An analysis of the sustainability of wine and its environmental impact.

Brice K. Allen

University of Colorado Denver

Author Note

Brice K. Alen https://orcid.org/0000-0002-8313-851X

Correspondence concerning this article should be addressed to Brice K. Allen, Department of Computer Science, School of Engineering, University of Colorado, 1201 Larimer St, Denver, CO 80204. E-mail: briceallen@gmail.com

References

Bonamente, E., Scrucca, F., Rinaldi, S., Merico, M. C., Asdrubali, F., & Lamastra, L. (2016). Environmental impact of an italian wine bottle: Carbon and water footprint assessment. *The Science of the total environment*, *560-561*, 274–283

Bonamente follows an Italian wine bottle from cradle to grave calculating both carbon and water footprints associated. Using a more comprehensive evaluation shows a direct correlation between water and carbon footprints.

Bosco, S., Di Bene, C., Galli, M., Remorini, D., Massai, R., & Bonari, E. (2013). Soil organic matter accounting in the carbon footprint analysis of the wine chain. *The International Journal of Life Cycle Assessment*, *18*(5), 973–989

Bosco studies nine vineyards in Italy, all of which associate with one co-op winery located in the Maremma Rural District of Tuscany, Italy. Moreover, the author attempts to integrate changes in the soil organic matter into the carbon footprint calculation using the Henin–Dupuis soil organic matter model.

Boulton, R. (2017). A self-sustainable winery, an advanced passive building and remote monitoring of environments in wineries. *Journal of agricultural engineering (Pisa, Italy)*, *48*(1s), 53–58

In this peer-reviewed article, the author profiles the University of California at Davis's platinum LEED-certified Winery-Brewery-Food Laboratory. Some of the technologies discussed are photovoltaic roof arrays with lithium-ion battery clusters for storage, a rain collection, and fermentor vents that capture all of the fumes produced during fermentation for later sequestration to calcium carbonate.

Gallenti, G., Troiano, S., Marangon, F., Bogoni, P., Campisi, B., & Cosmina, M. (2019). Environmentally sustainable versus aesthetic values motivating millennials' preferences for wine purchasing: Evidence from an experimental analysis in italy. *Agricultural and food economics*, *7*(1), 1–16

The focus of this article is the wine buying trends of Italian millennials. Two

categories explored are carbon footprint and winescape aesthetic. The study explains how a lower carbon footprint is worth the premium while winescape aesthetic is not.

Garcia-Casarejos, N., Gargallo, P., & Carroquino, J. (2018). Introduction of renewable energy in the spanish wine sector. *Sustainability (Basel, Switzerland)*, *10*(9), 3157

In this peer-reviewed article, the author explores the different takes on renewable energy in the Spanish wine sector. Additionally, the author uses statistical analysis to evaluate the viability of renewable energy.

Hannah, L., Roehrdanz, P. R., Ikegami, M., Shepard, A. V., Shaw, M. R., Tabor, G., Zhi, L., Marquet, P. A., & Hijmans, R. J. (2013). Climate change, wine, and conservation. *Proceedings of the National Academy of Sciences - PNAS*, *110*(17), 6907–6912

In this peer-reviewed article, the author explains the positive feedback loop between viticulture and climate change. Viticulture is an industry globally concentrated in hotspots for biodiversity, namely, Mediterranean climate regions. This location makes it an excellent metric to measure climate change. Additionally, it explores possible conservation conflicts in land use and freshwater ecosystems.

Kustas, W. P., Anderson, M. C., Alfieri, J. G., Knipper, K., Torres-Rua, A., Parry, C. K., Nieto, H., Agam, N., White, W. A., Gao, F., McKee, L., Prueger, J. H., Hipps, L. E., Los, S., Alsina, M. M., Sanchez, L., Sams, B., Dokoozlian, N., McKee, M., … Hain, C. (2018). The grape remote sensing atmospheric profile and evapotranspiration experiment. *Bulletin of the American Meteorological Society*, *99*(9), 1791–1812

In this peer-reviewed article, the author looks at ways for vineyards to remain profitable and sustainable in times of an extended drought. The author discusses tools used to collect micrometeorological and biophysical data from vineyards in California's Central Valley AVA.

Pattara, C., Raggi, A., & Cichelli, A. (2012). Life cycle assessment and carbon footprint in the wine supply-chain. *Environmental Management*, *49*(6), 1247–1258

Using both the Carbon Footprint and life cycle assessment, the author explains increasing pressure on the global wine industry to adapt and develop alternative approaches to reduce product-related greenhouse gas emissions. Additionally, the article discusses the limitations of both tools.

Pattara, C., Russo, C., Antrodicchia, V., & Cichelli, A. (2017). Carbon footprint as an instrument for enhancing food quality: Overview of the wine, olive oil and cereals sectors: Carbon footprint in the wine, olive oil and cereals sectors. *Journal of the science of food and agriculture*, *97*(2), 396–410

This peer-reviewed article explores the idea of Carbon Footprint as a metric for improving quality in three significant agro-food sectors in the Mediterranean area: wine, olive oil, and cereals. Furthermore, the author conducts a review of the supply chain and looks for ways to improve environmental sustainability.

Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science*, *360*(6392), https://science.sciencemag.org/content/360/6392/987.full.pdf, 987–992. https://doi.org/10.1126/science.aaq0216

In this peer-reviewed article, the author compares environmental impacts across several metrics: land use (m^2), $greenhousegasemissions(tonnesof CO_2\text{-equivalents})$, eutrophying emissions (grams of $PO_4 - equivalents)$, $freshwaterwithdrawals(liters)$, $scarcity - weightedwater(liters)$, $whicharefreshwaterwithdrawalsweightedforlocalwaterscarcity$

Rinaldi, S., Bonamente, E., Scrucca, F., Merico, M., Asdrubali, F., & Cotana, F. (2016). Water and carbon footprint of wine: Methodology review and application to a case study. *Sustainability (Basel, Switzerland)*, *8*(7), 621

Rinaldi studies the life cycle assessment of green, blue, and indirect and direct

greywater associated with red and white wine produced at the same winery in the same vintage(2002). The author presents a side-by-side comparison of both carbon and water footprints showing a strong (>70%) correlation.

Robinson, J. (2020). *Carbon footprints, wine and the consumer.* https://www.jancisrobinson.com/articles/carbon-footprints-wine-and-consumer

In this popular press article, author Jancis Robinson, OBE, ComMA, MW shares her insight on CO_2 emissions related to the wine sector. The paper aims to illustrate how impactful wine drinking is and contrasts it against other impactful consumer activities, such as meat-eating, air travel, and the size of the car they own.

Scrucca, F., Bonamente, E., & Rinaldi, S. (2018). Chapter 7 - carbon footprint in the wine industry. Elsevier Inc

In this chapter, the author sheds light on the carbon footprint of a 750ml bottle of Italian wine. Packing and distribution make up the most considerable portion of a bottle of wines' carbon footprint. This article aims at improving and optimizing those sectors.

Smith, D. (2009). Sustainable viticulture and winery practices in california: What is it, and do customers care? *International journal of wine research*, *1*, 189

This peer-reviewed article focuses on how producers are using sustainable viticulture and how it changes consumer perception. The author compares their independent research against previous studies. Further, the author delves into industry practices and the implications of product development.

Trombly, A. J., & Fortier, M.-O. P. (2019). Carbon footprint of wines from the finger lakes region in new york state. *Sustainability (Basel, Switzerland)*, *11*(10), 2945

Focusing on wine from the Finger Lakes AVA of New York state, the author compares three wineries and their end to end CO_2 equivalent emissions. The author used several aspects to track emissions: electricity, fertilizers, pesticides, and the volume of wine produced each year.

Vázquez-Rowe, I., Rugani, B., & Benetto, E. (2013). Tapping carbon footprint variations in the european wine sector. *Journal of cleaner production*, *43*, 146–155

In this peer-reviewed article, the author seeks to compare how nine different wineries in three separate countries handle the wine sector's environmental impact. Factors considered are varietal, the aging process, optimization of inputs, harvest yields, and agricultural practices.

Williams, J. N., Hollander, A. D., O'Geen, A. T., Thrupp, L. A., Hanifin, R., Steenwerth, K., McGourty, G., & Jackson, L. E. (2011). Assessment of carbon in woody plants and soil across a vineyard-woodland landscape. *Carbon balance and management*, *6*(1), 11–11

This peer-reviewed article studies the quantification of ecosystem services like carbon storage in an organic vineyard and adjoining woodland ecosystem. The author utilizes geographic information systems and remote sensing techniques to perform statistical analysis of this landscape's environmental impact.