Vineyards and Wineries in Arizona

An Economic Contribution Analysis

NOVEMBER 2021

*** REVISED FROM AUGUST AND SEPTEMEBER VERSIONS ***

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Executive Summary

What is the study about?

Arizona's wine industry has grown rapidly over the last decade, both in terms of the number and size of vineyards in the state, as well as the number of businesses involved in winemaking. Growing grapes and producing wine contribute to local economies, generating economic activity and supporting jobs and incomes within the wine industry and in businesses directly and indirectly linked to the wine industry. In addition to existing wine production and sales, investments to expand Arizona's wine industry also generate economy activity. Establishing a vineyard or winery requires large initial capital investments, in addition to recurring annual expenses. Such start-up spending contributes to the economy even before an operation begins to generate wine sales revenues.

The economic contribution of wine production in Arizona includes economic activity related to producing and selling wine (grape growing and winemaking) (***direct effects***), economic activity in businesses that provide goods and services as inputs to grape and wine production (***indirect effects***), and economic activity related to those employed within Arizona's wine industry spending their incomes within the state (***induced effects***). By purchasing inputs from within the state (indirect effects) and employing Arizonans that spend their incomes within the state (induced effects), a ripple of economic activity is generated beyond the direct contribution of the wine industry. These are referred to as economic multiplier effects.

This study presents revised estimates for the contribution of Arizona's wine industry to the state economy in 2019, including economic activity associated with wine grape growing, winemaking, wine sales, and investments in vineyard and winery establishments. The study also accounts for economic activity that is supported in other industries through linkages, also known as indirect and induced multiplier effects. Total economic contributions are presented using a variety of metrics, including output (sales), value added (synonymous with Gross State Product), income, and jobs. Finally, the study presents information about the size, structure, and vertical integration of Arizona's wine industry based on a statewide survey of firms involved in grape growing and winemaking conducted in mid-2020.

What did the study find?

Arizona's wine industry has grown rapidly over the last decade.

- Statewide, acreage in grapes (both wine and other grapes) has nearly doubled from 942 acres in 2012 to more than 1,500 acres in 2017 (USDA, 2019).
- Between 1999 and 2019, the number of bonded wine producers in Arizona increased from 12 to more than 120, with significant growth starting in the mid-2000s. As of 2019, there were 125 bonded wine producers in Arizona (TTB, 2019).

Revised estimates of economic activity directly associated with wine grape growing, winemaking, and wine sales in 2019 are an estimated $59.8 million.

- The value of grapes produced by Arizona vineyards in 2019 was an estimated $9.3 million.
- In 2019, 190,500 gallons of Arizona-produced wine were sold through various market channels. This is equivalent to nearly 1.0 million bottles and an estimated $23.1 million in sales.
- Finally, Arizona wineries produced 595,000 gallons of wine in 2019, equivalent to more than 3 million bottles of wine, the highest production levels to date. While sales revenues for these newly produced bottles will not be realized for a year or more as the wine ages, this production generates economic activity in the state through the purchase of inputs and hiring of labor, with an estimated $40.3 million spent in 2019 to produce this wine.
- Direct economic activity related to current wine production and sales have been revised from previous estimates. Previous estimates incorrectly overstated the direct contributions of existing vineyards and wineries in Arizona.
- The wine industry's revised direct value of output in 2019 is equal to its sales in 2019 plus the value of inventory change related to 2019 production. The estimated inventory change for 2019 was 404,500 gallons of wine (595,000 – 190,500), valued at approximately $27.4 million. Adding this to total sales in 2019, the revised output of existing wineries in Arizona is an estimated $50.5 million ($23.1 million in sales + $27.4 million in inventory). Finally, incorporating the value of grapes produced by existing vineyards ($9.3 million), the revised total direct output of vineyards and wineries in Arizona for 2019 was an estimated $59.8 million.

Investments in establishing new vineyards and wineries generated an additional $7.8 million in sales for Arizona's economy in 2019.

- Based on reported increases in non-bearing acreage from the 2017 Census of Agriculture, spending by Arizona wine grape growers on non-bearing acreage totaled $1.45 million in 2019. Despite the fact that this acreage has not yet reached maturity and isn't generating revenues, producers still must invest in materials, equipment, and labor to maintain this acreage and bring it into production.
- Additionally, there were 14 new wineries established in 2019, representing an estimated investment of $11.5 million in buildings and equipment.
- Accounting for the fact that not all vineyard and winery establishment purchases are made in-state, total economic activity associated with expanding the industry directly generated $7.8 million in sales in Arizona.

The total revised contribution of Arizona's wine industry to the state economy in 2019 was $133.0 million in sales and $68.7 million in gross state product (GSP). This includes grape growing, winemaking, wine sales, new investments in vineyards and wineries, and associated multiplier effects.

- Direct contributions of Arizona's wine industry include $67.6 million in sales, $32.2 million in gross state product, and $29.5 million in income.
- An additional $65.4 million in sales, $36.5 million in gross state product, and $21.5 million in income is supported through indirect and induced multiplier effects.
- These results reflect revised estimates and supersede any previous estimate reported in the August or September versions of this report.

Arizona's wine industry supported more than 1,100 jobs in 2019, including jobs supported through multiplier effects.

- Current production and sales by Arizona's vineyards and wineries directly supported an estimated 651 jobs. Investment and expansion in the industry directly supported an additional 46 jobs.
- Through indirect and induced multiplier effects, an additional 414 jobs were supported in other industries within the state.

Arizona's wine industry is highly vertically integrated, with most businesses involved in both grape growing and wine production.

- Survey results suggest that the vast majority of Arizona vineyards also produce wine, with a large proportion using their own grapes. Of 23 vineyards responding to the survey, 16 reported using 75% or more of the grapes grown in their vineyard within their own winery operation and approximately half of respondents (11 respondents) reported using 100% of the grapes produced in their vineyard within their own winery operation. No respondent reported selling grapes to out-of-state wineries.
- About two-thirds (67%) of responding wineries reported that more than 50% of the grapes they use for winemaking come from their own vineyard. Of 18 responding wineries, 7 reported that between 50% and 99% of grapes come from their own vineyard and 5 respondents reported that 100% of grapes come from their own vineyard. There were 6 responding wineries that reported not sourcing any grapes from their own vineyard, however, all of those respondents reported purchasing all grapes from other Arizona vineyards.

Arizona wineries rely heavily on their own sales and distribution channels to market their wines, with retail wine sales and tasting room fees playing an important role.

- On average, retail wine sales represent the largest share of winery revenues (39.4%), followed by tasting room fees (23.7%), wine club or internet sales (14.7%), and wine sales through wholesalers or distributors (10.6%).
- Many individual wineries rely heavily on retail sales and tasting room fees. For some individual wineries, tasting room fees and retail sales, independently, account for more than 76% of winery revenues. There are no other revenue sources that account for this large a share of revenues.

How was the study done?

The wine industry spans a wide range of economic activities including agricultural production, manufacturing, and distribution. Consequently, there is no single data source that provides information on all segments of the industry. Data available from government sources use varying definitions that make accounting for all operations involved in viticulture and winemaking challenging. Given these challenges, and to better understand the structure and size of Arizona's wine industry, we conducted an internet survey of grape growers and wineries in Arizona. Combined with secondary data sources, the results from the survey were used to quantify the size and composition of Arizona's wine industry, including economic activity associated with wine grape production, wine production, wine sales, and investments in vineyards and winery establishments in 2019. Then, to account for economic activity supported in other industries in the state (through indirect and induced multiplier effects), we conducted of an economic contribution analysis using the IMPLAN 3.1 software and data. Two separate revisions were made to the original August publication to correct for errors as noted below.

A Note About the September and November Revisions:

Revisions made in September correct for errors related to Figure 6. Bonded Arizona Wine Producers by Arizona County, 2019. The previous version incorrectly reported the number of wine producers for each county.

Revisions made in November correct for errors related to the total economic contribution of existing vineyards and wineries, presented in Table 12. Economic Contribution of Existing Arizona Wineries and Vineyards, 2019. Previous versions incorrectly overstated the direct contributions of existing vineyards and wineries in Arizona. This is due to a double counting of wine inventory and sales in 2019. Previous estimates included all economic activity associated with production in 2019 but should have only included the value associated with the change in wine inventory. As a result of this miscalculation, indirect and induced multiplier effects were also slightly overstated in earlier versions of this report.

Introduction

Arizona's wine industry has grown rapidly over the last decade, both in terms of the number and size of vineyards in the state, as well as the number of businesses involved in winemaking. Since 2012, statewide grape acreage has nearly doubled and the number of wineries in the state has more than doubled, from 58 wineries to 125 (USDA, 2019; TTB, 2021). While still small in comparison with neighboring California, Arizona's wine industry is young and has demonstrated the ability to grow exceptional grapes and produce high-quality wines.

The growth of Arizona's wine industry has been bolstered by the designation or proposed designation of three American Viticultural Areas (AVAs) within the state. AVAs are areas officially designated and recognized as wine grape-growing regions by the U.S. Alcohol and Tobacco Tax and Trade Bureau (TTB). To become an AVA, a region must demonstrate that it has distinguishable and unique qualities for wine grape production such as soil composition, microclimate, or topography (TTB, 2012). Arizona currently has two AVAs in southeastern Arizona, where a significant proportion of the state's vineyards are concentrated, and one proposed AVA that has yet to be approved. An AVA designation allows wineries to produce estate-bottled wines, or wines that are made exclusively from grapes grown in vineyards located within the AVA (Brady, 1987). For a wine to be bottled and labeled with an AVA name, at least 85 percent of the wine grapes used must be derived from within the region (Establishment of the Willcox Viticultural Area, 2016).

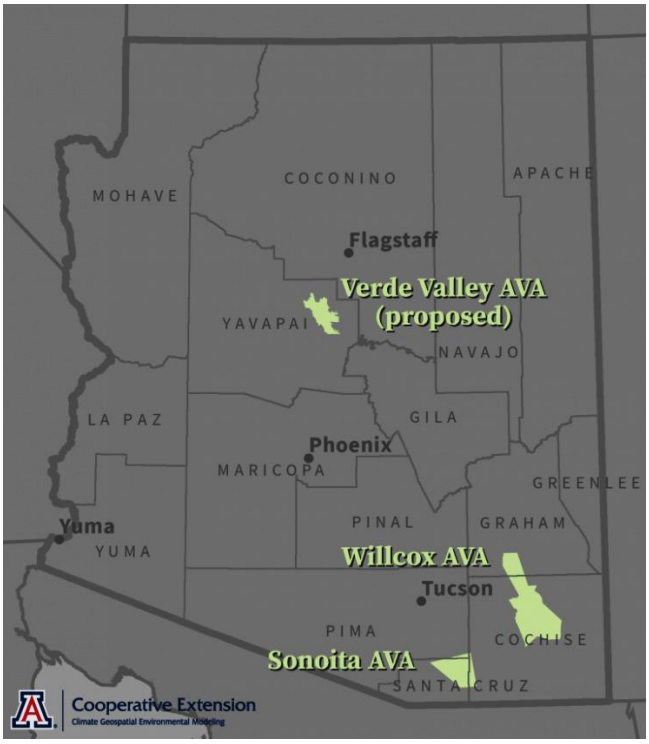
Arizona's first AVA designation was the Sonoita AVA in Santa Cruz and Cochise counties, just north of the Mexico border in Southeastern Arizona. Arizona's first commercial planting of wine grapes occurred in this area in the early 1980s. Production of wine grapes started in the early- to mid-1970s when the University of Arizona began collaborating with the Babocamari Ranch Company to grow wine grapes and produce wine (Establishment of the Sonoita Viticultural Area, 1984). While many people thought it would be too hot in Arizona to grow wine grapes, studies by University of Arizona researchers found that the soil characteristics, climate, and high altitude of the region were suitable for growing *Vitis vinifera* wine grapes (Dutt et al., 1976; Brady, 1987). *Vitis vinifera* wine grapes are a European vine species considered as one of the best for producing world-class wines (Thornton, 2013). *Vitis vinifera* grapes require mild, dry climates like those in California, Arizona, and Southern New Mexico (Hererra, 2000). European grape varieties include Cabernet Sauvignon, Merlot, Pinot Noir, Syrah, Zinfandel, Chardonnay, Pinot Blanc, and Sauvignon Blanc, among many others.

The state's second designated AVA was the Willcox AVA, a 526,000-acre viticultural area located within portions of Graham and Cochise counties in southeastern Arizona (Establishment of the Willcox Viticultural Area, 2016). At the time of designation in 2016, the region had 21 commercially producing vineyards on 454 acres and 18 wineries (Establishment of the Willcox Viticultural Area, 2016). Located within a shallow basin and surrounded by the Chiricahua, Dos Cabezas, Pinaleños, Dragoon, Little Dragoon, and Winchester mountains, the Willcox AVA has a topography, soils, and climate suitable for wine grape production (Establishment of the Willcox Viticultural Area, 2016).

Finally, in 2017, a designation was proposed for a 200 square-mile area in Yavapai County in central Arizona known as the Verde Valley AVA. At the time of the proposal, the region had 24 commercial vineyards on 125 acres and 11 wineries. Located within the Verde River basin, the grapes best suited for the region are warm-climate

grapes such as Syrah, Cabernet Sauvignon, Petite Sirah, Zinfandel, Malvasia Bianca, and Viognier (Proposed Establishment of the Verde Valley Viticultural Area, 2016). The locations of Arizona's designated and proposed AVAs are presented in Figure 1.

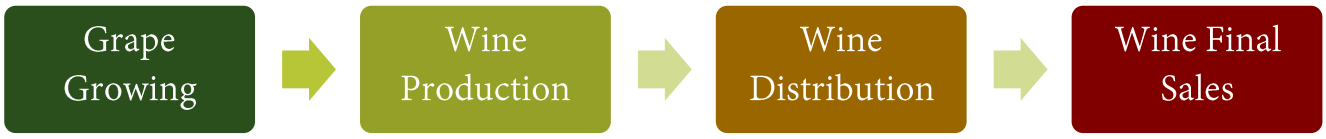
FIGURE 1. ARIZONA'S DESIGNATED AND PROPOSED AMERICAN VITICULTURAL AREAS (AVAS)



Source: Jeremy Weiss, University of Arizona Cooperative Extension

The production of wine encompasses a broad range of activities and incorporates businesses involved in different areas of the supply chain. The wine industry involves grape growing, wine making, and wine distribution – with final sales occurring either through direct-to-consumer sales, sales at grocery and other specialty stores, or restaurants (Figure 2). Revenues and profits are generated along the supply chain whenever the product changes hands, for example, when a grower sells grapes to a wine producer or when a wholesaler, retailer, or restaurant charges a markup on wine sales.

FIGURE 2. WINE INDUSTRY SEGMENTS



In many cases, businesses involved in the wine industry are active in more than one segment of the supply chain. For example, farm wineries may grow their own grapes as well as produce their own wine. In Arizona, many winemakers are involved in grape growing and wine production and more than one vineyard, winery, and/or

tasting room may be under the same ownership (Glenn, 2011). Similarly, many wineries rely heavily on their own sales and distribution channels as a major source of revenue. Revenues may be derived from tasting room fees, retail wine sales on the premises, wine club or internet sales, and wine festivals and other events. For some wineries, other possible sources of revenue include direct sales to restaurants and retailers (rather than through wholesale channels) and custom crush arrangements for other wineries. In Arizona, direct sales (and deliveries) to consumers, retailers, and restaurants are limited to farm wineries that produce less than 20,000 gallons of wine, and almost all Arizona wineries meet this requirement (Arizona State Research Staff, 2018). Generally speaking, Arizona's wine industry is heavily vertically integrated, with most operations involved in multiple steps along the supply chain.

An important source of revenue for vineyards and wineries is agritourism. In the case of wine agritourism, this includes tasting rooms and tours offered on vineyard and winery premises. Tourism not only provides an important source of revenue for businesses in the wine industry, but also supports other businesses in the local economy that cater to tourists such as hotels and restaurants, providing jobs and incomes for people in the region. In Arizona, the state tourism office promotes three major wine trails, all associated with the state's AVAs: (1) the Verde Valley Region, (2) the Sonoita Region and (3) the Willcox Region (Arizona Office of Tourism, 2020). A 2017 study found that the Arizona wine tourism industry supported an estimated $56.2 million in sales, 641 full-time equivalent jobs, and $3.6 million in local and state tax revenues statewide (Fitch, et al., 2017). The study also found that approximately 70% of visitors purchased a bottle of wine at the tasting room, winery, or vineyard that they visited, highlighting the importance of direct-to-consumer sales that take place on the vineyard/winery premises (Fitch et al., 2017).

Aside from tourism activity supported by Arizona's wine industry, wine grape growing and wine production both contribute directly to the state economy, generating economic activity and supporting jobs and incomes along the wine-making supply chain. Because production of a bottle of wine takes place over a number of years, estimating the economic activity occurring in a given year involves capturing activity at different stages of the production process. In a given year, vines of bearing age require agricultural inputs, as well as labor to maintain them and harvest their fruit. This production of wine grapes generates economic activity through expenditures on agricultural inputs and labor, as well as through the sale of grapes in some cases. At the same time, wineries transform grapes into wine by crushing, pressing, fermenting, aging, and bottling the wine, all of which also requires inputs and labor and generates economic activity. Meanwhile, wineries sell bottles of wine that were produced in previous years, though the wine sold corresponds to agricultural production in previous years. The economic activity generated by Arizona's wine industry in a given year, therefore, accounts for current production (maintaining existing wine grape acreage and wine production), as well as the sale of wine produced from years past. In order to avoid double counting of wine production and sales in a given year, adjustments must be made to only include the value of inventory change, not the full value of production in 2019. Thus, the wine industry's total value of output in 2019 is equal to its sales in 2019 plus the value of inventory change related to 2019 production.

Beyond current production and sales, investment in new wine grape acreage or new wineries generates additional economic activity in the state. Significant capital investment and ongoing operating expenses are required to

establish a vineyard or winery. While it often takes several years before vineyards and wineries begin producing revenues, the investments in new operations contribute to local and state economies in the year that they occur.

Finally, beyond economic activity directly linked to the wine industry, there are many businesses that supply goods and services to vineyards and wineries as inputs to production (also known as backward linkages). For example, there are agriculture-related businesses that provide harvest support services, irrigation supplies, fertilizer, and pest control advice to vineyards. Similarly, wineries purchase barrels, packaging materials, refrigeration equipment, and other items needed for operating their business. While not directly part of the wine industry, these support industries are critical to the continued growth of the wine industry in Arizona and, if located within Arizona, also contribute to state's economy.

This study estimates the contribution of the wine industry to Arizona's economy in 2019, including economic activity associated with wine grape growing, winemaking, wine sales, and investments in vineyard and winery establishments. Further, the study provides information on the size, structure, and vertical integration of the industry in Arizona. The study also estimates economic activity supported by Arizona's wine industry in other industries through multiplier effects. The total economic contribution is presented using a variety of metrics, including output (sales), value added

Growing Viticulture Expertise

Arizona's higher education system has played an important role in the development of the state's wine industry. In the early 1900s, the University of Arizona, the state's land grant institution, conducted field trials for a variety of fruits across the state, including wine grapes, and found that several varieties produced in Arizona were suitable for wine (Dutt et al., 1976). State and national legislation related to Prohibition, however, hampered any progress and in 1933 the university vineyard near Phoenix was plowed under (Dutt et al., 1976).

Interest was rejuvenated again in the early 1970s, and several experimental vineyards were planted around the state, including one in Sonoita in southeastern Arizona. Through this project, University of Arizona researchers learned of the relative low water requirements of grapevines (as compared to Arizona's traditional crops, cotton and alfalfa), determined that there was "good potential to produce fine, premium quality vintage wines" (Brady, 1987, p.4), and concluded that Mediterranean premium wine grapes held the greatest potential for wine production in Arizona (Dutt et al., 1976).

More recently, in 2009, the Southwest Wine Center at Yavapai College was established to "fulfill the education and workforce development needs of a thriving Arizona wine industry" (Southwest Wine Center, 2020). The Southwest Wine Center is a 13-acre working farm winery offering practical experience and degrees and certificates in viticulture (study of grape cultivation) and enology (study of wines). Many of the new vineyards and wineries throughout the state were started by graduates of the program. In fall of 2018, there were 104 students across Arizona enrolled in viticulture and enology classes (Southwest Wine Center, 2020).

Other current research at the University of Arizona explores the impacts of climate change and variability on vineyards in Arizona. A monthly *Climate Viticulture Newsletter* (https://cals.arizona.edu/research/climategem/content/climate-viticulture-newsletter) is produced for wine grape growers and provides a review of temperature and precipitation trends and an outlook for the coming month (CLIMAS, 2020). Workshops have also been held for growers to review the growing season and explore climate impacts on vine phenology (Weiss et al., 2020).

Looking ahead to future collaborations, survey respondents of this study were asked to select topics for future study with the University of Arizona. The most common topics selected were sustaining and enhancing soil health; conducting additional 'growing season in review' workshops; analyzing the economics of the Arizona wine industry (which will be largely addressed by this report); examining current weather impacts on viticulture; and better understanding climate change impacts on the future of viticulture. University of Arizona researchers will use this list of priorities to guide planning of new activities with the Arizona wine industry.

(gross state product), income, and jobs. While not explicitly measured or explored in this study, the state's higher education system has supported the wine industry in a variety of ways. This includes conducting initial agricultural research trials for determining the viability of wine grape growing, providing critical workforce training for future viticulturists and vintners, and conducting research to help better understand and manage risks associated with a changing climate (see text box on page 13).

Data and Methods

The wine industry spans a wide range of economic activities including agricultural production, manufacturing, and distribution. Consequently, there is no single data source that provides information on all segments of the industry. Data available from government sources use varying definitions that make accounting for all operations involved in viticulture and winemaking challenging[1]. Further, businesses involved in the wine industry often take part in more than one segment of the supply chain, creating challenges in identifying the number of unique businesses involved in the wine industry. While the State of Arizona actively regulates and tracks gallons of wine sold via different market channels, these data are not publicly available from the Arizona Department of Revenue. Finally, because production of a bottle of wine takes place over a number of years, estimating the economic activity occurring in a given year requires considerable care to avoid double counting.

Given these challenges, and to better understand the structure and size of Arizona's wine industry, we conducted a survey of grape growers and wineries in Arizona. Questions pertained to sales and production costs (for both vineyards and wineries), growing practices (vineyards), and marketing channels and revenue sources (wineries). Combined with secondary data sources, the results from the survey were used to quantify the size and composition of Arizona's wine industry, estimate the economic activity associated with production and sales, and estimate investments in vineyard establishment and new wineries.

To account for economic activity supported in other industries in the state (through indirect and induced multiplier effects), we conducted of an economic contribution analysis using the IMPLAN 3.1 software and data (IMPLAN Group, LLC, 2019). An economic contribution analysis presents a snapshot of existing economic activity surrounding a particular industry or attraction. In this case, the study reflects economic activity related to wine grape production, wine production, wine sales, and the establishment of new vineyards and wineries taking place in 2019. Economic contributions are presented using a variety of metrics, including output (sales), value added (synonymous with gross state product), income, and jobs.

Arizona Wine Industry Statistics

A variety of metrics can be used to characterize the state's wine industry. These include economic measures such as wine sales, value of grapes produced, number of jobs supported, and wages and incomes of people employed in the industry (the focus of this study). Other statistics that help describe the industry include the number of businesses in the industry, land acreage in grape production, tons of wine grapes produced, and volume of wine

[1] A detailed description of the various data sources is presented in Appendix A.

produced. While there is no single data source that provides this information, this section summarizes the most recent and relevant statistics available. A more detailed look at available data is presented in Appendix A.

Wine Grape Production

Wine grape production occurs in vineyards and involves the establishment of vines as well as cultivation and harvesting of wine grapes. Wine grape production is considered an agricultural industry, and this study relies on data from the U.S. Department of Agriculture's (USDA) Census of Agriculture to characterize the activities taking place in Arizona vineyards. Statewide, acreage in grapes[2] has nearly doubled from 942 acres on 178 farms in 2012 to more than 1,500 acres on 230 farms in 2017 (USDA, 2019). Approximately 87% of grape acreage (1,339 acres) in 2017 was of bearing age (USDA, 2019).

The top counties in Arizona for grape production (bearing and non-bearing acreage) were Cochise County (49%), Santa Cruz County (15%), and Yavapai County (10%) (USDA, 2019). Combined, these three counties accounted for 74% of Arizona's 2017 grape acreage. They also correspond to the locations of Arizona's three AVAs.

In general, farms with grape acreage are relatively small compared with farms producing other crops in the state. In 2017, about 35% of farms with grape acreage in Arizona were less than 1 acre in size (USDA, 2019). That said, there has been significant growth in Arizona farms producing grapes, with a significant increase in the number of farms with 1 to 4.9 acres (a 60% increase from 40 farms to 65 farms) and 5 to 14.9 acres (a more than two-fold increase from 26 to 57 farms) (Figure 3).

FIGURE 3. ARIZONA FARMS WITH GRAPE ACREAGE BY FARM SIZE, 2012 AND 2017

Source: USDA, 2019

Total acreage among farms with 5 to 14.9 acres and 25 to 49.9 acres has also increased significantly between 2012 and 2017. Acreage among farms with 5 to 14.9 acres increased from just over 200 acres in 2012 to nearly 450 acres in 2017 (Figure 4). Even greater is the increase in acreage of farms with 25 to 49.9 acres, with total acreage increasing from about 145 acres to more than 420 acres, nearly 3 times higher (Figure 4). Combined, these statistics suggest that growth

[2] Grape acreage reported by the Census of Agriculture includes all grapes. Statistics do not differentiate between wine grapes and table grapes.

in wine grape production in Arizona is fueled by new entrants to the industry as well as existing farms expanding their grape acreage.

FIGURE 4. ARIZONA GRAPE ACREAGE AND FARMS BY SIZE, 2012 AND 2017

Source: USDA, 2019

Data on yield and volume of production of wine grapes are sparse. A study conducted by the USDA National Agricultural Statistics Service Arizona Field Office reported an average yield of 1.8 tons per acre for Arizona vineyards (USDA, 2014). This was an average for all varieties, with yields ranging from less than 1 ton per acre to about 3.3 tons per acre[3] (USDA, 2014). Like other agricultural industries, yields can vary significantly from year to year due to production losses related to climate events like rain, frost, and hail, bird and animal damage, and plant disease. Given these risks, one of the challenges facing the industry is ensuring a sufficient supply of Arizona grapes for Arizona-made wine (Glenn, 2011; Burch, 2021). Top varieties in Arizona (in terms of acreage) were Cabernet Sauvignon, Syrah, Grenache, Zinfandel, and Merlot, though there were more than 25 varieties with reported acreage in Arizona (USDA, 2014). Based on acreage and reported average yield, the USDA NASS study estimated that there were 1,370 tons of wine grapes produced in Arizona in 2013 (USDA, 2014).

Wine Production

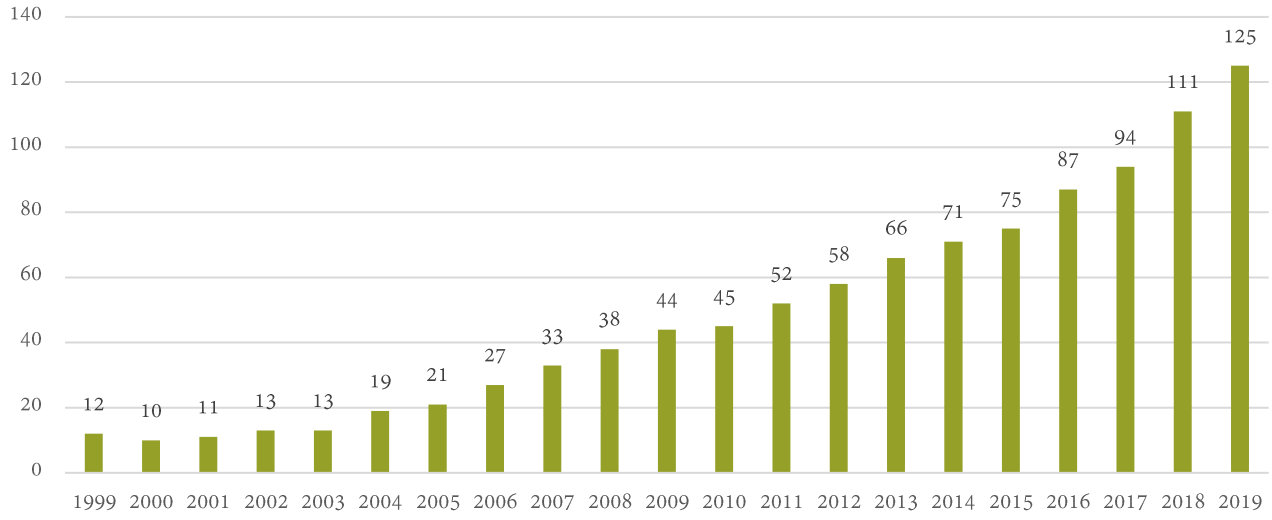
Wine production is the process through which wine grapes are transformed into wine. Broadly, this includes crushing and pressing, fermentation, clarification, and aging and bottling (Ste. Michelle Wine Estates, 2021). The U.S. Alcohol and Tobacco Tax and Trade Bureau (TTB) provides permits for any operation conducting wine operations (producing or blending wine) for sale. Wine producers are often bonded, meaning that the commercial winery has obtained a bond, essentially an insurance policy, to guarantee payment of the winery's excise tax liability to the TTB (Ken's Wine Guide, no date). At the state level, the Arizona Department of Liquor provides licenses for in-state farm wineries. An operation is licensed as a farm winery (Series 13) if it produces at least 200 gallons but less than 40,000 gallons of wine and has a TTB (U.S. Alcohol and Tobacco Tax and Trade Bureau) permit, or the operation has at least 5 acres of grapes or fruit with a contract to process fruit into wine (Arizona Department of Liquor, 2021). Above 40,000 gallons of production, the winery must have an in-state producer

[3] A review of the literature suggests that an average of 4 tons per acre is the expected maximum yield for European grape wine varieties grown in Arizona as vineyard practices aim to restrict yields to ensure quality in regard to sugar, acid ratios, and pH balance (Brady, 1987).

license (Series 01). According to officials at the Arizona Department of Liquor, there are no wineries that have exceeded 40,000 gallons of production in Arizona and, if production is close to exceeding that threshold, many wineries elect to remain small-scale and operate under multiple licenses.

The number of wineries in Arizona has increased dramatically over the past two decades (Figure 5). Between 1999 and 2019, the number of bonded wine producers in Arizona increased from 12 to more than 120, with significant growth starting in the mid-2000s. As of 2019, there were 125 bonded wine producers in Arizona (TTB, 2021).

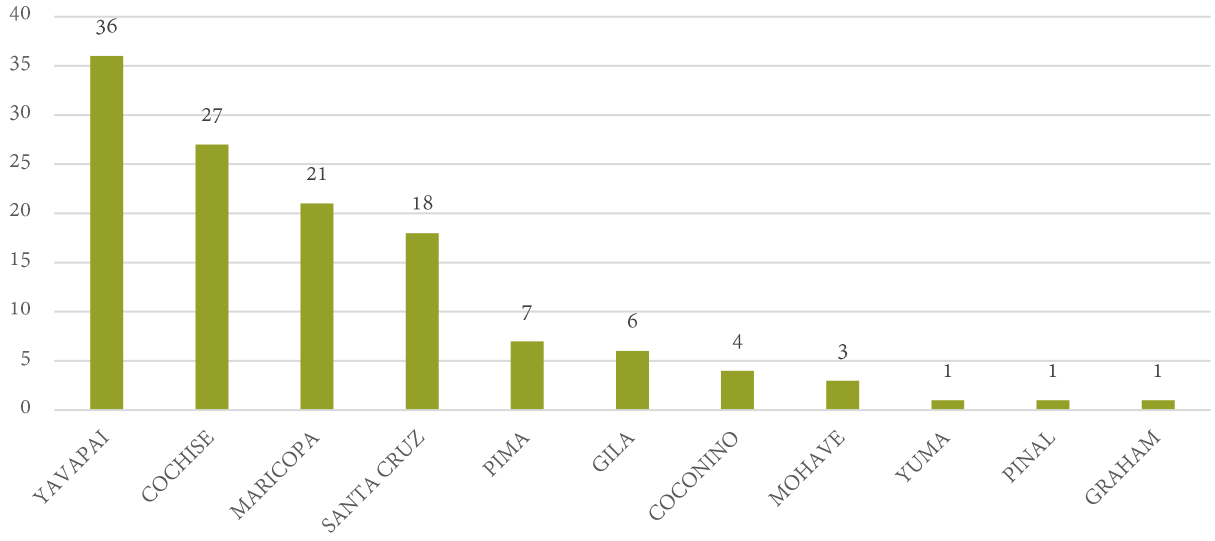
FIGURE 5. BONDED ARIZONA WINE PRODUCERS, 1999-2019



Source: TTB (2021)

As of 2019, Yavapai County had 36 bonded wineries, the largest number of wineries in the state. This is followed by Cochise County (27 wineries), Maricopa County (21 wineries), Santa Cruz County (18 wineries), and Pima County (7 wineries) (Figure 6). While Santa Cruz and Cochise counties account for nearly two-thirds of grape acreage, they account for only about one-third of wineries in the state. Relative to where most grape production occurs, there are more wineries in regions that are major tourist destinations, such as Yavapai County, or large population centers, such as the Phoenix metropolitan area in Maricopa County.

FIGURE 6. BONDED ARIZONA WINE PRODUCERS BY ARIZONA COUNTY, 2019



Source: TTB (2021); Revised from previous August publication

Wineries play an important role in rural areas because the sales they generate often bring net-new money into the local economy. When an industry brings money into the regional economy, it is considered as part of the area's ***economic base.*** A common way to evaluate an industry's contribution to a region's economic base is the application of location quotients (LQ). An LQ is simply the local industry's share of local employment divided by that same industry's national share of total national employment. An LQ of 1.25 or higher usually indicates that the sector is a ***basic sector*** – a sector that brings money into the region from outside. An LQ can also help demonstrate specialization by comparing the concentration of employment within a given industry in the region to concentration of employment in that industry for the nation as a whole. A more detailed description of economic base analysis is provided in Appendix B.

Tables 1-3 below present the top 10 industries in Yavapai, Santa Cruz, and Cochise counties by employment location quotient, with the LQ for wineries highlighted. With a location quotient of 7.37, employment in wineries in Yavapai County is roughly 7 times more concentrated than the national average. Similarly, the employment LQs for Santa Cruz and Cochise counties are 5.4 and 3.68, respectively, indicating that wineries are part of the economic base of those counties' economies.

TABLE 1. YAVAPAI COUNTY TOP 10 INDUSTRIES BY EMPLOYMENT LOCATION QUOTIENT, 2019

NAICS 5-Digit Industry	Annual Average Employment Location Quotient
NAICS 56159 Other travel arrangement services	10.77
NAICS 22132 Sewage treatment facilities	9.46
NAICS 49111 Postal service	9.27
NAICS 45392 Art dealers	8.85
NAICS 31213 Wineries	**7.37**
NAICS 22131 Water supply and irrigation systems	5.2
NAICS 62142 Outpatient mental health centers	5.03
NAICS 33711 Wood kitchen cabinet and countertop mfg.	4.2
NAICS 21231 Stone mining and quarrying	3.92
NAICS 62421 Community food services	3.85

Source: BLS, 2019

TABLE 2. SANTA CRUZ COUNTY TOP 10 INDUSTRIES BY EMPLOYMENT LOCATION QUOTIENT, 2019

NAICS 5-Digit Industry	Annual Average Employment Location Quotient
NAICS 42448 Fruit and vegetable merchant wholesalers	147.37
NAICS 49312 Refrigerated warehousing and storage	29.22
NAICS 44523 Fruit and vegetable markets	21.64
NAICS 48851 Freight transportation arrangement	18.65
NAICS 45392 Art dealers	16.59
NAICS 11211 Beef cattle ranching, farming, and feedlots	11.19
NAICS 44815 Clothing accessories stores	8.81
NAICS 11511 Support activities for crop production	6.78
NAICS 48423 Other specialized trucking, long-distance	5.56
NAICS 31213 Wineries	**5.4**

Source: BLS, 2019

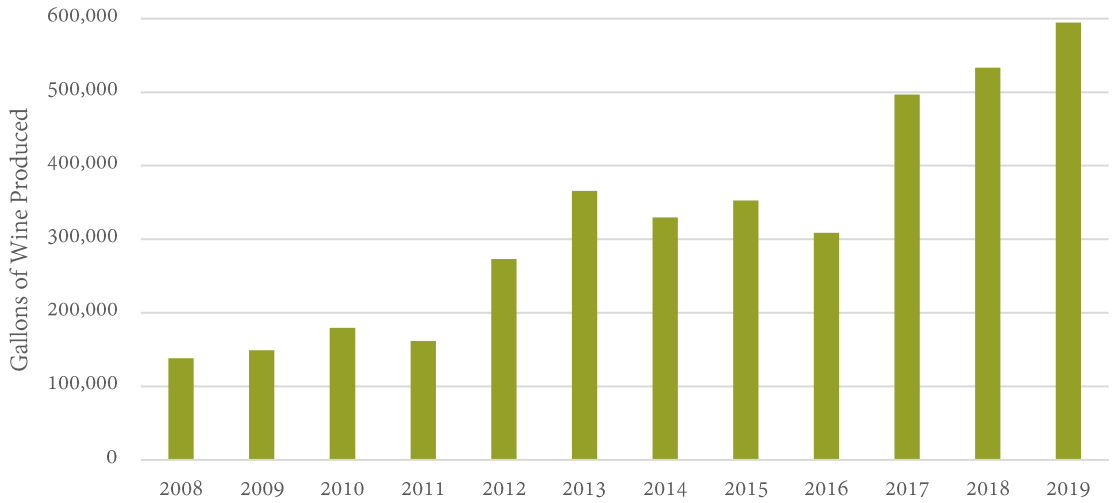
TABLE 3. COCHISE COUNTY TOP 10 INDUSTRIES BY EMPLOYMENT LOCATION QUOTIENT, 2019

NAICS 5-Digit Industry	Annual Average Employment Location Quotient
NAICS 11194 Hay farming	10.56
NAICS 42452 Livestock merchant wholesalers	8.94
NAICS 11133 Non-citrus fruit and tree nut farming	4.96
NAICS 48841 Motor vehicle towing	3.74
NAICS 56152 Tour operators	3.69
NAICS 31213 Wineries	**3.68**
NAICS 72121 RV parks and recreational camps	3.62
NAICS 44413 Hardware stores	3.56
NAICS 54133 Engineering services	3.03
NAICS 23834 Tile and terrazzo contractors	2.85

Source: BLS, 2019

Just as the number of wineries in Arizona's wine-producing regions has increased, so too has the volume of wine. Since 2008, production increased from around 140,000 gallons to nearly 600,000 gallons in 2019, the highest level of production to date (Figure 7). Production in 2019 is equivalent to more than 250,000 cases of wine, or approximately 3 million bottles of wine.

FIGURE 7. GALLONS OF WINE PRODUCED IN ARIZONA, 2008-2019



Source: TTB (2021)

Survey of Arizona Wine Industry

To better understand the structure and size of Arizona's wine industry, we conducted a survey of grape growers and wineries in Arizona. Questions pertained to sales and production costs (for both vineyards and wineries), growing practices (vineyards), and marketing channels and revenue sources (wineries). The survey also asked questions about respondents' participation in grape growing workshops held by researchers at the University of Arizona, as well as respondents' interest in continued research on the wine industry's contribution to the state economy, the links between climate and viticulture, and the effects of soil health on wine grapes. As the focus of this study is the contribution of the wine industry to the state economy, we present survey results for the economic sections of the survey only.

Invitations to participate in the survey were sent to any person associated with the wine industry, as identified by contact lists from the Arizona Wine Growers Association, the Arizona Vignerons' Alliance, and researchers at the University of Arizona. The survey was sent out in mid-2020 and recipients included members of each association, individuals that have attended University of Arizona wine grape growing workshops and events, individuals that currently receive the University's *Climate Viticulture Newsletter*, or others that have otherwise been identified as associated with the industry. An email was sent to all individuals on these lists, resulting in 243 invitations to participate in the survey. Of these, 52 responded to a majority of the survey for an overall response rate of 21%.

Respondent Role within the Industry

Respondents were asked to identify their role or roles in Arizona's wine industry, selecting all that apply from 7 predefined options: (1) vineyard owner, (2) vineyard employee, (3) winery/tasting room owner, (4) winery/tasting room employee, (5) viticulture/enology student, (6) viticulture/enology instructor, and (7) agriculture extension agent or specialist. If a respondent did not identify as any of the predefined categories, the respondent was able to select "other" and describe their affiliation with Arizona's wine industry. Figure 8 presents responses by role within Arizona's wine industry.

FIGURE 8. SURVEY RESPONSES BY ROLE WITHIN THE WINE INDUSTRY (ROLE NOT MUTUALLY EXCLUSIVE)

As the focus of this study is to understand the structure, size, and vertical integration of operations in Arizona's wine industry, responses from the owners of vineyards and wineries were of particular interest. Respondents could be vineyard owners, winery owners, or owners of both a vineyard and winery. In total there were 31 responses from owners. 23 respondents identified themselves as vineyard owners and 27 respondents identified themselves as winery owners, with a large proportion of respondents indicating that they owned both a vineyard and a winery (Figure 9). Only 4 respondents reported owning a vineyard only[4] and 8 respondents reported owning a winery only. These results suggest a very high level of vertical integration in Arizona's wine industry.

FIGURE 9. ROLE WITHIN THE WINE INDUSTRY, VINEYARD AND WINERY OWNERS

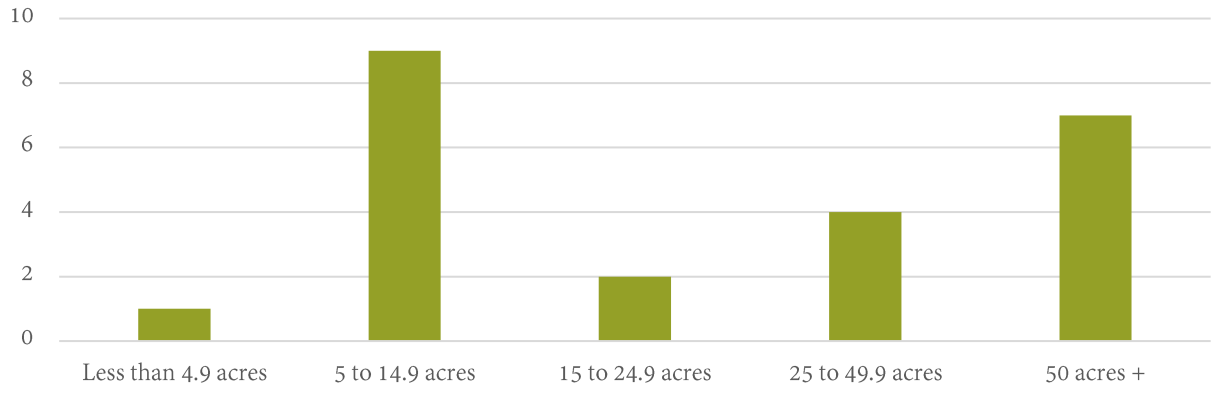
Vineyard Characteristics

Of 31 total business-owner respondents, 23 indicated owning and operating a vineyard in Arizona. Most respondents (9 respondents) reported having between 5 and 14.9 total acres (bearing and non-bearing), followed by respondents with more than 50 total acres (7 respondents) (Figure 10). Bearing-age acreage ranged from 0.5 acres to 110 acres, with an average and median of 21 acres and 11 acres, respectively. Non-bearing acreage had a wide range as well, with an average and median of 26 acres and 5 acres, respectively.

In total, survey respondents reported 477 bearing acres, representing approximately 36% of total bearing acreage in the state. Non-bearing acreage reported by respondents totaled 600 acres, significantly higher than nonbearing acreage reported by the 2017 Census of Agriculture. These results indicate that there may have been a significant increase in new acreage in recent years (after 2017). Of 23 respondents, 35% (8 respondents) indicated that they currently had more non-bearing acreage than bearing acreage.

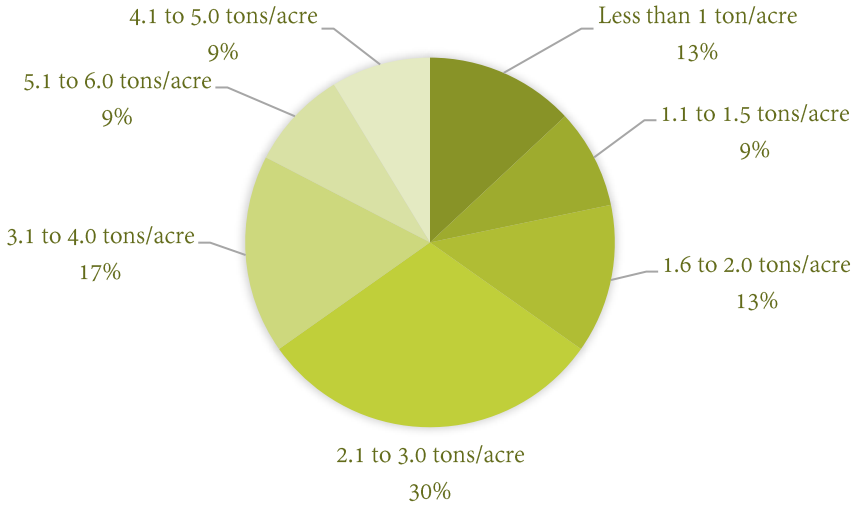
[4] Of the 4 respondents that reported owning a vineyard only, 2 respondents later reported marketing the grapes grown at their vineyard to their own winery, indicating that the level of vertical integration may be even higher than presented in Figure 9.

FIGURE 10. NUMBER OF RESPONDENTS BY TOTAL (BEARING AND NON-BEARING) ACREAGE



The most commonly reported average yield among respondents was 2.1 to 3.0 tons per acre, accounting for 30% of vineyard respondents, followed by 3.1 to 4.0 tons per acre (17%), 1.6 to 2.0 tons per acre (13%), and less than 1 ton per acre (13%) (Figure 11). Combined, average yield per acre was an estimated 2.7 tons per acre, higher than the statewide average yield of 1.8 tons per acre reported in the 2013 NASS report. Differences in yield could be due to a variety of factors, including the type of varieties grown, the geographic location, as well as production losses. Further, as mentioned previously, growers must balance productivity with fruit quality for winemaking. Yields for mature vineyards can range from 1 ton per acre to 12+ tons per acre, with an optimal range of 3 to 5 tons per acre (Extension Foundation, 2019).

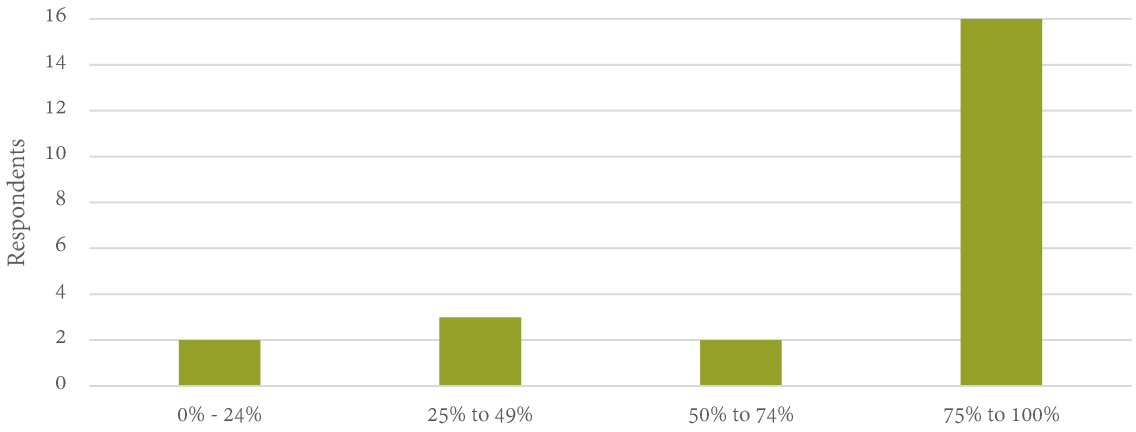
FIGURE 11. AVERAGE YIELD PER ACRE



The vast majority of vineyard respondents indicated that the grapes produced by their vineyard are used at their own winery. Of 23 vineyard respondents, 16 reported using 75% or more of the grapes grown on their vineyard within their own winery operation (Figure 12). In fact, approximately half of respondents (11 respondents) reported using 100% of the grapes produced within their own winery operation. Only 2 of 23 total vineyards reported selling 100% of their grapes to another winery, and no respondent reported selling grapes to an out-of-state winery. On

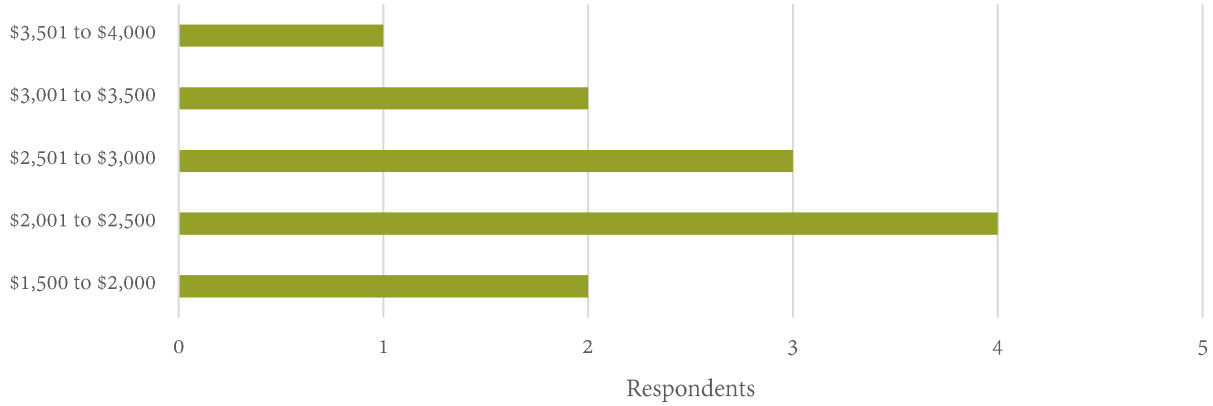
average, approximately 80% of respondents' grapes are used in their own winery operation and the remaining 20% of grapes are sold to an in-state winery.

FIGURE 12. DISTRIBUTION OF GRAPES USED AT OWN WINERY



Twelve (12) of the 23 vineyard respondents reported selling grapes produced by their vineyard to an in-state winery. As mentioned previously, there were two vineyards that reported selling 100% of their grapes to in-state wineries. Other vineyards reported selling between 5% and 67% of their grape production to an in-state winery. Of these 12 respondents with sales to Arizona wineries, the most common response for the average price received for grapes sold was between $2,001 and $2,500 per ton (Figure 13). On average, respondents reported receiving $2,583 per ton.

FIGURE 13. AVERAGE PRICE PER TON RECEIVED FOR GRAPES



Of 23 vineyard respondents, 17 reported their typical production costs per acre. Vineyard respondents reported $6,100 (median) and $6,700 (average) production costs per acre (Table 4). Production costs include labor, fuel, irrigation and irrigation supplies, herbicide/insecticide/fungicide, fertilizer, maintenance and repairs, custom services (such as harvest, hauling, consulting, etc.), and overhead expenses (including insurance, office supplies, etc.). Respondents reported that a large proportion of vineyard supplies are purchased from in-state suppliers.

Labor, fuel, irrigation supplies, herbicide/insecticide/fungicide, fertilizer, maintenance and repairs, and custom services are almost exclusively purchased from within state with the average proportion of expenses occurring in-state over 90%. Anecdotal evidence suggests that this is in large part due to a number of local agribusinesses catering specifically to vineyard operations. Other expenses are still heavily sourced from businesses located within Arizona, but average between 60% and 80%.

TABLE 4. MEDIAN AND AVERAGE COST PER ACRE AT VINEYARD BY EXPENSE CATEGORY

Expense Category	Median Cost/Acre	Average Cost/Acre
Labor	$2,500	$2,790
Fuel	$100	$169
Irrigation and irrigation supplies	$100	$567
Herbicide / Insecticide / Fungicide	$133	$166
Fertilizer	$300	$457
Maintenance and repairs	$100	$261
Materials	$100	$861
Custom services (harvest, hauling, consulting, etc.)	$200	$426
Overhead (insurance, office expenses, etc.)	$500	$1,021
Total	$6,100[1]	$6,718

1 Total median expenditure reported is the median of respondent reported total costs. The sum of median costs per acre for each expense category do not sum to median reported total costs.

The median number of full-time and part-time vineyard employees reported by survey respondents (all 23 vineyards) was 2 employees and 1 employee, respectively (Table 5). This labor is supplemented seasonally with a median of 5 additional seasonal employees during harvest. Similarly, the average reported full-time, part-time, and seasonal employees was 2, 2, and 7, respectively (Table 5).

TABLE 5. MEDIAN AND AVERAGE NUMBER OF PAID EMPLOYEES AT VINEYARD

Employee Type[1]	Median	Average
Full-time employees[2]	2	1.9
Part-time employees[3]	1	1.8
Seasonal employees	5	7.2

1 The survey question asked the number of paid employees, not including people working under a farm labor contractor.

2 Full-time employees work 30+ hours per week.

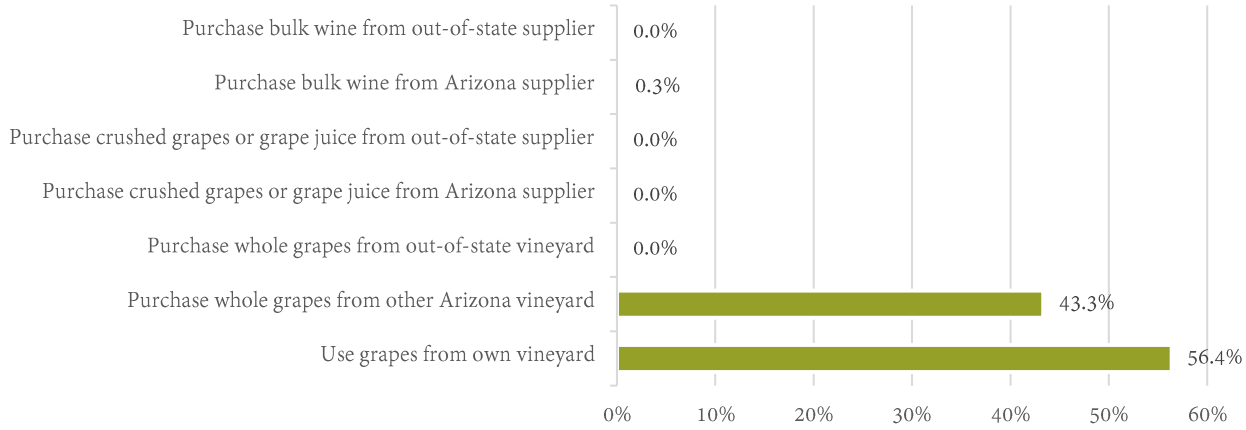
3 Part-time employees work less than 30-hours per week.

Winery Characteristics

Of 31 total business-owner respondents, 27 indicated that they owned and operated a winery in Arizona. Of these, 70% (19 respondents) reported also owning and operating a vineyard in Arizona with the remaining 30% (8 respondents) operating a winery only. Response rates were lower for winery owners than vineyard owners, with a total of 18 wineries completing a majority of survey questions. Winery respondents account for approximately 20% of wineries in the state.

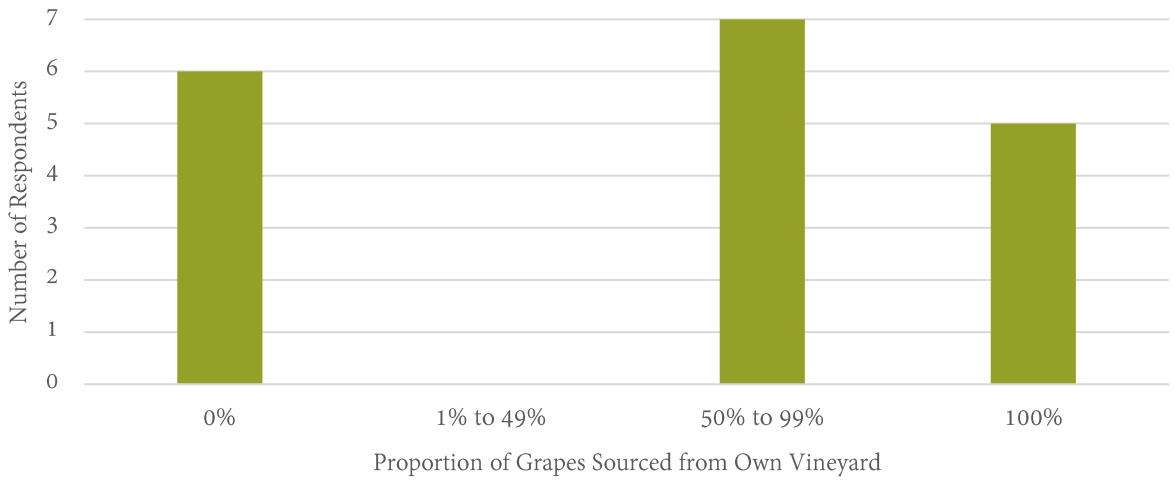
Responding wineries reported that an average of 57% of grapes used for winemaking came from their own vineyard, 43% came from other Arizona vineyards as purchased whole grapes, and less than 1% came from Arizona suppliers of bulk wine (Figure 14). Of all 18 winery respondents, none reported purchasing grapes, crushed grapes or grape juice, or bulk wine from an out-of-state supplier.

FIGURE 14. SOURCES OF GRAPES USED FOR WINEMAKING, AVERAGE SHARE BY SOURCE



Specifically, of 18 winery respondents, about two-thirds (67%) reported that more than 50% of the grapes used for winemaking come from their own vineyard, 7 reported between 50% and 99% of grapes are sourced from their own vineyard, and 5 respondents reported 100% of grapes come from their own vineyard (Figure 15). There were 6 winery respondents that reported that none of the grapes were sourced from their own vineyard, however, all these respondents reported that 100% of grapes used for winemaking were purchased as whole grapes from an Arizona vineyard.

FIGURE 15. DISTRIBUTION OF GRAPES SOURCED FROM OWN VINEYARD



Of 18 total winery respondents, 16 reported the typical production cost per case of wine produced by their winery. The median cost per case reported by winery respondents, not including labor, was $120 per case (Table 6), while the average cost per case was $178 per case. This is equivalent to about $50 to $75 per gallon of wine produced.

TABLE 6. TYPICAL PRODUCTION COST PER CASE OF ARIZONA WINE

	Median	Average
Cost per Case	$120.00	$178.00

Winery respondents reported total annual production costs ranging from $33,000 to nearly $3.0 million, with median and average annual expenses of $57,600 and $187,400, respectively. This wide range of production costs reflects wineries of different sizes and production capacities. Median and average annual expenses by expense category are not reported due to low response rates and lack of production costs on a per unit basis for all respondents. That said, the survey allows for identification of the top production costs and the proportion of inputs purchased from Arizona suppliers.

Grapes account for the largest production expense of Arizona wineries on an annual basis. The cost of grapes ranged significantly across respondents depending on the size of the winery and the degree to which grapes are sourced from its own vineyard, if applicable. As mentioned previously, 100% of the grapes used in Arizona winemaking were reportedly sourced from in-state, either through grapes produced at the winery's in-house vineyard or through grapes purchased from another Arizona vineyard. The second largest expense reported by respondent wineries was the cost of packaging materials, such as bottles, labels, corks, capsules, and case box materials. Given the specialty nature of these products, there were no respondents that reported purchasing these items from an in-state supplier. This is followed by marketing costs (on average, 70% purchased from within state), costs associated with overhead such as utilities, office supplies, and other miscellaneous items (on average, 88% purchased from within state), and the costs of barrels (on average, 7% from within state).

The median number of full-time and part-time winery employees reported by survey respondents (all 18 responding wineries) was 2 full-time employees and 1 part-time employee (Table 7). Influenced by responses from larger wineries, there were, on average, 3 full-time employees, 4 part-time employees and 2 seasonal employees (Table 7).

TABLE 7. MEDIAN AND AVERAGE NUMBER OF EMPLOYEES AT WINERY

Employee Type	Median	Average
Full-time employees[1]	2	3.3
Part-time employees[2]	1	3.6
Seasonal employees	0	1.7

1 Full-time employees work 30+ hours per week.

2 Part-time employees work less than 30-hours per week.

Of 17 winery respondents, the largest average share of winery revenues comes from retail wine sales (39.4%), followed by tasting room fees (23.7%), wine club or internet sales (14.7%), and wine sales through wholesalers or

distributors (10.6%) (Table 8). Median revenue shares highlight the importance of retail wine sales and tasting room fees, which account for 47.5% and 20% of winery revenues, respectively (Table 8).

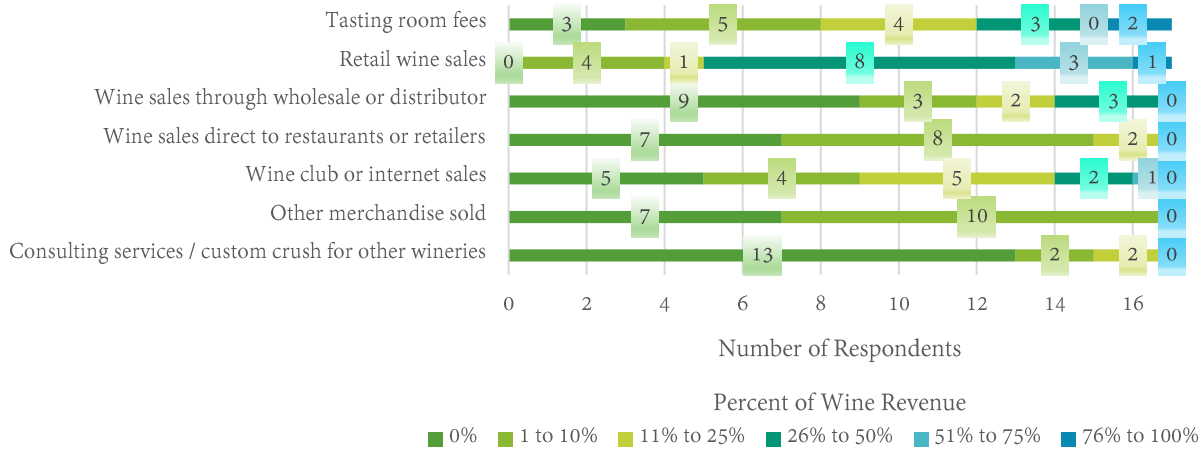
TABLE 8. MEDIAN AND AVERAGE SHARE OF WINERY REVENUES BY SOURCE

Winery Revenue Sources	Median	Average
Tasting room fees	20.0%	23.7%
Retail wine sales	47.5%	39.4%
Wine sales through wholesale or distributor	0.0%	10.6%
Wine sales direct to restaurants or retailers	0.5%	3.5%
Wine club or internet sales	10.0%	14.7%
Other merchandise sold	5.0%	3.2%
Consulting services / custom crush for other wineries	0.0%	2.1%
Festivals and other	0.0%	2.9%

The distribution of winery revenue by source reveals the importance of retail wine sales and tasting room fees in Arizona's wine industry. For some individual wineries, tasting room fees and retail sales, independently, account for more than 76% of winery revenues. There were 2 wineries that reported generating more than 76% of winery revenues from tasting room fees and 1 winery that reported generating more than 76% from retail wine sales. There are no other revenue sources that account for this large of a share of revenues. (Figure 16).

Regarding retail wine sales, 8 wineries reported 26% to 50% of revenues from retail, 3 wineries reported between 51% and 75%, and 1 reported more than 76% from retail wine sales. One respondent reported 51% to 75% of winery revenue sources coming from wine club or internet sales and 2 respondents reported 26% to 50%. Finally, there were a few wineries (3 respondents) that had between one-fourth and half of winery revenues generated by wine sales through a wholesaler or distributor (Figure 16). The majority of wineries (9 respondents), however, reported that none of their revenues were generated through a wholesaler or distributor.

FIGURE 16. PERCENT OF WINERY REVENUE BY SOURCE

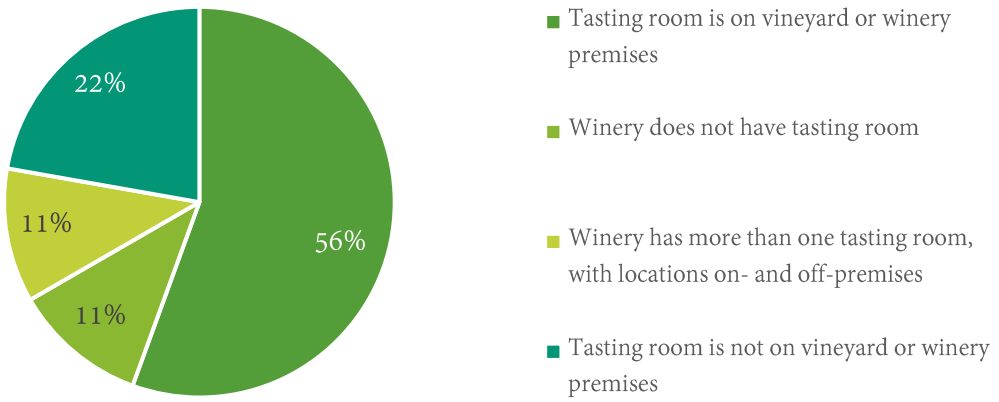


The most commonly reported price per bottle at retail was between $26 and $30 (8 of 18 respondents). This is followed by $31 to $40 (4 respondents) and $21 to $25 (3 respondents) (Figure 17). Using the midpoint for each price range, the average retail price per bottle was estimated at $26.33. The most common response for the average wholesale price per bottle was $11 to $15 (6 respondents), followed by less than $10, and $16 to $20, each with 4 respondents indicating these price ranges (Figure 17). The average wholesale price for all respondents was estimated at $13.57.

FIGURE 17. AVERAGE RETAIL AND WHOLESALE PRICE PER BOTTLE

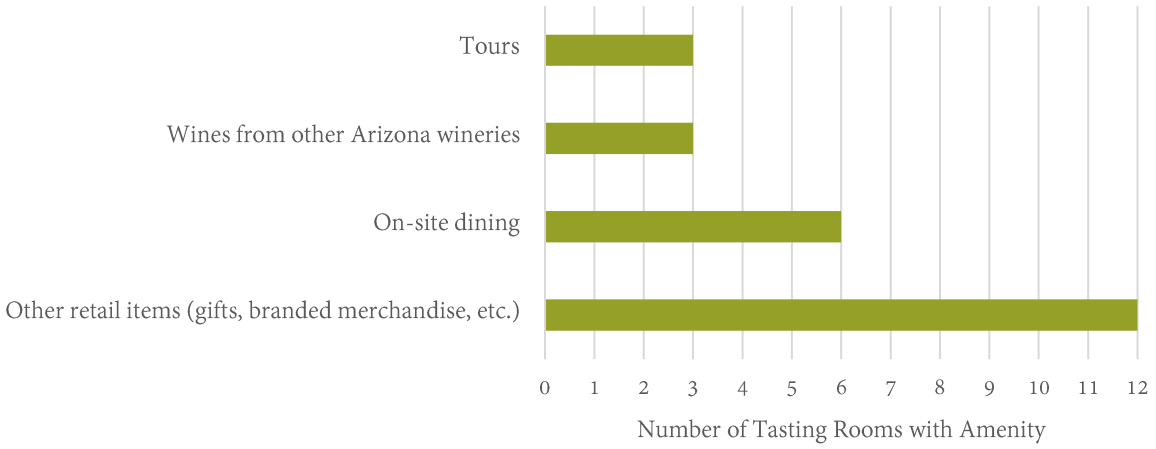
A large majority of winery respondents (89% or 16 of 18 respondents) reported that their winery operates a tasting room, either on or off the premises of the vineyard or winery. The largest share (56% or 10 respondents) reported that their winery operates a tasting room on the vineyard or winery premises and four respondents (22%) indicated that their winery operates an off-premises tasting room. Finally, 11% or 2 respondents reported that their winery has more than one tasting room, and the remaining 11% reported not having a tasting room (Figure 18).

FIGURE 18. LOCATION OF TASTING ROOM



12 of 18 respondents reported the types of amenities offered at their winery's tasting room. All 12 respondents reported selling retail items such as gifts and branded merchandise, 50% (6 respondents) reported offering on-site dining, 25% (3 respondents) reported selling wines from other Arizona wineries, and 25% (3 respondents) offered tours to visitors (Figure 19).

FIGURE 19. AMENITIES AVAILABLE AT WINERY TASTING ROOM



Estimates of the number of people that visit the winery's tasting room ranged from 150 visitors annually to more than 50,000 visitors annually. The median and average number of annual visitors were 8,300 and 12,500, respectively.

Economic Contribution Analysis

Arizona's wine industry contributes to the state economy in a variety of ways, generating sales and supporting jobs and incomes along the supply chain. Economic activity related to the wine industry includes producing wine (grape growing and winemaking) (***direct effects***), economic activity in businesses that provide goods and services that are used as inputs for grape and wine production (***indirect effects***), and economic activity related to those employed within the Arizona wine industry spending their incomes within the state (***induced effects***). By purchasing inputs from within the state (indirect effects) and employing Arizonans that spend their incomes within the state (induced effects), a ripple of economic activity is generated beyond the direct contribution of the wine industry. These are referred to as economic multiplier effects.

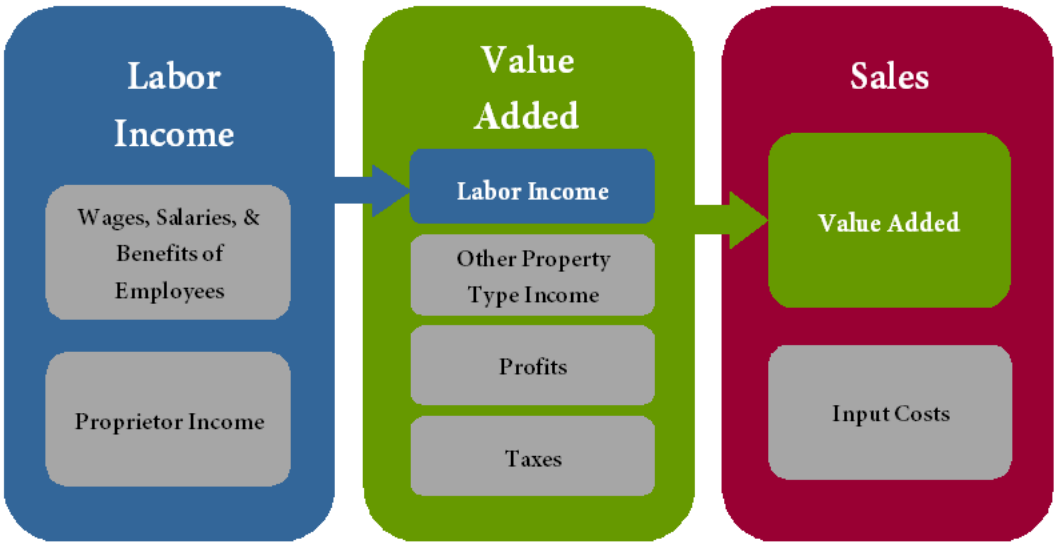
More specifically, indirect multiplier effects capture economic activity generated when businesses involved in grape and wine production purchase inputs from other Arizona businesses. These are business-to-business transactions and include economic activity within industries that are closely linked with wine production, but also include industries that are seemingly unrelated but nevertheless provide inputs to wine production, such the insurance and banking industries. Induced multiplier effects capture economic activity generated when employees of the wine industry spend their earnings on household goods and services, such as rent or mortgage, groceries, or medical care. These household-to-business transactions support sales, jobs, and incomes in consumer-driven industries. Both indirect and induced multiplier effects are limited by leakage, or when money is spent on goods and services from outside the regional economy -- in this case, the state. Once the money leaves the state, it no longer circulates within the state economy and multiplier effects reduce to zero.

In the following section we estimate the direct contributions of the wine industry to Arizona's economy in 2019, focusing on the value of grape production by Arizona vineyards, the economic activity generated by Arizona wineries through current production and sales, and the economic activity associated with establishing new vineyards and wineries. In order to avoid double counting of wine production and sales in a given year, adjustments were made to only include the value of inventory change, not the full value of wine production in 2019. Finally, we estimate the total contribution of Arizona's wine industry to the state economy in 2019, including direct, indirect, and induced multiplier effects using the IMPLAN 3.1 model. The economic contributions of the wine industry are quantified using a variety of metrics, including output (sales), value added (synonymous with gross state product), income, and jobs.

Sales or economic output (more colloquially known as business revenues) are a key measure of economic activity. Generally, economic output measures the total value of sales and represents the flow of money throughout an economy. As producers and consumers buy and sell goods and services, each additional change of hands constitutes a sale, with the total value of each sale incorporating all previous costs as well as the mark-up charged within that component of the supply chain. This leads to some double counting in the value of sales. A unique feature of manufacturing industries (of which wineries is one) is that their economic output does not just account for sales. Economic output for manufacturing industries is equal to the value of sales plus the value of inventory change. ***Value added*** is a measure that avoids double-counting inputs to production. It measures the net value of a good and service above and beyond the value of inputs. Value added includes labor income, profits, and taxes. At the national- and state-levels, value added is synonymous with gross domestic product and gross state product,

respectively. ***Labor income***, a component of value added, measures wages, salaries, and benefits to employees, as well as business-owner income. The relationship between these three measures is presented in Figure 20. Because these measures are components of one another, they are not additive, and convention is to report them separately. Finally, the economic contribution of an industry can also be measured in terms of the number of jobs that are supported through direct, indirect, and induced multiplier effects.

FIGURE 20. RELATIONSHIP BETWEEN SALES, VALUE ADDED, AND LABOR INCOME



Value of Arizona's Grape and Wine Production in 2019

Using existing data sources combined with results from the survey of Arizona vineyards and wineries, we estimate the economic activity generated by Arizona vineyards and wineries in 2019. The economic activity generated by the Arizona wine industry in a given year accounts for economic activity related to current production (current wine grape acreage and wine production) as well as economic activity related to the sale of wine produced from years past. This intertemporal component of production and revenues presents challenges to estimating the economic activity within a given year. Adjustments must be made to avoid double counting the wine sales and production in a given year. These adjustments involve only including the value of wine inventory change, not the full value of wine produced in 2019. The following section outlines the methods used to estimate the economic activity generated by Arizona vineyards and wineries in 2019.

The value of grape production is estimated using total bearing grape acreage in the state as reported by the 2017 Census of Agriculture with average yield and price per ton received as reported by survey respondents. As virtually all vineyards produce grapes for their own winery operation, very little Arizona grape production is actually sold (USDA, 2014). In fact, the previous USDA NASS study estimated the value of grapes produced by asking growers "the price per ton they thought they could get if they were to sell their 2013 production" (USDA, 2014, p. 12). This study's survey results suggest that some vineyards produce at levels above what they need for their own winery operation and sell grapes to other wineries in-state. Other vineyards sell grapes to in-state wineries

based on demand for particular varieties. Very few vineyards reported no winery activities, indicating a high-level of vertical integration. Notably, all survey respondents indicated either that the grapes they produced were sold to in-state wineries or they used their own grapes, and no grapes were sold to out-of-state wineries or through other marketing channels. The value of grapes produced by Arizona vineyards in 2019 was estimated at $9.3 million (Table 9). Indirect and induced multiplier effects associated with grape production are modeled in IMPLAN using an industry change.

TABLE 9. ESTIMATED VALUE OF GRAPE PRODUCTION IN ARIZONA, 2019

Measure	Value
Bearing Age Acreage	1,339
Average Yield (tons/acre)	2.7
Estimated Tons Produced	3,595
Average Price Received ($/ton)	$2,584
Estimated Value of Grape Production	$9,288,385

Source: Authors' calculation; USDA (2019), Survey Data

Winery sales in 2019 are estimated at $23.1 million (Table 10). Wine sales are estimated using total gallons sold in 2019 (as reported by the TTB) as well as the average distribution of winery revenue sources from the survey, average retail and wholesale prices as reported by survey respondents, and estimates of tasting room fees. It's important to note that wine sales in 2019 are not the same as wine produced in 2019. Wine sold in 2019 was produced in previous years, then aged until ready to be sold. Survey respondents reported receiving nearly one-quarter of winery revenues from tasting room fees and nearly 40% from retail wine sales. An additional 15% of winery revenues are generated through wine club or internet sales. According to TTB records, Arizona sold 190,500 gallons of wine in 2019, equivalent to approximately 80,000 cases of nearly 1 million bottles of wine.

The number of bottles sold through each distribution channel is estimated based on the average price per bottle and share of winery revenues through each channel. It is estimated that 475,000 bottles are sold through retail and internet club sales, nearly 87,000 bottles of wine are sold through tasting room fees, and approximately 400,000 bottles are sold through wholesale and other outlets (Table 10). Assuming the average retail price ($26.33), sales through retail channels are estimated at $12.5 million. Sales through tasting room fees are estimated at $5.2 million. The value of wine sales through tastings was estimated assuming that a tasting consists of a 5-ounce flight for an average tasting room fee of $12. Finally, assuming the remainder of winery sales occur through wholesale and other channels and receive an average wholesale price per bottle of $13.57, sales through these channels are estimated at $5.4 million. Combined, estimated sales from Arizona wineries were $23.1 million in 2019 (Table 10).

TABLE 10. ESTIMATED WINERY SALES IN ARIZONA, 2019

Measure	Retail	Tasting Room	Wholesale and Other	Total
Revenue Distribution	0.541	0.237	0.222	1
Estimated Bottles	475,000	86,572	400,000	961,572
Average Price/Bottle	$26.33	$60.00	$13.57	
Estimated Sales	$12,506,750	$5,194,323	$5,428,000	$23,129,073

Source: Authors' calculation; TTB (2019), Survey Data

Another activity occurring within Arizona wineries not yet captured in the study is current wine production. Although the wine produced in 2019 will not be sold until the following year or later (and therefore does not generate profits, taxes, or sales revenue in 2019), wineries support economic activity within the state by spending on inputs and labor to produce the wine. Economic activity related to current wine production is estimated using total gallons produced in 2019 (as reported by the TTB), estimates of the costs of production per gallon, and wage and salary data from the U.S. Department of Labor.

According to TTB records, Arizona produced 594,971 gallons of wine in 2019, equivalent to more than 250,000 cases or 3 million bottles of wine, the highest production level to date. Considering these production levels and costs of production of approximately $50 per gallon (the median response among survey respondents), an estimated $30.0 million in economic activity was generated in 2019 from the production of wine (Table 11). This reflects the spending on inputs that wineries incurred in 2019 to produce wine, not including labor.

TABLE 11. ESTIMATED WINE PRODUCTION COSTS IN ARIZONA, 2019

Measure	Value
Gallons Produced	594,971
Average Cost per Gallon (not including labor)	$50.47
Estimated Wine Production Costs	$30,029,703

Source: Authors' calculation; TTB (2019), Survey Data

Winery labor costs are accounted for using data from the Bureau of Labor Statistics. In 2019, total wages paid to individuals employed in wineries (NAICS 312130) was approximately $10.7 million. Adjusting the wage data to include benefits, total employee compensation (wages, salaries, and benefits of employees) was an estimated $13.5 million. This estimate reflects the spending that wineries incurred in 2019 to employ individuals for ***both*** current wine production in 2019 as well as sales of wine in 2019. To avoid double counting the value of income supported by the industry (because wages, salaries, and benefits of employees are a component of industry sales in 2019), the $13.5 million in employee compensation is divided between 2019 production and 2019 sales based on their respective gallons produced/sold. With 2019 production levels more than 3 times the gallons sold in 2019, it's estimated that approximately $10.3 million in employee compensation is supported by 2019 production and $3.3 million in employee compensation is supported by 2019 sales. Thus, the total economic activity supported by 2019 wine production is $40.3 million ($30 million for costs of production + $10.3 million for production labor).

To capture the indirect and induced multiplier effects associated wine production and sales, we use the IMPLAN model. Economic activity stimulated by current production is modeled through a baseline IMPLAN winery industry spending pattern (accounting for the $30 million in non-labor inputs for 2019 production) and a labor income change (accounting for the $10.3 million in employee compensation supported by 2019 production). Economic activity stimulated by current sales is modeled through a labor income change (accounting for the $3.3 million in employee compensation supported by 2019 sales and the estimated $10 million in business owner income). As production costs associated with this wine occurred in previous years, this does not generate any economic activity in 2019 and is therefore excluded from the analysis. The indirect and induced estimates presented in Table 12 have been revised from previous version of this report.

While the spending associated with 2019 wine production can be used to stimulate the IMPLAN model and estimate the indirect and induced multiplier effects, care must be taken to correctly estimate the direct output for the wine industry. This is due to the fact that wineries are a manufacturing industry that holds inventory, therefore total industry output is equal to the sales of the industry plus the value of inventory change. The estimate of total output for wineries has been revised from previous versions (the August and September versions) to account for this fact. The estimated inventory change for 2019 was 404,500 gallons of wine (595,000 gallons produced in 2019 – 190,500 gallons sold in 2019). Accounting for the cost of production per gallon (for both labor and non-labor inputs), this inventory change is valued at approximately $27.4 million. Combined, total direct gross economic activity (output) for Arizona's vineyards and wineries in 2019 is an estimated $59.8 million (Table 12). This accounts for the value of grape production in 2019 ($9.3 million), the revenues generated through wine sales in 2019 ($23.1 million), and the value of inventory change by 2019 wine production ($27.4 million). Again, this is a revised estimate and supersedes any previous estimate reported in the August or September version of this report.

Establishment of New Vineyards and Wineries in 2019

In addition to the economic activity that vineyards and wineries generate through production and sales, there is also economic activity occurring as a result of investment in new vineyards and wineries. In these cases, significant capital investment and spending occurs to establish a business, but revenues may not be generated for a number of years. Just because a vineyard or winery is not yet generating revenues, however, does not mean that it is not contributing to the state's economy. The spending that occurs to establish a new vineyard or winery is fulfilled in part by other Arizona businesses, generating the same multiplier effects as wine grape or wine production.

In establishing a vineyard, the vineyard operator will incur costs for three years before obtaining a usable crop and between five and seven years before the vines reach yield maturity or full production (Brady, 1987). First year costs include significant expenses such as site preparation, trellis construction, irrigation installation, and planting, with a majority of the cost associated with constructing the trellises and purchasing the vines themselves. Second and third year vineyard costs include maintaining the vineyard by pruning and thinning, irrigation, and other cultural practices. Generally, maintaining non-bearing vines requires less labor than caring for mature vines.

Similar to new vineyards, a new winery may not generate sales for between 18 and 36 months. The process of investing in a new winery may include building the facility in year one, making wine in year two, and beginning to

sell wine in year three (Martinelli, et al., 2015). Winery facilities and equipment are capital intensive, requiring presses, pumps, barrels, refrigeration equipment, bottling and labeling equipment, and other operating supplies. The capital investment requirements can vary significantly depending on the characteristics of the winery. Fickle et al. (1996) estimate investment costs ranging from $500,000 to $2.3 million to establish a winery in Washington state, with larger wineries requiring a larger total capital investment but benefiting from economies of scale. Adjusted for inflation, this is closer to $900,000 to $3.8 million in 2019 dollars. First year costs include real estate expenses as well as all equipment associated with winemaking: receiving, cellar, lab, fermentation and storage, refrigeration, and cooperage equipment (Virginia's Winery Business Plan Example, 2009). If establishing a tasting room is required, additional costs are incurred.

While specific data on new grape acreage between 2018 and 2019 are not available, the Census of Agriculture reports 199 acres of non-bearing acreage in 2017. Assuming non-bearing grape acreage was the same in 2019, we use average costs per acre from survey respondents, vineyard establishment budgets from University of California Agriculture and Natural Resources Cooperative Extension (UCCE), and non-bearing acreage in 2017 to estimate the total economic contribution of vineyard establishment. Of 17 vineyard respondents, 8 reported having more non-bearing acreage than bearing acreage, with non-bearing acreage accounting for an average of 75% of total reported acreage. These respondents were identified as vineyards with a majority of acreage as non-bearing. Total costs for this subset of respondents averaged $7,300 per acre, higher than average costs per acre for majority-bearing acreage vineyards of $6,400 per acre. The annual per acre costs reported by majority non-bearing vineyards in Arizona is lower than the annual 3-year average cost to establish a vineyard in the San Joaquin Valley in California but is within a reasonable range (UCCE, 2019). Given the annual establishment costs per acre and assuming non-bearing acreage of 199 acres, the total spending on non-revenue generating vineyards in 2019 was estimated at $1.45 million.

According to TTB records, there were 14 new bonded wineries established in Arizona between 2018 and 2019. As mentioned previously, the initial investment costs to establish a winery range significantly depending on the size of the winery. Assuming a new winery will start relatively small (2,000 cases), we estimate the total investment costs to establish a winery. Recent research reports that the establishments costs for a 2,000-case winery to be $411.07 per case, adjusted for inflation (Ball, 2013). Assuming each of the 14 new wineries start out at this level and produce 2,000 cases, total winery investment costs in 2019 are estimated at $11.5 million.

Total Contribution of the Arizona Wine Industry in 2019

The following section provides the revised results of the economic contribution analysis and reports the total contribution of Arizona's wine industry to the state economy in 2019, including direct, indirect, and induced multiplier effects. There are revised estimates and supersede any previous estimates reported in the August or September versions of this report. For completeness, total economic effects are reported separately for the three modeled components: (1) the contribution of existing vineyards and wineries, (2) the economic activity related to establishing new vineyards, and (3) the economic contributions related to establishing new wineries.

Table 12 presents the results of the analysis on existing vineyards and wineries. The revised direct contribution of vineyards and wineries in Arizona was an estimated $59.8 million in output[5], supporting 651 jobs and $28.0 million in income, and contributing approximately $28.7 million to Arizona's gross state product (also known as value added). The total number of jobs directly supported by Arizona's vineyards and wineries is estimated using federal data sources and responses from the survey. The U.S. Bureau of Labor Statistics reported 349 winery employees in 2019, not including proprietors. As a lower-bound assumption for proprietors, we assume there are at least 125 proprietors as there were 125 bonded winery operations in 2019. Finally, survey respondent vineyard acreage and employment responses were used to estimate the median full-time and part-time jobs supported per acre. Accounting for all 1,500 acres in the state, there were an estimated 177 full- and part-time jobs supported in Arizona vineyards. Combined, Arizona's vineyards and wineries are estimated to support 651 full- and part-time jobs.

Including multiplier effects, the total revised contribution of Arizona's wineries and vineyards to the gross state product is estimated at $60.8 million, corresponding to more than $116.6 million in sales. By purchasing inputs from other Arizona businesses and employing workers in vineyards and wineries who subsequently spend their paycheck at other Arizona businesses, there are an additional 360 full- and part-time jobs and $18.8 million in income, for a combined total contribution of more than 1,000 jobs and approximately $46.8 million in income. The estimates presented in Table 12 are revised estimates and supersede any previous estimates reported in the August or September versions of this report.

TABLE 12. ECONOMIC CONTRIBUTION OF EXISTING ARIZONA WINERIES AND VINEYARDS, 2019

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	651	$28,016,000	$28,770,000	$59,808,000
Indirect Effect	133	$7,718,000	$11,910,000	$21,995,000
Induced Effect	227	$11,109,000	$20,107,000	$34,832,000
Total Effect	1,011	$46,843,000	$60,787,000	$116,635,000

Source: Authors' calculations; IMPLAN Group, LLC, 2019

[5] Direct contributions of the wine industry include the value of grape and wine production as described in the previous section. Adjustments have been made to only include the value of inventory change related to 2019 production. Additionally, to prevent overestimating the sales associated with wine production, the model is specified such that wineries are unable to purchase grapes from within state. This has the effect of including wine grape production within the direct effects instead of indirect effects.

Table 13 presents the results of the analysis for vineyard establishment. As estimated previously, the total estimated spending by non-revenue-generating vineyards in 2019 was approximately $1.45 million. Not all inputs and supplies, however, are purchased from Arizona businesses. To account for leakages from the state economy due to purchase of non-local inputs, local purchase percentages were set to SAM (Social Accounting Matrix) values in the IMPLAN model. Based on these local purchase percentages, it is estimated that a little more than half of the vineyard supplies are purchased from within the state. This may be a conservative estimate of multiplier effects if specialized supplies, such as trellises, are purchased primarily from within the state. Including multiplier effects, spending associated with establishing vineyards in 2019 supported $1.6 million in sales, approximately $950,000 in gross state product, 15 jobs, and $697,000 in labor income (Table 13).

TABLE 13. ECONOMIC CONTRIBUTION OF VINEYARD ESTABLISHMENT IN ARIZONA, 2019

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	10	$435,000	$495,000	$757,000
Indirect Effect	1	$78,000	$120,000	$245,000
Induced Effect	4	$185,000	$335,000	$580,000
Total Effect	15	$697,000	$949,000	$1,582,000

Source: Authors' calculations; IMPLAN Group, LLC, 2019

Table 14 presents the results of the analysis of investment in new winery establishments in 2019. Assuming 14 new bonded wineries were established and a conservative total price tag of $11.5 million in initial investments, an estimated $7.1 million in sales was directly supported in the Arizona economy. Due to the specialized nature of winemaking, few supplies are purchased from businesses within Arizona. However, one of the largest investment expenses for a winery (accounting for more than 50% of investment costs) is real estate and building, most of which is assumed to be handled within the state. Including multiplier effects, spending associated with the establishment of 14 new wineries in Arizona supported $14.8 million in sales, approximately $7.0 million in gross state product, $3.4 million in labor income, and 85 total full-time and part-time jobs (Table 14).

TABLE 14. ECONOMIC CONTRIBUTION OF WINERY ESTABLISHMENT IN ARIZONA, 2019

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	36	$1,029,000	$2,934,000	$7,051,000
Indirect Effect	33	$1,558,000	$2,608,000	$5,229,000
Induced Effect	16	$804,000	$1,455,000	$2,520,000
Total Effect	85	$3,391,000	$6,998,000	$14,801,000

Source: Authors' calculations; IMPLAN Group, LLC, 2019

Combined, the total revised, estimated contribution of Arizona's wine industry to the state economy in 2019 was $133.0 million in output and $68.7 million in gross state product. Roughly 1,100 jobs were supported, as well as $50.9 million in employee and business owner income (Table 15). The estimates presented in Table 15 have been revised and supersede any previous estimates reported in the August or September versions of this report.

TABLE 15. ECONOMIC CONTRIBUTION OF ALL WINE INDUSTRY COMPONENTS, 2019

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	697	$29,480,000	$32,199,000	$67,617,000
Indirect Effect	167	$9,354,000	$14,638,000	$27,469,000
Induced Effect	247	$12,097,000	$21,897,000	$37,931,000
Total Effect	1,111	$50,931,000	$68,734,000	$133,017,000

Source: Authors' calculations; IMPLAN Group, LLC, 2019

Summary and Discussion

The wine industry in Arizona has been growing rapidly over the last several years, with significant increases in grape acreage and the number of vineyards and wineries throughout the state. Statewide, Arizona has more than 1,500 grape acres and, in 2019, produced nearly 600,000 gallons of wine, the highest level of production to date.

Most vineyards and many of the state's wineries are located in the state's three major wine regions, in the Sonoita AVA, the Willox AVA, or the proposed Verde Valley AVA (Santa Cruz, Cochise, and Yavapai counties). Other wineries in the state are located near major tourist destinations, such as communities in Yavapai County that fall outside of the Verde Valley AVA like Sedona, or large population centers, such as Phoenix in Maricopa County. Wineries play an important role in rural areas because the sales they generate often bring net-new money into the local economy from visitors from outside the county. On average, survey respondents reported more than 8,000 annual visitors to winery tasting rooms, representing an important driver of tourism to surrounding communities. Wineries are part of the economic base of the Yavapai, Santa Cruz, and Cochise County economies, with employment 4 to 7 times more concentrated than the national average. This means that these regions are likely net-exporters of wine, bringing revenue and income into the local area from outside.

The results of this study suggest that Arizona's wine industry is highly vertically integrated with most operations within the industry cluster involved in both grape growing and winemaking. Further, according to survey results, a large proportion of grapes are sourced from within Arizona, either from the winery's own vineyard or purchased from another Arizona vineyard. While it is impossible to say that all Arizona wineries source their grapes from Arizona vineyards, wineries responding to the survey accounted for 20% of the state's total wineries. These results suggest that Arizona wineries have a commitment to producing a product made from local grapes. That said, sufficient supply of Arizona grapes is one of the challenges facing the industry, particularly in the face of potential yield reductions due to natural risks (Glenn, 2011; Burch, 2021).

Survey results also suggest that many Arizona wineries rely heavily on their own sales and distribution channels. Retail wine sales and tasting room fees have been shown to be important source of revenues for many Arizona wineries, with some individual wineries obtaining about three-fourths of their revenues from either of these two sources. On average, the largest shares of winery revenues come from retail wine sales (39.4%), tasting room fees (23.7%), wine club or internet sales (14.7%), and wine sales through wholesalers or distributors (10.6%).

With a wide range of economic activities in various industries, from agricultural production to manufacturing and distribution, and an intertemporal component of production and revenue generation, estimating the economic

contribution of the Arizona wine industry within a given year presents a challenge. This study estimates the total economic contribution of the Arizona wine industry in 2019, accounting for economic activity related to ongoing, existing production (grape growing and wine production), sales of previously produced wine, as well as expansion of the industry through investment in new acreage in Arizona vineyards and new wineries throughout the state.

Including multiplier effects, the total revised contribution of Arizona's wine industry was estimated at $68.7 million in gross state product and $133.0 million in sales in 2019. Grape growing, wine production, wine sales, and expansion of the industry in 2019 supported nearly 1,100 jobs and $50.9 million in income, including jobs and income supported in other industries through multiplier effects. More than half of these jobs are directly supported in Arizona's vineyards and wineries.

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Appendix

Appendix A: Detailed Data Available

There is no single data source that provides information on all segments of the wine industry. Data available from government statistics use varying definitions that make accounting for all operations involved in viticulture and winemaking challenging. This section reviews available government statistics related to wine grape production and wine production in Arizona and highlights differences between each data source.

Wine Grape Production

There are two primary sources of secondary data on wine grape production in Arizona. The first is the Census of Agriculture, a comprehensive summary of agricultural activity for all states and counties in the United States. The Census of Agriculture is released every 5 years with the most recent statistics pertaining to agricultural activity in 2017. The Census reports a variety of statistics related to grape production, though no distinction is made between wine grapes and table grapes, and there are limitations for determining the number of operations producing grapes for commercial winemaking. The second data source is the USDA National Agricultural Statistics Service Arizona Field Office's 2013 Arizona Vineyard Survey. The statistics presented in the USDA NASS study are the most comprehensive statistics on Arizona's vineyards but are now a little outdated. Table 16 presents the data available from the 2017 Census of Agriculture, the 2013 USDA NASS Arizona Vineyard Survey, and the 2012 Census of Agriculture.

The Census of Agriculture reports all farms that have grape acreage. According to the 2017 Census of Agriculture, there were 230 farms with more than 1,500 acres of grapes in 2017. Between 2012 and 2017, statewide grape acreage nearly doubled from 942 acres on 178 farms to more than 1,500 acres on 230 farms. As noted previously, no distinction is made as to whether the acreage is of wine grapes or table grapes. An additional limitation of this data is that a farm is defined as any establishment that produced and sold, or could have sold, $1,000 or more worth of agricultural products in the Census year. Data from the Census, therefore, capture any operation that had *any* grape acreage -- even if the primary agricultural products produced were something other than grapes. The definition used to generate this statistic is quite broad and may overcount the number of operations growing grapes for commercial winemaking.

A more focused measure reported by the Census of Agriculture is the number of operations that are classified as grape vineyards by the North American Industry Classification System (NAICS). These operations are grape vineyards that derive more than 50% of their sales from the sale of grapes (NAICS code 111332). As of 2017, there were 152 operations specialized in grape production with 1,480 harvested acres. This is up from 73 operations and 882 harvested acres in 2012. Note, however, that the acreage statistic reports total harvested acres for all crops, not just harvested grape acreage.

Finally, there are statistics reported by the USDA NASS vineyard study. This study identified 96 wine grape vineyard operations in Arizona (64 of which had planted acreage in 2013), with a total of 950 bearing and non-bearing acres in 2013 (Table 16). However, the study also reported the additional acreage expected to be planted in the next 1-3 years and estimated that planted grape acreage would total about 1,300 acres by the end of 2016.

TABLE 16. FARMS AND GRAPE ACREAGE IN ARIZONA BY DATA SOURCE

Measure	2017 Census of Agriculture	2013 USDA NASS Study	2012 Census of Agriculture
All Farms with Grape Acreage	230		178
Acres (Bearing & Non-Bearing)	1,538		942
Vineyards (111332)	152	96	73
Vineyards with Planted Acreage		64	
Acres (Bearing & Non-Bearing)		950	
Harvested Acres[1]	1,480	750	882

1 Harvested acres reported by the 2013 USDA NASS study refer specifically to grape acreage. Harvested acres reported by the 2017 and 2012 Census of Agriculture reports refer to all harvested crop acreage.

Of the 1,538 total grape acres in Arizona in 2017, a large majority (87%) were of bearing age. There were, however, 199 non-bearing acres reported in 2017, with most non-bearing acreage located in Cochise County (Table 17). The top counties for grape acreage (bearing and non-bearing) in 2017 were Cochise County (49%), Santa Cruz County (15%) and Yavapai County (10%). Combined, these three counties account for 74% of Arizona's grape acreage in 2017.

TABLE 17. FARMS AND BEARING AND NON-BEARING ACREAGE BY ARIZONA COUNTY, 2017

County	Total		Bearing Age Acres		Non-Bearing Age Acres	
	Farms	*Acres*	*Farms*	*Acres*	*Farms*	*Acres*
Apache	4	(D)	2	(D)	2	(D)
Cochise	49	757	46	647	14	109
Gila	10	34	10	26	4	8
Graham	11	107	5	86	8	21
Greenlee	2	(D)	-	-	2	(D)
Maricopa	24	16	19	15	5	1
Mohave	14	(D)	11	(D)	8	(D)
Navajo	9	3	3	(Z)	9	3
Pima	21	(D)	21	(D)	-	-
Pinal	9	3	6	2	3	(Z)
Santa Cruz	25	229	22	(D)	8	(D)
Yavapai	52	152	40	127	20	25
AZ Total	230	1,538	185	1,339	83	199

Source: USDA, 2019

As noted previously, there is no formal distinction in the Census of Agriculture data as to whether statistics pertain to wine grapes or table grapes. However, the USDA NASS 2013 wine grape vineyard study corroborates that a majority of wine grapes are produced in Cochise, Santa Cruz, and Yavapai counties. According to this study, these three counties accounted for 95% of the state's wine grape acreage, with about 66% of the acreage in Cochise County in the Willcox area, 21% in Santa Cruz County in the Sonoita/Elgin area, and 7% in Yavapai County in the Verde Valley area (Table 18) (USDA, 2014).

TABLE 18. WINE GRAPE ACRES PLANTED AND HARVESTED BY ARIZONA COUNTY, 2013

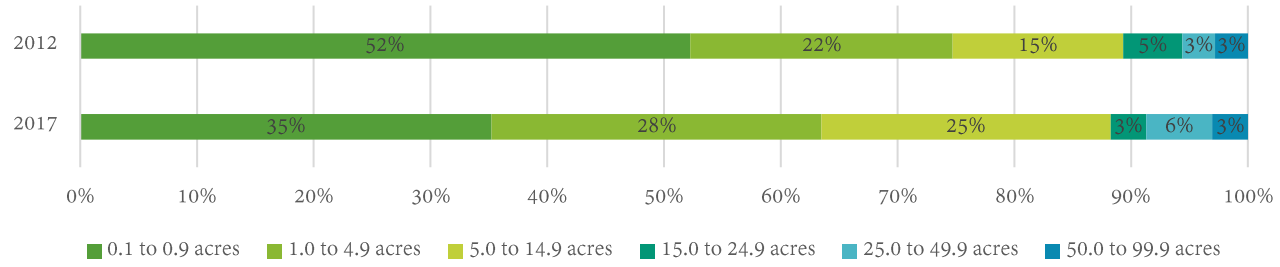
County	Acres Planted (Bearing & Non-Bearing)	Acres Harvested
Santa Cruz	200	175
Cochise	630	495
Yavapai	70	60
Other Counties[1]	50	20
Total	950	750

1 Other counties include Gila, Graham, La Paz, Mohave, and Pima counties.

Source: USDA NASS, 2014

Small-scale farms account for the largest share of farms with grape acreage, with 35% of farms having less than 1 acre of grapes, though that share has declined from roughly half in 2012 (Figure 21). The proportion of farms with more than 1 acre but less than 25 acres has increased between 2012 and 2017. While a direct comparison to the USDA NASS 2013 wine grape vineyard study is not possible due to different acreage ranges, results of the survey suggest that there is a bi-modal distribution of farms by farm size. The USDA NASS study found that 35% of wine grape vineyards had less than 2 acres, but that 25% had more than 15 acres, a higher proportion than reported by the 2017 Census of Agriculture.

FIGURE 21. PROPORTION OF ARIZONA FARMS WITH GRAPE ACREAGE BY FARM SIZE, 2012 & 2017



Source: USDA, 2019

There has been a large increase in statewide grape acreage for farms with 5 to 14.9 acres and 25 to 49.9 acres. Total grape acreage in farms with 5 to 14.9 acres increased from just over 200 acres in 2012 to nearly 450 acres in 2012 (Figure 22). Farms with 25 to 49.9 acres saw an even greater increase, with total acreage growing from about 145 acres to more than 420 acres, nearly 3 times higher (Figure 21). Combined with the statistics on the share of farms by farm size presented above, this suggests that farms with grape acreage have grown and expanded their acreage between 2012 and 2017.

FIGURE 22. ARIZONA GRAPE ACREAGE BY FARM SIZE, 2012 & 2017

Source: USDA, 2019

The Census of Agriculture does not report grape yields or total production, but the USDA NASS 2013 study reports yield by wine grape variety and estimates the total tonnage of wine grapes produced in Arizona. The top varieties in Arizona in terms of acreage were Cabernet Sauvignon, Syrah, Grenache, Zinfandel, and Merlot, among more than 25 varieties with reported acreage in Arizona (USDA, 2014). With yields ranging from less than 1 ton per acre to about 3.3 tons per acre and an average yield of 1.8 tons per acre, the estimated total production of wine grapes in Arizona in 2013 was 1,370 tons.

Wine Production

There are two primary sources of data on wine production in Arizona. The Arizona Department of Liquor reports the number of farm wineries in Arizona and the total gallons of wine produced. An operation is licensed as a farm winery if it produces at least 200 gallons but less than 40,000 gallon and has a TTB (U.S. Alcohol and Tobacco Tax and Trade Bureau) permit or the operation has at least 5 acres of grapes or fruit with a contract to process fruit into wine (Arizona Department of Liquor, 2021). This could undercount the number of wine producers in the state if the winery produces less than 200 gallons or more than 40,000 gallons yet also includes vineyards growing wine grapes that may contract with another winery to produce the wine. The second source of data is the U.S. Alcohol and Tobacco Tax and Trade Bureau (TTB). The TTB provides permits for any operation conducting wine operations (producing or blending wine) for sale. This could include wineries producing wine from grapes from all over the country.

According to Arizona Department of Liquor records, there were 110 farm wineries in 2019, up from 94 in 2017 and 100 in 2018 (Table 19). In 2019, reported production was just over 380,000 gallons. According the TTB, there were 125 bonded wine producers in Arizona in 2019, producing nearly 600,000 gallons of wine (TTB, 2021).

TABLE 19. NUMBER OF FARM WINERIES IN ARIZONA AND GALLONS PRODUCED, 2017-2019

Year	Number of Farm Wineries	Gallons Produced
2017	94	319,054
2018	100	285,081
2019	110	382,010

Source: Arizona Department of Liquor, 2019

Appendix B: Economic Base Analysis

In regional economics, economic base theory divides sectors of a local economy (such as a county economy) into basic and non-basic sectors. In basic sectors, the primary markets for locally produced goods and services lay outside of that county. The county produces more of the goods or services than needed to meet local demands. Much of what is produced locally is "exported" to other areas. "Exports" refer to sales to parties outside the county, not necessarily international exports. For example, sales from Yavapai County to California or Phoenix would be "exports." Basic sectors are important to a county economy because sales they generate bring money into the county economy from outside. Because exports draw new income and purchasing power into a county, expanding basic sectors is considered crucial for a region's economic development (Thulin, 2015).

Non-basic sectors are those that depend on the local population as their main source of demand. Many non-basic sectors are those that provide goods and services to proprietors and workers in basic sectors as well as proprietors and workers in other non-basic sectors. These sectors might include grocery stores, pharmacies, barbershops, auto repair shops, etc., that primarily serve the local population.

A common way to evaluate a sector's contribution to a county's economic base is through the use of location quotients (LQ), originally developed by Florence (1929). Mathematically, a LQ is measured as a local sector's share of total local employment divided by that same sector's share of total national employment. The formula for the location quotient for a sector *i* is

$$LQ_i = \frac{e_i/E}{n_i/N}$$

where
i = the particular economic sector
LQ_i = Location quotient for economic sector i
e_i = County employment in economic sector i
E = Total county employment
n_i = National employment in economic sector i
N = Total national employment.

LQs are often based on employment because employment data are collected for local areas in great sector detail. Sectors that employ roughly the same share of employees as the national average will have location quotients near one (1.0). This implies they are employing people and producing output to fulfill local needs. If a sector has a

location quotient greater than 1.25, it can indicate it is producing more than enough output to satisfy local demands and the sector is exporting goods or services outside the area (Crawley et al., 2013; Goetz et al., 2009; Morrissey, 2016). An LQ above1.25 usually indicates the sector is a basic sector – a sector bringing money into the county from outside. Tourism-related industries may also be thought of as a region's export sector because, even though tourists are coming into the county, they are bringing their spending from outside the county.

The Quarterly Census of Employment and Wages (QCEW) reports county-level location quotients for industries based on the North American Industry Classification System (NAICS). NAICS is a system of codes used in the United States, Mexico, and Canada to categorize businesses (as well as their sales, value added, employment, etc.) for statistical purposes based upon the economic activity or activities in which they are engaged). NAICS codes range from 2-digit codes to 6-digits codes. Each additional digit signifies greater industry detail. For example, the 3-digit code NAICS 312 is for Beverage and Tobacco Product Manufacturing, NAICS 3121 is Beverage Manufacturing, and NAICS 31213 is Wineries. Tables 1-3 in the report present the top 10 industries for Yavapai, Santa Cruz, and Cochise counties by employment location quotient, with the LQ for wineries highlighted.

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