

Environmental Impacts of Wine Production: A Pilot Study Exploring Consumer Knowledge and Environmental Concern

Michaela Nuebling

Purdue University, Indiana, USA
(mnueblin@purdue.edu)

Carl Behnke

Purdue University, Indiana, USA
(behnkec@purdue.edu)

Rhonda Hammond

University of Arkansas, Arkansas, USA
(rkhammon@uark.edu)

Purpose

The purpose of this study was pilot testing an instrument designed to measure subjective and objective knowledge about environmental practices in the wine industry, such as the use of pesticides in the vineyard and additives during wine making (e.g. sulfur or yeast), as well as waste (e.g. recycling) and water management. Additionally, concerns about the environment were captured through the revised New Environmental Paradigm (NEP) scale.

Design/methodology/approach

Participants with three distinct levels of expertise were recruited at a Midwestern University in the United States. An online survey was administered. Data was analyzed with SPSS version 21. The sample (n=38) consisted of a novice group (n=11), an intermediate group (n=15), and industry experts (n=12).

Findings

Between groups, there was a significant ($p < 0.003$) difference in objective knowledge ($\mu_{\text{novice}} = 4.00$, $\mu_{\text{intermediate}} = 4.33$, $\mu_{\text{expert}} = 5.75$). None of the participants achieved the maximum score (9.00). Subjective scores were significantly ($p = .026$) correlated with objective scores ($\mu_{\text{novice}} = 10.55$, $\mu_{\text{intermediate}} = 15.13$, $\mu_{\text{expert}} = 16.15$). Novice's subjective knowledge was significantly different from intermediate ($p = .005$) and expert participants ($p = .001$). Additionally, the high reliability of the NEP scale was confirmed (Cronbach's alpha = .859). There was no significant difference regarding the participants' environmental concern ($r(36) = .316$, $p = .731$).

Practical implications

Environmentally friendly products are receiving increased consumer interest. Organic, biodynamic, and sustainable are terms used in the wine industry; however, this study suggests a lack of comprehension across all examined knowledge groups. Term clarification (organic, biodynamic, sustainable, etc.) and wine production education is warranted. Industry stakeholders (experts) should especially be knowledgeable in order to foster consumer appreciation for environmentally friendly wines and wine packaging.

Key words: biodynamic, consumer behavior, environmental concern, knowledge, organic

1. INTRODUCTION

There are no simple answers as to what motivates people to consume wine. First and foremost, the consumption of wine is a highly subjective choice, unique to each individual. Wine consumer research has thus far investigated various factors influencing wine consumption behavior such as: involvement (Barber et al., 2007; Aurifeille et al., 2002), generational differences (Hammond et al., 2013a; Hammond et al., 2013b; Atkin & Thach, 2012; Hammond et al., 2009), gender differences (Atkin et al., 2007; Barber et al., 2006), lifestyle as a consumption driver (Brunner & Siegrist, 2011; Bruwer & Li, 2007), packaging effects (Barber et al., 2009; Marin & Durham, 2007), and wine label preferences (Barber & Almanza, 2006). Recently, environmental concerns related to the wine-supply-chain (Christ & Burritt, 2013; Forbes & DeSilva, 2012; Cordano et al., 2010; Pullman et al. 2010; Gabzdylova et al., 2009), green wine consumerism (Mann et al., 2012; Barber, 2010; Zucca et al., 2009), as well as wine knowledge (Johnson & Bastian, 2007; Dodd et al., 2005) have been studied.

Forbes et al. (2011) highlighted wine consumers self-reported lack of knowledge regarding how wine is made. The wine knowledge instruments used in academic research thus far include mostly general wine knowledge items. Johnson and Bastian (2007), for example, tailored their questionnaire to the Australian market asking questions such as *where the wine region, Pemberton, is located?*, *which Australian region produces the most wine?*, as well as general questions, such as *what grape varietal is red Burgundy made from?*. Loureiro (2003) and Imkamp (2000) stated that consumers across nations express an increased interest in ecological and environmentally friendly product information. Goode and Harrop (2011) highlighted that rules and regulations for organic, sustainable, and natural wine making vary greatly. Both, across and within countries, there exist a variety of sustainable or organic certifying organizations. An organic wine certified by BioGro New Zealand may not easily be exported to the United States because United States Department of Agriculture (USDA) rules and regulations differ slightly. Furthermore, the term “natural” has not been defined officially. Biodynamic, on the other hand, has been defined by Demeter International. Certification is available from Demeter and applicable to biodynamic agriculture internationally; however some wine industry representatives and consumers are skeptical regarding biodynamic methods (Goode & Harrop, 2011). Unfamiliarity and a lack of understanding of the differences between organic, biodynamic, sustainable, and natural wines may drive this reluctance. This brings into question what wine consumers know about these widely used wine industry terms. Thus, an instrument was created and pilot tested as part of this study to measure knowledge about the environmental impacts of wine production.

Today, a discussion of wine industry environmental impacts goes beyond wine making and grape growing. Wines are no longer consumed at their place of origin (Goode & Harrop, 2011). Packaging and distribution are highly relevant environmental aspects of wine production. Related to global warming and climate changes, carbon footprint is a key term across industries. Various wine processes and products add to the overall emission of greenhouse gases. Distribution and packaging contribute significantly to the carbon footprint of wine. Goode and Harrop (2011, p. 224) called wine packaging “the lowest-hanging fruit”, hence, suggesting it was the easiest to change in support of carbon footprint reduction. Recently, various innovative packaging options have been introduced to the international wine marketplace, such as, canned wine, wine in recyclable bottles and Tetra Pak, as well as wine on tap. Furthermore, long-standing bulk packaging, like bag-in-the-box, receives increased consumer appreciation due to heightened environmental awareness and for economic reasons. However, as consumers have long been accustomed to glass bottles sealed with natural cork, research frequently found hesitation regarding non-traditional packaging (Barber et al., 2009;

Marin & Durham, 2007). In other disciplines, for example political science, environmentalism has long been a topic. Dunlap and Van Liere (2008) first proposed their New Environmental Paradigm (NEP) scale in 1978. Since then it has been a widely used tool capturing peoples' environmental orientation. Dunlap (2008, p. 3) claimed the NEP scale was "the worlds' most widely used measure of environmental concern". In conjunction with exploring knowledge about the environmental aspects of wine making, it was deemed appropriate to learn whether wine consumers of differing expertise have different degrees of environmental concern.

2. LITERATURE REVIEW

Relevant literature confirms that the motivation to drink wine is complex in nature. Marketing research has attempted to segment the wine consumer population and cluster those who share similar motivation. Various segmentation approaches are available (Bruwer & Siegrist, 2011; Hall & Mitchel, 2008; Lockshin et al., 2001). Bruwer and Siegrist (2011) suggested that knowledge, perceived value, age, and intellectual challenge significantly influence motivations to consume wine. Multiple researchers highlighted the significance of knowledge as a motivator for wine consumption and purchase behavior, while differentiating between subjective and objective knowledge (Hammond et al., 2013a; Hammond et al., 2013b; Barber et al., 2009; Johnson & Bastian, 2007; Dodd, et al., 2005). Objective knowledge is learned information stored in memory. Subjective knowledge is individual perception based on past drinking behavior, also considered one's self-confidence related to wine consumption (Taylor, et al., 2008). Past research has found a discrepancy between levels of subjective and objective knowledge (Taylor et al., 2008; Johnson & Bastian, 2007; Dodd, et al., 2005). Frequently, subjective knowledge was not found to be a reliable indicator of objective knowledge. Furthermore, previous studies suggested that subjective knowledge is a stronger predictor of behavior than objective knowledge (Hammond et al., 2013a; Johnson & Bastian, 2007; Dodd, et al., 2005). One may argue that based on these findings subjective knowledge, also viewed as wine consumers' confidence, is more important. However, as consumers become more environmentally aware and start questioning the production and origin of the foods and beverages they consume, it will become increasingly important for industry to discern what consumers know. Distribution, retail, and hospitality operators need to be prepared to answer questions.

As part of this pilot study, subjective and objective measures were taken from three groups of participants. The groups were assumed to have distinctly different levels of knowledge due to pre-requisites of participant recruitment. Additionally, based on prior research, no significant correlation between subjective and objective scores was expected.

Environmental impacts of human behavior have been a topic of interest for the general public as well as academic research for decades. Recently, the food sector has experienced an increasing demand for environmentally friendly products. The "green" consumer is looking for organic dairy products, fruits and vegetables, as well as recyclable packaging materials. Sustainability has become a key term for many industries. Zucca et al. (2009) reported that consumers reside in a state of confusion regarding various terms used to express environmentally friendly efforts in the wine industry, such as organic, green, biodynamic or sustainable and confirmed a low consumer awareness of environmental considerations related to winemaking, and grape growing. Compared to the food industry, the wine industry has been rather slow in its adaptation to environmental concerns. Forbes et al. (2011) found that while consumers in New Zealand claimed to be concerned about the effects of food production, a large proportion of their sample admitted not knowing how wine is made. The need for consumer education and further research was highlighted by Forbes et al. (2011), but the

current status quo of consumers' environmental wine knowledge is unidentified. Goode and Harrop (2011) suggested that consumers may not be very knowledgeable about the use of additives and other aspects of wine making or grape growing. Christ and Burritt (2013) pointed out that exploring environmental concerns in wine production is an under-researched field despite the recent growth of consumer interest and the increasing demand for wine. Goode and Harrop (2011) cautioned the wine industry; sooner rather than later wineries will be required to provide information and justification for their practices to address environmentally concerned consumers' demands. Environmental surveys across disciplines and countries have used the NEP scale to explore consumers' environmental concern (Kotchen & Moore, 2007; Casey & Scott, 2006; Shafer, 2006; Liu & Sibley, 2004). Pilot testing knowledge related to the environmental impacts of wine making and grape growing is warranted and relevant. It appears that knowledge and concern are related. Consumers who know more may be more concerned and vice versa. The quest for knowledge is likely driven to some degree by environmental concern; therefore, it was proposed that there is a difference between groups' relative levels of environmental concern.

3. METHODOLOGY

3.1. Design

The study was conducted in November 2013 utilizing Qualtrics (online survey data collection software). The study was approved by the Institutional Review Board of a Midwestern University in the United States. Data analysis was conducted using SPSS 21.0. The formal (directional) hypotheses under consideration were:

H₁: There will be significant differences ($p < 0.05$) between subject groups with regards to their subjective and objective knowledge scores.

H₂: There will be no relationship ($p < 0.05$) between subjective and objective knowledge scores.

H₃: There will be significant differences ($p < 0.05$) between subject groups' relative levels of environmental concern.

3.2. Participants

Forty-two surveys were collected. Thirty-eight questionnaires were complete and usable. The novice subjects ($n=11$) were recruited from a preparatory class for the American Court of Master Sommeliers' Level 1 seminar. Students in this class were between the ages of 21 and 23, and fairly inexperienced with wine. However, as part of the preparation class the students were exposed to fundamental wine education. The intermediate sample consisted of 15 participants; these participants were students recruited from a commercial grape growing and wine making class. The students had been exposed to sustainable aspects of wine making and grape growing as part of the class's curriculum. Additionally, industry experts ($n=12$) were recruited from the researchers' professional network. The survey was distributed to academics in the respective fields as well as industry professionals from wineries, as well as wine sales, marketing, and distribution. The industry experts were asked to pass the online survey on to colleagues. The total sample consisted of 21 male and 15 female participants (two subjects chose not to respond to the gender question).

3.3. Measures

The instrument was designed to measure the participant's knowledge of environmental practices in the wine industry. In this context, environmental practices referred to, but were not

limited to, the use of pesticides in the vineyard, the use of additives during wine making (e.g. sulfur or yeast), wine packaging, facility cleaning and maintenance, as well as waste (e.g. recycling) and water management. The questionnaire was modeled after previous instruments (Johnson & Bastian, 2007; Dodd et al., 2005). Objective knowledge questions were developed based on the review of sustainable wine making and grape growing literature pertaining to rules and regulations in the United States. The initial scale was reviewed by three academic and two industry experts and revised accordingly with the goal of providing easy to understand, non-ambiguous questions related to the environmental impacts of wine making and grape growing.

The final questionnaire (see Appendix 1) was composed of 3 subjective, 9 objective, and 15 environmental concern items adapted from Dunlap et al. (2000). Dunlap et al. (2000) reported inter-item reliability (Cronbach's alpha) of .83. This scale was designed to capture five factors of pro-environmental worldviews including: reality of growth limits, significance of the human species on the planet, delicacy of nature's balance, as well as, the possibility of an ecological crisis, and human control over nature. All even-numbered items were reverse coded, as disagreement indicated a pro-environmental worldview.

3.4. Results

The maximum objective score achievable (multiple choice items) was 9, however, no respondent scored 100%. The mean scores ranged from 4.00 (novice) over 4.33 (intermediate) to 5.75 (expert). One-way ANOVA was conducted to compare the objective scores between the three groups. Between group scores were significantly different ($t(36)=6.737$, $p=.003$). Tukey HSD analysis was applied to explore differences further. A significant difference ($p=.005$) was found between the expert and the novice group as well as between the expert and intermediate sample ($p=.015$). No significant difference ($p=.777$) was found between the intermediate and novice group. A detailed question-by-question analysis suggested that there were some questions where more intermediate-level participants than experts scored the correct answer.

A 7-point-Likert scale was used for the three subjective measurement items. The third item was reverse coded for the purpose of aggregating responses to a subjective knowledge score. Therefore, by summarization the maximum score was 21. With regards to the respondent's perception of their level of knowledge about environmental practices, the experts mean score of 16.15 indicated that they rated themselves as highly knowledgeable as compared to the intermediates, who rated themselves as generally knowledgeable ($\mu=15.13$), and the novices, who rated themselves as minimally knowledgeable ($\mu=10.55$). Tukey HSD analysis was further applied to explore differences. A significant difference ($p=.005$) was found between the intermediate and the novice group as well as between the expert and intermediate sample ($p=.001$). Reliability analysis of the 3-item-subjective knowledge scale was conducted. Cronbach's alpha of .815 for all three items and .845 for the first two items suggested high internal consistency. These findings support H_1 which proposed a significant difference in subjective and objective knowledge between groups.

Correlation analysis was conducted. Contrary to previous studies' findings, the data suggested that the subjective and objectives scores were significantly and positively correlated ($r(36)=.356$, $p=.026$). This finding failed to support H_2 which proposed that there was no relationship between objective and subjective knowledge scores. Multiple comparison analysis further explored the differences between samples. Tukey HSD suggested a significant difference in subjective knowledge levels between the novice and intermediate sample ($p=.005$) as well as between the novice and expert sample ($p=.001$). There was no significant

difference found in terms of subjective knowledge between the expert and the intermediate sample, suggesting that their self-perception was similar.

Examination of environmental concern of the three samples revealed the following findings. The high reliability of the scale was confirmed with Cronbach's alpha of .859. Across all three groups there was no significant difference regarding the participants' environmental score ($r(36)=.316, p=.731$). The mean scores were 72.27 (intermediate), 69.75 (expert) and 68.45 (novice). These findings failed to support H_3 which proposed that there were significant differences between subject groups' relative levels of environmental concern. Correlation analysis revealed no significant relationship between subjective or objective knowledge and environmental concern.

In summary, only one out of the three hypotheses was confirmed; the data provided evidence of a significant difference in subjective and objective knowledge between groups. However, the lack of support for H_2 was an unexpected and intriguing finding. Literature review suggested that previously no significant relationship between subjective and objective knowledge scores have been found, however, the data collected for this study suggested there was a significant correlation when analyzed by expertise. Additionally, due to their wine industry background it was expected that the expert group's subjects would achieve almost perfect scores, which was not confirmed by the data. A significant difference was expected to emerge for environmental concern across the groups of expertise, but all participants displayed similar levels of concern.

4. DISCUSSION

Even though a significant difference was found in terms of subjective and objective knowledge between the three groups, the detailed findings raise further questions. On one hand, the mean score (5.75) of the expert group was surprisingly low as it was expected to be closer to a perfect score. An examination of the questions found that, for four out of nine questions the intermediate participants were more likely to score correctly than the experts. Scoring correctly can be explained by the specific education these students in the intermediate group were exposed to during their commercial wine making class. At the same time, this may suggest that industry representatives may not be clear about the meaning of the various terms. Uncertainty about wine production practices and little exposure to information pertaining to environmental impacts could explain these findings. Regarding the use of sprays in organic grape growing over 30% of the sample ($n=38$) responded "cannot be sprayed at all," which may suggest a common misconception regarding the meaning of organic. Therefore, it seems crucial to educate sales and marketing personnel in retail, winery, and hospitality operations to enable them to meet the needs of consumers who display an increased concern regarding environmentally responsible practices. Recently, the wine industry has introduced more environmentally friendly wine packaging materials. Unless the consumer understands the benefits of these practices, it will be a challenge to overcome reluctance. For alternative materials such as bag-in-the-box, Tetra Pak, and cans, as well as dispensing methods such as wine on tap to be successful, the wine industry needs to increase consumer's knowledge.

The finding of a significant correlation between subjective and objective knowledge scores was unexpected. This may suggest adequate awareness across the members of each group regarding their actual level of knowledge. In other words the study participants did not think they were more knowledgeable than they actually demonstrated; an appropriate explanation of these findings. Students in the novice group were especially aware of their beginner status due to their enrollment in the level 1 sommelier course. Additionally, regarding environmental concern, there was no significant difference between the groups; hence, the proposed

relationship was not confirmed. Concern seems to be a relevant antecedent of knowledge. At the same time, environmental concern is subject to social norms. Thus, it is possible that participants' responses could have been based on what they deemed to be socially acceptable rather than what they truly thought or felt. This warrants further exploration, especially considering the display of knowledge. Could it be possible that consumers pretend to be environmentally concerned due to peer pressure? That, in turn, might explain the low levels of objective knowledge related to environmental impacts of the wine industry.

5. LIMITATIONS

The purpose of the study was to pilot test a newly proposed knowledge instrument. Various limitations such as the small sample size as well as the study location should be considered. Furthermore, the objective-knowledge-items were based on rules and regulations for the United States wine industry, therefore not all questions can be used in international studies. Additionally, wine making and grape growing is complex, therefore, more questions could be asked to assess consumers' knowledge level.

REFERENCES

Atkin, T. and Thach, L. (2012), "Millennial wine consumers: risk perception and information search", *Wine Economics and Policy*, Vol. 1, pp. 54-62.

Atkin, T., Nowak, L., and Garcia, R. (2007), "Women wine consumers: information search and retailing implications", *International Journal of Wine Business Research*, Vol. 19 No. 4, pp. 327-339.

Aurifeille, J.-M., Quester, P.G., Lockshin, L., and Spawton, T. (2002), "Global versus international involvement-based segmentation: a cross-national exploratory study", *International Marketing Review*, Vol. 19 No. 4, pp. 369-386.

Barber, N.A. (2010), "Green wine packaging: targeting environmental consumers", *International Journal of Wine Business Research*, Vol. 22, pp. 423-444.

Barber, N.A., Taylor, C., and Strick, S. (2009), "Wine consumers' environmental knowledge and attitudes: influence on willingness to purchase", *International Journal of Wine Research*, Vol. 1, pp. 59-72.

Barber, N. A. and Almanza, B. (2006), "Influence of wine packaging on consumers' decision to purchase", *Journal of Foodservice Business Research*, Vol 9 No. 4, pp. 83-98.

Barber, N. A., Almanza, B. A., and Donovan, J. R. (2006), "Motivational factors of gender, income and age on selecting a bottle of wine", *International Journal of Wine Marketing*, Vol. 18 No. 3, pp. 218-232.

Barber, N. A., Ismail, J., and Dodd, T. (2007), "Purchase attributes of wine consumers with low involvement", *Journal of Food Products Marketing*, Vol. 14 No. 1, pp. 69-86.

Brunner, T. A. and Siegrist, M. (2011), "Lifestyle determinants of wine consumption and spending on wine", *International Journal of Wine Business Research*, Vol. 23 No. 3, pp. 210-220.

Bruwer, J. and Li, E. (2007), "Wine-related lifestyle (WRL) market segmentation: demographic and behavioral factors", *Journal of Wine Research*, Vol. 18 No. 1, pp. 19-34.

Casey, P. J., and Scott, K. (2006), "Environmental concern and behaviour in an Australian sample within an ecocentric–anthropocentric framework", *Australian Journal of Psychology*, Vol. 58, pp. 57–67.

Christ, K. L. and Burritt, R. L. (2013), "Critical environmental concerns in wine production: an integrative review", *Journal of Cleaner Production*, Vol. 53, pp. 232-242.

Cordano, M, Marshall, R. S., and Silverman, M. (2010), "How do small and medium enterprises go green? A study of environmental management programs in the U.S. wine industry", *Journal of Business Ethics*, Vol. 92, pp. 463-478.

Dodd, T. H., Laverie, D. A., Wilcox, J.F., and Duhan, D.F. (2005), "Differential effects of experience, subjective knowledge, and objective knowledge on sources of information used in

consumer wine purchasing”, *Journal of Hospitality and Tourism Research*, Vol. 29 No. 1, pp. 3-19.

Dunlap, R. E. (2008), “The new environmental paradigm scale: from marginality to worldwide use”, *Journal of Environmental Education*, Vol. 40 No. 1, pp. 3-18.

Dunlap, R. E. and Van Liere, K. D. (2008), “The new environmental paradigm”, *Journal of Environmental Education*, Vol. 40 No. 1, pp. 19-28.

Dunlap, R. E., Van Liere, K. D., Mertig, A. G., and Jones, R. E. (2000), “Measuring the endorsement of the new ecological paradigm: a revised NEP scale”, *Journal of Social Science*, Vol. 56 No. 3, pp. 425-442.

Forbes, S. L., Cullen, R., Cohen, D. A., Wratten, S. D., and Fountain, J. (2011), “Food and wine production practices: an analysis of consumer views”, *Journal of Wine Research*, Vol. 22 No. 1, pp. 79-86.

Forbes, S. L., and De Silva, T. (2012), “Analysis of environmental management systems in New Zealand wineries”, *International Journal of Wine Business Research*, Vol. 24, pp. 98-114.

Gabzdylova, B., Raffensperger, J. F., and Castka, P. (2009), “Sustainability in the New Zealand wine industry: drivers, stakeholders and practices”, *Journal of Cleaner Production*, Vol. 17, pp. 992-998.

Goode, J. and Harrop, S. (2011), *Authentic wine: toward natural and sustainable winemaking*, University of California Press, Los Angeles, CA.

Hall, C. M. and Mitchell, R. (2008), *Wine marketing: a practical guide*, Elsevier Butterworth-Heinemann, Oxford, UK.

Hammond, R. K., Velikova, N., and Dodd, T. H. (2013a), “Information sources used by restaurant wine consumers: are millennials that different?”, *Journal of Foodservice Business Research*, Vol. 16 No. 5, pp. 1-18.

Hammond, R. K., Velikova, N., and Dodd, T. H. (2013b), “Effects of processing styles on preference of restaurant menu type: how do millennials compare to other segments?”, *Journal of Foodservice Business Research*, Vol. 16 No. 1, pp. 20-39.

Hammond, R., Barber, N., and Almanza, B. (2009), “Retirees’ restaurant wine service preferences”, *Journal of Culinary Science & Technology*, Vol. 7, pp. 19-33.

Imkamp, H. (2000), “The interest of consumers in ecological product information is growing – evidence from two German surveys”, *Journal of Consumer Policy*, Vol. 23, pp. 193-202.

Johnson, T. E. and Bastian, S. E. P. (2007), “A preliminary study of the relationship between Australian wine consumers’ wine expertise and their wine purchasing and consumption behaviour”, *Australian Journal of Grape and Wine Research*, Vol. 13, pp. 186-197.

Kotchen, M. J., and Moore, M. R. (2007), “Private provision of environmental public goods: Household participation in green electricity programs”, *Journal of Environmental Economics and Management*, Vol. 53, pp. 1-16.

Liu, J. H. and Sibley, C. G. (2004), "Attitudes and behavior in social space: Public good interventions based on shared representations and environmental influences", *Journal of Environmental Psychology*, Vol. 24, pp. 373–384.

Lockshin, L., Quester, P., and Spawton, T. (2001), "Segmentation by involvement or nationality for global retailing: a cross-national comparative study of wine shopping behaviours", *Journal of Wine Research* Vol. 12 No. 3, pp. 223-236.

Loureiro, M. (2003), "Rethinking new wines: implications of local and environmentally friendly labels", *Food Policy*, Vol. 28, pp. 547-560.

Mann, S., Ferjani, A., and Reissig, L. (2012), "What matters to consumers of organic wine?", *British Food Journal*, Vol. 114 No. 2, pp. 272-284.

Marin, A. B. and Durham, C. A. (2007), "Effects of wine bottle closure type on consumer purchase intent and price expectation", *American Journal of Enology and Viticulture*, Vol. 58 No. 2, pp. 192-201.

Pullman, M. E., Maloni, M. J., and Dillard, J. (2010), "Sustainability practices in food supply chains: how is wine different?", *Journal of Wine Research*, Vol. 21 No. 1, pp. 35-56.

Shafer, W. E. (2006), "Social paradigms and attitudes toward environmental accountability", *Journal of Business Ethics*, Vol. 65, pp. 121–147.

Taylor, D. C., Dodd, T. H., and Barber, N. (2008), "Impact of wine education on developing knowledge and preferences: an exploratory study", *Journal of Wine Research*, Vol. 19 No. 3, pp. 193-207.

Zucca, G., Smith, D. E., and Mitry, D. J. (2009), "Sustainable viticulture and winery practices in California: what is it, and do consumers care?", *International Journal of Wine Research*, Vol. 2, pp. 189-194.

APPENDIX

Appendix 1: Final questionnaire

1. Please indicate your *level of knowledge* about environmental practices in the wine industry.

1	2	3	4	5	6	7
Not very knowledgeable						Very knowledgeable

2. Among my circle of friends, I am one of the “*experts*” on environmental practices in the wine industry.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

3. Compared to most other people I know *less* about environmental practices in the wine industry.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

4. *Sustainable* means meeting:

- environmental, social and economic needs
- environmental needs
- environmental and social needs
- environmental and economic needs

5. In the United States, which organization certifies *organic products*:

- Food and Drug Administration (FDA)
- United States Department of Agriculture (USDA)
- Demeter Biodynamic Trade Association (DBTA)
- Environmental Protection Agency (EPA)

6. *Biodynamic viticulture* (grape farming) includes:

- use of mineral substances
- use of animal manure
- use of astronomy and astrology
- all of the above

7. *Organically* grown grapes may be sprayed:

- with some insecticides, fungicides, and herbicides
- with some insecticides
- with some fungicides, and herbicides
- cannot be sprayed at all

8. In the United States 100% *organic wine*:

- cannot contain added sulfites
- can contain up to 12ppm of added sulfites per bottle
- can contain up to 18ppm of added sulfites per bottle
- can contain up to 20ppm of added sulfites per bottle

9. In the United States for the production of *biodynamic wine*:

- .03-ounces of yeast can be added per gallon of grape juice
- .05-ounces of yeast can be added per gallon of grape juice
- .07-ounces of yeast can be added per gallon of grape juice
- yeast cannot be added

10. On average, how much *wastewater* is created per gallon of wine made:

Answer options provided in form of a sliding scale from 0-20 gallons

11. The majority of pollution (carbon footprint) can be traced back to:

- grape growing
- wine packaging
- wine making
- wine tasting

12. In the United States approximately 300 Million cases of wine are sold annually. What percentage (%) of bottles is recycled:

Answer options provided in form of a sliding scale from 0-100 %

13. We are approaching the limit of the number of people the earth can support.

1	2	3	4	5	6	7
Strongly						Strongly
Disagree						Agree

14. Humans have the right to modify the natural environment to suit their needs.

1	2	3	4	5	6	7
Strongly						Strongly
Disagree						Agree

15. When humans interfere with nature it often produces disastrous consequences.

1	2	3	4	5	6	7
Strongly						Strongly
Disagree						Agree

16. Human ingenuity will insure that we do NOT make the earth unlivable.

1	2	3	4	5	6	7
Strongly						Strongly
Disagree						Agree

17. Humans are severely abusing the environment.

1	2	3	4	5	6	7
Strongly						Strongly
Disagree						Agree

18. The earth has plenty of natural resources if we just learn how to develop them.

1	2	3	4	5	6	7
Strongly						Strongly
Disagree						Agree

19. Plants and animals have as much right as humans to exist.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

20. The balance of nature is strong enough to cope with the impacts of modern industrial nations.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

21. Despite our special abilities humans are still subject to the laws of nature.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

22. The so-called "ecological crisis" facing humankind has been greatly exaggerated.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

23. The earth is like a spaceship with only limited room and resources.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

24. Humans were meant to rule over the rest of nature.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

25. The balance of nature is very delicate and easily upset.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

26. Humans will eventually learn enough about how nature works to be able to control it.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

27. If things continue on their present course, we will soon experience a major ecological catastrophe.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree