Agribusiness & Economics Research Unit
LINCOLN UNIVERSITY

Californian wine consumer consumption behaviours and product preferences: A Latent Class Analysis of New Zealand Sauvignon blanc

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Research Report No. 377
August 2022

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Key Points

- The Agribusiness and Economics Research Unit (AERU) at Lincoln University with the support of research partners under the *Unlocking Export Prosperity from the Agri-food Values of Aotearoa New Zealand* research programme has estimated willingness-to-pay (WTP) values for selected credence attributes of Sauvignon blanc wine by New York State consumers, with a focus on identifying preferences for attributes considered *distinctively New Zealand.*

- Preferences for many of the credence attributes considered here are not readily observable from market prices and so the non-market valuation method of Discrete Choice Experiments was used. This involved an online survey of New York State residents in May 20121 using a research panel. The survey process achieved 837 responses with suitable representation of key population demographics.

- As well as WTP values, this survey reports on:

    - Purchase frequency overall, and by country-of origin
    - Consumption frequency
    - Prices paid
    - Country-of-origin quality ranking
    - Wine experience and engagement
    - Sustainability reporting perceptions and preferences
    - Sustainability labelled wine purchasing
    - Familiarity with the Sustainable Wine NZ programme
    - Attributes perceived as associated with Sustainable Wine NZ programme
    - Use of digital media and smart technologies for wine information and shopping

- About two out of every five consumers in this study purchases Sauvignon blanc at least fortnightly, and half of respondents consumed Sauvignon blanc more than once a week (but not every day). The average price usually paid was $22/bottle, the most common price point was between $16-20/bottle, and a quarter of respondent usually spent more than $30/bottle.

- New Zealand Sauvignon blanc was the third most purchased by country-of-origin after the US first and France second. Fifty-three percent of consumers purchased NZ Sauvignon blanc at least occasionally. Consistent with this finding, New Zealand Sauvignon blanc is ranked third highest quality behind the same two countries. Forty-nine percent of consumers rank New Zealand in the top three countries for quality.

- Wine experience and engagement varied over the sample. Two thirds indicating that they often read front labels, 60 per cent often read back labels. One in five consumers often attend wine tasting, almost a third of respondents read wine magazines and catalogues.

- Many consumers had purchased a sustainably labeled Sauvignon blanc in the previous month including California Certified Sustainable (43 per cent), USDA Organic (41 per cent) and Napa Green (28 per cent). SWNZ was the fourth most purchased sustainability label (20 per cent) and around 22 per cent of respondents indicated that they were very familiar with SWNZ and another 25 per cent were moderately familiar.

- When asked to indicate which attributes are associated with SWNZ, consumer awareness is low for about half of respondents, while about 20 per cent have a more accurate assessment. Forty percent of consumers associate the SWNZ programme with high quality wine.

- Many consumers are concerned about environmental effects of conventional production (66 per cent) and three quarters of consumers feel that purchasing a sustainable label wine helps protect the environment, however about 40 per cent of consumers have relatively low trust in sustainability claims.
- Access and use of sustainability information was important to many consumers. Only 17 percent thought it was easy to find the information they wanted, or that it was easy to understand. Seventy-one per cent were interested in wine labels that showed more detailed sustainability information, and 57 per cent wanted sustainability information reporting specific to a winery.
- A high proportion of wine drinkers used the internet to help them decide which wines to buy (79 per cent) and make wine purchases using their mobile phone (49 per cent). Use of mobile device smart technologies for purchasing and information searching is relatively high including bar codes for information searching (56 per cent) and purchasing (44 per cent), QR codes (55 per cent and 45 per cent), and RFID/NFC (40 per cent and 34 per cent). Many consumers use phone apps related to wine, with top uses including for product reviews (43 per cent), purchasing (41 per cent) and discounts (35 per cent). Uses with lowest current uptake include traceability (19 per cent) and verification of sustainability claims (25 per cent) but these areas have some of the highest levels of interest by consumers (48 per cent and 49 per cent interested in using).
- The highest level of wine expenditure occurs through grocery stores (36 per cent), followed by specialty stores (15 per cent) and liquor stores (11 per cent). Over half of consumers buy wine online, with an average expenditure across the sample of 12 per cent.
- The survey included a Discrete Choice Experiment to assess the willingness-to-pay by consumers for different attributes associated with wine. Using a Latent Class Modelling approach the consumers were segmented into 3 classes each with different characteristics and preferences.
- The results demonstrate significant preference differences between consumer segments. The first segment is the largest of the three consumer groups. These consumers have the strongest preferences of the three segments spanning all attributes other than for a 100 per cent organic claim. They have the highest willingness-to-pay for Māori produced wine of the three segments. Consumers in this segment are more likely to be accepting of other cultural experiences, have higher usual wine spend, believe sustainability is associated with high quality, be younger and have higher purchase and consumption frequency.
- The second group is the smallest segment of the three and these consumers value Organic production more than other consumers, and they value the closely aligned Pest & Disease Management claim. Segment three consumers have a strong focus on Critic Score and value this significantly more than other attributes.

- Respondents' average willingness-to-pay per 750ml bottle of New Zealand Sauvignon blanc:

Wine attributes	Segment One (48%)	Segment Two (17%)	Segment Three (36%)
Biodiversity Management	41% (22%, 59%)	10% (6%, 14%)	10% (7%, 12%)
Water Management	30% (16%, 45%)		7% (5%, 10%)
Energy Management	22% (12%, 33%)		
Pest & Disease Management	36% (20%, 52%)	13% (10%, 17%)	9% (6%, 11%)
Social Responsibility	31% (18%, 43%)	9% (5%, 12%)	8% (5%, 11%)
GHG Management	24% (11%, 37%)	8% (4%, 12%)	10% (7%, 13%)
Soil Management	39% (26%, 51%)		
By-products Management	32% (20%, 43%)	5% (0%, 10%)	4% (2%, 7%)
100% Organic Production		8% (3%, 14%)	
Māori Production	41% (21%, 60%)	12% (8%, 16%)	9% (6%, 12%)
Critic rating (per point >80)	0.4% (0.2%, 0.5%)	0.1% (0.1%, 0.2%)	0.2% (0.2%, 0.3%)

Average marginal WTP/750ml bottle of Sauvignon blanc.
95% Confidence Interval in brackets.

Chapter 1
Introduction

This study is part of a research programme entitled *Unlocking Export Prosperity from the Agri-food Values of Aotearoa New Zealand*. It is funded by the Ministry of Business, Innovation and Employment (MBIE) Endeavour Fund for science research programmes.

The research aims to provide new knowledge on how local enterprises can achieve higher returns by ensuring global consumers understand the distinctive qualities of the physical, credence and cultural attributes of agri-food products that are "Made in New Zealand".

Agricultural exports are an important contributor to the New Zealand (NZ) economy. While NZ historically relied on key markets such as the United Kingdom for export trade, NZ has more recently significantly expanded its export markets and the United States of America (USA) has become established as an important wine product destination. It is critically important for NZ exporters to understand export markets and the different cultures and preferences of those consumers to safeguard market access, and for realising potential premiums.

This report describes the application of a survey of Californian Sauvignon blanc consumers that is designed to examine consumption behaviour and consumer Willingness-to-Pay (WTP) for credence attributes. While *search attributes* such as price or colour can be observed directly, and *experience attributes* such as flavour can be assessed when consumed, *credence attributes* such as environmental sustainability cannot be immediately seen or experienced at the point of sale. For products promoting credence attributes, the role of verification including labelling is of significant importance.

Our approach is to apply a Discrete Choice Experiment economic valuation method, analysed using a statistical approach called Latent Class Modelling that describes profiles for different consumer segments identified in the data and provides estimates of attribute WTP across these segments.

Chapter 2
Wine Survey Method

To understand how consumers value NZ credence attributes this study used a structured self-administered online survey that included the Discrete Choice Experiment, conducted in California in June 2021. The survey was administered through Qualtrics™, a web-based survey system, and focused on Sauvignon blanc wine consumers with purchase frequency of at least monthly.

The survey was developed by the research team drawing from a literature review on consumer trends for wine products, results from previous surveys examining consumer preferences in overseas markets including California, New York State and Texas, and consultation with industry partners and stakeholders, especially those on the AERU advisory board.

Sampling involved recruiting participants from an online consumer panel database provided by an international market research company (dynata.com). Panel members are recruited by online marketing across a range of channels and panels are profiled to ensure adequate representativeness. Panels are frequently refreshed, with the participation history of members reviewed regularly. Respondents for each survey are compensated with a retail voucher for completing a survey.

2.1 Using Discrete Choice Experiments to examine consumer preferences

Discrete Choice Experiments are a survey-based valuation approach that have been widely used to value consumer preferences for food and beverage product attributes. They are particularly useful for examining the role of new attributes, and attributes that are not easily observable in market prices such as the attributes explored in the current report. The ability of this method to identify which individual attributes are more important in consumer choices, and to estimate consumers' WTP for these, has seen this approach to valuation become increasingly favoured by researchers.

Designing a Discrete Choice Experiment survey involves deciding which product attributes are of interest, combining these into different product offerings, and asking consumers to pick which offering they prefer from a range of alternatives. In this study, alternative Sauvignon blanc wine products are described by production practices, critic score, and price (Table 2-1). Attribute selection was primarily informed by previous surveys, including scoping surveys that used a combination of open text and structured questions to identify which attributes Californian consumers considered distinctive of NZ wine.

Table 2-1 Sauvignon blanc wine attribute descriptions used in the Discrete Choice Experiment

Sauvignon blanc wine attributes	Attribute descriptions
Biodiversity Management	The winery or grower has set aside area for biodiversity restoration or enhancement on the same property as the vineyard, or off-site.
Water Management	Monitoring, measurement and limitation of water resources is undertaken.
By-product Management	Production by-products are diverted from landfill and turned to beneficial use.
Energy Management	Monitoring, measurement and limitation of energy resources is undertaken.
Pest & Disease Management	Integrated control strategies are used to optimize control and fruit quality and prioritize minimization of the impact on the receiving environment.
Soil Management	Monitoring and measurement to maintain and improve soil structure, organic matter and nutrient status is undertaken
GHG Management	Monitoring, measurement and limitation of GHG emissions is undertaken.
Social Responsibility	From socially responsible vineyards and wineries that actively include public interest into their decision-making.
Organic Production	The wine may be labelled as *100% Organic*: Both growing and processing are Organic. No GMOs. No added sulfites. No synthetic fertilizers or agrichemicals.
Māori Production	The wine may be labeled as being produced by Māori wineries. Māori are New Zealand's indigenous people, they see themselves as belonging to the land. Māori seek to maintain and protect the health of their land for the welfare of current and future generations, and so to produce food that supports the health and wellbeing of their customers.
Critic rating	The wine may be labelled showing a score out of 100, from a well-known critic. A wine score is a simple way for a wine critic to communicate their opinion about the quality of a wine.
Price	The wine is labeled with the price for a 750ml bottle of Sauvignon Blanc.

Changes in wine attributes are described using the levels in Table 2-2. Price levels were determined by market prices, and from what scoping survey respondents said that they usually paid. An example of alternative product offerings presented to respondents is shown in Figure 2-1. Each set of offerings comprises three options, of which respondents chose their preferred one. Two options present alternative Sauvignon blanc products, while the third is a 'none of these' option. Each respondent answered ten choice sets. Product choices are statistically analysed using Latent Class Models to identify consumers preferences for each product attribute and to estimate consumers' WTP for each attribute. A more detailed description of the theoretical foundation and statistical procedure of Discrete Choice Experiments can be found in Appendix A.

Table 2-2 Sauvignon blanc wine attribute levels used in the Discrete Choice Experiment

Sauvignon blanc wine attributes	Attribute levels				
Biodiversity Management	No Label	Certified			
Water Management	No Label	Certified			
By-product Management	No Label	Certified			
Energy Management	No label	Certified			
Pest & Disease Management	No label	Certified			
GHG Management	No label	Certified			
Soil Management	No label	Certified			
Social Responsibility	No label	Certified			
Production System	Conventional	100% organic	Māori		
Critic rating	No Label	80-84	85-89	90-94	95-100
Price US$/750ml	$8.95	$13.55	$17.85	$23.15	

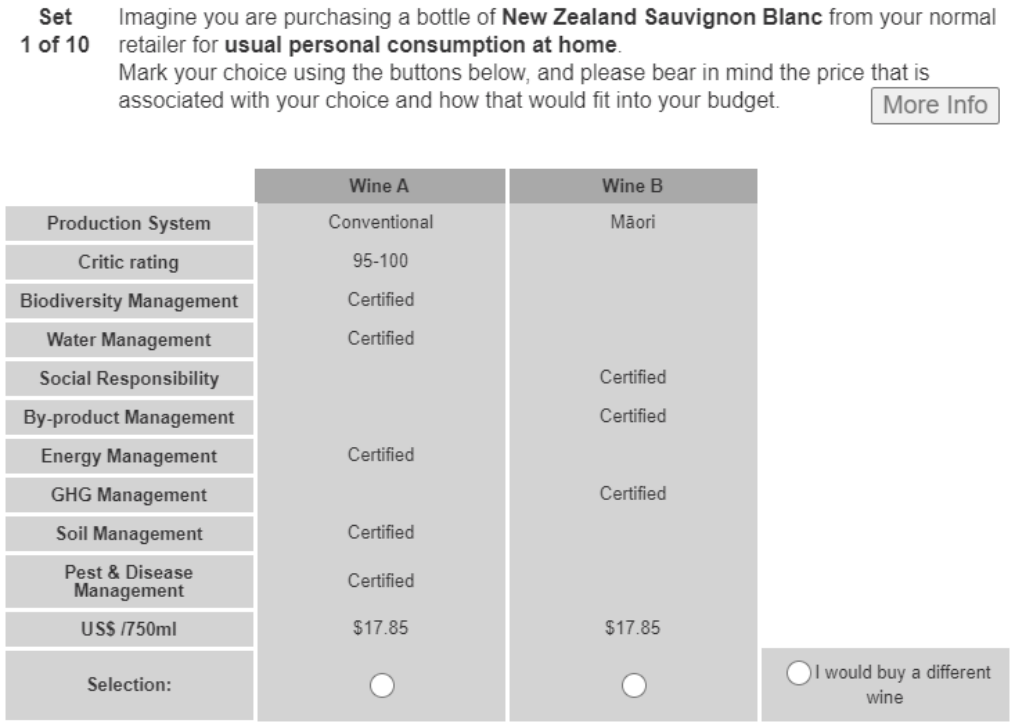
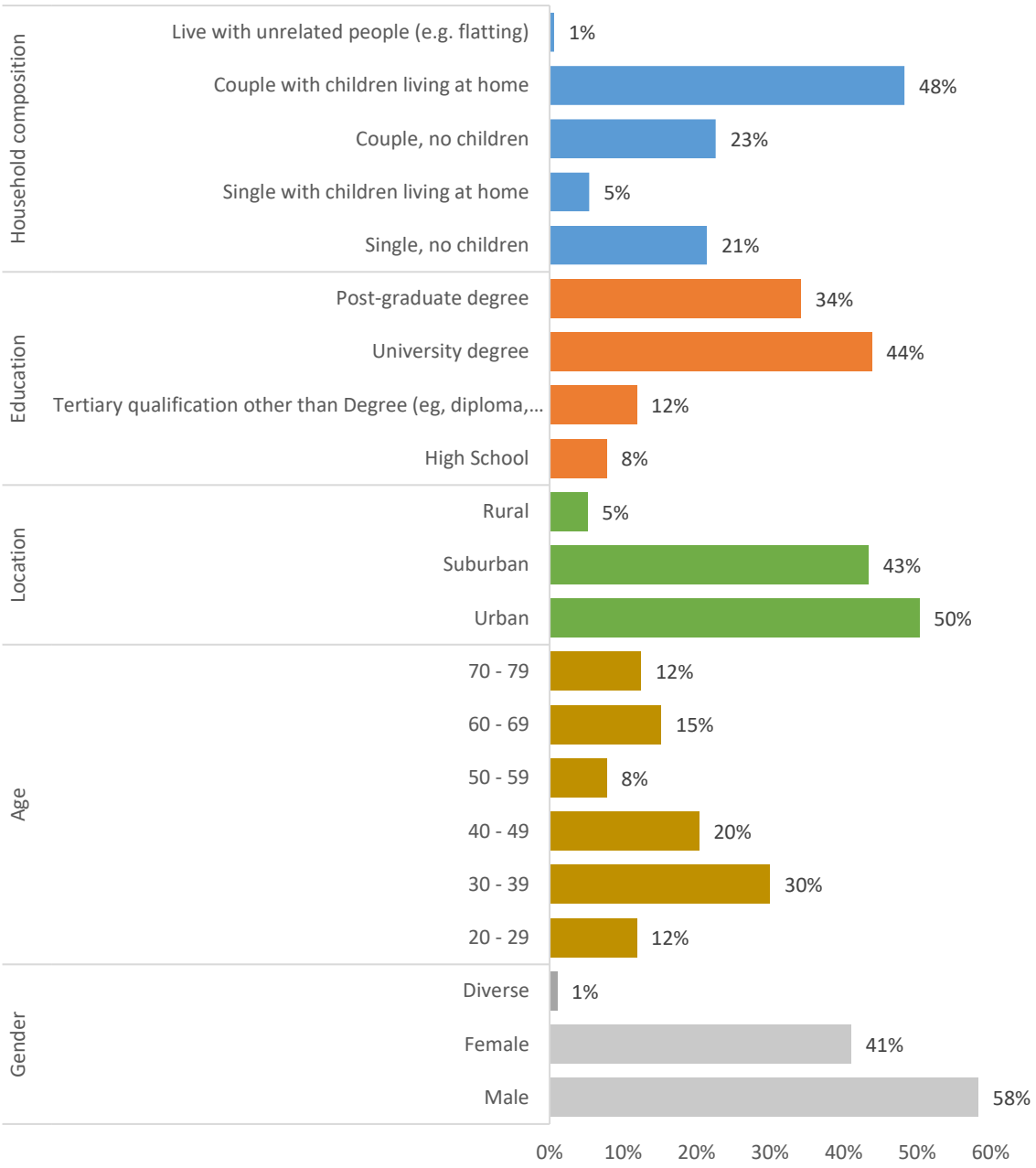


Figure 2-1 **Example of a DCE question shown to respondents**

Chapter 3
Survey Results

3.1 Sample demographic description

- The sample comprised a wide range of demographics, which is important to ensure that the sampling process has broadly canvased the relevant population (Figure 3-1).
- It is important to note that we are not attempting to represent the overall New York State population, but rather those that purchase Sauvignon blanc wine at least monthly.



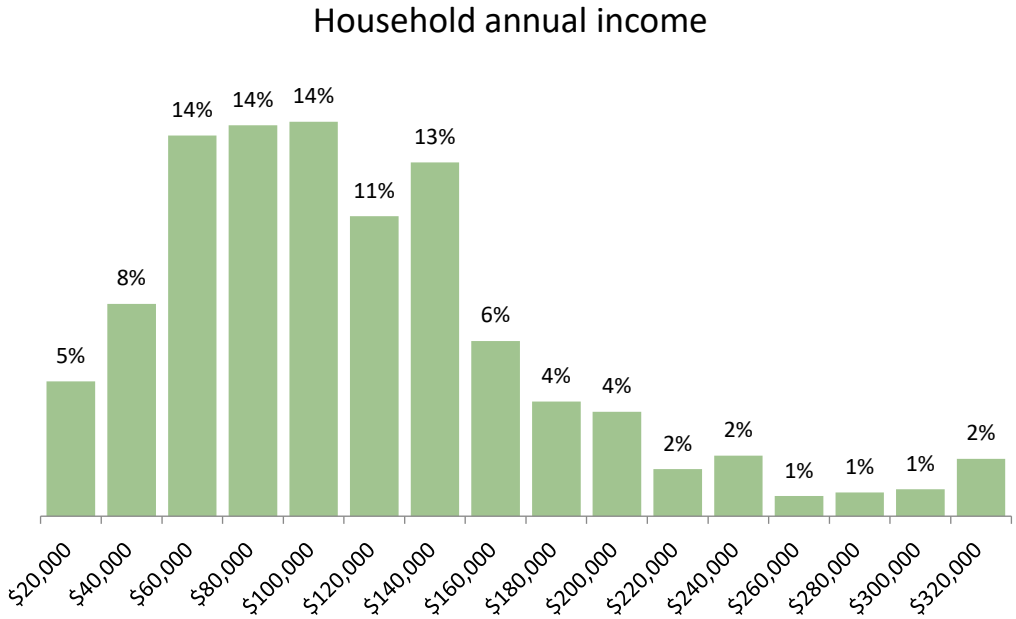


Figure 3 1 Sample demographics

3.2 Purchase and consumption behaviour

3.2.1 Purchase and consumption frequency

- About two out of every five respondents purchases Sauvignon blanc at least fortnightly (Figure 3-2).

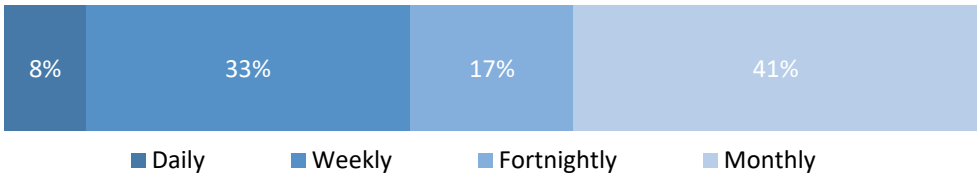


Figure 3-1 Sauvignon blanc purchase frequency

- 68 per cent of respondents consume Sauvignon blanc at least once a week (Figure 3-3).

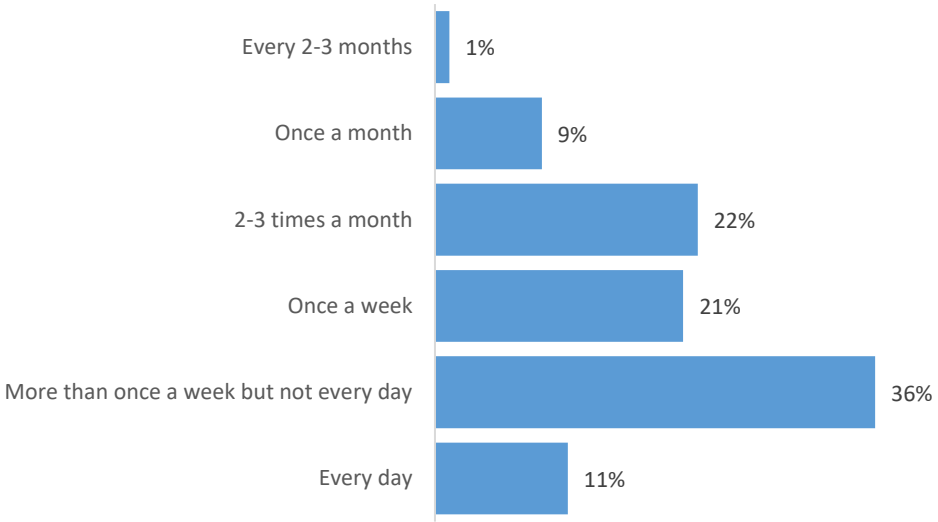


Figure 3-2 Sauvignon blanc consumption frequency

3.2.2 Prices usually paid for Sauvignon blanc

- The most common price point usually paid is between $16-20/bottle (Figure 3-4).
- The average price usually paid was $22/bottle.
- The box-and-whisker graph shows that the median price usually paid was $20, and that 25 per cent of consumers paid more than $30/bottle.

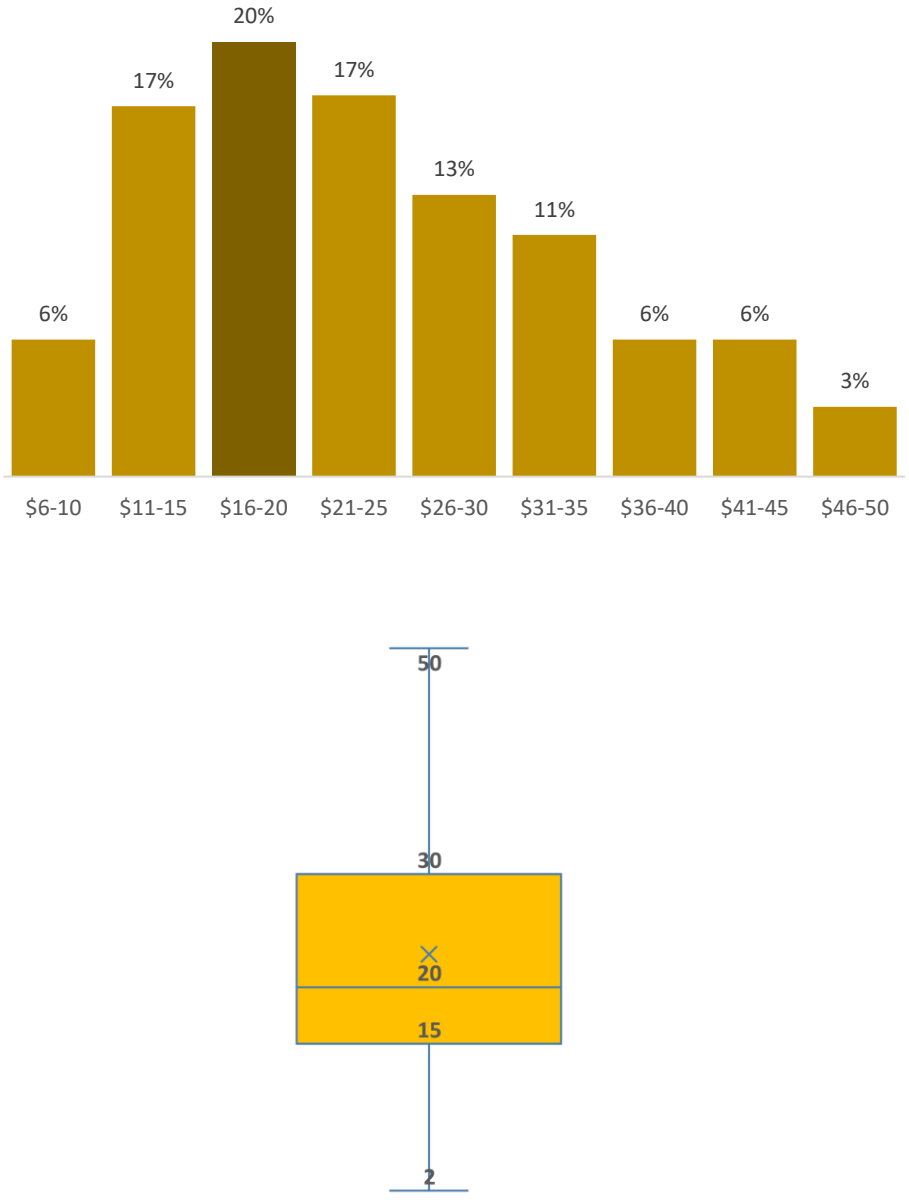


Figure 3-3 Usual price paid per bottle for personal consumption

3.2.3 Country-of-origin purchase frequency

- NZ has the third highest country-of-origin purchase frequency for Sauvignon blanc overall (Figure 3-5).

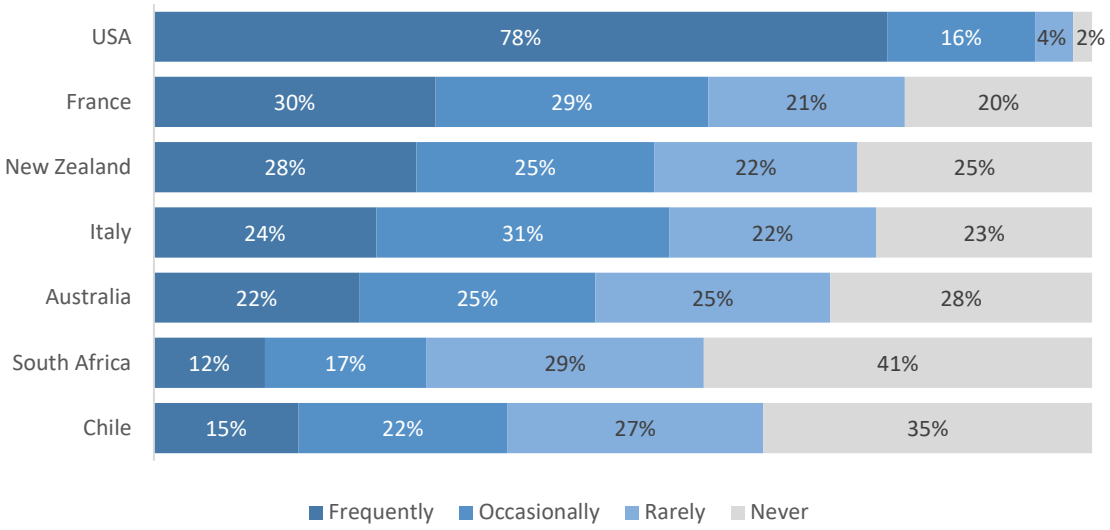


Figure 3-4 Country-of-origin purchase frequency

3.2.4 Wine experience and engagement

- The degree to which consumers engage with wine varies over the type of experience and the type of information (Figure 3-6).
- About a third of consumers don't often read labels, while almost half use internet wine sites.

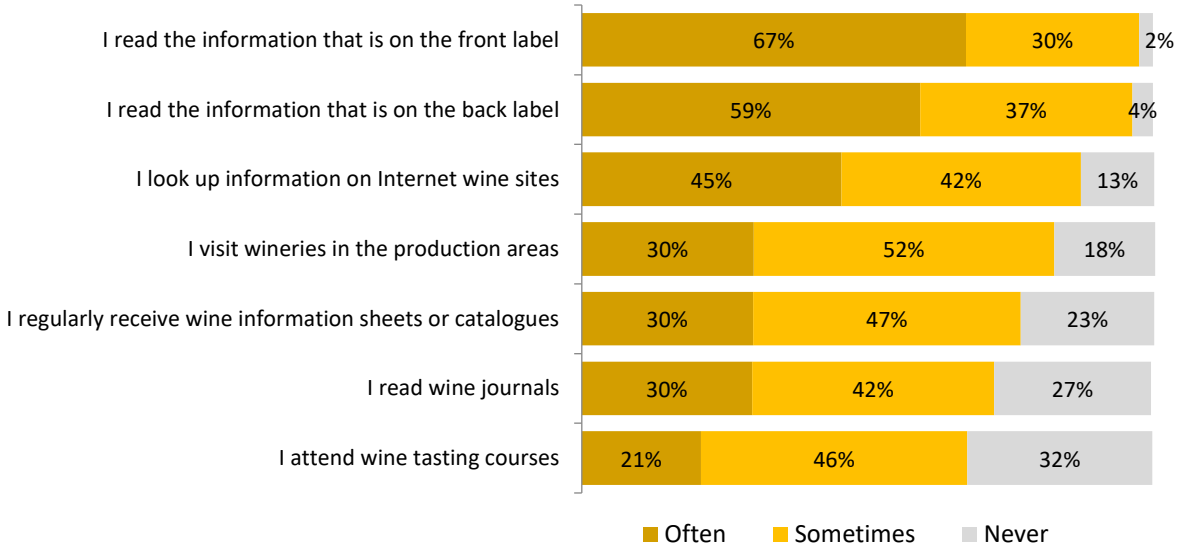


Figure 3-5 Wine experience and engagement

3.2.5 Country-of-origin quality ranking

- Respondents were asked to rank countries according to the quality of Sauvignon blanc produced in that country-of-origin (Figure 3-7).
- Out of the seven main Sauvignon blanc producers in-market, we see that NZ is ranked third overall and is closely ranked with Italian wine, and in the top three by 39 per cent of respondents

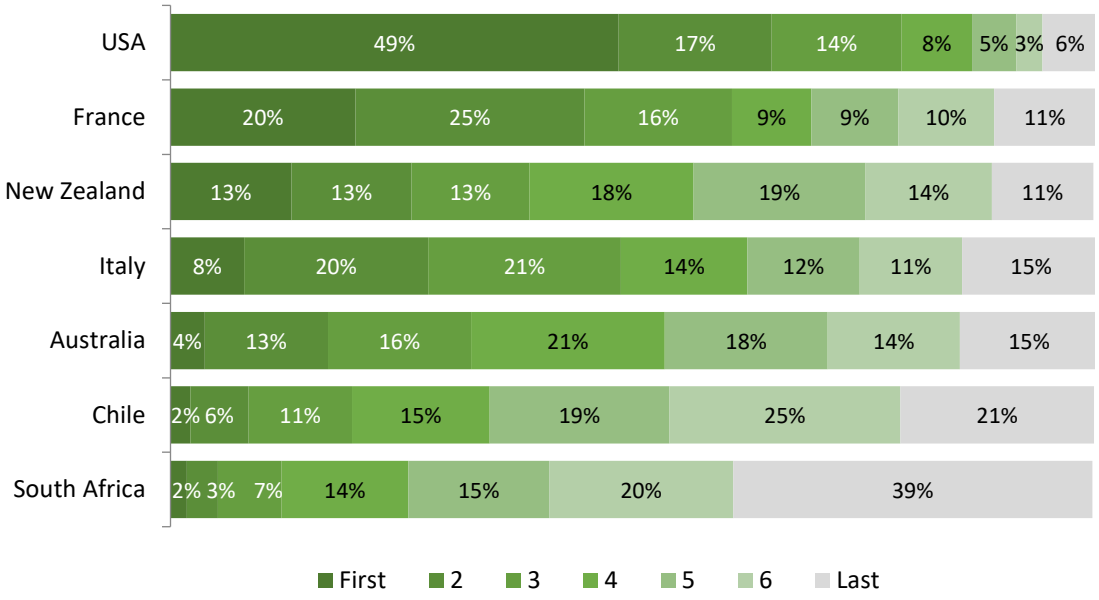


Figure 3-6 Country-of-origin quality ranking

3.3 Sustainability in the wine sector

3.3.1 Sustainability label purchase frequency

- Consumers were asked to indicate if they had purchased Sauvignon blanc that was produced under one of the sustainability certification programmes present in-market (Figure 3-8)
- Forty three percent of respondents had purchased a California Certified Sustainable labelled wine in the previous month).
- 20 per cent of respondents had purchased a SWNZ labelled wine in the previous month.

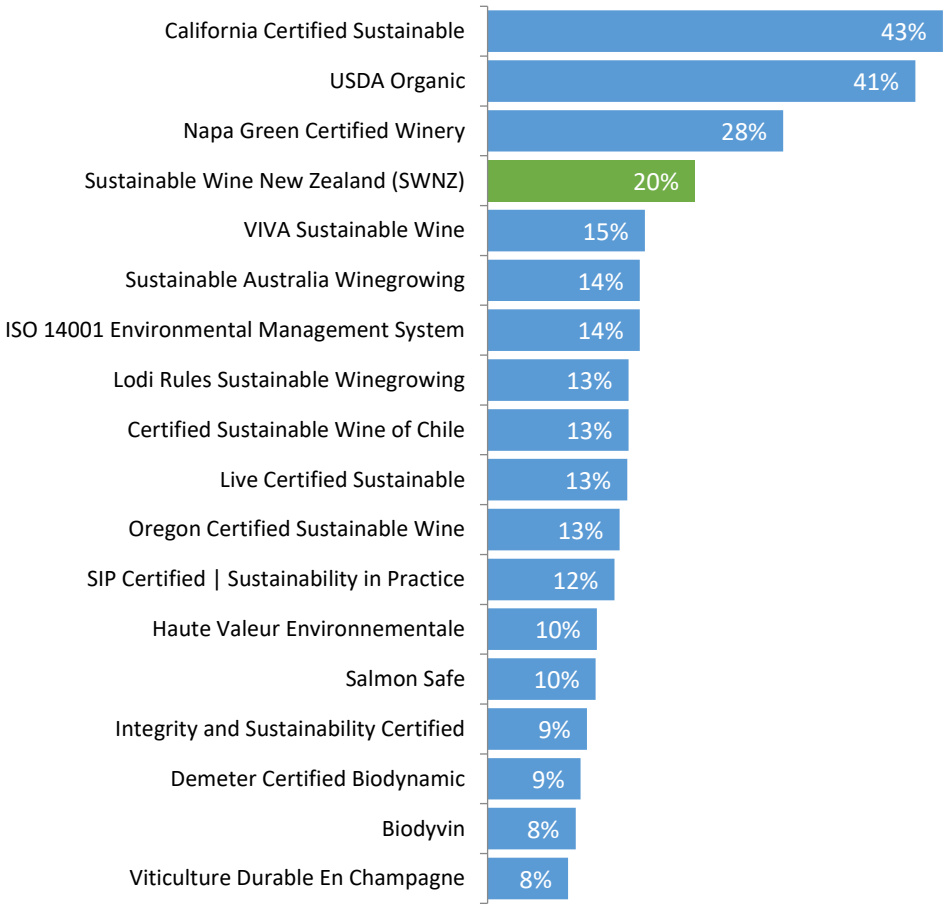


Figure 3-7 Sustainability certification purchase frequency

3.3.2 Sustainable Wine New Zealand awareness

- Consumers were then asked how familiar they were with the Sustainable Wine New Zealand programme (Figure 3-9).
- Just over two thirds of respondents have some level of knowledge about what SWNZ involves, and about one is five state that they are very familiar.

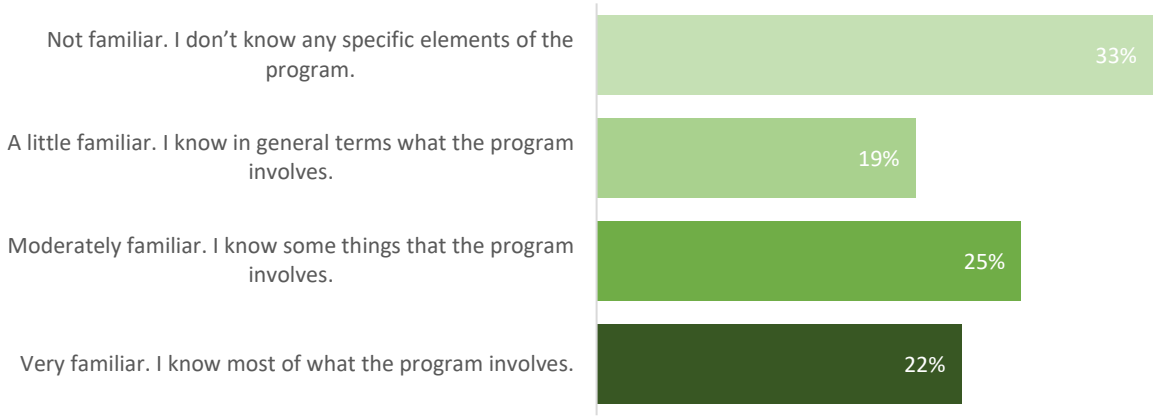


Figure 3-8 Familiarity with Sustainable Wine New Zealand programme

- Consumers were then asked which characteristics that they thought were associated with the Sustainable Wine New Zealand programme (Figure 3-10).
- Awareness of which attributes are associated with SWNZ is low for about half of respondents, while about 20 per cent have a more accurate assessment.

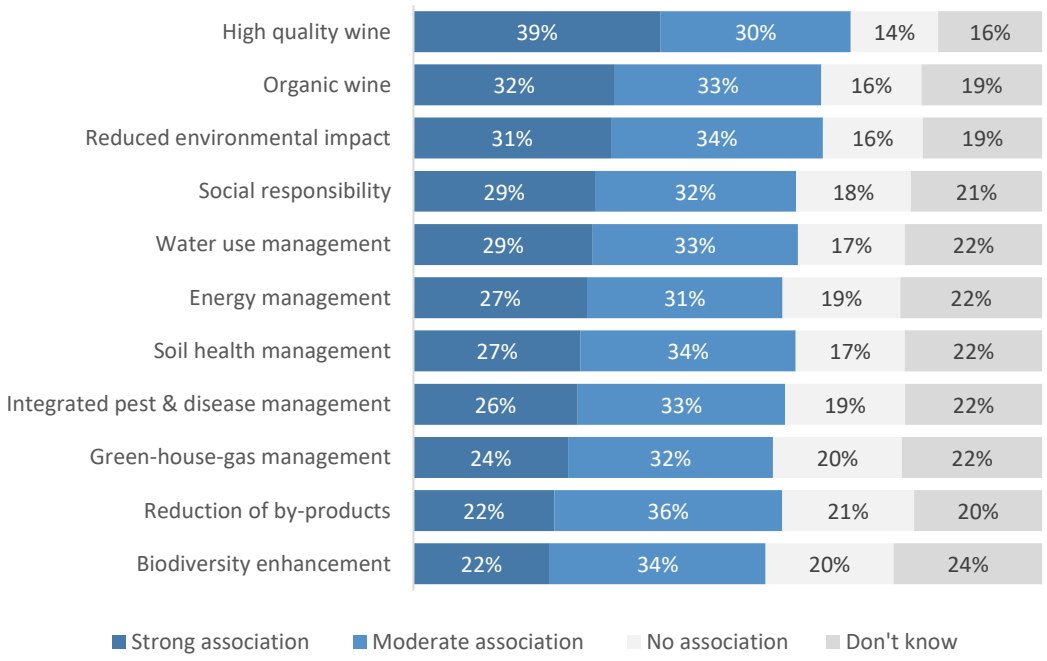


Figure 3-9 Attributes associated with SWNZ

3.3.3 Sustainability reporting preferences and perceptions

- Consumers were asked about their preferences concerning provision of sustainability reporting information (Figure 3-11).
- Overall, responses indicate a desire for more detailed sustainability reporting, that is easier to find, and understand.

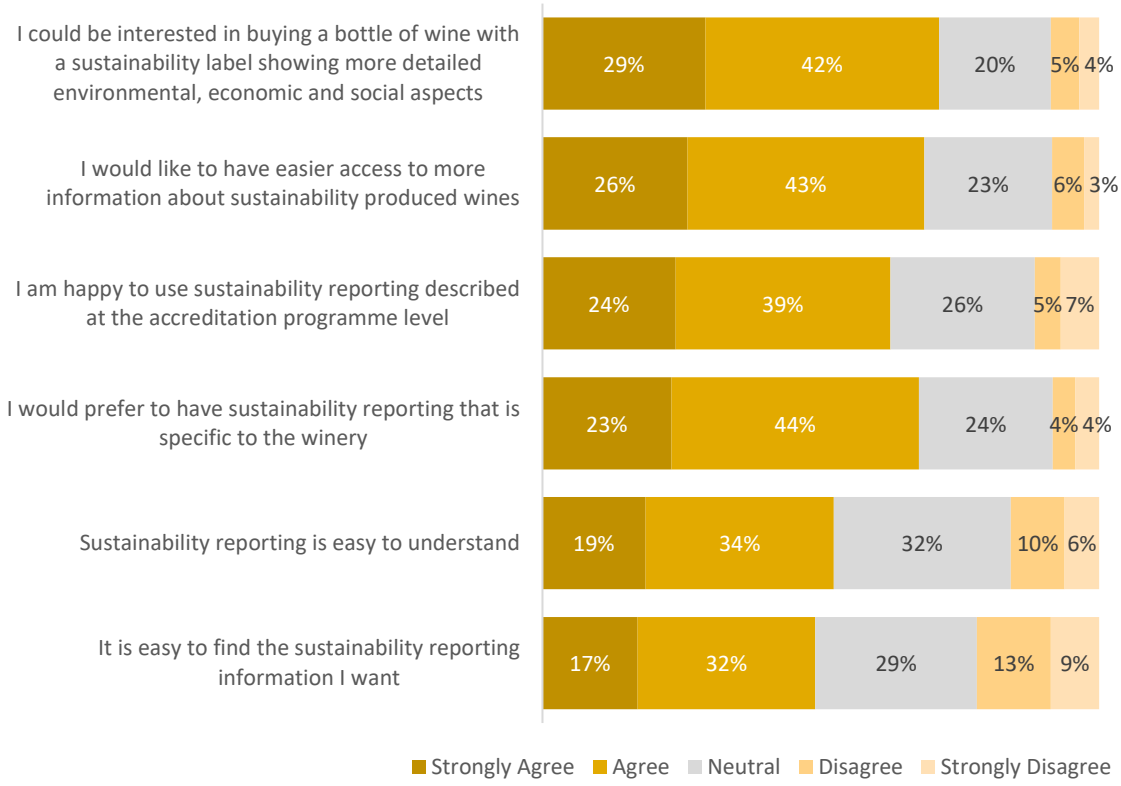


Figure 3-10 Sustainability reporting preferences and perceptions

3.3.4 Perceptions of sustainability in the wine sector

- Consumers were asked to indicate their level of agreement with statements describing various aspects of sustainability programmes in the wine sector (Figure 3-12).
- Many consumers are concerned about aspects of conventional production and believe that buying sustainable products has environmental benefits.
- 60 per cent of consumers associate sustainability certification with high quality wines.
- However, about 40 per cent of consumers have relatively low trust in sustainability claims.

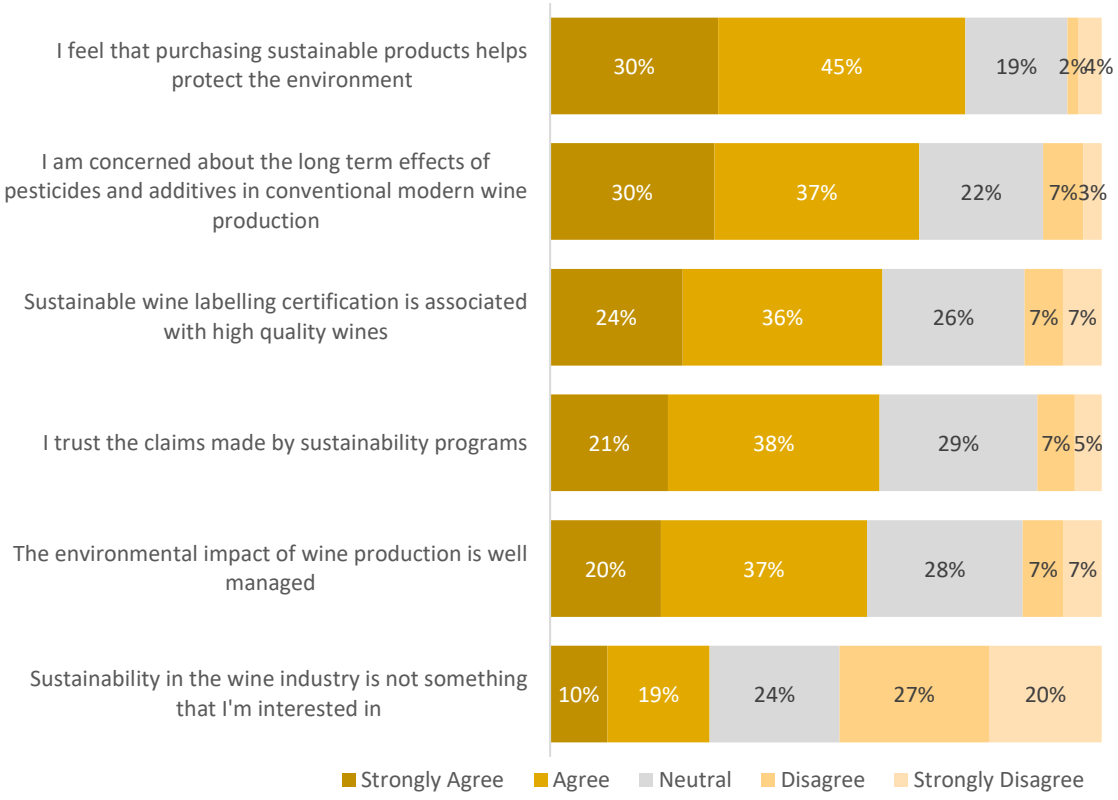


Figure 3-11 Perceptions of sustainability in the wine sector

3.4 Use of digital media and smart technology for wine shopping

3.4.1 Internet access by device and use

- Over 80 per cent of respondents access the internet daily, with mobile device use (e.g. smart phone) moderately higher than home computers (e.g. desktop/laptop) (Figure 3-13).

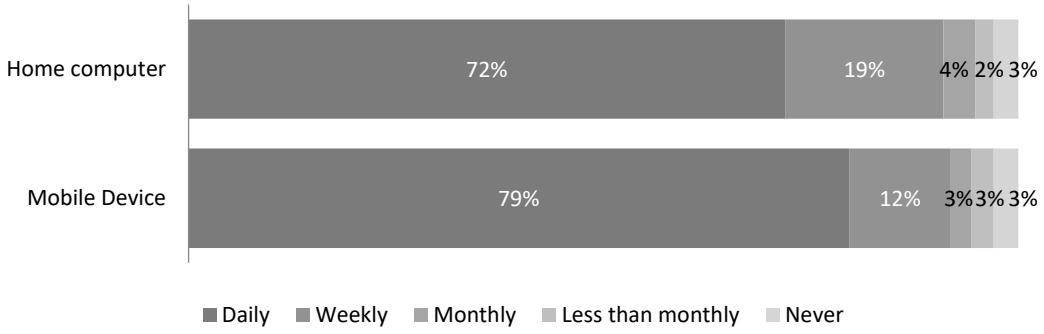


Figure 3-12 Frequency of internet access

- Many consumers use the internet to help them decide which wines to buy (Figure 3-14). With 47 per cent often using their mobile device to search the internet for wine information.

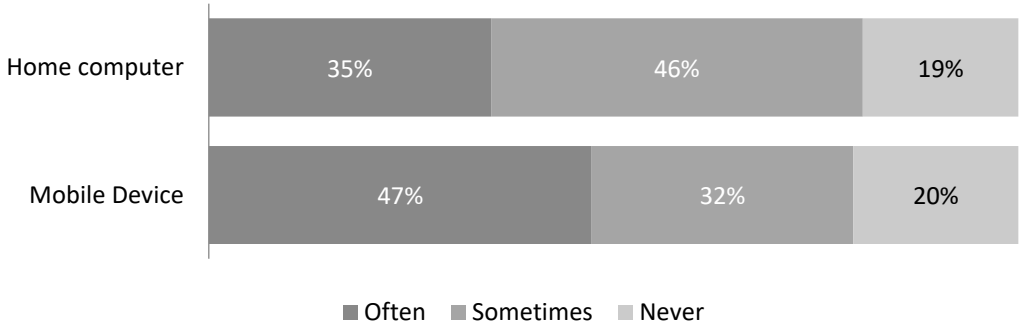


Figure 3-13 Use of internet for wine selection

- Considering the use of mobile devices specifically, many consumers use their smartphones to search for wine information and, to a lesser degree, to make purchases (Figure 3-24).

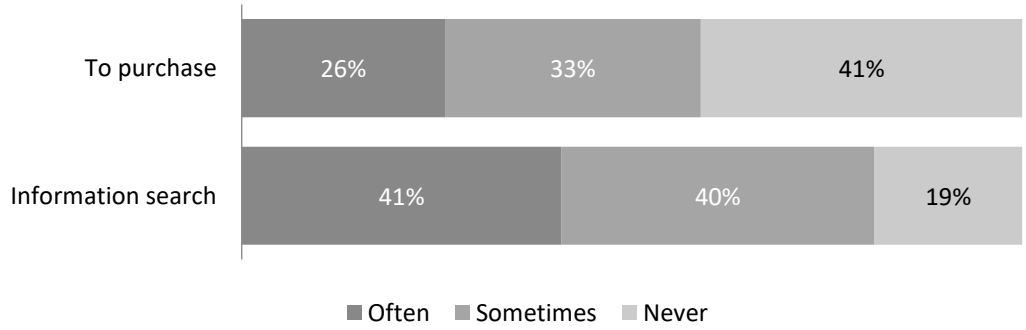


Figure 3-14 Use of mobile devices for purchasing and information searching

3.4.2 Use of mobile device smart technologies for wine

- Looking at the use of mobile device smart technologies shows that the use of technologies for purchasing and information searching is relatively high (Figure 3-16).
- About one in four consumers are often using barcodes to search for wine information, while about one in five are often using this technology to make purchases.

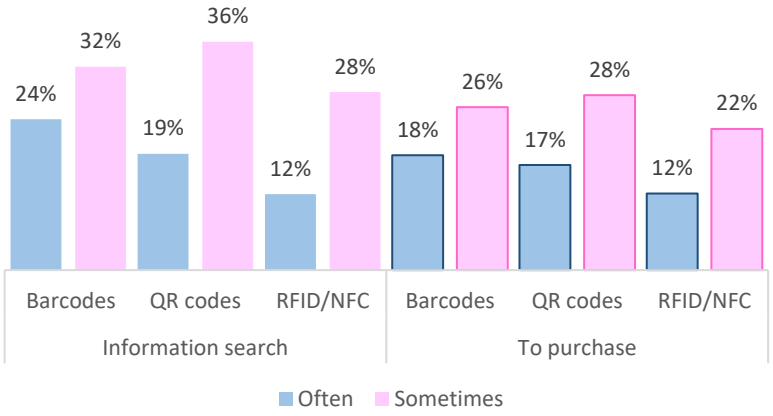


Figure 3-15 Use of smart technologies for information searching and purchase

3.4.3 Mobile app use related to wine

- The most common use of a smartphone app is to access product reviews. While just one in five consumers use apps for traceability, almost half are interested in this use (Figure 3-17).

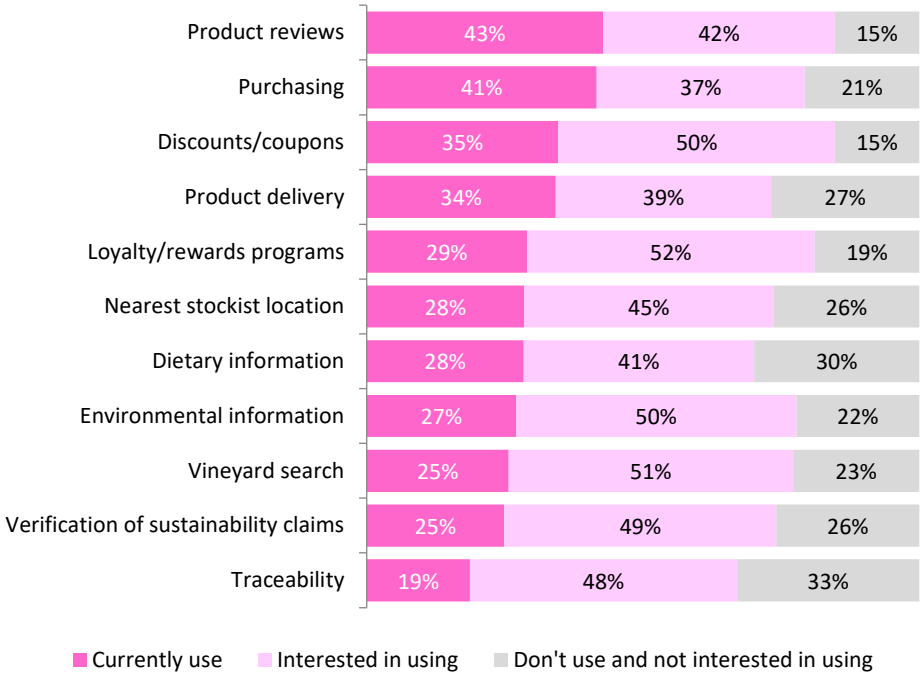


Figure 3-16 Current and potential uses of mobile applications

3.4.4 Wine expenditure by purchase channel

- Respondents were asked to allocate their wine expenditure according to their usual purchase channels (Figure 3-18). The graph below shows the average expenditure by channel.
- This shows that on average, the highest level of expenditure occurs with grocery stores.

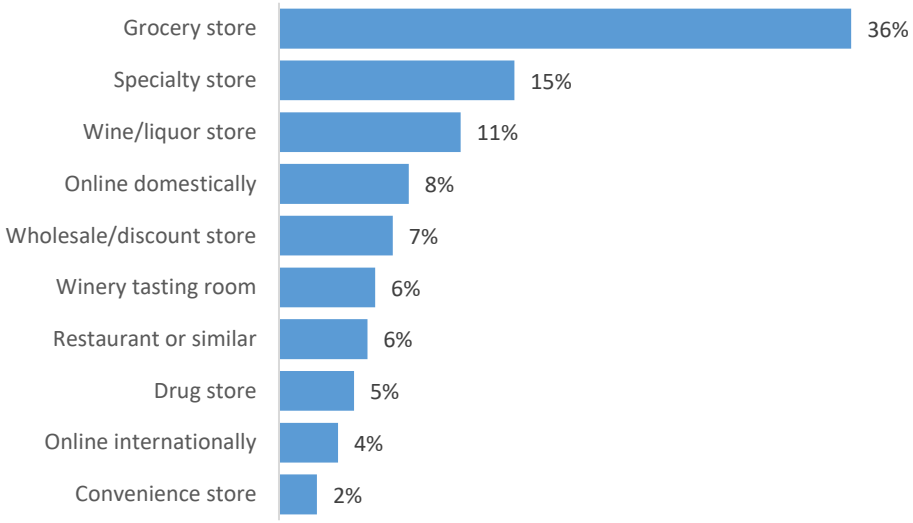


Figure 3-17 Retail channel use for wine purchasing

- Half of consumers purchase wine online. The main benefit of online shopping was the availability of greater product variety (Figure 3-19).

Figure 3-18 Main benefit of shopping online for wine

3.5 Discrete Choice Experiment analysis of Sauvignon blanc wine choices

In this section we present findings of the Discrete Choice Experiment. Our objective is to identify which Sauvignon blanc attributes drive product choices, by how much, and by who. We do this using a statistical method called Latent Class Modelling that identifies consumer segments in the data based on which product offerings consumers preferred. The model parameter estimates can be found in Appendix B. Discrete Choice Experiments can be somewhat more difficult to answer compared with the usual question formats that people have typically seen before, so it is important to check whether respondents have been able to complete the exercise reliably. Overall, the choice task and product attribute understanding was high, respondents felt that they were able to express what was important to them concerning wine attributes, and most respondents felt certain that their responses reflected real-world choices if these wine products were available (Figure 3-20).

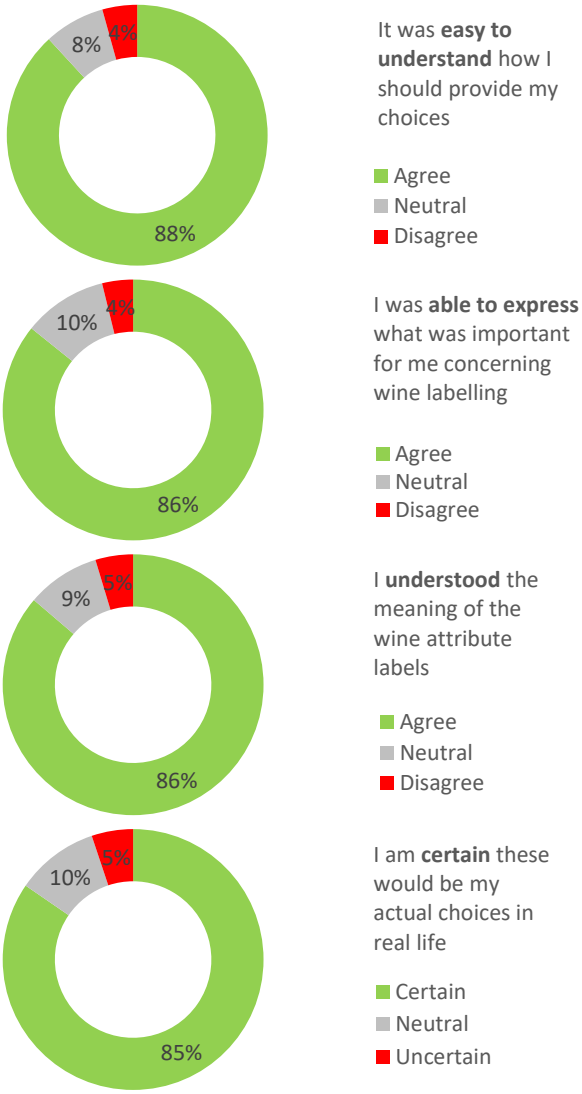


Figure 3-19 DCE task and attribute understanding, preference ability, choice certainty

3.5.1 Consumer willingness-to-pay values

Estimates of WTP tell us how much more the average consumer is willing to pay for a 750ml bottle of Sauvignon blanc with a particular attribute, over one that does not have this attribute (Table 3-1, Figure 3-21, Figure 3-22). For example, members of Segment Three are willing to pay, on average, $2.10 more for wine that is produced with Biodiversity Management standards over one that is not. There is some uncertainty in WTP estimates, and the Confidence Intervals reported indicate that we can be 95 per cent sure that the true WTP falls within this interval, in this case between $1.47 and $2.73.

We can see that the Latent Class Modelling has identified three distinct consumer groups. Reported under each segments column heading is the size of each segment, Segment One has an estimated size of 48 per cent, the second segments size is 17 per cent and the third is 36 per cent. These segment sizes tell us the probability that a randomly selected Californian Sauvignon blanc purchaser belongs to that consumer segment.

Table 3-1 Sauvignon blanc wine attribute WTP by consumer segment

Wine attributes	Segment One (48%)	Segment Two (17%)	Segment Three (36%)
Biodiversity Management	$8.96*** (4.90, 13.0)	$2.13*** (1.28, 2.97)	$2.10*** (1.47, 2.73)
Water Management	$6.64*** (3.47, 9.80)		$1.58*** (1.00, 2.16)
Energy Management	$4.91*** (2.58, 7.23)		
Pest & Disease Management	$7.85*** (4.31, 11.4)	$2.87*** (2.12, 3.63)	$1.88*** (1.32, 2.43)
Social Responsibility	$6.76*** (3.97, 9.56)	$1.90*** (1.13, 2.68)	$1.78*** (1.20, 2.37)
GHG Management	$5.27*** (2.39, 8.15)	$1.75*** (0.93, 2.57)	$2.19*** (1.59, 2.80)
Soil Management	$8.52*** (5.72, 11.32)		
By-products Management	$6.98*** (4.49, 9.46)	$1.10*** (0.09, 2.10)	$0.96*** (0.36, 1.56)
100% Organic Production		$6.80*** (5.58, 8.01)	
Māori Production	$8.92*** (4.62, 13.22)	$2.66*** (1.73, 3.58)	$1.98*** (1.29, 2.67)
Critic rating (per point >80)	$0.08*** (0.05, 0.11)	$0.03*** (0.02, 0.04)	$0.05*** (0.04, 0.06)

Average marginal WTP/750ml bottle of Sauvignon blanc $USA 2021.
95% Confidence Interval in brackets.
***, **,* denote statistical significance at the 1%, 5% and 10% levels indicating that a willingness-to-pay estimate is significantly different from zero.

Californian Consumer Willingness-to-pay Segments

1. Cultural Consumer

48% of consumers

This segment is the largest of the three consumer groups. These consumers have the strongest preferences of the three segments spanning all attributes other than 100 organic. They have the highest willingness-to-pay Māori produced wine of the three segments.

Consumers in this segment are more likely to:

- Be accepting of other cultural experiences
- Have higher usual wine spend
- Have children
- Believe sustainability is associated with high quality
- Be younger
- Have higher purchase and consumption frequency

2. Organic Origin

17% of consumers

This is the smallest segment of the three. These consumers value Organic production and the closely aligned Pest & Disease Management attribute.

Consumers in this segment are more likely to:

- Be older
- Have lower usual spend

3. Score Strategy

36% of consumers

These consumers have a strong focus on Critic Score and value this significantly more than other attributes.

Consumers in this segment are more likely to:

- Be middle aged
- Have lower knowledge of Māori culture

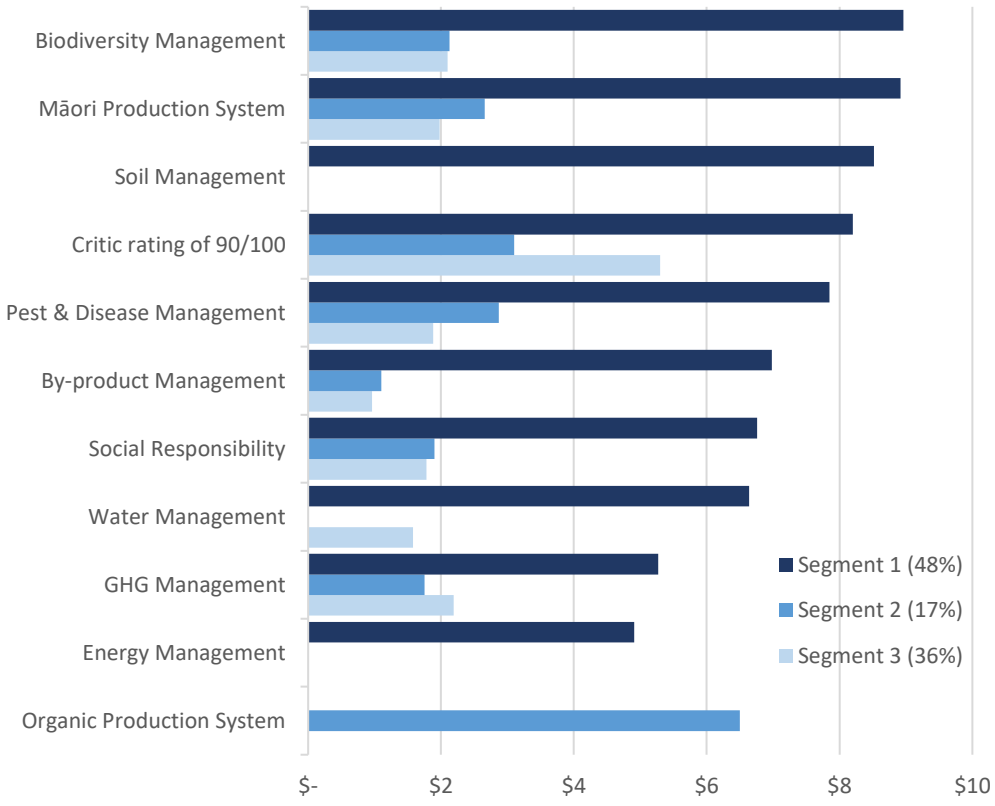


Figure 3-20 Californian consumers' willingness-to-pay for wine attributes

To provide an indication of the overall preferences and willingness-to-pay values the Latent Class Modelling presented above is combined to form an aggregate estimate for each attribute (Figure 3-22). These estimates are formed by weighting each willingness-to-pay value for each class by their class size and summing across segments. These estimates are presented as a percentage of the average price usually paid ($22).

Overall:

- Citric score has a very important role in wine choice, and is often perceived as a risk reducing mechanism in wine choice quality.
- Māori production is valued highly. This is a new result that has not been examined previously.
- While organic appears to be valued lowly, many of the other attributes represent the types of individual management actions and benefits inherent in an organic production standard. In particular 'Biodiversity Management' and 'Pest & Disease Management' which are valued highly by respondents.

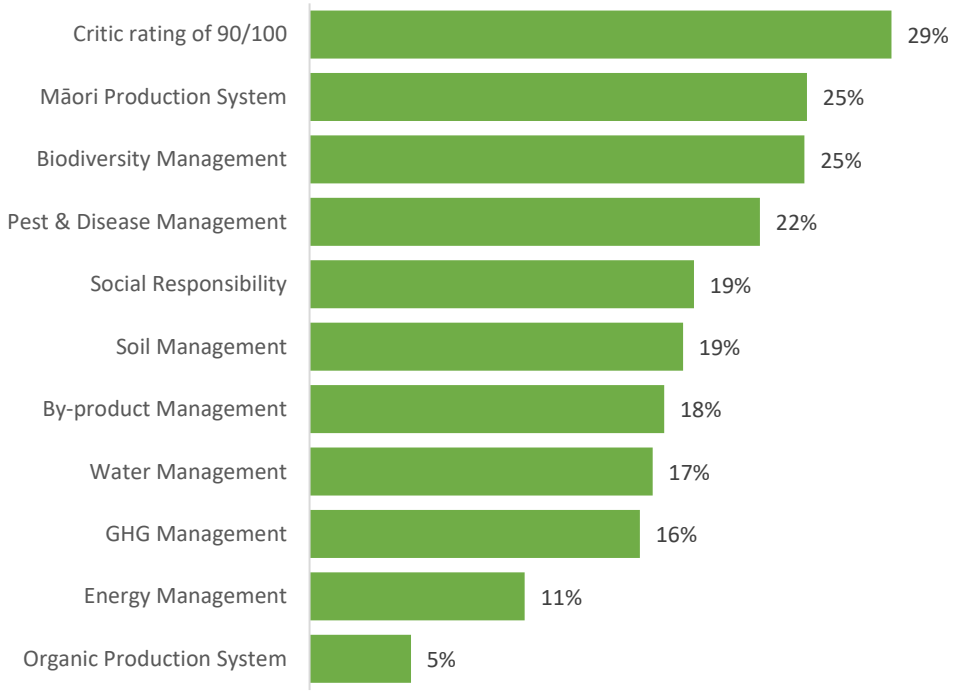


Figure 3-21 Weighted willingness-to-pay as percent of usual price paid

Chapter 4
Conclusions

This report presents the findings of a structured online survey of Californian Sauvignon blanc consumers. The surveys objective was to provide insights into consumers purchase and consumption behaviours. The information gathered included examining perceptions of important drivers of product characteristics, the role of digital media and smart technologies, and consumers preferences for distinctively New Zealand credence attributes.

Overall, results clearly indicate that New Zealand Sauvignon blanc is held in high regard as a high-quality offering with characteristics that consumers prefer and value. The statistical analysis of consumers Sauvignon blanc choices using the Discrete Choice Experiment and Latent Class Modelling provides a robust analytical framework to identify consumer segments with differing characteristics and product preferences. Profiling high value consumers informs marketing strategy aimed at engaging consumers with highest willingness-to-pay for the product attributes that New Zealand can deliver.

This survey is the second to survey Californian Sauvignon blanc consumers with the first survey in 2017[1]. The two samples are broadly consistent on demographic measures including income, gender, location, education, age, and household composition. Comparing results found here to the previous survey show that:

- Overall purchase frequency is consistent at monthly interval across surveys, while weekly consumption frequency has increased considerably. In the 2017 survey 44 percent consumed at least weekly and this has increased to 68 per cent of consumers in 2021.
- Prices usually paid for Sauvignon blanc have increased significantly from an average of $19/bottle in 2017 to $23/bottle in 2021, which is about a 20 per cent increase. The most common price point has increased from $10-$15 in 2017 to $16-$20 in 2021. Just 16 per cent of respondents in 2017 usually paid more than $25/bottle while in 2021 this proportion of consumers has increased considerably to 56 per cent.
- Wine experience and engagement has lifted moderately overall and considerably for some activities. In 2017, 56 per cent of respondents indicated that they read wine labels, this has increased to 67 per cent in 2021. The number of consumers using the internet to find information on wine sites has increased significantly from 31 per cent (2017) to 45 per cent (2021), and use of wine catalogues and journals has also increased significantly from 15 per cent (2017) to 30 per cent (2021).
- New Zealand country-of-origin purchase frequency has increased from a fourth rank (out of 7 countries in-market) in 2017 to now sit third, behind USA in first and France second. Ranking of country-of-origin quality is consistent with purchases, with New Zealand's overall third ranking behind the same two countries. The perception that purchasing sustainable products helps protect the environment has increased from 65 per cent (2017) to 75 per cent (2021). The number of people concerned about long term effects of pesticides and additives in conventional wine making has increased from 59 per cent to 67 percent. More people consider sustainable wine certification to be associated with high quality, 49 per cent in 2017 to 60 per cent in 2021. More

[1] Tait, Peter, Paul Rutherford, Tim Driver, Xuedong Li, and Caroline Saunders (2018). *Consumer insights and willingness to pay for attributes: New Zealand wine in California, USA.* Research Report No. 349, Lincoln University: Agribusiness and Economics Research Unit.

people are interested in wine labels with more detailed sustainability information, 62 per cent in 2017 to 71 per cent in 2021.

- The number of consumers buying sustainably certified wines increased significantly between survey rounds. In particular, purchasing of California Certified Sustainable wine increased significantly from 27 per cent in 2017 to 43 per cent in 2021. 12 per cent of respondents purchased Sustainable Wine NZ labeled wine in 2017 which increased to 20 per cent in 2021. However, purchases of Organic wines decreased moderately between survey rounds. Respondents awareness of wine growing practices associated with the SWNZ programme, while relatively low overall, has increased only slightly. In 2017, the most associated practice was 'Water use Management' (26 per cent strongly associated) and in 2021 this is still the most associated practice (29 per cent).

- Use of digital media and smart technologies related to wine increased moderately overall between survey rounds. More consumers were often using barcodes for information searching in 2021 (24 per cent) than in 2017 (17 per cent), while rates of QR codes are similar and use of RFID/NFC have fallen slightly (16 per cent v. 12 per cent). Rates of purchases with barcodes (17 per cent v. 18 per cent) and QR codes are similar and have fallen for RFID/NFC. Use of mobile phone apps related to wine has increased significantly from 42 per cent to 63 per cent of respondents. Product reviews are the most used application in both survey rounds, increasing from 30 per cent to 43 per cent. Notably, the number of respondents who do not currently use apps, but are interested in a range of uses, has increased significantly. The number of consumers buying wine online increased from 34 per cent in 2017 to 50 per cent in 2021, and the average proportion of wine expenditure spent online increased from 7 per cent, to 12 per cent.

- Comparing the WTP estimates from each of the surveys reveals an overall increase in Californian wine consumers preferences for sustainability attributes (Figure 4-1). The 2017 survey round did not include 'Soil Management' or 'Māori Production System' attributes.

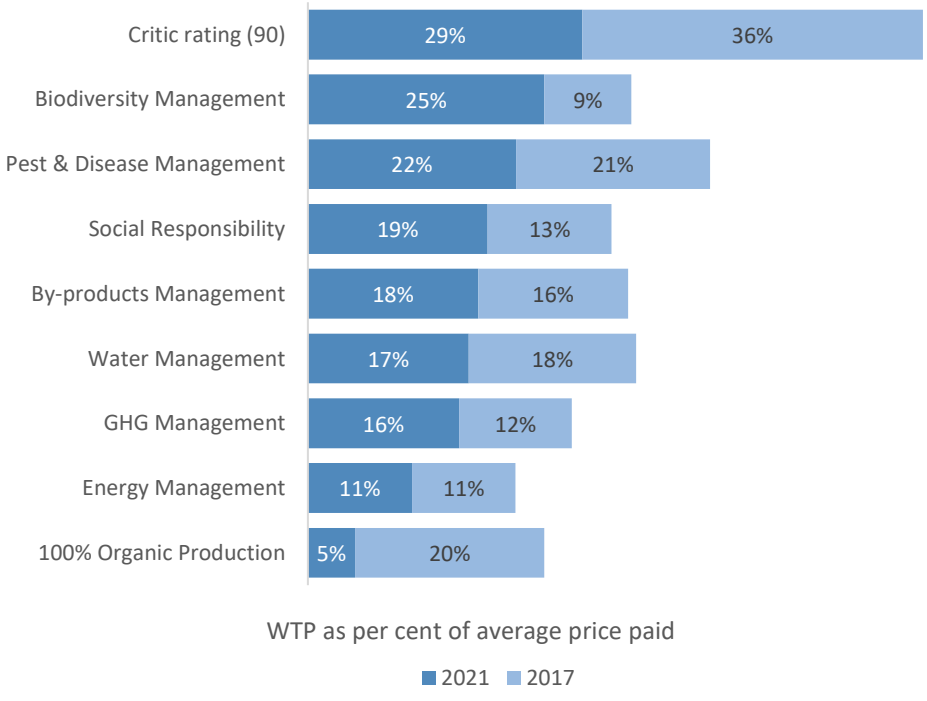


Figure 4-1 Comparing WTP 2017 v. 2021

Appendix A
Statistical Method

This appendix provides technical details of statistical analysis of choice data. The appendix includes a brief description of the theoretical foundations of choice analysis followed by statistical probability estimation approaches, focusing on contemporary models applied in this report. Lastly, the method used in generating monetary estimates is described.

A-1 Conceptual Framework

In Choice Experiments (CEs), researchers are interested of what influences, on average, the survey respondents' decisions to choose one alternative over others. These influences are driven by people's preferences towards the attributes but also the individual circumstances such as their demographics or perceptions of the choice task (e.g., the level of difficulty or understanding) (Hensher et al. 2015).

Each alternative in a choice set is described by attributes that differ in their levels, both across the alternatives and across the choice sets. The levels can be measured either qualitatively (e.g., poor and good) or quantitatively (e.g., kilometres). This concept is based on the characteristics theory of value (Lancaster 1966) stating that these attributes, when combined, provide people a level of utility[2] *U* hence providing a starting point for measuring preferences in CE (Hanley et al. 2013; Hensher et al. 2015). The alternative chosen, by assumption, is the one that maximises people's utility[3] providing the behavioural rule underlying choice analysis:

$$U_j > U_i \tag{0.1}$$

where the individual *n* chooses the alternative *j* if this provides higher utility than alternative *i*. A cornerstone of this framework is Random Utility Theory, dated back to early research on choice making (e.g., Thurstone 1927) and related probability estimation. This theory postulates that utility can be decomposed into systematic (explainable or observed) utility *V* and a stochastic (unobserved) utility ε (Hensher et al. 2015; Lancsar and Savage 2004).

$$U_{nj} = V_{nj} + \varepsilon_{nj} \tag{0.2}$$

where *j* belongs to a set of J alternatives. The importance of this decomposition is the concept of utility only partly being observable to the researcher, and remaining unobserved sources of utility can be treated as random (Hensher et al. 2015). The observed component includes information of the attributes as a linear function of them and their preference weights (coefficient estimates).

$$V_{nsj} = \sum_{k=1}^{K} \beta_k x_{nsjk} \tag{0.3}$$

with *k* attributes in vector x for a choice set s. Essentially, the estimated parameter β shows "the effect on utility of a change in the level of each attribute" (Hanley et al. 2013, p. 65). This change can be specified as linear across the attribute levels, or as non-linear using either dummy coding or effect coding

[2]Related terminology used in psychology discipline is *the level of satisfaction* (Hensher et al. 2015).
[3]In choice analysis, utility is considered as *ordinal utility* where the relative values of utility are measured (Hensher et al. 2015).

approaches. The latter coding approach has a benefit of not confounding with an alternative specific constant (ASC) when included in the model (Hensher et al. 2015).

A-2 Statistical Modelling of Choice Probabilities

The statistical analysis aims to explain as much as possible of the observed utility using the data obtained from the CE and other relevant survey data. In order to do so, the behavioural rule (eq. 1.1) and the utility function (eq. 1.2) are combined (Hensher et al. 2015; Lancsar and Savage 2004) to estimate the probability of selecting an alternative *j*:

$$\Pr_{nsj} = \Pr\left(U_{nsj} > U_{nsi}\right) = \Pr\left(V_{nsj} + \varepsilon_{nsj} > V_{nsi} + \varepsilon_{nsi}\right) = \Pr\left(\varepsilon_{nsi} - \varepsilon_{nsj} < V_{nsj} - V_{nsi}\right) \forall j \neq i \quad (0.4)$$

where the probability of selecting alternative *j* states that differences in the random part of utility are smaller than differences in the observed part. A standard approach to estimate this probability is a conditional logit, or multinomial logit (MNL) model (McFadden 1974). This model can be derived from the above equations (1.2 and 1.3) by assuming that the unobserved component is independently and identically distributed (IID) following the Extreme Value type 1 distribution (see e.g. Hensher et al. 2015; Train, 2003). Although the MNL model provides a "workhorse" approach in CE, it includes a range of major limitations (see e.g. Fiebig et al. 2010; Greene and Hensher 2007; Hensher et al. 2015):

- Restrictive assumption of the IID error components
- Systematic, or homogenous, preferences allowing no heterogeneity across the sample
- Restrictive substitution patterns, namely the existence of independence of irrelevant alternatives property where introduction (or reduction) of a new alternative would not impact on the relativity of the other alternatives
- The fixed scale parameter obscures potential source of variation

Some or all of these assumptions are often not realised in collected data. These restrictive limitations can be relaxed in contemporary choice models. In particular, the random parameter logit (RPL) model (aka, the mixed logit model) has emerged in empirical application allowing preference estimates to vary across respondents (Fiebig, et al. 2010; Hensher et al. 2015; Revelt and Train, 1998). This is done by specifying a known distribution of variation to be parameter means. The RPL model probability of choosing alternative *j* can be written as:

$$\Pr_{nsj} = \frac{\exp(\beta_n' x_{nsj})}{\sum_J \exp(\beta_n' x_{nsj})} \quad (0.5)$$

where, in the basic specification, $\beta_n = \beta + \eta_n$ with η being a specific variation around the mean for *k* attributes in vector *x* (Fiebig, et al. 2010; Hensher et al. 2015). Typical distributional assumptions for the random parameters include normal, triangular and lognormal distributions, amongst others. The normal distribution captures both positive and negative preferences (i.e., *utility* and *disutility*) (Revelt and Train, 1998). The lognormal function can be used in cases where the researcher wants to ensure the parameter has a certain sign (positive or negative), a disadvantage is the resultant long tail of estimate distributions (Hensher et al. 2015). The triangular distribution provides an alternative functional form, where the spread can be constrained (i.e., the mean parameter is free whereas spread is fixed equal to mean) to ensure behaviourally plausible signs in estimation (Hensher et al. 2015). Further specifications used in modelling include parameters associated with individual specific characteristics (e.g, income) that can

influence the heterogeneity around the mean, or allowing correlation across the random parameters. The heterogeneity in mean, for example, captures whether individual specific characteristics influence the location of an observation on the random distribution (Hensher et al. 2015). In this study, the frequency of visits to rivers, streams and lakes was used to explain such variance.

Another way to write this probability function (in eq. 1.4) (Hensher et al. 2015) involves an integral of the estimated likelihood over the population:

$$L_{njs} = \int_{\beta} \Pr_{nsj}(\beta) f(\beta|\theta) d\beta \tag{0.6}$$

In this specification, the parameter θ is now the probability density function conditional to the distributional assumption of β. As this integral has no closed form solution, the approximation of the probabilities requires a simulation process (Hensher et al. 2015; Train, 2003). In this process for data *X*, *R* number of draws are taken from the random distributions (i.e. the assumption made by the researcher) followed by averaging probabilities from these draws; furthermore these simulated draws are used to compute the expected likelihood functions:

$$L_{nsj} = E(\Pr_{nsj}) \approx \frac{1}{R} \sum_{R} f(\beta^{(r)}|X) \tag{0.7}$$

where the $E(\Pr_{nsj})$ is maximised through Maximum Likelihood Estimation. This specification (in eq. 1.6) can be found in Hensher et al. (2015). In practice, a popular simulation method is the Halton sequence which is considered a systematic method to draw parameters from distributions compared to for example, pseudo-random type approaches (Hensher et al. 2015).

A-3 Econometric Extensions

Common variations of the RPL model include specification of an additional error component (EC) in the unobserved part of the model. This EC extension captures the unobserved variance that is alternative-specific (Greene and Hensher 2007) hence relating to substitution patterns between the alternatives (Hensher et al. 2015). Empirically, one way to explain significant EC in a model is SQ-bias depicted in the stochastic part of utility if the EC is defined to capture correlation between the non-SQ alternatives (Scarpa et al., 2005).

Another extension which has gained increasing attention in recent CE literature, is the Generalized Mixed Logit (GMXL) model (Czajkowski et al. 2014; Hensher et al. 2015; Juutinen et al. 2012; Kragt 2013; Phillips 2014). This model aims to capture remaining unobserved components in utility as a source of choice variability by allowing estimation of the scale heterogeneity alongside the preference heterogeneity (Fiebig et al. 2010; Hensher et al. 2015). This scale parameter is (inversely) related to the error variance, and in convenient applications such as MNL or RPL, this is normalised to one to allow identification (Fiebig et al. 2010; Louviere and Eagle 2006). However, it is possible that the level of error variance differs between or within individuals, due to reasons such as behavioural outcomes, individual characteristics or contextual factors (Louviere and Eagle 2006).

Recent GMXL application builds on model specifications presented in Fiebig et al. (2010), stating that β_n (in eq. 1.4) becomes:

$$\beta_n = \sigma_n \beta + \gamma \eta_n + (1-\gamma)\sigma_n \eta_n \tag{0.8}$$

where σ is the scale factor (typically = 1) and $\gamma \in \{0,1\}$ is a weighting parameter indicating variance in the residual component. In the case the scale factor equals 1, this reduces to the RPL model. The importance of the weighting parameter is the impact on the scaling effect on the overall utility function (population means) versus the individual preference weights (individual means): when *γ* parameter approaches zero the scale heterogeneity affects both means, whereas when this approaches one the scale heterogeneity affects only the population means (Hensher et al. 2015; Juutinen et al. 2015). Interpretation of these parameters includes

- If *γ* is close to zero, and statistically significant, this supports the model specification with the variance of residual taste heterogeneity increases with scale (Juutinen et al. 2012); and
- If *γ* is not statistically significant from one, this suggests that the unobserved residual taste heterogeneity is independent of the scale effect, that is the individual-level parameter estimates differ in means but not variances around the mean (Kragt, 2013)

The scale factor specification (eq. 1.7) can also be extended to respondent specific characteristics associated with the unobserved scale heterogeneity (Hensher et al. 2015; Juutinen et al. 2015):

$$\sigma_n = \exp\{\bar{\sigma} + \tau\omega_n\} \tag{0.9}$$

where $\bar{\sigma}$ *is* the mean parameter in the error variance; and ω is unobserved scale heterogeneity (normally distributed) captured with coefficient *τ* (Hensher et al. 2015; Juutinen et al. 2015; Kragt, 2013). Juutinen et al. (2012), for example, in context of natural park management found that respondents' education level and the time spent in the park explained the scale heterogeneity ($\tau > 0$, p-value < 0.01). In this study, the respondents indicated levels of choice task understanding and difficulty were used to explain scale heterogeneity.

A-4 Estimation of Monetary Values

Typically the final step of interest in the CE application is the estimation of monetary values of respondent preferences for the attributes considered in utility functions. These are commonly referred to as marginal willingness-to-pay (WTP). WTP estimation is based on the marginal rate of substitution expressed in dollar terms providing a trade-off between some attribute k and the cost involved (Hensher et al. 2015) and is calculated using the ratio of an attribute parameter and the cost parameter. WTP can take into account interaction effects, if statistically significant, such as with the respondent demographics. WTP of attribute *j* by respondent *i* is calculated as the ratio of the estimated model parameters accommodating the influence of the random component (Cicia et al. 2013) as:

$$WTP_i^j = -\left(\frac{\beta_j + \varepsilon_{ij}}{\beta_{price} + \varepsilon_{ip}}\right) \tag{0.10}$$

The estimated mode parameters can also be used to estimate compensating surplus (CS) as a result of policy or quality change in a combination of attributes, using (Hanemann, 1984):

$$\mathbf{CS} = \frac{-1}{\beta cost}\left[\ln\sum_{j=1}^{J}\exp\left\{V_j^0\right\} - \ln\sum_{j=1}^{J}\exp\left\{V_j^1\right\}\right] \tag{0.11}$$

which calculates the difference in utilities before the policy or quality change (V_0) and after the policy or quality change (V_1) (Hanley et al. 2013; Lancsar and Savage 2004). Similar to WTP, the monetary estimation of this change is possible by using the estimate for the monetary attribute $\beta_{cost.}$. Lastly, there are some challenges associated with the empirical estimation of the WTP in the RPL based models. One approach is to use a fixed cost, which simplifies the WTP estimation (Daly et al. 2012) but which may not be as behaviourally a plausible consideration as allowing heterogeneous preferences towards the cost attribute (Bliemer and Rose, 2013; Daziano and Achtnicht, 2014). Conceptually, the estimated cost parameter is a proxy for the marginal utility of income for respondents and economic theory suggests individuals will respondent differently to varying income levels. The use of a random cost parameter however, presents complications in deriving population distribution moments from the ratio of two random parameters.

Appendix B
Latent Class Model of Sauvignon Blanc Wine Choices

Table B-1 Latent Class Model of wine choices

Utility parameters[1]	Class 1	Class 2	Class 3
Biodiversity Management	0.49***(0.06)	0.43***(0.10)	0.34***(0.06)
Water Management	0.36***(0.05)	0.12 (0.11)	0.26***(0.05)
By-product Management	0.38***(0.04)	0.22** (0.10)	0.16***(0.05)
Energy Management	0.27***(0.05)	0.11 (0.10)	- 0.04 (0.06)
Pest & Disease Management	0.43***(0.05)	0.59***(0.09)	0.31***(0.05)
Social Responsibility	0.37***(0.05)	0.39***(0.09)	0.29** (0.05)
GHG Management	0.29***(0.05)	0.36***(0.09)	0.36***(0.05)
Soil Management	0.47***(0.05)	0.02 (0.11)	0.07 (0.05)
Organic Production System	0.28 (0.47)	1.30***(0.42)	- 0.78** (0.27)
Māori Production System	0.49***(0.06)	0.54***(0.12)	0.32***(0.07)
Critic rating	0.01***(0.00)	0.01***(0.00)	0.01***(0.00)
Price $/750ml bottle -	0.05***(0.01)	- 0.20***(0.02)	- 0.16***(0.01)
Opt-Out -	1.09***(0.27)	- 0.92***(0.16)	- 4.12***(0.12)
Class Membership			
Ethnocentrism Score -	0.02* (0.01)		
Sustainable certification signal high quality	0.92***(0.22)	- 0.54* (0.28)	
High Māori Knowledge		- 0.47* (0.27)	
Usual Spend	0.07***(0.01)	- 0.06***(0.02)	
Age		0.02***(0.01)	
Has children	0.50** (0.21)		
Average class probability	0.47	0.17	0.36
Model Fit Statistics			
Log Likelihood function -	6,030		
Log Likelihood chi^2 stat (74 d.f.)	6,330***		
McFadden Pseudo R^2	0.35		
Number of observations	8,370		
Number of respondents	837		

***, **,* denote statistical significance at the 1%, 5% and 10% levels respectively for the null hypothesis that a parameter estimate is not significantly different from zero.

Standard errors in brackets.

[1] Parameter mean estimates indicates the estimated average value in the model for each different parameter

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