

Barossa Valley and Napa Valley GIS Analysis

Longhan Zhang
University of Adelaide
Computer Science
Adelaide SA Australia
a1737480

September 2020



Contents

1 Executive summary	3
2 Introduction	3
3 Barossa Valley	4
3.1 Barossa Valley Histroy	4
3.2 Barossa valley climate	4
3.3 Barossa Valley vineyard slope aspect	7
3.3.1 Effects of sunshine hour for grape	9
3.3.2 Effects of preventing frost	9
3.3.3 Effects of drainage	9
3.3.4 Soil type	9
4 Napa Valley	9
4.1 Napa Valley History	10
4.2 Napa Valley Climate	10
4.3 Nape Valley Slope	10
4.4 Napa Valley soil	11
5 Common feature between Nape Valley and Barossa Valley	11
5.1 Appropriate soil Matching valley Terrain	11
5.2 Unique climate providing high quality of grape	12
5.3 Slope Terrain Providing efficient drainage	12
6 Conclusion	13
7 Method	13
7.1 Data resource	13
7.2 flow chart	14
8 Reference	15

1 Executive summary

In this report, we are implementing a geographic information system to analyse how the valley affects wine region between Napa Valley and Barossa Valley. Since going through the given Valley information, we will consider all the geographic information to determine why valley can produce higher quality wine from grapes. Firstly, the sloping terrain plays the important role of preventing frost, improving drainage and longer sunshine hours; Secondly, the climate of the wine region is also a contributing factor in the maturity time of grapes; Thirdly, the type of soil also influences the heat preservation and drainage. Therefore, the fine quality of the wine is basing the geographic resource of wine region whereas the wine making skill is not deterministic for the high quality of the wine, it explains the higher quality of wine from one region always gathers in a specific year and specific region rather than skills of the winemaker.

2 Introduction

Wine is one of the most civilized things in the world and one of the most natural things of the world that has been brought to the greatest perfection, it offers a greater range for enjoyment and appreciation than, possibly, any other purely sensory thing. (Hemingway).

Wine tasting is one of my interests since I moved to South Australia, I tried the 2010 Napa Valley Cabernet Sauvignon from Stags Leap District a few weeks ago, the full-bodied with complex flavour of black fruit and dried herbs give me a great first impression and spark my interests about California wine, So In this report, I will launch a deep investigation through GIS analysis to determine the reasons why Barossa Valley and Napa Valley produce premium wine basing on environmental circumstance. The reason I chose this topic is the quality of wine depends on the quality of the grape, but the quality of the grape is depending on the geographic features of the winery region. As the grapes start maturing the sugar level inside grape will gradually accumulate, when sugar level reached a certain level the grapes can be considered mature. On the other hand, the flavour maturity is not necessary to match sugar maturity-the grape needs longer time on the vine to fully develop flavour, the quality of the grape is basing on the balance between sugar maturity and flavour maturity. For example, the hot weather during veraison will produce grapes with high sugar levels without flavour which means poor quality wine, however, the grapes in the cool region tends to be more flavoursome and elegant. therefore the most of premier wine from France frequently located in the warm region(Average temperature is low).On the other hand, The cool region in Australia also produces higher quality wine (e.g. Tasmania region). Regardless of temperature, other geographic factors are also important, for example; the elevation can cool down the daily temperature; the slope facing also determines the sunshine time and preventing

frost; the location of wine region also determines the amount of rainfall; the soil is also an important part because of heat preservation, drainage and nutrition. Therefore, the geographic information strongly affects the quality of wine and geographic information system analysis also help people to make the premier wine.

The majority of the world's wine-producing regions are between the temperate latitudes of 30 degrees and 50 degrees in each hemisphere (Barossawine,2020), and Barossa Valley and Napa valley are no exception, the Barossa Valley is sitting at approximately 34° South of the Equator, whereas the Napa Valley is sitting at approximately 38.5° north of Equator. My project aims to analyse two new world wine regions which are Barossa valley and Napa valley.

The Napa Valley is an American viticulture area located in northern of California, there is also one of premier wine region which produces premier wine and commercial wine, the California states produces around 90 percent wine in the united states(Hugh and Jancis,2013).

3 Barossa Valley

3.1 Barossa Valley History

Barossa Valley is the most famous wine region in South Australia located in the northeast of Adelaide City, there is also one of the oldest and most premier wine regions in Australia and one of the well-known wine regions in the new world(e.g.Australia, America). There yield around 50 percent wine in Australia (Hugh and Jancis,2013)

In Barossa Valley includes approximately 50 wine producers, some producers are well known and famous in the world includes Penfolds, Lehmann, Lando Wines, Seppeltsfield, Wolf Blass and Yalumba. The wine industry began in 1841, the large part of Australia wine industry was influenced by British approach and tasting, but the Barossa valley is shaped by the influence of German shelters(Allen,2012).

At the early time of Barossa Valley wine industry people are focusing on the production of Riesling and Port-style wine. As the tasting of Australians and people around the world evolved, the Barossa Valley mainly produces the fullest body Shiraz and Cabernet Sauvignon to satisfy the current market. The reputation of Barossa Valley was increased by the late 20Th century, some of the unique varieties of wine have begun to earn the significant acclaim for Barossa Valley.

3.2 Barossa valley climate

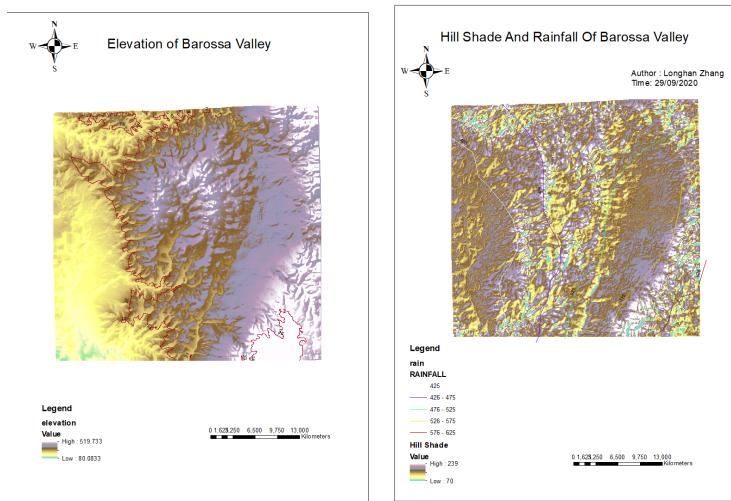
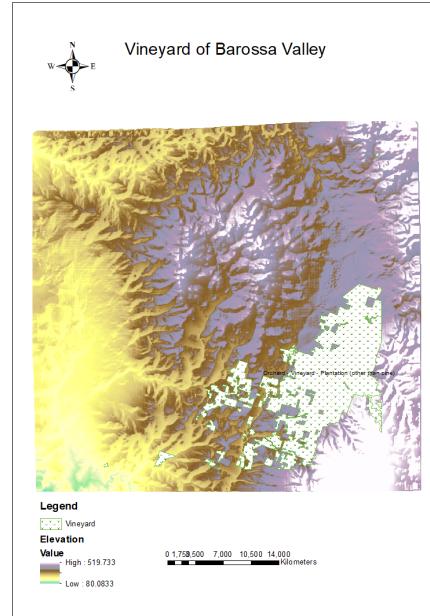
The weather is the most significant external factors to determine the quality of the wine, but the climate usually depends on the geographic feature, so in my

report, the geographic feature and climate is mutually connected. Broadly speaking the Barossa Valley has a continental climate but its series of transverse valleys and gently sloping hills do produce a wide range of microclimates(Wikipedia contributors,2020), the continental climate often has the significant annual weather feature which is hot dry summer and mild wet winter. According to the below statistics, it is clear to see that maximum winter temperature range is from 18.7 °C in May and 18.4 °C in September; the maximum summer temperature range is from 28.4 °C in December and 27 °C in March; The mean winter rainfall is from 53.1mm in may and 53.1mm in September; the mean summer rainfall is from 24.1mm in December and 20.1mm in March. As a result, it is considered continental climate. The westerly prevailing wind brings sufficient rain to the Barossa Valley when the prevailing wind encounters the high altitude hill in the east side of Barossa Valley, the amount of rainfall in the east side of Barossa Valley will be more than the west side of Barossa Valley. At the below map there is clearly to see the elevation of the east side of the hill is higher than the west side of the hill, therefore the most of vineyard is located at the east side of Barossa Valley.

Figure 1: The rainfall and temperature of Barossa Valley

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	Pct	Map
Temperature																
Mean maximum temperature (°C)	30.6	30.5	27.4	23.2	18.7	15.6	14.8	15.9	18.4	22.2	25.9	28.6	22.6	58	1902	
Mean minimum temperature (°C)	15.2	15.5	13.4	10.7	8.3	6.1	5.6	5.6	6.6	8.3	11.2	13.5	10.0	58	1902	
Rainfall																
Mean rainfall (mm)	18.6	18.6	20.1	36.4	53.1	58.2	58.3	57.6	53.1	42.8	29.3	24.1	486.2	119	1982	
Decile 5 (median) rainfall (mm)	12.7	10.4	12.6	27.0	47.5	51.9	56.6	58.4	47.4	39.0	26.0	19.0	458.8	89	1982	
Mean number of days of rain ≥ 1 mm	1.8	1.4	2.1	3.3	5.5	6.6	7.1	6.8	5.7	4.3	2.9	2.4	49.9	89	2020	

Figure 2: The Vineyard location and elevation of Barossa Valley



(a) Elevation of Barossa Valley

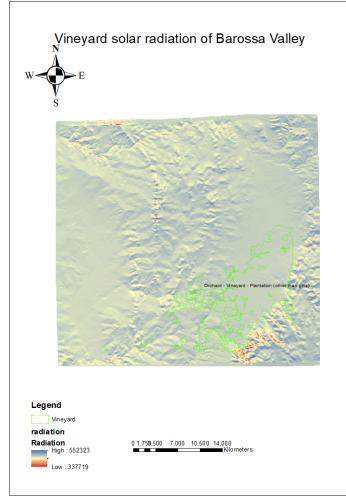
(b) Hill Shade and Rainfall of Barossa Valley

3.3 Barossa Valley vineyard slope aspect

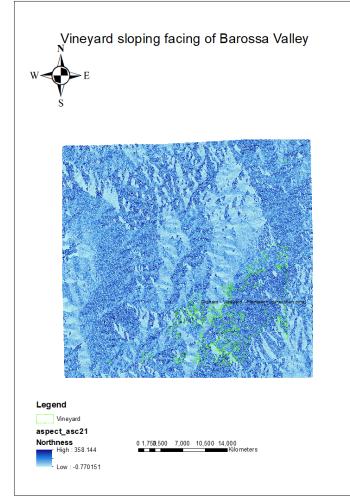
The chosen vineyard location is an important part of wine-making because the climate factors are difficult and expensive to change, but the possible change areas of wine-making are in the location of the vineyard. So the slope facing is one of the important factors to determine the quality of the wine.

A vineyard's degree of the slope can be very important for several reasons: airflow through the canopy, soil drainage, level of water movement, possible erosion, and ease of working in amongst the vines, managing with equipment and then ease of harvesting. There is no perfect slope as it will depend on what is the primary limiting factor of concern. (Gavin,2017)

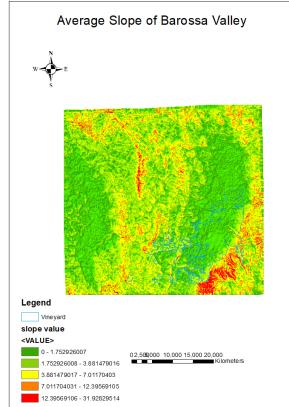
After we implement the slope build-in function through GIS, it shows apparent information about vineyard slope facing which most of the vineyard is faced to north. At the third image we clearly see the average slope degree of vineyard is between 0 to 1.75.



(c) Solar radiation of Barossa Valley



(d) The Vineyard location and elevation of Barossa Valley



(e) Average slope of vineyard

The north-facing of the slope can receive higher average sunshine hour during the year. To prove my assumption I used the solar radiation inside the GIS application, the result gives clear facts that most of the vineyard is located in high solar radiation place. In other words, higher solar radiation indicates higher sunshine.

3.3.1 Effects of sunshine hour for grape

The grape requires approximately 1300 hours to 1500 hours of sunshine to reach perfect balance in the growing season. the balance is mainly from the acid level and sugar level. In the summer the long sunshine hours and less humidity contribute the full-bodied,dark chocolate and spicy flavours to the Barossa Valley Shiraz. According to the above image, the vineyard of Barossa valley is often located in the sloped hill, thus the less hill shadow causes longer sunshine hours.

3.3.2 Effects of preventing frost

The most important element of frost protection is of course site selection and choice of varieties (late vs. early variety). Since cold air flows downhill, the mid-slope positions are warmer, if there are no trees, brush or other air dams that prevent cool air to flow out of the vineyard. Different grape varieties vary in the date of budburst, so it's somewhat recommended to choose early bud burst varieties in locations with the lowest risk of frost(Urska,2019).

3.3.3 Effects of drainage

A slight to moderate slope of 5 percent to 10 percent is desirable for vineyard sites as it encourages the drainage of denser cold air from the vineyard. Cold air is denser than warm air and will drain downhill, if there are no barriers to air movement such as trees or berms. Vineyards sloping greater than 15 precent become much more difficult to manage, as it is hazardous to operate machinery on steep, fragile slopes and these sites can erode more easily.(Gavin,2017)

3.3.4 Soil type

The soil in the Barossa Valley varies considerably - from deep sandy soils on the sloping areas to sandy loam and heavy red-brown clay soils on the flats. It is floored with Tertiary and Quaternary sediments, mainly silts and sands on which the relief is gently undulating and the soils highly productive(Magnum,2006). The red clay in Barossa valley contribute too much for high-quality grape, for example; red clay provides good water retentive approach, it is possible to store the water from winter season to use during the growing period; it can balance the PH value of grape to a neutral level.

4 Napa Valley

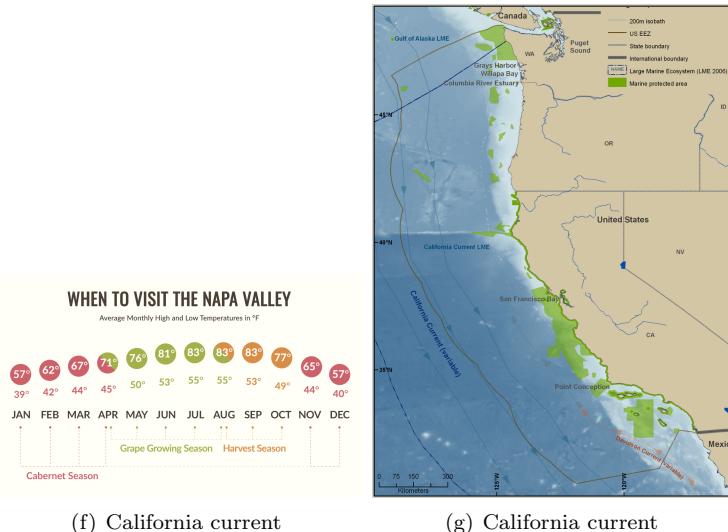
the Nape valley data is found from ARCGIS official website, the topic is discovering the suitable vineyard. so I will analyse geographic information from given data.

4.1 Napa Valley History

Napa Valley has a long history about winemaking and the first winemaking record is at 1839. In the early expansion, the Napa Valley holds approximately 140 wineries in 1861. After many years developing the America wine industry encounters the first challenge which is the enactment of Prohibition in 1920. With the repeal of Prohibition in 1933, the Napa Valley wine industry was slowly recovered .from the last 50 years the wine industry of Napa Valley are growing exponentially, the special climate and consistent market investment achieve the success of Napa Valley. Currently, the one ton of Cabernet grape price from Napa Valley is already more than 30,000 USD, in the comparison, the price of grape from Barossa valley is only around 1,000 AUD.

4.2 Napa Valley Climate

The Napa Valley is located at the north of San Pablo Bay in California, The cool California Current offshore, enhanced by up-welling of cold sub-surface waters, often generates summer fog near the coast, creating Mediterranean climate. The Mediterranean feature provides the long growing season which has warm-dry day time and cool evenings. As a result, This kind of climate feature provides sufficient water resource for grape growing and production.



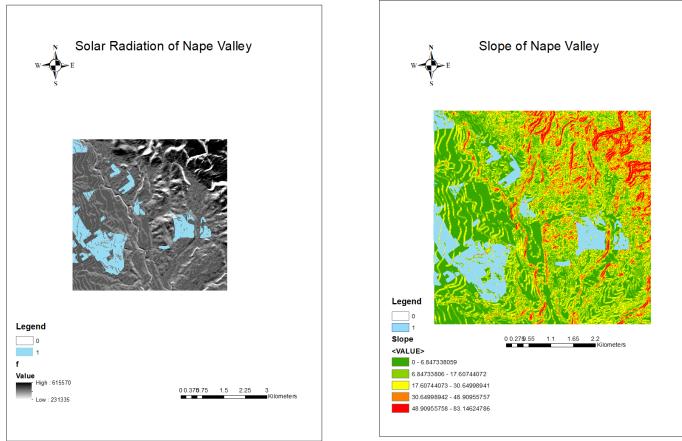
(f) California current

(g) California current

4.3 Nape Valley Slope

In this process I will implement the spatial analysis for given data, the main method is to analyse the surface slope of the Napa area. On a given image there is clear evidence that suitable vineyard of the slope is often from 0 degrees to 17 degrees. this interval of the slope is usually good for drainage development.

because north California is a Mediterranean climate in summer the long sunshine hours may sunburn the grape, therefore the hill shadow is necessary to keep grape healthy.



(h) Napa valley Solar Radiation

(i) Napa valley slope

4.4 Napa Valley soil

In the Napa Valley, there are more than 30 types of soil, but I will mention the most distinct type which is Alluvium. Napa Valley is home to several alluvial fans, which consist of layers of gravel, sand and silt that have descended from the western Mayacamas Mountains over millennia. These soils are deep and well-draining, which is a necessity if one's goal is to produce intensely concentrated Cabernet Sauvignon wines. Such soils are so granular that gravity pulls water away from the vines, forcing them to chase after it. The result is smaller berries with more intense flavour.(Anon,2014) .The valley terrain usually includes Alluvial Soil which is accumulated by actual debris and organic material from nature.therefore, the Alluvial Soil holds the amount of nutrition. It also explains the reason why grape is expensive in Napa Valley.

5 Common feature between Nape Valley and Barossa Valley

5.1 Appropriate soil Matching valley Terrain

Both wine regions hold a special type of soil regarding local geographic terrain. Due to the dry weather in summer of Barossa Valley the red clay store the water from winter, it perfectly balances the water supply from natural soil. In Napa valley the fertile soil supply high quality of the grape, but the most of Alluvial

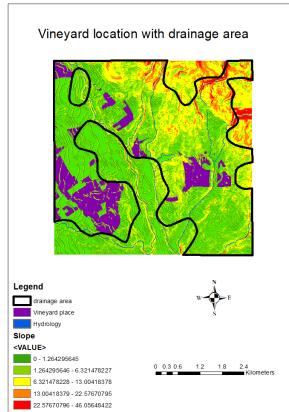
Soil is in the sloped ground, it explains that the vineyard of the slope is between 0 degrees and 15 degrees.

5.2 Unique climate providing high quality of grape

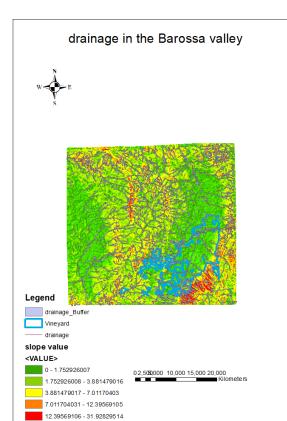
In the Barossa Valley, the continental climate provides the longer hours sunshine to mature the grape in the growing period, but the typical winter temperature of Barossa is above zero degrees, so the frost chance is relatively lower than another region. In the Napa Valley, the unique Mediterranean provides a warm summer and cooler winter. the warm summer supplies the sufficient sunshine hours to grape at daytime, however In the morning or evening it provides sufficient water from fog, therefore the climate can provide two of the most important recourse to the grape.

5.3 Slope Terrain Providing efficient drainage

The sloping terrain shares the convenience of drainage, the both of vineyard location is nearby drainage because of more convenient drainage, the effect of drainage only can be work in a certain area. it is clear to see that most of the vineyard is located in the drainage area.



(j) drainage of Napa valley



(k) drainage of Barossa valley

6 Conclusion

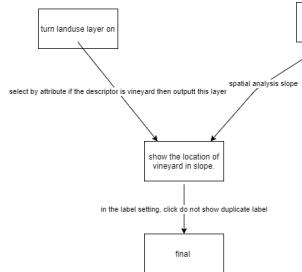
In conclusion, this report has discussed the three main feature of the valley wine region and has analysed the common geographic feature between Barossa Valley and Napa Valley. The Barossa valley provides the unique red-brown clay soil brings the advantage of higher productivity, water-retentive ability and balancing PH level; The Continental climate supplies the sufficient sunshine hours and water supply for grape growing; The sloping terrain shares the advantage of preventing frost, improving drainage and longer sunshine hours. On the other hand, The Napa valley unique Mediterranean climate and California cool current share the warm temperature and water supply of fog to mature of grapes; The Napa valley slope provides the sufficient sunshine hours and convenient drainage; The fertile Alluvial soil provides the amount of nutrition for the grape growing season. Therefore the unique climate, special soil type and slope terrain usually achieve the success of wine region, it explains that the success of wine is not the main masterpiece of the winemaker, but the masterpiece of geographic feature.

7 Method

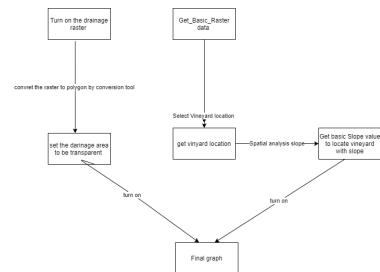
7.1 Data resource

The Napa valley data is from Arcgis website <https://www.arcgis.com/home/search.html?t=contentq=tags>

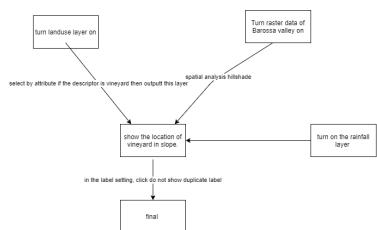
7.2 flow chart



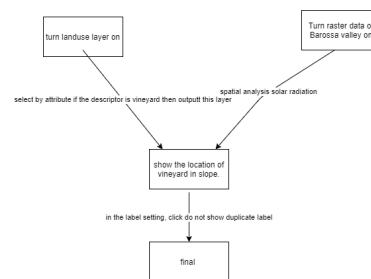
(l) Vineyard location and elevation of Barossa valley



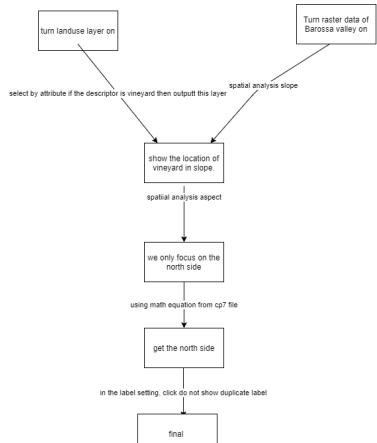
(m) Drainage area of Napa valley



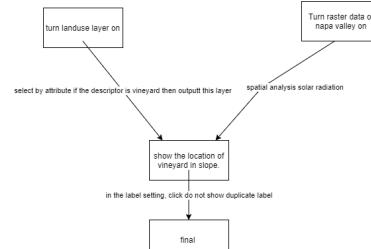
(n) hillshade and rainfall in barossa valley



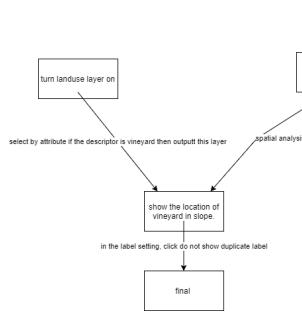
(o) vineyard solar radiation in barossa valley



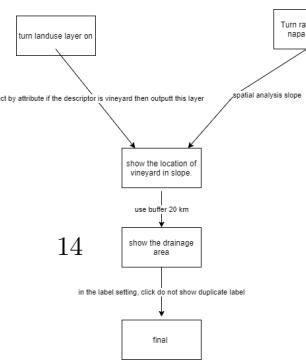
(p) vineyard sloping north facing in barossa valley



(q) solar radiation of napa valley



(r) slope of napa valley



8 Reference

- Max Allen, The History of Australian Wine: Stories From the Vineyard to the Cellar Room, Carlton, Victoria: Victory Books, 2012, p. 91
- Australian Wine and Brandy Corporation "Barossa Valley Archived 25 November 2009 at the Wayback Machine" Official Site, Australian Government. Accessed: 13 January 2010
- Commission, corporateName=South A.T. (2020). Visit South Australia - feel stimulated, relaxed, and inspired. [online] southaustralia.com. Available at: <https://southaustralia.com/places-to-go/barossa..>
- Hemingway, E. (2003). Death in the afternoon. New York: Scribner.
- Barossa Wine. (n.d.). Barossa Climate. [online] Available at: [https://www.barossawine.com/barossa/barossa-climate/..](https://www.barossawine.com/barossa/barossa-climate/>.)
- Urska 2019, How to prevent vineyard frost damage?, eVineyard blog, viewed 1 October 2020, [http://www.evineyardapp.com/blog/2019/07/03/how-to-prevent-vineyard-frost-damage/..](http://www.evineyardapp.com/blog/2019/07/03/how-to-prevent-vineyard-frost-damage/>.)
- www.wineguy.co.nz. (n.d.). Flat vs Sloping Vineyards: [online] Available at: <https://www.wineguy.co.nz/index.php/glossary-articles-hidden/862-flat-slope> [Accessed 1 Oct. 2020].
- Anon, (2014). Four distinct soil types behind some of the world's greatest wines. - Napa Valley Wine Academy. [online] Available at: [https://napavalleywineacademy.com/four-distinct-soil-types-behind-some-of-the-worlds-greatest-wines/..](https://napavalleywineacademy.com/four-distinct-soil-types-behind-some-of-the-worlds-greatest-wines/.)
- www.sunspotsbonaire.com. (Magnum.2006.). Barossa Valley. [online] Available at: <http://www.sunspotsbonaire.com/MagnumTrek/barossavalley.html: :text=Soil> [Accessed 1 Oct. 2020].
- Wikipedia contributors, "Barossa Valley (wine)," Wikipedia, The Free Encyclopedia, [https://en.wikipedia.org/w/index.php?title=Barossa_valley_\(wine\)&oldid=972569084](https://en.wikipedia.org/w/index.php?title=Barossa_valley_(wine)&oldid=972569084)(accessed October 2, 2020).