not here," or "to find a good,

FIGURE 5: **Economic Sustainability Challenges Facing Maine Wineries**

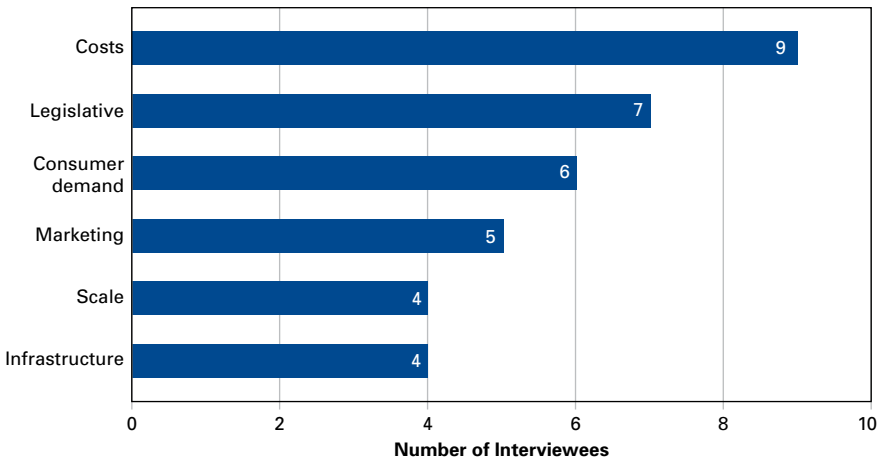


FIGURE 6: **Social Sustainability Challenges Facing Maine Wineries**

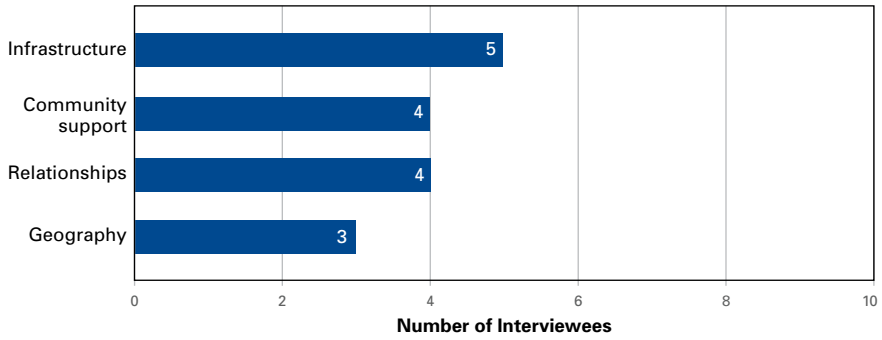
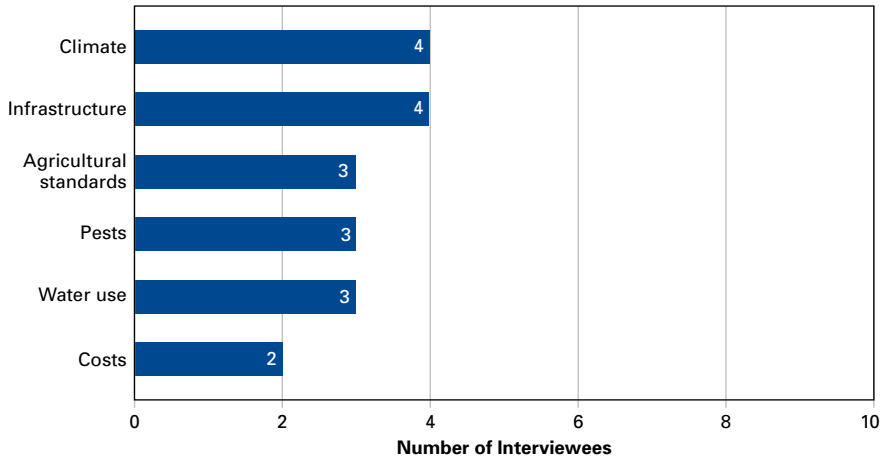



FIGURE 7: **Environmental Sustainability Challenges Facing Maine Wineries**




dependable source of blackberries at the quantity we need, that's not easy in Maine." Other barriers to social sustainability include lack of community support such as farm-to-table restaurants or local wine stores. One participant stated that "great chefs in these restaurants have everything farm-to-table and they stop right at the wine list," while another complained that "the last thing these wine stores want is local wine." Some participants noted the lack of educational services from UMaine Cooperative Extension, which leads winery owners to feel isolated. One winery owner complained, "it's not like you call 'Vineyard Manager 101' who knows things."

Four of the respondents mentioned challenges with some relationships, for example, with a distributor, a supplier, or members of the Maine Winery Guild. One participant stated, "there is no such thing as a good distributor," and another said, "I've had it out twice with [my supplier] over pricing and stuff." The last social issue mentioned by multiple winery owners was geographic isolation; 30 percent of the winery owners interviewed felt challenged by their location, which it made it more difficult to interact with customers and other wineries.

Eight participants mentioned challenges relating to environmental sustainability (Figure 7). Climate challenges, the most-cited problem, was addressed by four interviewees. This concern was expected as Maine has a short growing season and variable weather patterns.

Four winery owners mentioned agricultural inputs as environmental sustainability barriers. One winery owner found the accessibility of organic inputs to be a challenge; two others felt that natural or organic chemicals were inadequate for winegrowing. As one winery owner stated frankly, "organic chemicals…[are] not very efficacious on the funguses or the insects… and they have detrimental effects to the trees."

## POLICIES AND ADVOCACY

The goal of this study was to explore sustainability in Maine's wine industry and the challenges Maine wineries face in implementing sustainable practices. Overall, we found that Maine's wine industry is diverse, both in terms of scale and type of products and in the role of sustainability within these businesses. While economic sustainability is the priority for all research participants, individual winery owners ranged in their conceptualizations of sustainability and adjoining practices.

It is worth discussing participants' focus on economic sustainability. Our interviews revealed a sense of synergy among winery owners with the greater

mission to build Maine's wine industry. More than one participant mentioned the "rising tide" phenomenon, implying that if current wineries can continue to develop and more new winery businesses open, the industry as a whole is bound to grow. In other words, most participants felt optimistic about the benefits accruing to individual wineries of a growing sector. This perception might stem from the recent success of Maine's craft beer industry, which has seen enormous growth in the last decade. This study found that Maine wineries are largely focused on economic concerns relating to their individual business operations and developing the industry as a whole rather than any social and environmental issues. It is an opportune moment for the Maine Winery Guild to bolster the Maine wine brand by building on successes such as the Maine Wine Trail, wine festivals, and winery concerts and concentrating on building an internally cohesive group that can advance the brand.

This focus on economic sustainability, however, does not overwhelm winery owners' environmental and social sustainability considerations. Indeed, a substantial portion of the winery owners interviewed in this study had social sustainability measures in place. Maine wineries are collectively fulfilling the roles of provider, sponsor, guardian, or promoter in a local community. They serve as both providers and sponsors by providing donations to other local businesses, employing local people, sponsoring local festivals and events, and buying inputs from local suppliers. A smaller number of the interviewees also act as guardians by safeguarding the physical landscape and preserving family farm traditions that were once commonplace throughout Maine. Finally, a number of wineries serve as promoters by drawing tourism to an area. The close-knit nature of Maine communities and the general understanding that local businesses are a fundamental part of Maine's economy may explain the presence of social sustainability practices among wineries in this study.

Out of three pillars of sustainability, environmental sustainability is currently the least important for winery owners. Some respondents mentioned environmental practices, but it was clear that these practices were not an important part of their business plans. Additionally, few participants mentioned environmental challenges, perhaps a further indication of an overall lack of involvement in environmental considerations. It is important to note that the Maine wine industry's lack of attention on environmental sustainability is different from the attention being paid to this issue in other wine regions across the globe such as California, France and New Zealand. As mentioned previously, these mature industries have developed sustainability workbooks and in some cases policies that address sustainable viticulture and winemaking procedures.

Some of the most important economic sustainability challenges faced by Maine wineries include costs, legislation, and consumer demand. Addressing the legislative issues could help the wine industry increase its economic sustainability. A number of wineries in this study mentioned Maine laws that prohibited them from selling at festivals and events or to out-of-state markets; another issue revolves around zoning regulations. These rules and regulations limit the profitability of Maine wineries and diminish their capacity to be economically sustainable. Maine's craft beer industry serves as an example of the benefit of focusing on legislative action. The beer industry has spent several years lobbying the state legislature to replace antiquated alcohol laws with regulations that are supportive of the state's growing alcohol industry. The success of the Maine Brewery Guild illustrates that there is an opportunity for the Maine Winery Guild to follow suit, either independently or in conjunction with other alcohol guilds in the state. With proper legislation, wineries may face fewer cost concerns and find it easier to market their products, which in turn could alleviate challenges with the lack of consumer demand.

A few of the participants mentioned community support as a social sustainability challenge. Winery owners often feel they have to fend for themselves; not only is there little support from the state legislature, but there is also little support from Cooperative Extension and local restaurants and liquor stores. A majority of participants expressed interest in educational programs in which a professional in either winemaking, sustainable agriculture, or some other applicable industry provides guidance for how to best grow grapes and make wine in Maine given its unsuitable climate and topography. This could be an opportunity for University of Maine Cooperative Extension to devote more resources to growing grapes in Maine, perhaps even establishing a research vineyard as the University of Massachusetts has done.

With increased educational opportunities, more of Maine's winery owners might try growing their grapes, which could facilitate a stronger niche-market for Maine-grown grape wine products. This niche could appeal to certain consumers, as suggested in Michigan's

market research study (5 Lakes Energy 2015), and help strengthen demand and increase the viability of the industry overall. Furthermore, it is likely that appealing to local restaurants and other businesses will become easier with increased consumer demand for Maine wines. Maine winery owners should continue to develop their products, perhaps with a focus on unique Maine grape products or wine with other fruit flavor profiles such as blueberry and apple. With stronger relationships between winemakers, community education services, and other local businesses, the social sustainability of the Maine wine industry is apt to increase.

Few participants mentioned particular environmental challenges that constrained their ability to run their businesses in a more environmentally sustainable manner. Climate was a salient issue, but winemakers cannot change the weather or growing season length. The winery owners should perhaps focus on other environmental challenges: more effective organic practices and treatments for diseases and pests for fruit growers. Winemakers also expressed frustration with a lack of price premiums for organic products in Maine, which makes it hard to justify adhering to organic standards. If Maine can develop a stronger market for organic wine products, wine producers will implement more environmentally sustainable practices.

Maine's wine businesses require many inputs that need to be shipped from afar (e.g., barrels, presses, bottles, grapes), which results in a large amount of greenhouse gas emissions. An increase in local (i.e., Maine or New England) winemaking infrastructure may reduce the carbon footprint of Maine's wine industry, helping the sector become more environmentally sustainable. Maine or other neighboring states could create incentives for companies that produce the necessary infrastructure for the wine industry, which would help the burgeoning beer and spirit sectors as well.

Participants also mentioned water usage as an area of concern for wine production, but water usage needs to be addressed across the global wine industry, not just by individual wineries in Maine. According to interviewees, winemaking requires a lot of water, and as one participant mentioned, there seems to be nothing that can be done to change that until the broader industry creates new technology to reduce the water needs for winemaking and cleaning purposes. Larger global wine stakeholder groups should invest in or create incentives for these new technologies. In the meantime, however, educational programs about controlling water usage and effectively managing waste water could help to facilitate marginal changes in a winery's environmental sustainability.

Research has shown that many winery owners feel that they lack the appropriate knowledge when it comes to how sustainability can be applied in their business (Dodds et al. 2013; Szolnoki 2013). During our interviews, it was clear that all winery owners had some sustainability measures in place, but they did not think the measures were a priority, perhaps because they were unsure of their significance. Additionally, their sustainability conceptualizations and practices were motivated entirely by personal values, which is to say, the only things pushing Maine winery owners to operate in a sustainable way were their own values, goals, or concerns for their businesses. Although self-motivation is arguably a good thing, stronger external factors could help push Maine's wine industry towards more sustainable operations. Cordano et al. (2009) found both internal and external pressure made for the most success in the greening of California's wine industry. Following suggestions of Silverman et al. (2005), developing programs that both educate about and create incentives for sustainability practices could be beneficial for Maine's wineries. We suggest that the Maine Winery Guild work with the University of Maine and state legislature to conduct market research blending Maine's brand for quality and sustainability with local wine. This would be a first step in promoting wine industry growth in the future with respect to all three pillars of sustainability.

## NOTES

1. Basic statistics about the US wine industry is available on the following websites: https://www.statista.com/statistics/259353/number-of-wineries-in-the-us/; https://discovercaliforniawines.com/media-trade/statistics/.
2. More information about New England wineries is available on this website: https://sipnewengland.com/.
3. "About Us." *Maine Wine Trail*. https://www.mainewinetrail.com/.
4. "About CSWA." *California Sustainable Winegrowing Alliance*. https://www.sustainablewinegrowing.org/.

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**Michaela Murray** earned her BS in ecology and environmental sciences with minors in economics and sustainable food systems in 2019 from the University of Maine. As a member of the Honors College, she conducted her undergraduate thesis research on the sustainability of Maine's wine industry under advisor Dr. Mark Haggerty. Murray currently resides in the Boston area where she works as a research analyst for Industrial Economics, Inc.

**Mark Haggerty** is currently an associate professor in the Honors College at the University of Maine. His research interests include sustainability in food systems, local foods and the farm-to-institution movement, and pedagogy.

**Stephanie Welcomer** is a professor of management at the University of Maine. Welcomer's research has focused on the intersection of sustainable businesses, communities, and environments, and she has recently published articles on climate change and farming, farmers' adaptation strategies for energy resources, and pro-environmental behavior. Her work is undergirded by interests in sustainable food systems, and she has conducted research on artisan cheesemaking in Maine, as well as farm-to-institution networks.