



EVALUATING

WINE WASTE

AT CONSUMER LEVEL IN SOUTH AFRICA

WRITTEN BY

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Evaluating wine waste at Consumer level in South Africa

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Preface and Acknowledgements

As part of the Bachelor programme International Agribusiness at the Aeres University of Applied Sciences in Dronten, I conducted a research project linked to several courses offered within the program. The research project has resulted in a thesis written during my placement in the first semester of the second year at the Aeres University. The present report constitutes final proof of proficiency of the study program undergone.

I chose a topic which relates to my personal interests and current issues in the wine industry – environmental organizations point to an enormous waste. This topic was inspired by the following quote which appeared in the 8th August 2019 newsletter by Premier Cru Wines (a French wine and Champagne importer in South Africa): “Wouldn’t we all love to unwind after a long day, and have a glass of wine... But there is always the dilemma of an open bottle that must be finished – or a risk of losing the wine over the following days. And let’s agree – it breaks our hearts to have to let a stunning wine go to waste, as much as it breaks our wallet.” I hope to evolve professionally within the wine industry, and I would like to help ensure it is possible to enjoy what is often considered a “luxury product” whilst contributing to the sustainability of food and beverage consumption.

I would like to thank the Aeres Hogeschool Dronten and particularly Pat Burgess and Corry Uenk, for advising me and helping me during my course and thesis preparation. I would also like to thank Herve Delabesse, my company coach and manager, for helping me discover various aspects of the wine industry in South Africa.

Summary

The aim of the conducted research is to understand wine consumption in South Africa compared to historical wine-consuming countries and why it is wasted at consumer level. This report is destined to professionals of the wine industry but also to consumers and environmental institutions.

Food waste can be observed at all stages of the food supply chain and affects all food categories – and that includes alcoholic and non-alcoholic beverages. The South African market is growing and maturing regarding wine consumption. But there is a growing concern within the wine industry that waste at consumer level is becoming an important issue. Wine waste exists in wine consuming countries and has already been studied in some of them. But there is very little documentation regarding wine waste at consumer level in South Africa. This report describes and discusses the research behind estimating and evaluating this topic.

In order to answer the main question, research is conducted according to relevant sub-questions, following specific methodology. An international literature and article review is conducted to find and compare the most effective ways to evaluate wine waste at consumer level. The most effective and most adaptable method is intended to be applied to South Africa to estimate wine waste at consumer level. Moreover, surveys are carried out directly and online to a sample of South African consumers. An interview is also carried out to representatives of on-trade businesses. These methods are used to support previous research and to try to explain the causes for wine waste which are then included in a diagram.

The results of the conducted research show that the most effective way to quantify wine waste is to focus on households and on-trade businesses separately, as data often conflicts between the two. By carrying out waste composition studies and household diaries, it would be possible in the future to estimate wine waste at consumer level more effectively. When applying an existing method, wine waste in South Africa is judged significant for an emerging country and can be estimated at nearly four percent of total wine consumption. This result is backed by consumer surveys and on-trade businesses interviews. However, the exact consumer habits and behaviours responsible for this issue are unknown by consumers and representatives. While wine waste is a growing concern at consumer level in the world and in South Africa, most wine consumers do not value this as a serious matter compared to similar issues.

To conclude, the existing insufficient information regarding this topic limits the ability to reach a valid conclusion or result. Wine consumers and representatives are aware of the existence of wine waste at consumer level but it had never been evaluated for South Africa. The results and discussion of this report are intended to evaluate the scope and challenges of wine waste at consumer level in South Africa for possible future research.

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Chapter One: Introduction

The aim of the conducted research is to understand wine consumption in South Africa compared to historical wine-consuming countries (in 2018: the US, followed by France and then Italy (Statista, 2019)) and to what extent it is wasted at consumer level. To do so, wine waste at consumer level will be quantified in South Africa to assist consumers, environmental institutions and actors of the wine industry in building awareness.

This introduction aims to contextualise wine waste. To do so, the question and complexity of food waste will be reviewed. This research thus depends on how food waste can be defined. The research carried out in this report will follow the definition from Parfitt, Barthel & Macnaughton (2010); Smil (2004); FAO (1981), Stuart (2009) and more recently Papargyropoulou, Lozano, Steinberger, Wright & Ujang (2014). According to the previous, food waste is considered *any edible material intended for human consumption that is thrown out, lost, or degraded*. In addition to this, according to Gustavsson, Cederberg & Sonesson (2011) and Grolleaud (2002), food waste and loss refer to the *decrease of consumable material which is lost throughout the human food supply chain*. With wine being a product that is featured in the human food supply chain, this definition is particularly relevant. In addition to this, a synthesis report was carried out in Dutch households in 2019 (Dooren, 2019) regarding the amount of food wasted at consumer level. This report also includes liquid waste, which refers to wine and other beverages. In fact, it is noted that wine is a product that it is more rarely wasted, but it is often thrown away because it cannot be finished. It is estimated that 0,8 litres of wine are wasted per person and per year in the Netherlands – or approximately 1,8% of the total liquid waste thrown down the toilet or sink per person per year in Dutch households. This is why wine waste can relevantly be included in the research area of food waste. Whilst food waste is a global issue in modern societies, beverage waste and more precisely wine waste is an issue that is often overlooked.

The sources in the following Table 1 form a relevant research background for the topic of wine waste at consumer level. It gives an overview of key findings, developments and concepts which are directly or indirectly linked to the research question. The included sources of literature will not necessarily be reviewed as part of the materials and methods of this thesis but can be quoted to support further discussion. The summary table provides a documentation overview of the research topic for the reader to understand the current state of knowledge in relation to wine waste at consumer level.

Source	Topic	Description
<p>Laura Bravi, Barbara Francioni, Federica Murmura, Elisabetta Savelli, 2019</p>	<p>Behavioural aspects influencing young consumers in Europe regarding household food waste. A focus on the United Kingdom, Italy and Spain.</p>	<p>Food waste has social, environmental and economic consequences. This article investigates what most causes food waste and what actions can prevent it at household/consumer level. The focus is on the whole consumption process from purchasing to end consumption. The data to back this study was collected in the United Kingdom, Italy and Spain and concerns young consumers between 18 and 35 years of age. The study shows evidence that in-store behaviour and food management at home are important to minimize food waste.</p>
<p>Galanakis, 2018, pp. 401-419</p>	<p>The prospects and opportunities in food waste recovery.</p>	<p>Though industries concentrate on treating, minimizing and preventing waste occurring along the food supply chain, food waste can be recovered just as well. Indeed, food waste contains a number of nutrients that could feed a fast growing population. This chapter explains how by-products can be re-utilized throughout the food supply chain. It also highlights the current challenges and tools to improve sustainability in modern food systems.</p>

Ozbuk & Coskun, 2019	Factors causing food waste differ according to the entity in the food supply chain.	Understanding food waste is a complex matter and requires analysing each entity of the food supply chain. The article explains that little attention has been paid to understanding the food waste factors downstream in the supply chain. After analysing over 90 articles which study waste and loss in the food supply chain, potential factors were identified into three groups (internal, micro-environmental and macro-environmental).
Haque et al., 2017	Managing waste in the most sustainable way in the beverage industry.	Most studies focus on converting solid food waste for chemicals or fuel. However, not as much effort has been given to recover liquid waste generated by the beverage industry. This is a significant sewage stream in urban areas. In this article, the study focuses on a bioconversion process to produce low-cost fructose syrup using beverages. The beverage waste was collected at local supermarkets.
Diego-Diaz, Fernandez-Rodriguez, Vitas & Penas, 2018	During the production of alcoholic beverages, many by-products are generated throughout the process. These can be reutilized or recycled.	Barley malt and sloe are used in the production of beer, gin and a Spanish spirit called pacharan. This article explains the chemical and microbiological reactions which occur in these products which can be reutilized or recycled.

Andrew Parry, n.d.	Estimation of the impact of anti-waste campaigns in the United Kingdom (e.g. WRAP). Ways to reduce household food and drink waste.	The amount of food waste generated by households has reduced: this is due to campaigns, increasing prices, difficult economic conditions and changes to food waste collection systems. The models used in this report show the amount of food and/or wine waste in tonnes which could be avoided every year.
WRAP, 2008	Quantification and exploration of food and drink waste disposed in the sewer by UK households.	Food and drink waste is measured according to the type of food and drink. Studies were carried out on UK households and data was collected from water industries to estimate the overall impact of food and drink waste in households. This includes alcoholic beverages and wine.

Table 1: Overview of relevant theory for research background

The complexity of food waste

Food waste can be observed at all stages of the food supply chain and concerns all actors: producers, processors, distributors or transporters; without forgetting the end consumer. Indeed, huge amounts are thrown away by the average consumer: an accumulation of small daily losses (a yoghurt base thrown away at the end of the meal, the apple left in the fruit bowl) and occasional accidents involving larger volumes, resulting from a misinterpretation of consumption dates, a lack of rigour in managing the refrigerator, stocks, or even a dish cooked in large quantities. Put together, these losses end up weighing heavily.

The causes of food waste are many and include

- the loss of monetary and symbolic value of food compared to other expenses and activities,
- changes in society,
- new ways of eating and dietary trends,
- changes in the pace of life.

And the consequences are serious on environmental, economic or social levels.

It is possible to estimate food loss and food waste at between a third and a half of the total of food produced worldwide (Institution of Mechanical Engineers, 2013). The FAO (Food and Agriculture Organisation of the United Nations) carries out multiple studies that show that one third of food that is produced for human consumption does not even arrive at consumer level (i.e it is lost or wasted before then) (FAO, 2016). This means that over half of fresh fruit and vegetables and a quarter of the meat produced globally is lost or wasted (FAO, 2018). According to the World Health Organisation, this amounts to enough calories to feed and satisfy an extra 1.9 billion people who are currently dying of hunger or suffering from malnutrition.

Consumers in more developed countries waste nearly as much food as is produced by a large part of Africa. North America and Europe are responsible for waste that amounts to around 100kg on average per person per year. The developing countries of Asia and Africa only waste about 10kg (FAO, 2011; 2015) of food per person per year on average.

With regards to the FAO's studies on global food waste:

- Eight percent of global greenhouse gas emissions are due to food waste. If food waste were to be compared to national greenhouse gas emissions, it would rank third, just after the USA and China.
- Around one third of the world's cultivated land (i.e. 1.4 billion hectares of land) is used to produce food that doesn't make it to the end of the food chain. According to environmental reports, this is equivalent to the total agricultural surface of Africa.
- Food waste has a water footprint of 250km³. This is equivalent to three times the amount of water contained in Lake Geneva.

However, nearly 800 million people are undernourished (FAO, 2018) – this represents 1 in 9 people – and one in five deaths in the world is linked to malnutrition. Yet, paradoxically, enough food is produced to feed everyone on the planet.

The food distribution systems have been centralised and distance consumers significantly from local sources. In this perspective, food is lost in larger quantities before it reaches the end consumer. The world population is estimated to increase to 9.9 billion by 2050 (i.e. an additional 3 billion people on Earth) and the world needs to ensure necessary food resources will be sufficient whilst trying to reduce the negative impacts of food production. This means reducing food waste but also improving access to healthier food and whole foods, creating opportunities for a more circular economy.

According to the UNO, the FAO and the UNEP, food losses and food waste can be differentiated slightly.

- Food loss is a term which is used when the quantity or the quality of the food is somewhat decreased throughout the supply chain. This can happen because of policies, regulations, storage, packaging, transport.
- Food waste is a variation of food loss when food is removed from the supply chain although it was fit for consumption or because of specific rules. This can be explained due to economic behaviour or mediocre inventory management. Nowadays, a lot of products have an expiry date or a sell-by date. For retailers or distributors, exceeding this date would be

a health hazard. It is often displayed on yoghurts, fresh meat, cream or ready meals. It is illegal to sell food which is past its sell-by date. This is why many products end up in supermarket garbage bins.

NB: Not everyone agrees with this view on best before or sell-by dates. This is the case with Freegans, who look for food in supermarket trash.

Food waste and food loss are observed at all stages of the food supply chain. According to FAO (2013), 54% of food waste occurs upstream in the chain: production, harvesting, handling. 46% occurs downstream in the chain: processing, distribution, consumption.

Food waste occurs mainly upstream in the food supply chain in developing countries. In fact, during production, harvest and manufacturing, mediocre equipment, infrastructure and organisation often lead to damage. Many retailers in developed countries source their produce from developing countries – these often have very high selection standards so large quantities can be left behind. When storing or handling the food, or due to delays in the supply chain, it can deteriorate because of pests, bacteria or fungi. Food waste at consumer level is a lot less important as individuals spend a larger proportion of income on food and simply cannot afford to let it go to waste.

In countries with a higher income per capita, food supply chains tend to be longer and more complex. These supply chains are also subject to precise regulations and are thus equipped with cutting-edge technology for production, harvesting, processing, transport and packaging. Because food is available in larger amounts and individuals spend a lower proportion of income on food, a lot of it is often wasted at distribution stage or at consumer level.

Causes for food loss and food waste can be explained through specific mechanisms. In addition to this, there are ways to avoid doing so which have been developed by official institutions.

Psychological mechanisms and reduction tactics

So much is thrown away because individuals buy in large quantities in relation to what will actually be consumed. To understand what drives consumers to buy more than necessary, Mia Birau and Corinne Faure, two marketing researchers from the Grenoble School of Management (EMG), studied the psychological processes that drive people to consume more than is physically needed. The end consumer's behaviour was therefore examined during the four stages of consumption: pre-purchase, purchase, consumption and storage.

Signalling identity

Individuals are prone to food waste during grocery shopping. In the fruit and vegetable section, consumers are attracted by "beautiful" products and reject imperfect products. This is a huge waste for producers, but the mass distribution sector seems to have taken up the problem. Where it becomes interesting is that the study highlights the fact that, unconsciously, some products are

chosen by consumers to show a type of social standing. This is what researchers call the "identity signalling theory": consumers simulate a situation of abundance or wealth and are thus more sensitive to marketing efforts.

Naive diversification

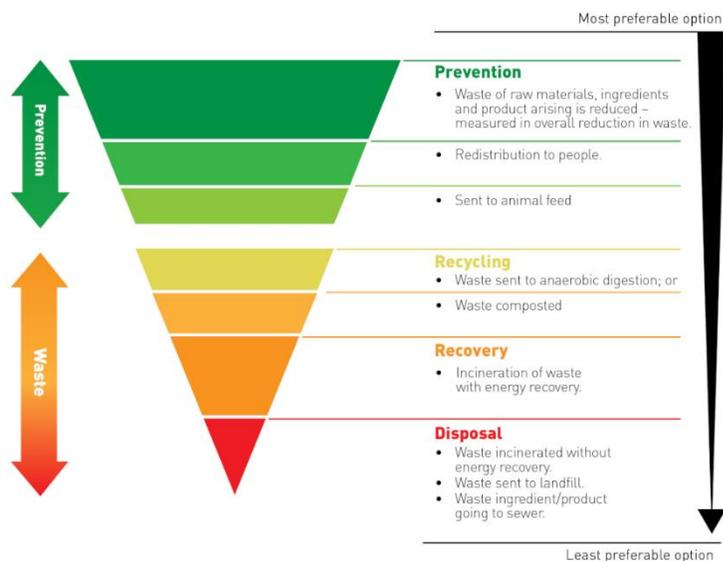
Consumers like to diversify the products that are purchased. Unfortunately, once the food actually arrives at consumption stage, most of it ends up in the garbage or down the drain. This is what researchers refer to as the "naive diversification bias", which refers to two different mechanisms: the "present bias" and the "future bias".

The present bias refers to the moment when the consumer puts more value on the benefits of the present moment. The product is attractive and creates a sense of need. Then comes the "future bias". Consumers often think about being more responsible and ecologically sound in the future by behaving and eating in a more thoughtful way. As a result, healthy products are purchased but at the time of consumption, the consumer relies on hedonistic motivations: "What do I want to eat?".

The guilt-free effect of composting

Salads and other products that have been purchased in the supermarket wither or rot in the refrigerator until being thrown out in the garbage. But in the consumer's mind, composting is a no-worry solution. Indeed, once composted, plants and meat can be used as fertilizer. It effectively contributes to reducing the negative impact of waste. But it could have a guilt-free effect on

consumers, according to Mia Birau: "Composting gives the consumer the impression of doing something good. Therefore, wasting no longer causes a feeling of guilt," she says (Peyre, 2016).



This leads to mentioning the diagram (Figure 1) published by the European Waste Directive (by WRAP: Waste & Resources Action Programme) which shows the different levels of treating food waste (and trying to avoid it before it happens).

Figure 1 (above): *Food waste hierarchy, WRAP*

Table 2 (below): Description and examples of each level of food waste

1. Prevention/Reuse:

This is the most preferable option according to WRAP. Food waste can be prevented at consumer level by forward planning and by paying close attention at the time of purchase. Preventing waste is also a way to reduce the cost of food, as it is purchased in smaller quantities and with more thought with regards to how long it can be stored.

If prevention fails, the consumer can give up the position of end-consumer and reuse the food by redistributing it to other consumers or to animals. This is supported by the United Nations (UNO, 2015) as goals for zero-hunger and well-being – if food is still edible, it should be eaten. *E.g. Grootbos (South Africa) (Grootbos Foundation, 2019) is known for growing most of its food locally to support the community and small farmers who produce food exclusively for the inhabitants. This helps prevent food waste, as the food supply chain is shorter and production can be forecast more easily.*

2. Recycling:

Recycling is already considered wasting (EPA, n.d.), as it has not been successfully used as intended, although, it contributes to reducing the negative impact of waste.

Food that is wasted and isn't edible anymore can be transformed through anaerobic digestion or can be composted and used as fertilizer. This is a good solution for damaged and inedible fresh produce.

3. Recovery:

The recovery of food waste contributes to the concept of a circular economy (EPA, n.d.). Any type of food waste (whether fruit, vegetables, grains or meat) can be incinerated and the energy recovered and transformed into heat or electricity. Businesses often own their own facilities, whereas household food waste can be sent to independent stations.

4. Disposal:

Disposal is the last level of food waste. It is the option that should be most avoided, as this means sending the waste to landfills or sewers, which implies using space and spending on specialized treatment.

The Waste and Resources Action Programme (WRAP, n.d.) has also developed an acronym for changing people's behaviour to prevent food waste: EATS. The acronym stands for the following:
Easy

Planning, reducing portion sizes, purchasing in a smarter way.

Attractive

Marketing suggestions to give people ideas and to feed creativity. Some products now feature small print on the packaging suggesting consumers should freeze half of a portion to keep it for longer.

Time

Planning according to meals, dates, the next shop.

Social

Sharing and exchanging to inspire others and give others new ideas.

Still, according to the FAO (2018), it could be possible to reduce food waste from 24% to 12% if effective action is taken immediately. To feed the total world population projected for 2030, the current food production does not even need to be increased. By decreasing food waste, consequences would also be decreased significantly.

How does this apply to wine?

Food loss and waste affects all food categories – and that includes alcoholic and non-alcoholic beverages. With 760 litres drunk every second, world wine consumption represents over 240 million hectolitres (French Ministry of Ecology, 2015).

In modern oenology, researchers have showed that, in addition to wine production, grapes can offer much more than just this famous drink that is used to enhance our most refined food. Indeed, the use of the grape perfectly reflects the old adage by Lavoisier in the XVIIIth Century "nothing is created, nothing is lost, everything is transformed". Thus, from seeds to pomace, grape by-products are gems that hold an important place in different sectors of activity, whether in the food industry, the pharmaceutical industry or the cosmetics industry.

To produce a 750ml bottle of wine, a winemaker needs just over one kg of grapes. After the juice is squeezed out of the grapes, 20% of the remaining matter is skins, seeds, stems (Comprehensive Reviews in Food Science and Food Safety, 2016). Although the liquid has been taken away, what is left has a large variety of uses. Most wineries send pomace away to distilleries or breweries, to transform it into other alcoholic beverages – grappa, marc, brandy, even beers or cider.

Pomace is often recycled within the vineyard itself as a fertilizer, but also as animal feed as a lot of wineries are still also farms. Scientists are studying ways of using the components of pomace to create fuel. In a distillery very close to Bordeaux, the home of wine, specialists are preparing to produce bioethanol in large quantities this year (2019). The grape pomace is transformed into raw alcohol, then distilled and dehydrated to obtain a fuel that is much less polluting than diesel. "Compared to diesel, this is -95% CO₂ emission, -50% nitrogen oxide and practically no particles," explains Jérôme Budua, director of Raisinor France Alcools (FranceTVinfos, 2018). In other wineries in California, pomace is being used to make cookies, flour and cooking oils (Swindell, 2015).

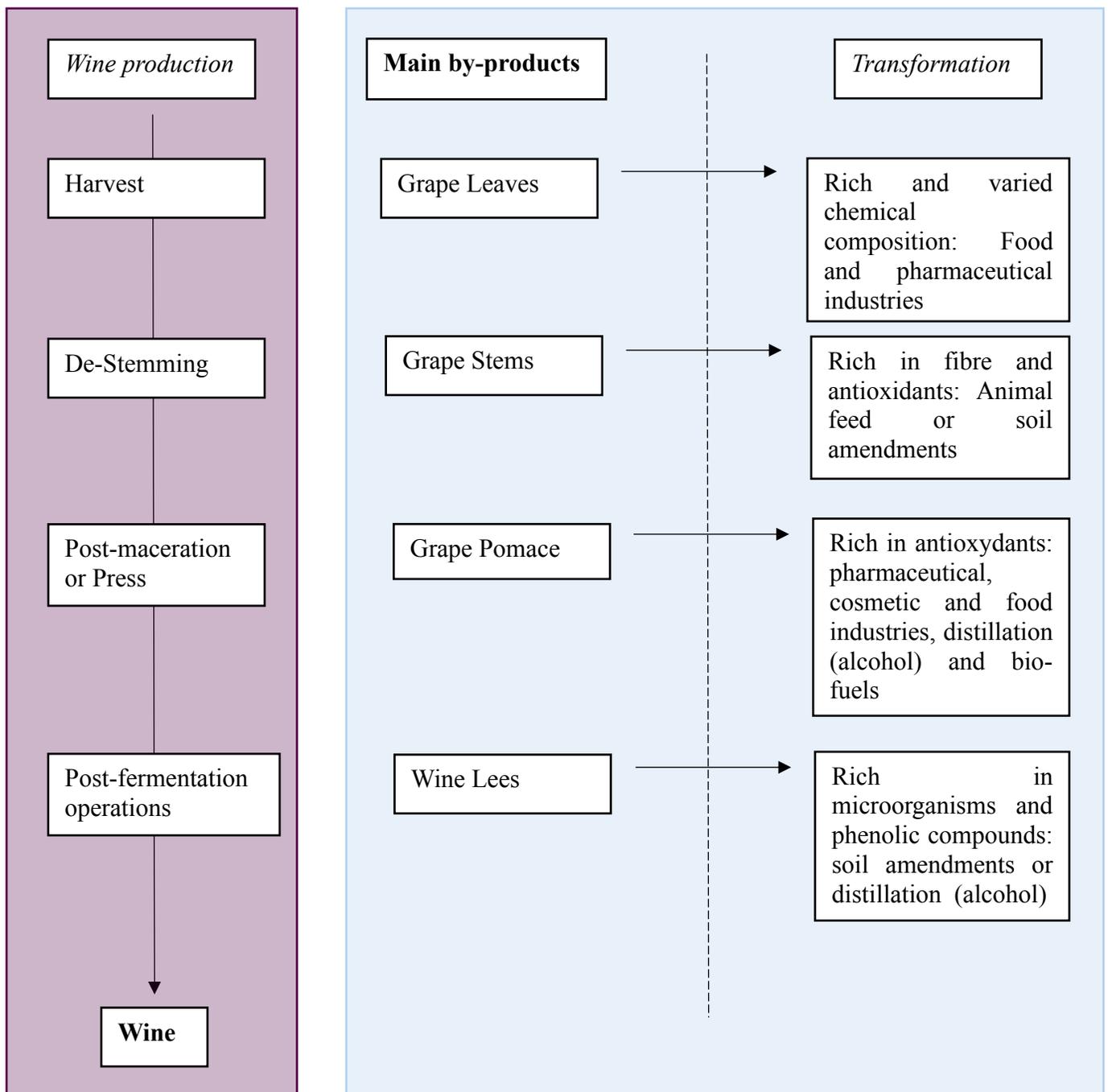


Figure 2: Different uses of the main by-products generated at key moments of wine production. According to Ana Texeira et al., 2014).

In addition to pomace, more by-products generated during the winemaking process (Texeira et al., 2014) can also be reutilized and transformed. These include vine leaves, grape stems and wine lees.

But one way that wine goes to waste – and which is often overlooked - is at consumer level. There is no doubt that once wine is opened, it begins to age more quickly and it should be stopped in order to preserve it for longer and to enjoy it to the very last drop. "Throwing wine down the drain" is a common act: it is not thrown on compost or used as another product (vinegar, disinfectant). It has been thrown down the drain, probably in the kitchen sink. Nothing is known about the condition of the wine at the time of the act (Was it still drinkable? Was it past its best?), nor its history: where was it bought? By whom? For what occasion? At what price? How was it packaged?... If the wine is not perfectly drinkable anymore, common sense dictates not to drink it, and simply pour it down the drain. But who evaluates the drinkability of the wine? The person holding it in his or her hands. Thus this evaluation will depend on the person (knowledge, beliefs, motivations, health risk, etc.). Was the hypothetical drinkability of the wine assessed? Or was it simply assessed whether this wine is still good or not? Or, if this wine is still appetising or not? But the exact reason for this alteration (good or not) is oxygen. Indeed, the air that is breathed, and specifically oxygen molecules, act on the wine as soon as it has been opened and begin to oxidise it. What makes the phenomenon even more complex is that wine cannot develop its aromas without air. Wine must be allowed to aerate in order for it to open up, because it is thanks to oxygen (Wine Folly, 2019) that wine shows its features.

A large number of organoleptic defects in wines are due to microbiological deviations. The development of micro-organisms can, in some cases, be accompanied by the production of various molecules that mask the fruity and expressive character of wines. The action of micro-organisms is nevertheless essential to obtain quality wines. Oxidation is a chemical reaction (Navarre, 2010) involving the transfer of electrons in contact with oxygen in the air. Rust is a result of iron oxidation, and vinegar is the ultimate stage of wine oxidation. In contact with air, part of the alcohol present in wine in the form of ethanol is transformed into ethanal. Then the oxidation of ethanal transforms it into acetic acid, the main component of vinegar. Oxidation, which is irreversible, alters the wine's colour. White wines will turn yellow and the colour of the red wines will evolve towards purplish reflections and then cloudy brown. It also modifies the balance of the wine, which loses alcohol and freshness – and the wine becomes a lot less appetizing.

Whether in households or in restaurants, there is a large variety of wines which can be purchased and savoured. Although consuming wine by the glass is a way for consumers to immerse and educate themselves about wine, important amounts of wine end up being leftover. According to Beverage Information Services (2012), on-trade businesses lose between 10 and 15% of profit due to wine oxidation. This is even with correct inventory management, as wine consumption is difficult to forecast. It is estimated that the equivalent of around 20 million bottles is poured down the drain every year, based on 475 million bottles on premise (Statista, 2018). Studies have been carried out to understand and quantify wine waste at consumer level in historical wine-consuming countries. A formal report was carried out by WRAP in 2008 and quantifies food and drink waste disposed in the sewer in UK households. Wine is the most expensive beverage (followed by smoothies, fruit juices, sodas and milk) that is poured down the drain and amounts to 450 million

GBP every year (WRAP, 2008) in households. It is reported that the main reason is an overestimation of the amount poured in a glass – only a small amount is thrown away because it is considered “off”. In fact, 870 000 tonnes of drinks (incl. wine) could be avoidable in the United Kingdom every year. With only simple efforts like awareness of “best before” and “use by” meanings, five percent of this waste could be reduced, which amounts to 43 500 tonnes of drinks saved every year (Parry, WRAP, n.d.). In the United States, the amount of wine which is poured down the drain every year equates to 1,27 Billion USD (Art Wine Preservation, 2017). However, wine waste at consumer level is an issue that is not always taken seriously – especially in countries which do not have a big history in wine consumption.

The case of South Africa

"The problem of food waste is very recurrent in industrialized countries. Because in developing countries, the level of poverty is such that people simply cannot afford to waste food," says Robert Van Otterdijk of FAO. But the emerging South Africa is also one of the most unequal countries in the world. In fact, one quarter is short of food and half is poor. But wasting would not be the first vice that emerging countries copied from the Western model. And the causes are the following: poor meal planning, bad stock management in the refrigerator, preparation of overly large rations, festive meals. All these causes also have a place in African households. At the local level, food waste can vary even more depending on wealth.

With a total population of nearly 59 million people, food waste amounts to ten megatonnes per year (over 30% of national food production). Five percent of that food is wasted at consumer level (WWF, 2019). However, according to WWF, avoiding waste at consumer level or at later stages of the food supply chain can save 3 times more energy than tackling waste at production level. In South African households, which are very unequal, the volume of food waste from one household to the next may be the same – but in low-income households, it is maize and rice; in high-income households it is fresh produce. This is a country where nearly half of the population could go hungry in a day (WWF, 2019) if food supply fails. And this is without even mentioning the surplus and unsold food from hotels and restaurants (ON-trade). 90 % of food waste in South Africa (YWaste, 2010) ends up in landfills every year. Unfortunately, there is no legislation or regulation that governs food waste and food losses exclusively, though 46 policies indirectly cover food waste (as well as the issuing of licenses and the management of waste in general: cosmetics, plastics). The three main policies and regulations (WWF, 2019) supported by the Department of Water and Sanitation and the Department of Environmental Affairs are the National Environment Management Acts, the National Waste Management Strategy and Foodstuffs and the Cosmetics and Disinfectants Act.

The African continent is expanding rapidly. Double-digit growth is flourishing in many countries, leading to a transformation in people's lifestyles. Among the latter, wine consumption is high on the list. Once reserved for an elite, wine is becoming more and more popular and is now on all tables, offering the prospect of exceptional developments for the sector. Africa is getting into wine. While beer is the king of alcohol in the vast majority of African countries, wine is gradually becoming a drink that is appreciated and sought after by consumers. South Africa is a world-renowned wine-producing country. For many years, South Africa's wine industry has been viewed as one of the most progressive and successful of many wine-producing countries. In addition to producing more wine, the number of consumers is also increasing. With 58.06 million inhabitants in 2019 and an annual consumption of 7.5 litres of wine per inhabitant in 2018 (Export Entreprises SA, 2019), the South African market is significantly large. According to the International Organisation of Vine and Wine (OIV, 2019), the total wine consumption in 2018 amounted to 430 million litres, down 4.4% the previous year, and corresponds to 1.74% of world wine consumption. South Africa was the 9th largest wine producer in the world with 950 million litres produced in 2018, down 1.4% the previous year, corresponding to 3.25% of world production (ExportEntreprisesSA, 2019). The country offers a varied range of wines and therefore imports little from abroad. In 2018, the country was the world's 6th largest exporter in terms of volume and 12th in terms of value (OIV, 2019).

The South African wine consumer

Of the 4,3 million hectoliters of wine yearly consumed by South Africans, 36% is red wine, 51% is white wine and 13% is rose (Export Entreprises SA, 2019). Most of these targets are called "experienced consumers". 70% of the consumed wine is distributed in retail stores (The main ones being Woolworths Food, Pick'n'Pay Liquor, Target, Checkers) for home consumption, while 30% is sold in the catering industry (Export Entreprises SA, 2019).

South Africa is known as the Rainbow Nation because of its large diversity of cultures. The wine consumer profile is shifting due to the societal changes occurring since the end of Apartheid in 1994. With populations which were previously segregated and the black population which had always been considered poor, the new middle class is slowly becoming richer and a small part of this same population is becoming wealthy. These are known by many as Black Diamonds, i.e. black high net worth individuals. This is one of the reasons for the change in wine consumption trends: these people are seeking the finer things on the market and wine is a lifestyle product that fulfills those needs. This is an explanation for wine becoming more accessible to different consumer profiles, which were historically strictly reserved to the white population.

Figure 3: Description of the South African wine consumer

The South African market is growing and maturing regarding wine consumption. But there is a growing concern within the wine industry that waste at consumer level is becoming an important issue.

Knowledge gap

This leads to a significant knowledge gap. Wine waste exists in wine consuming countries and has already been studied in some of them. But there is very little documentation regarding wine waste at consumer level in South Africa. The insufficient information regarding this topic limits the ability to reach a conclusion or result. People in the industry are aware of it existing but it has never been quantified for South Africa. Despite the relatively consensual idea among consumers that "it is not good to waste", food waste (especially household waste) now represents a significant fraction of the food produced in South Africa. Several questions then come up: How can this paradox be explained? Do all consumers consider waste when shopping or at home? Can this phenomenon be better understood?

The knowledge gap hypothesis is the notion that the question of quantifying wine waste in South Africa can be answered. This can be done by finding valid sources of information and understanding them in a way that this can then be applied to this topic.

Research proposal

To conclude this introduction, the first questions to which this thesis will aim to answer can now be set out, and the general plan. The aim is to understand wine consumption and wine waste in South Africa compared to other countries. It needs to be proven that wine waste is a problem at consumer level even in South Africa and that it needs to be managed according to the reasons for this waste. This thesis is destined to professionals of the wine industry but also to consumers and environmental institutions, and will make them aware of the scope of the problem and understand why it is happening.

The main objectives will be to quantify wine waste at consumer level in South Africa; identify consumer behaviour that leads to waste; conceptualize wine waste and ways to avoid it.

This thesis will be written in order to answer the following main question: What challenges is South Africa facing regarding wine waste?

- What is the most effective way to quantify wine waste at consumer level?
- How much wine waste is happening at consumer level in South Africa?
- What type of consumer behaviour is causing wine waste?
- How can the challenges of wine waste in South Africa be illustrated?

The aim of this report is to provide consumers, environmental institutions and beverage businesses in South Africa with reasons to become more aware of the way wine is consumed and then wasted.

Chapter Two: Material and Methods

In order to answer the main question, research was conducted according to the relevant sub-questions. Primary and secondary research was carried out following specific methodology which will be detailed in the paragraphs below.

Primary research is a qualitative method of research for "tailor-made", unclassified information that are collected through a survey, observation or experimentation. Specific questions that can be addressed in a primary study. Direct mail, telephone, in-person or online surveys are the most commonly used tools for a primary study. In this case, it was consumers and on-trade professionals who can provide information about consumer habits and possible solutions. These were people and businesses located in South Africa and who can provide information about the topic.

A secondary study extracts the information sought from existing sources such as official statistics, published studies, directories, press articles, websites, etc. What are the trends in the wine industry in South Africa? Is the type of question that can be answered at low cost by secondary research. Relevant targets in literature were South African press and media, but also global wine press, with an importance of finding the most relevant and up-to-date information and data. To be more specific, research was carried out with the following key words: wine consumer, "on-trade" behaviour and wine waste. Secondary research was mainly used to contextualise and verify primary research.

Even though waste due to operations along the supply chain remains another issue, and the same can be said for wine as any other good: most wine waste happens at consumer level. When speaking of consumer level in the wine industry, this mostly means households and in the places where wine is most consumed – hotels, bars and restaurants (on-trade).

Although the waste of fresh produce throughout the supply chain is often defined by regulating production quantity according to consumer trends, this is not the case with artisanal/luxury products like wine, for which quantities are rarely forecast.

What is the most effective way to quantify wine waste?

This sub-question is an essential starting point for this study. As mentioned in the introduction, studies about wine waste have already been carried out regarding traditional wine consuming countries. Additional data was collected through a study of existing literature, which is considered secondary research.

Millions of articles are published every year, which makes it complex when searching for specific information. A review of literature was necessary in order to find up to date information. There are two types of literature reviews: systematic and traditional. The literature review carried out to

answer this sub-question was traditional. This is because wine waste is a vast topic that is not necessarily proven by research studies – but can be developed by experts in a conceptual way.

In this review, the documents found were written by one or more authors who should be experts in the area of research, i.e. wine. There was no specific study protocol, as the study protocol or model is the main reason for the literature review. The sources of literature were specialised publications or scientific reports, as the conclusion can be evidence-based but also influenced by subjectivity. It is not said that calculating wine waste at consumer level can be done using different methods and suppositions, as it is a less-known topic. The information found can tackle on-trade businesses and households which waste wine but is not strictly reduced to South Africa. PICO (Problem – Intervention – Comparison – Outcome) was a useful tool for this literature research and is often used to make quantitative and qualitative reviews. The search in this review was carried out because of the existence of wine waste at consumer level (Problem). The aim was to find the most effective way to quantify wine waste (Intervention). It was possible to compare (Comparison) wine waste at consumer level with wine waste at production level thanks to the literature found in the thesis introduction. The possible outcomes were finding specific calculations, methods or models to measure wine waste at consumer level which have already been used in other countries than South Africa (Outcome).

The research question remains broad and is conducted using key words. The key words used to find documentation regarding this topic were *consumer habits*, *wine waste*, *model*, *drain*, *wasted*, *supply chain*. These key words were used in the search engine Google. They were also used with the source platform Science Direct (www.sciencedirect.com). The purpose of this platform is to provide individuals with journals, books and articles proposing scientific and technical research. These key words were also used to create an alert on Google Alerts. This enabled a review of new articles which can appear every day.

The limits of this literature review were the languages, as they needed to be translated accurately to avoid misinterpretation. The literature could thus be in English, French or German. The material was ideally no older than 15 years as the topic of the thesis is current.

This extended literature review showed different models and formulas which have been used by researchers to quantify wine waste at consumer level.

The models and formulas which were found in the literature review were compared. Key elements were rated:

- Sample: size, age, sex, status, location (rural/urban areas)
- Study: organisation/business, year
- Variables: drink group (wine), results in value or volume, knowledge about product state

This is critical, as some models identify covariates as significant which may not be or use too many variables.

The answer to this sub-question led to judging which model is the most effective and precise in calculating the impact of wine waste at consumer level in a specific country.

How much wine waste is happening at consumer level in South Africa?

As a result of primary and secondary research, the main trends in wine consumption through South African history led to explaining how wine waste can be such a problem in this emerging country, in comparison to old world wine consuming countries.

Secondary research enabled the application of the most effective calculations to South Africa with a similar waste ratio as the studies which the calculations were based on. The literature review to answer the first sub-question was used as a result to answer this sub-question. The most relevant model for calculating wine at consumer level was applied to South Africa using necessary variables. This gave an estimate of how much wine waste at consumer level weighs in this country.

Primary research was then completed through a survey provided to South African consumers. In this survey, consumers were asked elements about their profile (age, sex, status, location), the occasions in which wine is consumed, what type of wine is consumed. The consumers were also asked to assess and to estimate the amount of wine that is wasted weekly. The first survey was completed on November 1st 2019 at WineX, the biggest and most popular festival in South Africa showcasing South African Wine producers. This was an effective way to be in contact with wine consumers. The number of attendees at this event was 10 000 people. The survey was carried out by directly asking attendees to answer the questions prepared. The questionnaire is provided in Appendix A, where the questions on the first page are related to this sub-question. This survey mainly focused on Johannesburg and Gauteng consumers and not the whole of South Africa, as Johannesburg was where the event took place. The same questionnaire in Google Forms was published in Facebook groups such as “I Know a Place” or “South Africa Market Place” and on LinkedIn to intercept consumers and/or professionals of the industry who are located in South Africa.

Approximately one hundred individuals were to be surveyed randomly. As the whole South African population could not be surveyed, this number of interviewees was representative because the goal was to support the previously calculated quantity of wasted wine at consumer level. The aim was not to calculate wine waste with this survey but rather to find a pattern in the consumers who waste. Answers to the questions of the survey were presented in a dynamic table which could be converted into a graph. The figures which were created from the data collected were used to calculate statistics and to analyse demography and trends. The aim was to show evidence that wine waste at consumer level in South Africa is an issue and that it can be quantified. This also supported the previously calculated wine waste using the adapted model.

On-trade businesses were also asked an estimate of the amount of wine that is wasted yearly. This included fine dining restaurants and casual restaurants. In this interview, nine on-trade businesses were asked elements about customers, wine lists and wine selections, the occasions in which wine is consumed, what type of wine is consumed. The on-trade businesses were also asked to assess and to estimate the amount of wine that is wasted yearly. Question 9 in the interview for on-trade businesses found in Appendix B helps to answer this question. These nine businesses are leading

in popularity in South Africa and have experience in the industry. The person interviewed was either a sommelier or general manager. This was critical as only expert opinions were relevant to answer this question. In fact, a conference held by Dieter Pennerstorfer (2018) explains that in the wine industry, a large number of studies as well as consumers rely on experts to give opinions on wine and issues within the industry. There is no exact definition of a wine expert. A wine expert can be considered a person with a great knowledge of wines in general (including viticulture and oenology) and different wines from around the world. Such a person is also very skilled in the art of tasting.

Table 3: On-trade businesses which were interviewed during research

Name	Type	Location
De Grendel	Winery Restaurant	Cape Town
Aubergine	Fine Dining	Cape Town
Publik Wine Bar	Wine Bar	Cape Town and Johannesburg
Thief	Wine Bar/Restaurant	Sandton, Johannesburg
Hussar Grill	Franchise/Casual	Sandton, Johannesburg
Eatalian	Casual	Sandton, Johannesburg
Marble	Fine Dining	Sandton, Johannesburg
Mosaic	Fine Dining	Pretoria
Tashas	Franchise/Casual	Cape Town and Johannesburg

The research conducted here enabled a more accurate picture of the disposal of wine from South African households and on-trade businesses.

What type of consumer behaviour is causing wine waste?

The goal of this sub-question was to evaluate the influence of external factors on the studied question. This sub-question was a large step towards answering our main question, as it helped to show different angles and stages at which wine is most wasted. This means that the quantity of wine waste at consumer level could be better understood and a relevant correlation could be found.

Secondary research helped explain the reason why wine waste should rather be tackled at consumer level – and why it cannot easily be tackled at other levels of the supply chain. This information could be found in articles and research papers written by wine specialists. It could also be found in specialised wine publications like *Decanter*, *Le Figaro Vin*, or *Winemag*, which explain the value of wine and the meaning of its production to its producers. The criteria of the research were values, personalities, interests, attitudes, conscious and subconscious motivators, lifestyles, and opinions. To carry out this research, key words were used in order to find relevant documents.

The key words used to find documentation regarding this topic were *consumer habits, South Africa, wine waste, finish bottle, wine consumption in South Africa*. These key words were used in the search engine Google. They were also used with the source platform Science Direct (www.sciencedirect.com). The purpose of this platform is to provide individuals with journals, books and articles proposing scientific and technical research. The found information tackled consumer profiles in South Africa and behavior regarding wine consumption.

Primary research was then completed through a survey provided to South African consumers. The first survey was completed on November 1st 2019 at WineX, the biggest and most popular festival in South Africa showcasing South African Wine producers. This was an effective way to be in contact with wine consumers. The number of attendees at this event was 10 000 people. The survey was carried out by directly asking attendees to answer the questions prepared. The questionnaire is provided in Appendix A, where the questions on the first page are related to this sub-question. This survey mainly focused on Johannesburg and Gauteng consumers and not the whole of South Africa, as Johannesburg was where the event took place. The same questionnaire in Google Forms was published in Facebook groups such as “I Know a Place” or “South Africa Market Place” and on LinkedIn to intercept consumers and/or professionals of the industry who are located in South Africa. These were asked to assess the occasions that lead to wasting wine and to note the reasons for disposal on each occasion. The questions on the second page of Appendix A refer to this sub-question.

The on-trade businesses which were interviewed to answer sub-question two were also asked about the existence of any general causes and solutions. The interview for on-trade businesses found in Appendix B helps to answer this question. These nine businesses are leading in popularity in South Africa and have experience in the industry and are the same as interviewed to answer sub-question two. The person interviewed were either a sommelier or general manager. This is critical as only expert opinions were relevant to answer this question.

The objective was to understand consumers’ and business’ observations regarding the way wine is consumed (occasions, frequency, format) and if there is a general awareness on this issue.

How can the challenges of wine waste in South Africa be illustrated?

The answer to this final sub-question aimed to develop and illustrate the main challenges which are faced when tackling wine waste at consumer level. It was to be a summary of the previous sub-questions with additional openings for implementation to build awareness, to prevent and reduce household and on-trade wine waste. The data used in this section was mostly from previous primary and secondary research and aimed to design a schematic model which is unique to this phenomenon in South Africa.

To answer the first, second and third sub-question, primary and secondary research was carried out. This entails of literature reviews, an interview and a survey. The results were used in this section to illustrate the challenges of wine waste at consumer level in South Africa. The following elements were critical at this stage:

- Quantity of wine wasted
- Consumer profile
- Consumer location
- Consumer behaviour

This section aimed to define milestones and create indicators for wine waste at consumer level in South Africa. This was key for mapping the concept of wine waste at consumer level, the causes, quantities and possible space for implementing solutions. The idea was to design an abstract model that takes into account the fine details (individual properties of people and products) of the wine waste issue at consumer level and produce a general representation of the issue. The model was designed to conceptualise the wine waste system and was characterized by interdependence and interaction, information feedback, and circular causality. The challenging part was to figure out how all the variables interact and how they influence each other.

Many models have been used to illustrate systems such as the process map, failure modes and effects analysis, causal loop diagram (Rushing, n.d.). One of the models that was the most adapted to this situation is the fishbone diagram (Ishikawa, 1962). This model identifies the possible causes for a specific issue. The major categories used in this diagram for variables are methods, equipment, people, materials, measurement and environment. The resulting diagram was to illustrate wine waste at consumer level with its causes and subcauses, leading to the unwanted effect that is wasting.

The aim of this sub-question was to provide consumers and on-trade businesses with reasons to choose to be careful of how much wine that is wasted. The goal was to share solutions that will benefit a common cause and each individual, according to his or her consumption habits. These results gave an idea of how future research could be carried out regarding wine waste at consumer level in South Africa: how value can be recaptured from wine waste at consumer level and how to inform further about this issue (e.g. through marketing techniques).

Chapter Three: Results of conducted research

This part of the report presents the data which resulted from the methods and materials used to answer the relevant sub-questions.

What is the most effective way to quantify wine waste at consumer level?

This sub-question is an essential starting point for this study. As mentioned in the introduction, studies about wine waste have already been carried out regarding traditional wine consuming countries. Additional data was collected through a study of existing literature and articles, which is considered secondary research. This is a synthesis of studies available to date, with a summary table of possible methods. The methods which will be detailed below are also given by the Canadian National Zero Waste Council (2018).

- Household diary

A household diary consists of individuals within a chosen sample maintaining a daily tracker of food and/or beverage waste. Usually, a specific number of people are recruited to keep a diary for a specific amount of time which can then be put into a yearly perspective, for example. Many elements can be recorded with this method, namely: the type of item, the exact quantity (by weighing), time of disposal and reason for disposal. Before, during and after the survey, demographics can be collected to find out more about the sample which has been questioned. The sample of individuals can be collected randomly and categorized according to age, location, gender for example. The individuals can also be recruited through an open call for participation to a study (through social media, email campaigns or adverts).

A household diary is a relevant tool for researching the type of behaviour which can lead to wasting and to quantify food and/or beverage waste which cannot be measured otherwise. However, some inaccuracies can occur because of the lack in objectivity in the study which can lead to changes in behaviour: drop-outs, changes in food consumption, forgetfulness.

Many studies have been carried out following this specific method, as this method gives a better overview of a typical behaviour regarding waste. A study was carried out in Croatia by Ilakovic, Ilickovic & Voca (2019), asking 115 Croatian households to keep a diary for seven days. The aim of the study was to show what type of food and amount of waste was produced according to the socio-demographic characteristics of each participating member and household. This method was also used alongside surveys in a study conducted by Bravi, Francioni, Murmura & Savelli (2019) searching for what causes food waste and what actions can prevent it at household/consumer level. The data to back this study was collected in the United Kingdom, Italy and Spain and concerns young consumers between 18 and 35 years of age. The study shows evidence that in-store behaviour and food management at home are important to minimize food waste.

- Waste composition studies

Waste composition studies require physically separating waste into categories and measuring these categories. As opposed to a visual assessment (i.e. a household diary), this method requires conversion to weight using specific densities or material sizes, instead of item counts. This reduces the risk of errors significantly. This method is useful for avoiding biases associated with household diaries detailed earlier. However, waste composition studies are sometimes limited to measuring solid waste rather than liquid waste. Challenges in this method are measuring food and/or beverage waste that has been wasted in ways that simply cannot be estimated (animal feed, anaerobic compost) or that has been degraded or modified by losing water weight, for example. These waste composition studies can be conducted in different ways and with different samples. Often, samples are aggregated in bulk or small areas, or individual. Bulk sampling is carried out at disposal locations like landfills or general compost facilities. Small-area sampling is carried out at a specific disposal location and is simply a more targeted bulk sample. Individual sampling is carried out by collecting the waste of individual households which can be recruited like for household diaries. This method was used in a study by Edjabou, Petersen, Scheutz & Astrup (2017) in a composition analysis of household waste in Denmark. The aim of this study was to assess the influence in sociodemographic factors and seasonal behaviour in the way items of food and beverage are wasted. This was done by collecting the waste from 101 Danish households throughout each season and categorizing and quantifying the waste generated. As beverage waste is difficult to quantify (National Zero Waste Council, 2018) as it is often thrown down the drain, this method is more useful when combined with another method. In fact, the formal study carried out by WRAP (2009) uses the household diary method detailed earlier and completes the study with a composition study to adjust for inaccuracies. Even according to WRAP, items which are disposed down the drain are difficult to measure, which is why the method used for the report was a household diary held by 355 people across the United Kingdom for seven days, noting down each time a solid or liquid item of food was disposed of. By reporting and measuring the exact quantities of liquid food and beverage items which were thrown away, excluding daily water consumption, the amount of a specific food category thrown down the drain could be measured accurately. The study showed that households in the United Kingdom wastes 450 million GBP (approximately 534,59 million euros) worth of wine every year. This was calculated by measuring the volume of wine which is poured down the drain in households every year (48 000 tonnes of wine, which is 48 000 000 litres of wine – equivalent to 64 million 75cl bottles of wine) compared to the amount of wine which is actually consumed (nearly 1,27 billion litres in 2009, equivalent to 1,69 billion 75cl bottles of wine ; usually measured by volume purchased – and not actually consumed). This means that for every 26,5 bottles of wine purchased, approximately one bottle of wine is wasted.

- Waste ratio

While ratios are often used to compare two numbers, problems can also be solved thanks to the use of ratios in mathematical and professional environments. In fact, ratio analysis is a technique

of analysis and interpretation which is most often used in financial studies in order to get an understanding of the strengths and weaknesses of a business (Mishra, S., n.d.). Because of the trends in environmental studies, though scarcity of resources regarding food and/or beverage waste, relevant data can be selected from an existing study, depending on the aim of the analysis. The data can then be used to calculate ratios which can be applied to a similar situation (same location or industry for example) in order to make an estimate of the scope of a problem. This method is rather an indicator more than a method which quantifies with precision.

By using a similar waste ratio for the United States, Ryan from ArT Preservation Systems (2015) found that wine waste equates to 1.27 billion USD (approximately 1,15 billion euros) every year. This was done by using a similar ratio as in the United Kingdom with the study by WRAP (2009). By considering a consumption of approximately 2:1 compared to the United Kingdom, with a 13% increase from 2009 to 2015.

<i>Factor</i>	<i>Study type</i>		
	<i>Household diary</i>	<i>Waste composition study</i>	<i>Waste ratio</i>
Cost and Resources: financial and material	<p>High</p> <ul style="list-style-type: none"> -Requires recruiting trustworthy samples -Sample needs to be accompanied and supported -Each participant requires an incentive as well as material which could be missing (e.g. kitchen scale, measuring cups) -Time for data measurement and analysis 	<p>Low to Medium</p> <ul style="list-style-type: none"> -According to aggregated or individual sampling: samples are to be collected by specific teams or if already existent, low cost to find -Requires a large amount of samples -Requires sorting and analysing data 	<p>Low</p> <ul style="list-style-type: none"> -Used when resources are few, so proxy data sources can be used -Requires calculations
Understanding of reasons: attitude and behaviour	<p>High</p> <p>Sample is asked about the drivers of food waste each time data is measured</p>	<p>Low</p> <p>Waste is measured directly without being linked to generators</p>	<p>Low</p> <p>Waste is being measured according to existing numbers which are adapted to case</p>
Precision category of study: distinguishable types of food and/or beverage waste	<p>High</p> <p>Food waste is measured with a categorization of each item</p>	<p>Medium-High</p> <p>Items are more or less distinguishable when extracted from waste or sewers, and are rather measured in chemical composition</p>	<p>High</p> <p>Data for precise item is used, comparing existing waste and/or consumption</p>

			numbers and ratios
Demographics: information on the sample	High Sample participants complete surveys which ask about elements such as age, sex, location and marital status	Low-Medium Approximate locations are known for this type of study depending on where the waste is extracted from. It is more difficult to calculate per capita wastage or to isolate waste from a specific unit	Low Demographic information is unknown – except for the information and data used to calculate (population, consumption) but is very limited.
Objectivity	Low Sample participants could change behavior during study or do not all measure wastage in the exact same way	High Participants in study are either not aware of participation or are not expected to change any habits	High Participants are not aware of participation as existing data is used for calculations
Precision on waste destination	High Sample participants are asked to give details on the item wasted and how it is wasted (compost, trash, drain). This is especially useful for liquid waste like wine.	Medium Includes measurable destinations and mostly solid waste. Liquid waste can be measured but at higher cost (chemical composition in waste water)	Low Details on waste destination are unknown, though are sometimes considered in the used ratio (e.g. wine is typically wasted down the drain)
Source example	Ilakovac et al. (2019) Bravi et al. (2019)	Edjabou et al. (2017) WRAP (2009)	ArT Wine Preservation (2017)

Table 4: Summary table of comparison of waste measurement methods found in literature and articles

How much wine waste is happening at consumer level in South Africa?

The aim of this sub-question is to assess the importance of wine waste at consumer level in South Africa and to give an indicator of the amount of wine waste that possibly needs to be dealt with. The results are given according to the survey to consumers and the interview to on-trade businesses.

Although separated, both consumers (household consumption) and on-trade businesses (on-premise consumption) refer to consumer level.

Due to the available resources, the waste ratio method is relevant for this study. If the same waste pattern and ratio occur in South Africa as in the United Kingdom and the United States of America, it is possible to estimate the amount of wine that goes to waste every year in South Africa – in value and in volume.

With 58.06 million inhabitants in 2019 and an annual consumption of 7.5 litres of wine per inhabitant in 2018 (Export Entreprises SA, 2019), this comes to a total yearly consumption of approximately 435,45 million litres of wine in 2018. This is equivalent to a consumption of 580,6 million 75cl bottles of wine in 2018. With the same waste ratio as found for the United Kingdom by WRAP, the amount of wine waste which goes down the drain every year in South Africa can be estimated at just over 21,98 million 75cl bottles of wine based on data from 2018.

It is interesting to estimate this wine waste from a value point of view. The average prices of bottles of wine can vary according to the type of wine: the national average cost of a 75cl bottle of red wine is R63.22, whereas a 75cl bottle of white wine costs on average R53.45. The cost of wine varies depending on the province of South Africa, the Western Cape being the wine hub – where wine is produced and most expensive. In fact, according to Numbeo (2019), the average price of a bottle of wine in supermarkets in 2019 is R60.00 (approximately 3,70 euros). Restaurants generally mark up a bottle of wine on average 250% (Eatout ZA, 2011). As mentioned in the introduction, 70% of the consumed wine is distributed in retail stores for home consumption, while 30% is sold in the catering industry (Export Entreprises SA, 2019). This can be calculated as an average spend of R87 (approximately 5,40 euros) for a bottle of wine, whether for home consumption or on premises (restaurants, cafes, hotels). This enables a value estimate of wine waste at consumer level of over 1,91 billion ZAR (1 912 260 000 ZAR) – which is equivalent to over 118,4 million euros wasted per year.

Primary research was completed through a survey provided to South African consumers. In this survey, consumers were asked elements about their profile (age, sex, status, location), the occasions in which wine is consumed, what type of wine is consumed. The consumers were also asked to assess and to estimate the amount of wine that is wasted weekly. The first survey was completed on November 1st 2019 at WineX, the biggest and most popular festival in South Africa showcasing South African Wine producers. This is an effective way to be in contact with wine consumers. The number of attendees at this event is 10 000 people. The survey was carried out by directly asking attendees to answer the questions prepared. The questionnaire is provided in Appendix A, where the questions on the first page are related to this sub-question. This survey mainly focused on Johannesburg and Gauteng consumers and not the whole of South Africa, as Johannesburg is where the event takes place. The same questionnaire was published in Facebook groups such as “I Know a Place” or “South Africa Market Place” and on LinkedIn to intercept consumers and/or professionals of the industry who are located in South Africa. Approximately one hundred individuals were surveyed randomly and gave the following results.

- The importance of wine waste in households

In order to correctly interpret the results in “Chapter Four: Discussion”, it is critical to describe the sample which was used. In total, 93 individuals were surveyed. 46 of these people were directly surveyed at the WineX festival on November 1st 2019, whilst 47 people answered the online form published on Google Forms. All numbers are rounded to 0,1.

		WineX	Google Forms	Total
Age (in years)	Average	36.7	31.8	34.2
	Min.	19	21	19
	Max.	68	56	68
Sex (%)	F	43.5	55.3	49.5
	M	52.2	38.3	45.2
	Other	4.3	6.4	5.3
Status (%)	Student	23.9	29.8	26.9
	Working	56.5	70.2	63.4
	Retired	19.6	0	9.7
Location (%)	Gauteng	65.2	29.8	47.3
	Western Cape	0	29.8	15.1
	Eastern Cape	0	8.5	4.3
	Northern Cape	2.2	4.3	3.2
	North West Province	0	4.3	2.1
	Kwa-Zulu Natal	15.2	14.9	15.1
	Limpopo	6.5	2	4.3
	Mpumalanga	2.2	6.4	4.3
	Free State	8.7	0	4.3
Total		46	47	93
Total (%)		49.5	50.5	100

Table 5: Characteristics of samples used for direct and online surveys about wine consumption and wastage

According to the Table 5 (above), showing the main characteristics of the individuals included in the samples for surveys, the average age of the surveyed individuals was 34.2 years of age. The youngest individual to be surveyed was 19 years of age, and the oldest was 68 years of age. It should also be mentioned that the average age for those who filled in the Google forms survey was 31.8 years old, and 36.7 years old for the direct survey at the WineX festival.

The sample was quite equal from a gender point of view, as 49.5% of the individuals surveyed were female, 45.2 were male, and 5.3% of them identified themselves as “other”.

When it came to status, 26.9% of individuals surveyed were students, 63.4% were working professionals and 9.7% were retired. Moreover, 100% of retired individuals were surveyed at WineX on November 1st 2019.

Finally, most individuals surveyed were originally from the province of Gauteng (47.3%), followed by the Western Cape and KwaZulu-Natal (both at 15.1%). Only 2.1% came from the North West Province. Moreover, nearly 70% of the surveyed from Gauteng were questioned at the WineX festival on November 1st 2019.

Within the sample of individuals who were surveyed online and at the WineX festival on November 1st 2019, the frequency of wine consumption per week was questioned. Possible answers to choose from were the following: “one time per week”, “two times per week”, “less than four times per week” and “more than five times per week”. Figure 4 shows the results for this specific question. A majority of people consume wine twice per week (40 people or approximately 43%) followed by 30 people (32.3%) who consume wine less than four times per week (meaning three to four times per week). Only eight people (8.6%) consume wine once per week.

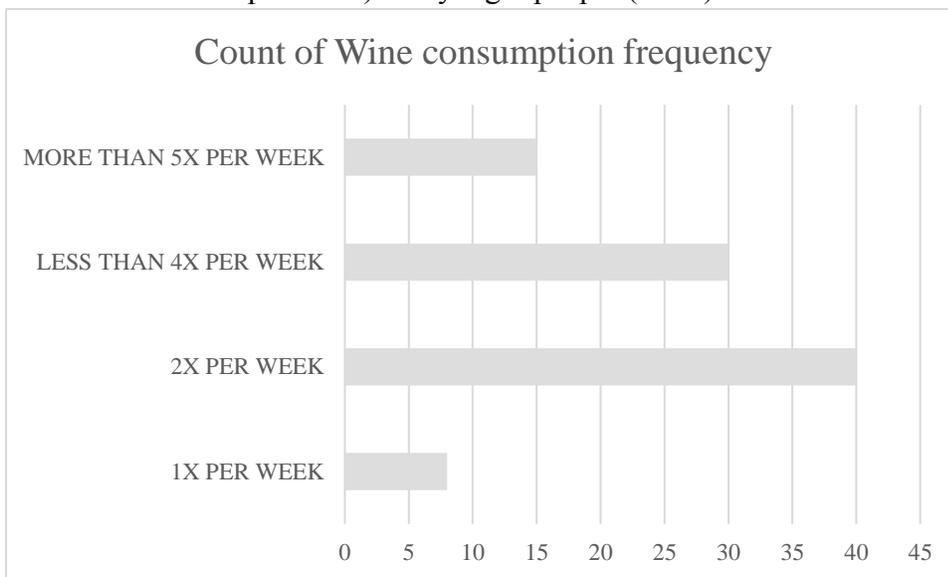


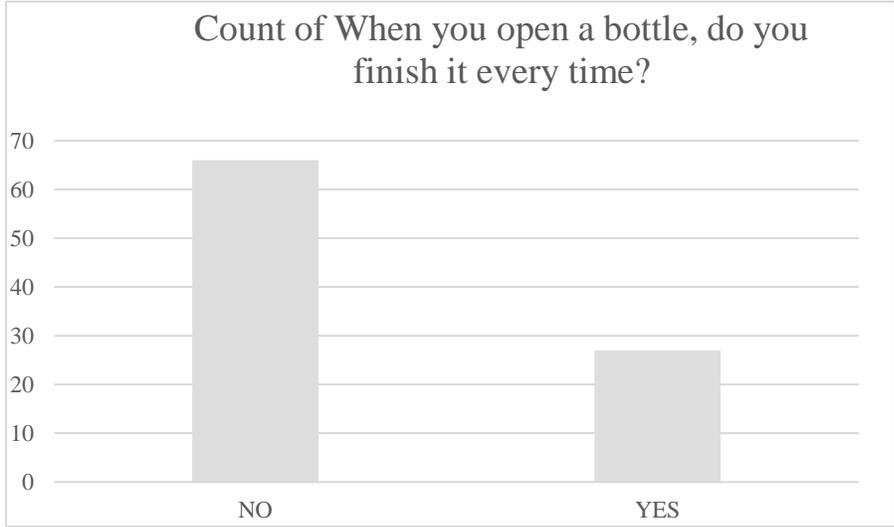
Figure 4: *Count of wine consumption frequency measured in the survey*

The type of wine which is consumed or preferred was also measured. Figure 5 shows the results for this specific question. In the sample of individuals surveyed, there was an outstanding preference for red wine (39 votes or 41.9%), followed by sparkling wine (22 votes or 23.7%) and rose and white wine at a tie with 16 votes (17.2%).



Figure 5: *Count of wine consumption types measured in the survey*

The individuals who were surveyed were also asked if an opened bottle of wine is always finished, and to make an estimate of the amount of wine that is wasted in the respective households per week. Figure 6 and 7 show the results for these specific questions. Of the 93 individuals surveyed online and at WineX festival on November 1st 2019, 66 (or 71%) stated that open bottles of wine were not always finished within a households. The same sample was then asked to estimate the amount that is wasted weekly regarding the unfinished open bottles. As an open question, the answers were then categorized in the following categories: “one glass”, “none”, “I don’t know”, “bottle ends”, “a couple of glasses”. 30 (32.3%) individuals in the sample stated “I don’t know”, and 18 (19.4%) estimated a weekly wine waste of “one glass” or “bottle ends”. 15 (16.1%) of the



surveyed stated “none” – 100% of those who stated “none” also answered that open bottles were finished every time.

Figure 6: *Count of individuals who finish open bottles of wine measured in the survey*

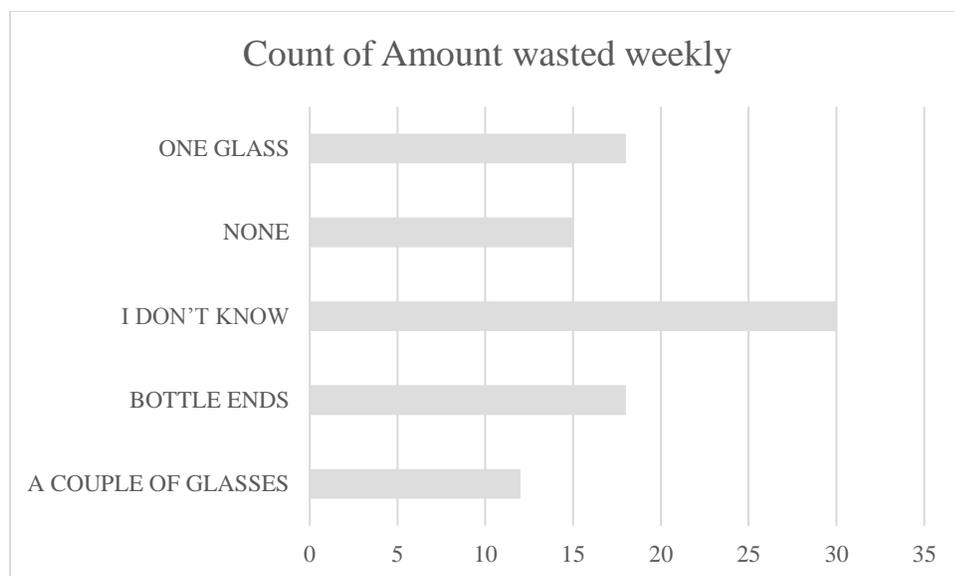


Figure 7: Estimate of weekly wine waste amounts measured in the survey

- The importance of wine waste in on-trade businesses

On-trade businesses were also asked an estimate of the amount of wine that is wasted yearly. This included fine dining restaurants and casual restaurants. Nine on-trade businesses (see Table 3) were interviewed to find the following results. All nine restaurants were different types and were focused on the two hubs of South Africa: Gauteng with Johannesburg and Pretoria, and Western Cape with Cape Town. With three of the nine restaurants being fine dining restaurants (Aubergine, Mosaic and Marble), the main customer profile was high net worth individuals. The six remaining on-trade businesses quoted an array of customer profiles ranging from middle to high class, and sometimes wine connoisseurs.

According to the interviewed staff, all on-trade businesses interviewed confirmed the wine list is constructed and designed according to the demand. Whilst fine dining restaurants change the wine selection every year or very rarely, the more casual on-trade businesses interviewed like Hussar Grill or Publik Wine Bar change wine selection every season or according to the supplier.

All nine interviewees confirmed the on-trade business suggested wine by the glass on the menu. The three fine dining restaurants noted that the wine by the glass selection was very rarely sought after and most customers order a bottle. The more casual on-trade businesses noted that wine is served by the glass a couple of times per service. It stands to reason that the same casual businesses claim that a new bottle of wine is opened to serve by the glass every day or every other day, without giving details on whether the bottle was finished or not.

To prevent wastage, the wine list is kept short to ensure a fast bottle turnover. But even with the interviewed staff being aware of the existence of wine waste, the amount wasted each year was significant for some. In fact, for the fine dining restaurants, wine wastage seemed to be quite rare or “non-existent” (according to staff). However, in more casual restaurants, wine waste due to non-

consumption or oxidation was estimated on average at ten percent of lost profit, with the specialised wine bars Thief and Publik Wine Bar standing out at a lower five percent profit lost. These results will be discussed further in Chapter Four.

What type of consumer behaviour is causing wine waste?

The aim of this sub-question is to assess whether there is a pattern in consumer behaviour leading to wine waste.

The following results originate from the same survey provided to the same sample South African consumers (see Table 5). The consumers were also asked to assess the occasions and possible reasons why wine would go to waste in a household. Figure 8 shows the count of occasions in which an open bottle or part of an open bottle of wine would go to waste. The occasions which were suggested in the direct survey at WineX festival on November 1st 2019 and in the form on Google Forms were the following: “casual” (everyday wastage), “cooking” (cooking wine), “meal” (special occasions or at a restaurant) and “party” (nights in or out). 53 (57%) individuals in the sample stated wine waste as something “casual” that can happen anytime, as an everyday wastage. Wine is then most likely wasted during parties by 17.2%, followed by meals at 15%. The occasion which most rarely leads to wine wastage was cooking, voted for by ten people (10.8%).



Figure 8: *Count of occasions in which consumers waste wine measured in the survey*

The surveyed were then asked to give a most probable reason for wine going to waste at home. This was an open question and the given answers were categorized into four choices (Figure 9): “bad wine” (wine was off or unappetizing), “had enough” (only wanted a certain amount in the first place), “I don’t know” (no specific reason) or “too much” (amount overestimated). 48 (51.6%) surveyed answered “I don’t know”, giving no specific reason why wine would go to waste. This

was followed by “too much” with 21 answers (22.6%), noting that the served portion was too big. 19 individuals (20.4%) stated “had enough”, followed by “bad wine” for 5.4%.

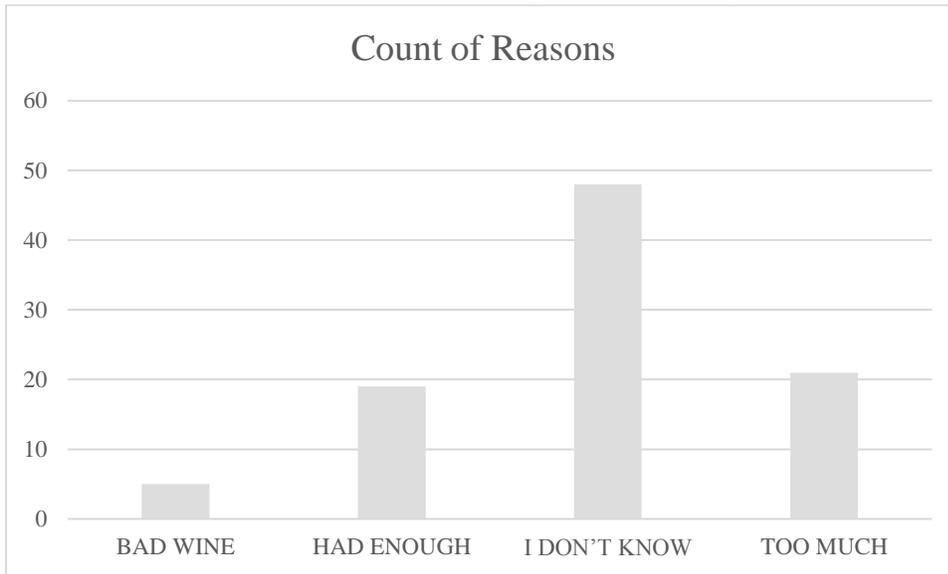


Figure 9: *Count of reasons for which consumers waste wine measured in the survey*

On-trade businesses were also asked about the wine by the glass trend and a change in popularity during the different seasons of the year. Nine on-trade businesses (see Table 3) were interviewed to find that four out of nine interviewees of all types (whether fine dining or casual) noticed an increase in demand for wine by the glass in the Summer (i.e. September to February in South Africa, including Christmas and New Year celebrations). Eatalian and Publik Wine Bar added the fact that many more bottles of wine had to be opened, and not necessarily used, during this season. The two on-trade businesses did not give any quantities or numbers. The five remaining interviewees noted that there was no significant difference in demand of wine by the glass throughout the year.

Secondary research helped explain the reason why wine waste should rather be tackled at consumer level, by acting on behaviour. This information was found in articles and research papers written by wine specialists. According to zzysh.me (2019), wine is wasted, like any item of food, due to a lack of knowledge of how to manage leftovers. Without knowing how to store food and drink properly, consumers throw away what is leftover too easily. As far as wine is concerned, consumers believe that wine turns immediately once opened. Individuals discard wine once it has actually oxidised, either because it was left open overnight or after storing it for a week in the refrigerator. Other explanations for wine wastage can be found in more urban and solitary lifestyles. Indeed, active singles throw away more wine (Le Figaro, 2015), opening bottles more often for consumption by the glass. This distressing waste could be avoided, however, if all wine consumers knew the mechanisms of wine spoilage and mastered the - yet existing - techniques available to preserve wine in a perfectly reliable and efficient way. This will be detailed further in Chapter Four.

How can the challenges of wine waste in South Africa be illustrated?

The aim of answering this sub-question is to identify the awareness of wine waste at consumer level and of existing solutions. According to the surveys carried out to South African wine consumers and the interview of on-trade businesses, it is then possible to adapt a model to the situation and challenges of wine waste in South Africa.

The following results originate from the same survey provided to the same sample South African consumers (see Table 5). The consumers were also asked about the existence of a solution to battle wine waste in a household and which this solution is. The results in Figure 10 show the awareness of a solution to combat wine waste among the sampled wine consumers. A majority of consumers are not aware of a solution. These represent 48 people, or 51.6% of the sample surveyed.

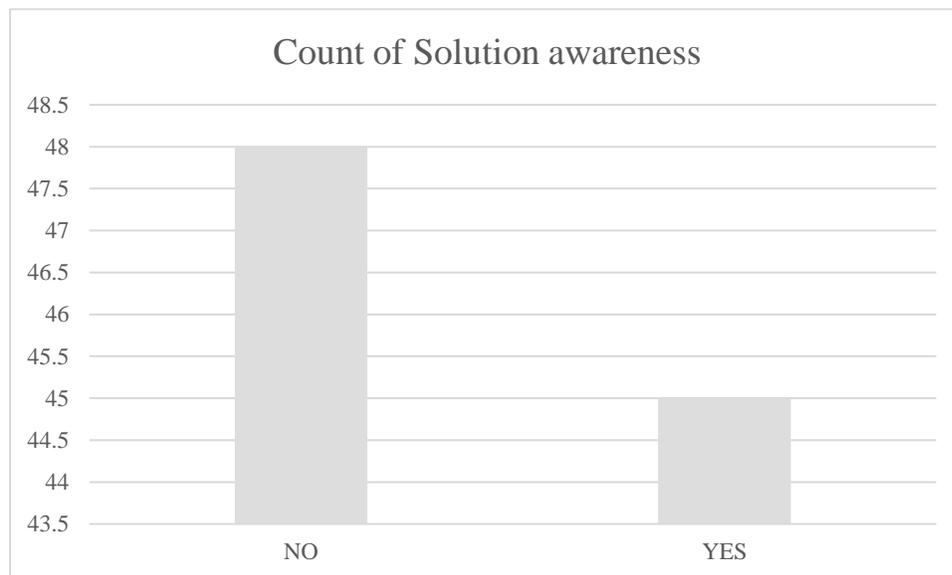


Figure 10: Count of solution awareness measured in the survey

Consumers surveyed online and at WineX were then asked which type of solution came to mind if aware of one. Figure 11 shows the count of solutions which were mentioned. Of the 48.4% of individuals aware of solutions, most mentioned wine preservers which enable a longer preservation after opening a bottle. 19 people surveyed mentioned making vinegar as a solution to a wine going to waste. There were no additional elements which came to the mind of the surveyed consumers. Of the 45 individuals aware of a solution to battle wine waste at consumer level in South Africa, 22 stated Gauteng as residential province. Only six of these individuals mentioned vinegar as opposed to a wine preserver.

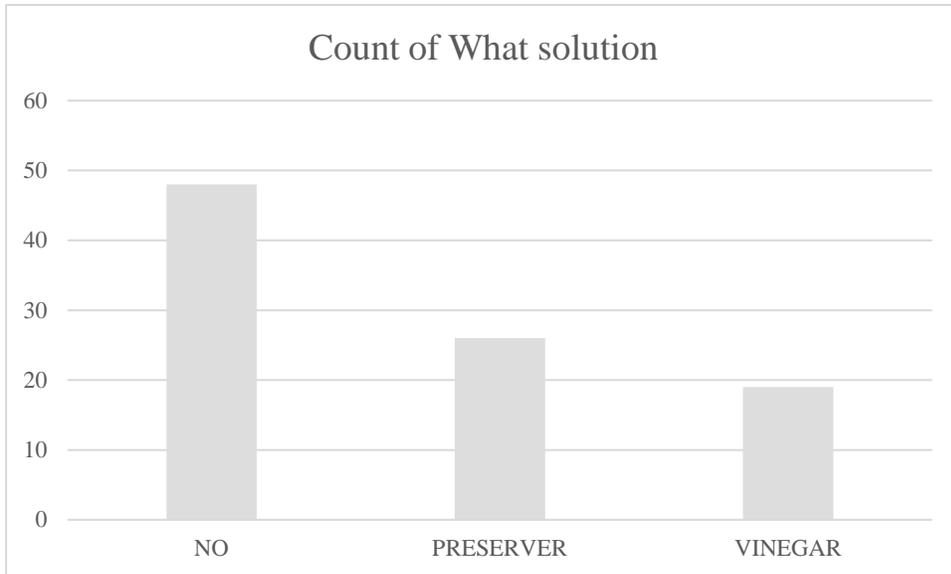


Figure 11: *Count of known solutions in the survey*

On-trade businesses were also asked about an existing solution that is used or known of in the business. Nine on-trade businesses (see Table 3) were interviewed to find the following results. Figure 12 shows the count of businesses interviewed aware of a solution against wine waste at consumer level (i.e. in on-trade businesses). Six out of the nine interviewees were aware of a solution to combat wine waste at consumer level. Five out of these six people were specialised in wine and/or spirits. The four remaining were staff not originally from the wine and/or spirits industry.

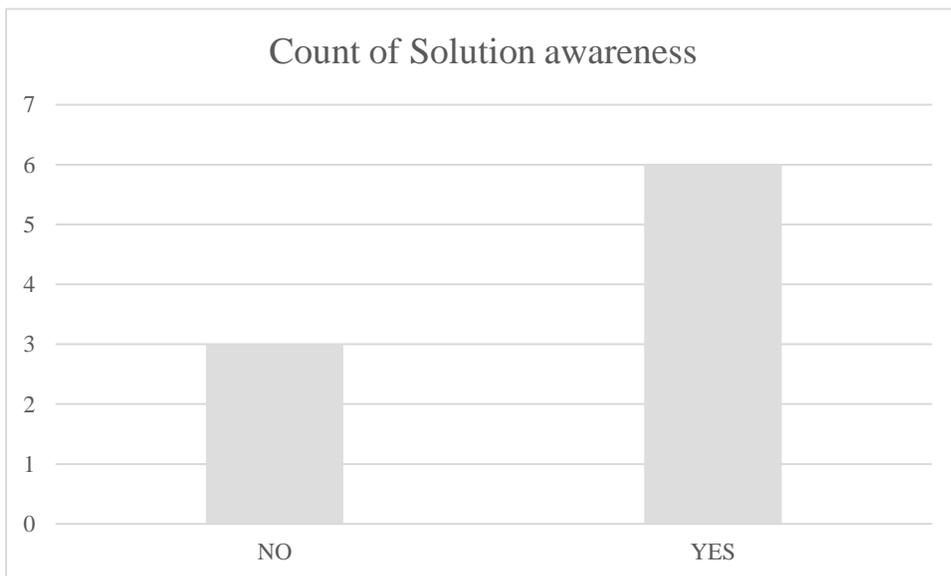


Figure 12: *Count of solution awareness measured in on-trade interview*

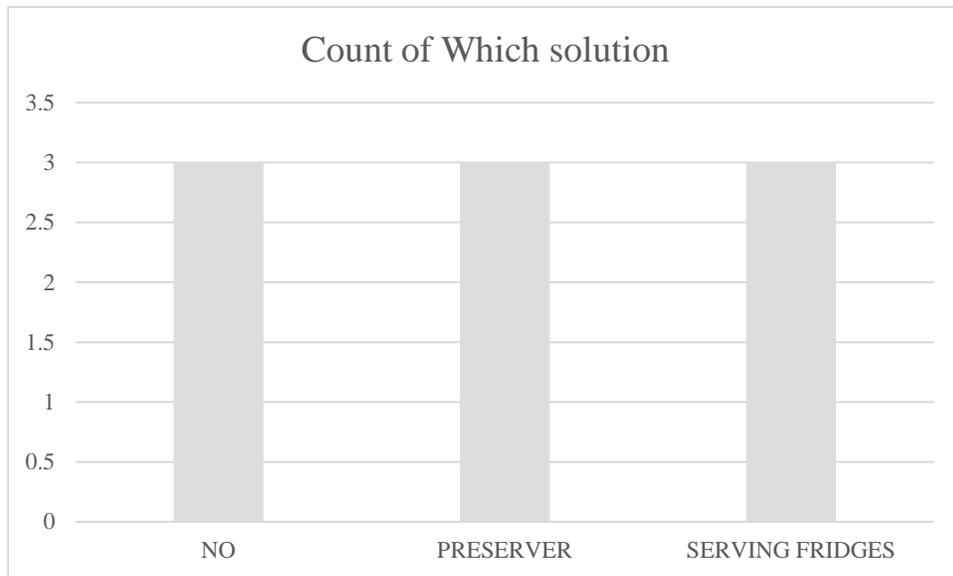


Figure 13: *Count of types of known solutions measured in on-trade interview*

Other than the three interviewees unaware of an existing solution to combat wine waste at consumer level, the six remaining interviewees were asked to give a

solution which is or is not used in the business (Figure 13). Three interviewees noted the existence of specialised service refrigerators, serving wines by the glass and preserving them for longer. Three interviewees noted the existence of wine preservers in different formats, enabling wine preservation for longer after opening a bottle. The two wine bars interviewed were aware of a solution and are running tests for the business.

The elements which can illustrate the scope of wine waste at consumer level in South Africa can be included in a model or diagram. Indeed, it is agreed that wine waste is a statement, i.e. an effect which is directly or indirectly linked to various elements. When brainstorming the major categories of causes of the problem, the following categories can be noted:

- Measurement: difficulties in measurement and finding data which can potentially lead to wine waste at consumer level.
- Method: ways and forms in which wine is served that can potentially lead to wine waste at consumer level.
- Equipment: existing solutions which may or may not exist which can potentially lead to wine waste if absent.
- Environment: external influence on the consumer (social, cultural, political or environmental) which may potentially lead to wasting wine in South Africa.
- People: consumer behaviour which may potentially lead to wine waste.
- Materials: elements linked to the product itself or the way it is packaged which can potentially lead to wine waste at consumer level.

Chapter Four: Discussion

The aim of this chapter is to critically reflect on the research methods used and the results. The results are to be interpreted and reviewed.

What is the most effective way to quantify wine waste at consumer level?

The review of literature and articles conducted led to comparing three different and most popular methods for evaluating food and/or beverage waste at consumer level.

- Household diary:

Household diaries, interviews and surveys can be an inexpensive way to make rough quantitative estimates of waste and gather information on its causes. Surveys can also gather information from a wide variety of individuals or entities about attitudes toward food waste. A survey can be used to determine the causes and contributing factors of waste. Participants may be asked to provide information on the reasons for wasting in a specific area.

The main advantage of this method is the amount of information given about core reasons for wasting wine. However, this method is inaccurate when it comes to objectivity and representation of all consumers. This method was used by the study carried out in Croatia by Ilakovic et al. (2019), and alongside surveys in a study conducted by Bravi et al. (2019). The aim of these studies were rather to explain the causes for waste than to quantify waste.

- Waste composition study:

Waste composition studies can be considered direct measurement. There are a variety of methods to measure waste directly - by counting, weighing or other means. Direct measurement often produces the most accurate figures, but it is also sometimes the one that requires the most expertise and time, and costs the most money. The difficulty with wine waste is that it cannot easily be analysed in waste unless the study is conducted in individual sampling with direct measurement by households. This method was used in a study by Edjabou et al. (2017) and by WRAP (2009), which aim to quantify waste rather than search for an explanation.

This type of analysis does not provide direct information on the causes of waste, since food is analysed after it is discarded. For this reason, waste composition analysis is often conducted in conjunction with a survey or process log to obtain qualitative data on causes and contributing factors.

- Waste ratio:

Because computational inference is a mathematical operation based on material flows and indirect data, it will not provide information on causes and contributing factors to waste. It only provides a quantitative estimate of waste for a sector or commodity type. An analysis of the sector or commodity in question will be required to understand the causes of waste. This method was used by ArT Preservation Systems (2015) and aimed at quantifying waste for sales purposes.

Unfortunately, when quantifying waste (at consumer level and in general), there are inaccuracies regarding the actual amount that is wasted. In fact, as waste that is in liquid form, and mostly poured or thrown down the drains, it is a complex task to measure the amount of wine that is contained in waterways. As of today, the amount of wine that is estimated to be wasted in South Africa is very inaccurate. This is because the exact amount of wine wasted by restaurants and in individual households must be measured and compared to the amount of wine that is consumed. This considers the fact that, sometimes, wine is not necessarily poured down the drain. In this respect, this review has highlighted a certain number of limitations. Through a bibliographical analysis of international sources, an official definition of food and beverage waste is still lacking today. The major pitfall encountered during the course of the study is the availability of reliable and representative quantitative data, both in South Africa and abroad. The subject of losses and wastage is still relatively little addressed, even though more and more players are beginning to take an interest in it. It should also be pointed out that wine waste remains a delicate subject to discuss with certain professionals who consider that everything is already made possible to avoid it. Another aspect is that these measurement methods rarely take on-premise wine consumption (what is not consumed in a household) into account, meaning “consumer level” remains a very vague topic for wine.

In the studies consulted, a certain confusion is made between the terms waste, loss or food waste and thus cannot be measured correctly. As a result, the scope covered by these studies can vary greatly, as well as the methodologies used to collect data, which naturally influence the final results. The method used in this thesis could be improved by applying these methods and the evolution of wine waste could be better tracked over time.

When working on the topic that is waste, many entities face the problem of missing resources. Usually, the quantity and quality of resources and information available makes it difficult to choose the right method and stay consistent throughout the study. One way to select the ideal method is to use a decision tree (see Appendix I). One downside to adapting the methods mentioned earlier is that consuming wine outside of the household, i.e. on-premises, is yet again separated from household consumption. Ways to fill this gap will be discussed further in sub-question two.

The answer to this sub-question was then used and applied to wine waste at consumer level in South Africa.

How much wine waste is happening at consumer level in South Africa?

The problem with using this specific method to quantify wine waste is that the exact evolutions of wine consumption and waste are not taken into account: a similar ratio is used as in the calculations

carried out for this topic in other countries. This implies many assumptions which increase the inaccuracy in the results.

The applied waste ratio measurement deducts wine loss and waste by comparing inputs (e.g., wine production) to outputs (wine consumption), as well as changes in inventory. At its most basic level, this method estimates waste by subtracting outputs from inputs, with the difference being considered the volume of waste. In this case, existing ratios were used with a similar aim and in a similar way. If input/output data is available, this method can be relatively inexpensive, as it was the case here: if not, it can be expensive. Using a waste ratio is a good way to estimate wine waste at consumer level as no direct data is available. At Bachelor level and with less time and fewer methods, this method of calculation was ideal. However, there can be significant inconsistencies depending on the type of data available, making it difficult to make estimates when there is uncertainty. This method does not give any information about behaviour which leads to wine waste.

South Africa has quite a low per capita wine consumption compared to other countries (South Africa ranks 14th according to Statista in 2018). This is mostly due to the inequalities within the country which makes the average wine consumption drop significantly. With the same waste ratio as found for the United Kingdom by WRAP, the amount of wine waste which goes down the drain every year in South Africa was estimated at just over 21,98 million 75cl bottles of wine based on data from 2018. From a value point of view, wine waste at consumer level was estimated at over 1,91 billion ZAR (1 912 260 000 ZAR) – which is equivalent to over 118,4 million euros wasted per year. With a total yearly consumption of approximately 435,45 million litres (580.6 million 75cl bottles) of wine in 2018, this means South African consumers waste nearly 4% of wine. This is considering the data regarding wine consumption only relates to the action of purchasing the wine. This places South Africa behind the United States of America (1,27 Billion USD every year (Art Wine Preservation, 2017); i.e. approximately 1.14 billion euros) and the United Kingdom (450 million GBP every year (WRAP, 2008); i.e. approximately 527.6 million euros). This amount of wine waste should remain an estimate as the data cannot be used to track progress over time, nor can it be used to identify sensitive areas or root causes of waste (because the data is from an external source).

As mentioned in the introduction, South African wine consumers can mainly be distinguished into two groups: white individuals (being historically the biggest wine consumers) and black or urban individuals from other ethnicities. But South African individuals can have similar perceptions regarding wine even throughout different ethnic groups. This was a relevant reason to search for another research method to support the previously estimated wine waste at consumer level.

- Households

Within the food supply chain, consumer level mainly focuses on the preparation and consumption of food at home. Although households rarely track food wastage, governmental and non-governmental organizations may wish to know the extent of waste in this sector.

As the whole South African population couldn't be surveyed, this number of interviewees was only lightly representative because the goal was to support the previously calculated quantity of wasted wine at consumer level. According to the sample characteristics (see Table 5), the average age of individuals surveyed was above 30, which means that the sample is less focused on the younger population but rather mid-age. This makes the results more inaccurate, as younger populations often have a different perception and different habits. It is also notable that most of the older interviewees were only surveyed at WineX festival on November 1st 2019 rather than through the online form due to absence on social media.

When it came to counting wine consumption frequency, the most popular answer remained "2x per week". This can be explained by a vague perception of wine consumption, also not giving precisions about the quantity consumed at that time. Whether students, working professionals or retired, there was no specific pattern regarding frequency of wine consumption. However, individuals located in Gauteng, KwaZulu-Natal or Western Cape (wine producing region) were more inclined to consuming wine more often. It was also noted that red wine is the most preferred type of wine to be consumed in the surveyed sample. This follows the trend of the South African market mentioned in Chapter One: 36% of South African consumption is red wine, 51% is white wine and 13% is rose (Export Entreprises SA, 2019). In this sample, there was a tie between the preference for white wine and for rose. With a focus on modern South African consumers being separated by ethnicity, this measurement method did not take this factor into account.

Regarding wine waste and awareness of wasting, a majority of individuals surveyed admitted to not always finishing a bottle of wine. This can be linked with a shift in perception on the value of wine as a product and being able to afford to purchase it. When asked to estimate the weekly amount of wine wasted, the most popular answer within this sample was "I don't know". This shows that if most wine consumers are aware of not consuming 100% of wine purchased, there is rarely a further thought on the scope of the waste. The remaining answers are also vague and do not refer to any exact amounts of wine wasted.

Because of the low representativeness of the sample studied and the very great variability of situations and practices encountered, the generalisation of the data presented below involves a high degree of uncertainty. The results obtained allow an initial estimate of the volumes generated by each business line. A better knowledge of the volumes of wine losses and wastage in each trade should however be aimed at. This type of survey is relatively inexpensive to conduct. It can generate data for a precise type of food and/or beverage (in this case, wine). It can also provide information by demographic group and/or other characteristics. However, respondents tend to

underestimate the amount of food wasted due to poorly defined objectives. In addition to this, it is not yet known how these underestimates vary over time, across groups and during studies.

- On-trade businesses

Consumer level also includes food or beverages which are consumed outside of homes, i.e. on premises. The method of interviewing professionals in this sector was an inexpensive method of collecting information and standardizes the information requested from each interviewee. However, this method relies on third parties. In addition to this, it can be difficult to extract the exact type of information needed and to ensure that the information collected has the same definition and corresponds to the same amount of waste from all interviewees' point of view. In the future, the questionnaire may need to be better tailored to different levels of information (e.g., the level of precision of the data). As for this case, the method was limited by the need for confidentiality. This type of interview is also unlikely to include information about the real causes of wine waste. Moreover, businesses often measure profit loss, which doesn't give a clue about the exact quantity of wine wasted.

An interesting aspect in interviewing representatives from different on-trade business types was understanding that all worked according to demand. This was thus influenced by the type of consumer profile that can be found at specific on-trade locations. According to the style and concept of the business, the wine list is changed or updated at different times and frequencies to please the consumer. There was a general idea that wine by the glass has to figure on a wine menu or list, regardless of its popularity. Demand for this new way of drinking is essentially spontaneous in wine bars and restaurants at lunchtime, during executive lunch breaks, or during business meals. According to some, those who do not offer this choice are destined to serving water in a carafe, without any benefit. This is why it is no doubt that the more casual on-trade businesses interviewed serve wine by the glass many times per service. However, this is one of the reasons for opening new bottles every day or every other day, according to interviewees. As mentioned in Chapter One, according to Beverage Information Services (2012), on-trade businesses lose between 10 and 15% of profit due to wine oxidation. This is even with correct inventory management, as wine consumption is difficult to forecast. It is estimated that the equivalent of around 20 million bottles is poured down the drain every year, based on 475 million bottles on premise (Statista, 2018). A limitation faced in this interview method was when interviewees were asked about the yearly amount of wine waste due to consumer behaviour on premises. The general impression was an average of ten percent profit loss per year, which is in line with the data given by Beverage Information Service (2012). However, it was difficult to extract the exact type of information needed and to ensure that the information collected was consistent from one interviewee to another. Whether the information about wine waste was to remain confidential or whether the interviewees were inaccurately estimating the amount wasted is unknown.

Although few studies are available today in the countries analysed to account for the volumes of wine lost or wasted in the direct-to-consumer delivery business, interest in this subject is growing. There are methods which can be used to measure food waste in on-trade businesses. These come at a cost and are rather unpopular. For example, smart bins and plate weighing are sometimes used to measure waste in the food service industry (Samann, 2017). A smart bin is a bin connected to a data entry system. It weighs food as it is added to the bin. It also has a terminal that allows the user to enter details about the type of food wasted and the reason for the waste. This information is transferred to a database that can be analysed to prevent food waste (or to divert waste into the waste stream). It can also be connected to supply systems to obtain financial information. A desire for international cooperation based on an exchange of data and this type of methodological approaches was put forward by the actors interviewed (representatives of the industry).

What type of consumer behaviour is causing wine waste?

Having interviewed a sample of wine consumers of the South African population through an online form and a direct survey at WineX festival on November 1st 2019, clues about a link between behaviour and wine waste were found. Figures 8 and 9 show the count of reasons for wasting wine, but also occasions in which wine is most wasted. When counting the occasions on which wine waste is most likely to happen in a household, all surveyed individuals picked an answer that was suggested. The most popular answer was “casual”, followed by “party” and “meal”. This means that most individuals who were surveyed consider wine waste to be a habit that isn’t linked to any particular event, but rather can happen on a daily. The answer “party” refers to events or special occasions which are organised in households. In fact, South Africa is known for its vibrant celebrations and nightlife, often organising day drinking sessions and braai (literally: grill). These events and occasions usually include alcohol consumption and more precisely wine and could be linked to waste. The next most popular answer given by the surveyed individuals was “meal”. This refers to wine that is wasted outside the household when eating or drinking out. This answer showed that some individuals who were surveyed realised that bottles or glasses of wine are not always finished when eating or drinking outside the household. However, exact reasons for wasting wine on these occasions were difficult to think of for most interviewees. Over half of the interviewees indicated no specific reason for wasting wine, regardless of the occasion. This again shows that most wine consumers are aware of not consuming 100% of wine purchased, there is rarely a further thought on the scope of the waste. The next most popular answers were “too much”, meaning the amount needed or wanted was overestimated or “had enough”, meaning the consumer only wished to consume a small quantity of wine in the first place. With developing countries following trends from the Western model, alcohol consumption is often seen as an addiction. Reducing alcohol consumption on a daily basis to merge towards a lighter consumption of higher quality products is becoming more popular. An official website for prevention today is CDA (Central Drug Authority – www.cda.gov.za), which presents the National drug master plan in accordance with the ONDCP (US Office of National Drug Control Policy) and focuses on policies,

legislation and annual reports. A small part of surveyed individuals indicated the wine that is wasted is probably “bad wine”. Nothing is known about the condition of the wine at the time of the act (Was it still drinkable? Was it past its best?), nor its history: where was it bought? By whom? For what occasion? At what price? How was it packaged? Thus this evaluation depends on the consumer (knowledge, beliefs, motivations, health risk, etc.).

The food culture of each country, its relationship to food and the global place reserved for food in daily life as well as the socio-economic context make each country a specific case. In direct delivery professions, food losses and wastage are not, a priori, generated voluntarily, but are the result of a certain social organization and a set of technical choices specific to each country. For this reason, a comparison of the volumes produced by each of these countries proves, in the current state of the available data, to be of little relevance.

An interesting aspect in interviewing representatives from different on-trade business types was understanding that all worked according to demand, influenced by the type of consumer profile that can be found at specific on-trade locations. There were mixed views on the impact of seasonality when it came to the choice of wine by the glass and the amount of wine wasted due to consumer behaviour. Indeed, some of the interviewees noted an increase in wine by the glass consumption during the Summer months, when others did not believe the time of year is linked to wine waste. Indeed, there can be certain market requirements at certain times of the year, but wine waste is very different from the waste of fresh produce. Indeed, a study by Laurentiis, Corrado & Sala (2018) states that measurements regarding household waste of fresh fruit and vegetables may be affected by seasonal variation in consumption patterns. This leads to believing that, even though consumer behaviour can be observed through marketing studies, it is a complex task to forecast consumer demand and seasonal preferences. This is especially true when focusing on wine, as seasonality can only be conceptualised for certain types of wine, but the volumes of wine to be consumed can rarely be forecast.

Wine is not a product quite like any other. Economically speaking, it is also quite unique. Wine is not an ordinary product for consumers, because its quality is only discovered after. Moreover, great wines are luxury products such as jewellery or handbags. These particular traits lead to competition that is not quite the same as elsewhere. As detailed in Chapter One, in modern oenology, researchers have showed that, in addition to wine production, grapes can offer much more than wine. Grape by-products are gems that hold an important place in different sectors of activity, whether in the food industry, the pharmaceutical industry or the cosmetics industry. Although the liquid has been taken away, what is left has a large variety of uses. Most wineries send pomace away to distilleries or breweries, to transform it into other alcoholic beverages – grappa, marc, brandy, even beers or cider. As wine mostly gains value with time (Cardebat, 2017), wine production does not lead to the same needs in volume forecasting for the market as other food and beverage products. Indeed, drivers for production are rather long-term and financial. According to zzysh.me (2019), wine is wasted, like any item of food, due to a lack of knowledge about the

product. Other explanations for wine wastage can be found in more urban and solitary lifestyles and ways of life (Le Figaro, 2015), opening bottles more often for consumption by the glass. This distressing waste could be avoided, however, if all wine consumers knew the mechanisms of wine spoilage and mastered the - yet existing (See sub-question four or Chapter Four)- techniques available to preserve wine in a perfectly reliable and efficient way.

How can the challenges of wine waste in South Africa be illustrated?

Having interviewed a sample of wine consumers of the South African population through an online form and a direct survey at WineX festival on November 1st 2019, a main objective was to understand if wine consumers were aware of waste and possible solutions. Indeed, over 50% of the individuals surveyed were not aware of a solution to battle wine waste in a household. This can be indirectly linked to sub-question three, with over half of the interviewees indicating no specific reason for wasting wine, regardless of the occasion. Among the interviewees who stated the existence of a solution to combat wine waste in households, the answers were categorized into two terms: “preservers” and “vinegar”. According to the diagram (Figure 1) published by the European Waste Directive (by WRAP: Waste & Resources Action Programme), these terms do not fit the same position in the food waste hierarchy. Indeed, “vinegar” is rather an old-fashioned destination for wine that has gone to waste and can be categorized into level two of the hierarchy: recycling. Transforming wine into vinegar is not quite a solution, as the wine has not been successfully used as intended, although, it contributes to reducing the negative impact of waste. This could be linked to the location of interviewees who chose this answer: mainly in the countryside of Mpumalanga, Northern Cape, Eastern Cape, or near wine farms and wine producers in Western Cape. However, interviewees aware of a “preserver” were mainly from business hubs like in Gauteng province. An explanation for this phenomenon could be proximity to businesses, thus marketing campaigns, and a better understanding of modern issues. In fact, “preserver” could be categorized in level one of the hierarchy, “Prevention and/or reuse”, because wine waste can be prevented at consumer level by forward planning and by keeping the item for longer with modern technology.

A similar pattern was noticed when interviewing the nine different on-trade businesses. Even though the answers to sub-questions two and three show an interest in wine waste and managing the wine list more sustainably, only two thirds of the interviewees were aware of a solution to battle wine waste within the on-trade business. The six interviewees aware of a solution were asked to give a solution which is or is not used in the business (Figure 13). Three interviewees noted the existence of specialised service refrigerators, serving wines by the glass and preserving them for longer. Three interviewees noted the existence of wine preservers in different formats, enabling wine preservation for longer after opening a bottle. Both refrigerators and preservers could be categorized in level one of the food waste hierarchy, “Prevention and/or reuse”, because wine waste can be prevented at consumer level by forward planning and by keeping the item for longer

with modern technology. One expected answer which was not stated during the on-trade businesses interview was container sizing. Indeed, wine is usually sold in 75cL glass bottles. Whilst reducing packaging materials, wine is a delicate product that starts to oxidise very quickly, as developed in Chapter One. Some wine producers sell wine in bulk, especially to on-trade clients. Unfortunately, wine in bulk or larger containers (e.g. Bag in Box) is sometimes expected to be of lower quality, and are less eco-friendly as these use more packaging. Smaller containers exist (e.g. half bottles or single-servings) though are also less sustainable from a packaging point of view and do not always contain the best quality wine. Indeed, wine that is of higher quality is usually contained in the traditional size glass bottle, which is more ideal for ageing, i.e. value creation (Cardebat, 2017).

The elements which can illustrate the scope of wine waste at consumer level in South Africa were included in a Fishbone diagram. These are all elements which have been reviewed as results in Chapter Three. These categories are used as branches in the Fishbone diagram, adding smaller branches for ideas. The concentration of branches will then indicate causal relationships between the elements.

Indeed, it is agreed that wine waste is a statement, i.e. an effect which is directly or indirectly linked to various elements. When brainstorming the major categories of causes of the problem, the following categories were noted:

- Measurement

Forecasting difficulties: As wine mostly gains value with time wine production does not lead to the same needs in volume forecasting for the market as other food and beverage products. This means that the main reason for wine waste at consumer level is not a volume forecast error from producers (because wine mostly improves rather than rotting). Even in on-trade businesses, there is no real pattern for wine consumption, so it is a complex task to construct a relevant wine list.

Little data and studies: The insufficient information regarding this topic limits the ability to reach a valid conclusion or result. This means that there is very little awareness because the topic is still unknown.

- Method

Wine By the Glass: It is a debate whether wine by the glass in on-trade businesses is a solution to wine waste or a cause for wine waste. Wine by the glass can generate a high demand and high bottle turnover, or can be a cause for wine waste, having to open a bottle and leave it to rot until another customer orders the very same wine.

Bad Consumption management: Wine is wasted, like any item of food, due to a lack of knowledge of how to manage leftovers.

- Equipment

Inadequate storage solution: Most consumers are unaware of an existing solution to prevent wine from going to waste. Even if aware of a solution, most common consumers or on-trade representatives do not have a solution at home or are not prepared to invest in one.

- Environment

Mother Nature – Oxidation: A chemical reaction which is irreversible, alters the wine's colour and balance. The wine loses alcohol and freshness – and becomes a lot less appetizing.

Health Awareness: With developing countries following trends from the Western model, alcohol consumption is often seen as an addiction. Reducing alcohol consumption on a daily basis to merge towards a lighter consumption of higher quality products is becoming more popular, which leads consumers to not finishing a whole 75cL bottle of wine.

Seasonality: Even though measurements regarding household waste of fresh fruit and vegetables may be affected by seasonal variation in consumption patterns, this is controversial when studying wine waste.

- People

Customer preferences: Behaviour and compulsive consumptions (rather than purchases: wine can be purchased and laid down) from consumers.

Lack of knowledge: Wine waste is still an unknown topic, and most consumers are not aware of the issue. Alcoholic beverage waste differs slightly from food waste, thus consumers do not feel the same responsibility towards everyday habits.

Lack of interest: In emerging countries where individuals are becoming wealthier, the discovery of new pleasures is often more important than considering important issues like food and beverage waste. Wine is consumed and the scope of the issue is not taken into account.

Traditions, history and culture: The South African population is very heterogenous and a part of it is only becoming interested in wine. This means that wine is not valued in the same way by all consumers.

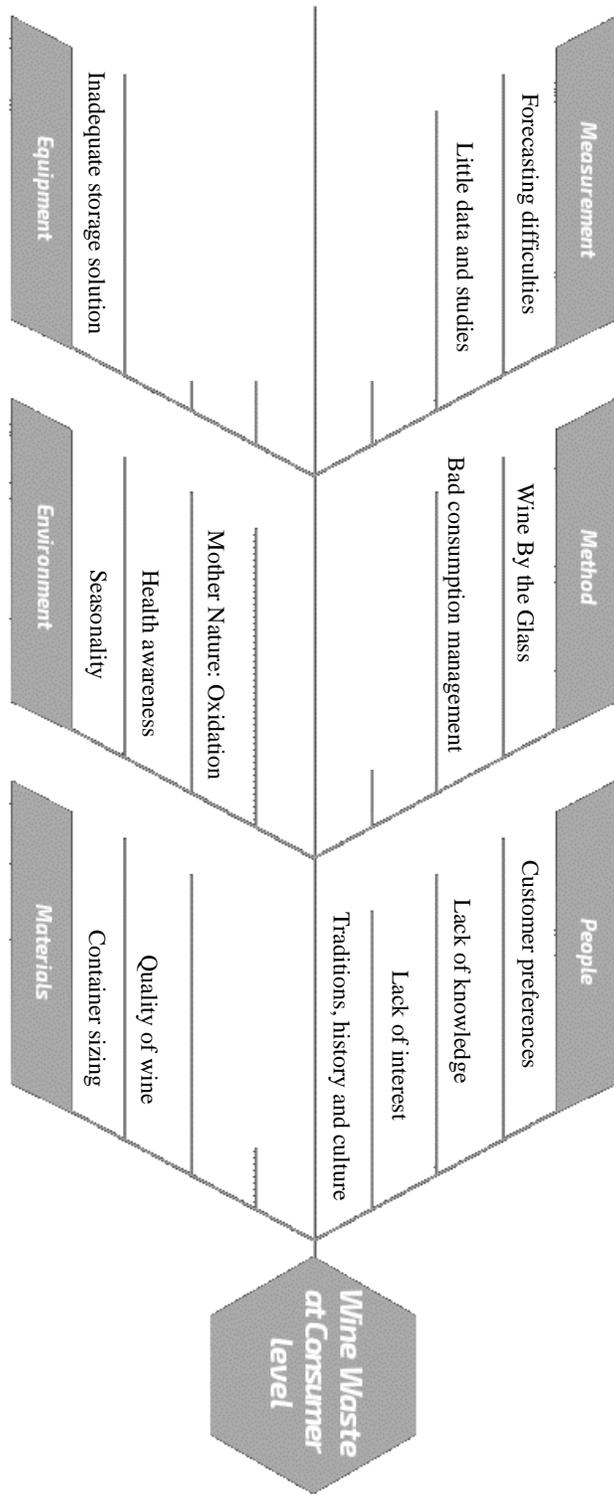
- Materials

Quality of wine: Some wine references are more vulnerable when it comes to waste, as less work from the producer has gone into protecting the wine. Moreover, a low quality wine which has been purchased at a lower price goes to waste more easily because it has not been a large investment for the consumer.

Container sizing: Wine that is of higher quality is usually contained in the traditional size glass bottle of 75cL, which is more ideal for ageing the wine, i.e. value creation on the long-term.

The advantage in using this model is understanding the elements which could potentially lead to wine waste at consumer level. An aspect that does not figure in this diagram is the difference in impacts and factors between households and on-trade consumption. This information is fundamental to account for the scale and volume of needed intervention and to develop impact studies accordingly. Research and evaluation findings should then be shared with all stakeholders and serve as a basis for further discussion and action.

Figure 14: Fishbone diagram and framework assessing challenges of wine waste at Consumer level in South Africa



Chapter Five: Conclusion and recommendations

The purpose of this report was to estimate and evaluate wine waste at consumer level in South Africa, meaning in households and in on-trade businesses (cafes, hotels, bars and restaurants).

What is the most effective way to quantify wine waste at consumer level?

The review of literature and articles conducted led to comparing three different and most popular methods for evaluating food and/or beverage waste at consumer level: the use of household diaries, waste composition studies and the use of ratios. The most effective way to quantify wine waste to this day is to focus on households and on-trade businesses separately, as data often conflicts between the two. By carrying out waste composition studies and household diaries, it would be possible in the future to estimate wine waste at consumer level more effectively. The following proposed methodology is destined to be used in the future by the wine industry to quantify wine waste at consumer household level in a more precise and relevant way.

However, the following proposed method, adapted to wine waste from the method by National Zero Waste Council (2018), could be used by interested consumers, professionals and institutions for future studies and measurements. With different methods available to conduct additional studies quantifying wine waste, this proposed study resembles the method used by WRAP (2009) as it gives an idea of the weight of wine waste as well as the reasons for it.

- **Wine waste study**

A relevant way to measure wine waste in households in South Africa would be to combine the use of household diaries and a type of composition study. In fact, as a lifestyle product, wine waste can be best estimated if taking more factors into account: habits, reasons, sociodemographics, occasions, measurement and price of a specific wine. The study would be conducted during seven days, without influence of yearly celebrations (e.g. Christmas, Easter or New Year) to capture casual happenings. A paper diary would have to be filled in by participants, ensuring follow-ups during the study to avoid unsatisfactory participation.

- **Sampling method**

Due to the very heterogenous population of South Africa, as overviewed in Chapter One, capturing attitudes and perceptions of wine waste is essential yet complex. Using existing data regarding wine consumption and geomarketing in the wine industry may assist in selecting hotspots for sampling. Samples would have to be of a significant size to enable significant assumptions (typically over 100 in measurement reports on countries significantly smaller than South Africa: WRAP (2009), Ilakovac et al. (2019), Edjabou et al. (2017)).

- **Measurement method**

As for the formal study by WRAP (2009), it would be required of the participants to measure exact amounts of wine each time it was wasted by using standardized measuring cups. The waste could then be transferred to a household container which would be measured at the end of the set duration.

This was an alternative methodology mentioned in the formal study from 2009, but abandoned because of smell and hygiene problems – this not being so much of an issue with wine only. This method of small scale composition study would then enable to calculate a total volume of wasted wine in a household at the end of the study duration.

How much wine waste is happening at consumer level in South Africa?

The applied waste ratio measurement used to calculate wine waste at consumer level in South Africa showed significant results for an emerging country and can be estimated at nearly four percent of total wine consumption. This is just over 21,98 million 75cl bottles of wine – which is equivalent to over 118,4 million euros wasted per year.

This result was backed by consumer surveys and on-trade businesses interviews which revealed that there was a global awareness of wine going to waste at the time of consumption. The aim was not to calculate wine waste with this survey but rather to find a pattern in the type of consumers who waste. The consumer profiles encountered in the surveyed individuals matched the profile described in the contextualization research carried out for this thesis. Indeed, there is a growing interest in wine for younger individuals, who generally consume wine more than once per week. These are mainly consumers of red wine, which matches customer profile expectations mentioned in the introduction. No correlation was found between the weekly amount of wine consumption and the weekly amount of wine waste generated. The answers give the impression that the surveyed individuals realise that waste is happening. Indeed, due to difficulties in estimating waste for a single survey, there may have been inaccuracies in consumer habits.

The interview carried out to representatives of various on-trade businesses showed that, regardless of the type of business and usual customers, wine by the glass or by the bottle are often a main part of a meal outside the household. However, even with correct inventory management, a profit loss of approximately ten percent per year was estimated for on-trade businesses. This represents a larger percentage of wastage than calculated earlier and could explain inaccuracies between calculating wine waste at consumer level in households and outside the household. Using cutting edge technology for liquid waste could be a future research topic for progress in this field.

Because of the low representativeness of the sample studied and the very great variability of situations and practices encountered, there is a high level of uncertainty in the results supporting the initial result of nearly four percent waste per year. A better knowledge of existing data regarding wine losses and wastage in each trade should however be aimed at.

What type of consumer behaviour is causing wine waste?

The causes of waste in households are varied: errors in preparation, inadequate infrastructure or storage methods, wine spilled or spilled during handling, poor portion planning, contamination, wine safety concerns and a host of other factors. One of the biggest challenges of wine waste at

consumer level in South Africa is the part of consumers clouding the issue. Most of all, it is the nonchalant acceptance of wine waste as something less urgent than food waste, for example. This is mainly because consumers are not aware of the factors that lead to wine waste. However, the exact consumer habits and behaviours responsible for this issue are unknown by consumers and representatives. It has thus been assumed that, as for food waste, the main reason for wine waste at consumer level is a lack of knowledge about the product and a lack of interest. These elements lead to supporting the suggestion of a household waste diary being an interesting study to dig deeper into the exact reasons and occasions which lead to wasting wine in households. With a focus on modern South African consumers being separated by ethnicity or cultural origin, this measurement method did not take this factor into account and could be an interesting field for future research.

Regarding the occasion on which wine is mostly wasted by consumers, the interviewed sample gave a global impression of something very casual. Other than celebrations and meals outside the household (in restaurants, for example), most consumers would admit wine waste would be possible on a daily basis. This was combined to a common lack of knowledge regarding the reason why wine would go to waste in a household. While wine waste is a growing concern at consumer level in the world and in South Africa, most wine consumers do not value this as a serious matter compared to similar issues. Even from an on-trade point of view, representatives did not give any noticeable pattern in behaviour or seasonality when it came to wasting wine. This would be a point to develop and research further to evaluate and build awareness.

This means that the main reason for wine waste at consumer level is not a volume forecast error from producers (because wine mostly improves rather than rotting), but behaviour and compulsive consumptions (rather than purchases: wine can be purchased and laid down) from consumers.

The answer to this sub-question aims to help consumers and industry professionals distinguish the behaviours which can lead to wine waste.

How can the challenges of wine waste in South Africa be illustrated?

When questioned about the existence of a solution to battle wine waste, it was obvious that most wine consumers are aware of not consuming 100% of wine purchased and there is rarely a further thought on the scope of the waste. The interview of representatives of on-trade businesses also revealed that the knowledge of a solution is not well-spread across the industry. A common solution for on-trade businesses is wine by the glass. This has many advantages for the customer, wishing to drink less and better, and for the on-trade business, who continues to sell wine. The solutions stated earlier are in fact existing and accessible in South Africa, according to zzysh.me, a Swiss innovation which aims to preserve wine and Champagne by the use of argon gas and carbon dioxide. Additional solutions invented in South Africa are available, such as Le Verre de Vin (www.bermarcollection.co.za) which enables bottle preservation, or Glass of Wine (www.glassofwine.co.za), which sells single serving wines. While existing solutions and value creation within the wine supply chain can be a topic of interest, the objective of this report is not

to detail these solutions further. A point of discussion regarding existing solutions and the impression of the on-trade interviewees, was the controversy of wine by the glass. Indeed, it is a debate whether wine by the glass in on-trade businesses is a solution to wine waste or a cause for wine waste. According to the more casual restaurants, wine by the glass seemed to be a solution to wine waste, with a high demand and high bottle turnover. For the fine dining references, wine by the glass seemed to be a cause for wine waste, having to open a bottle and leave it to rot until another customer orders the very same wine.

The elements which can illustrate the scope of wine waste at consumer level in South Africa were then included in a Fishbone diagram. Indeed, it is agreed that wine waste is a statement, i.e. an effect which is directly or indirectly linked to various elements. By presenting the causes and factors in a diagram, the challenges brought up by the issue of wine waste at consumer level in South Africa were revealed.

Indeed, it can be inferred that wine waste at consumer level is potentially caused by methods (ways and forms in which wine is consumed), equipment (solutions which may or may not exist and are not accessible), environment (external factors), people (behaviour) and materials (factors from the product itself). Interesting aspects which could be added to this model are the possible solutions i.e. ways to avoid waste happening by using the waste hierarchy classification by WRAP.

This part also showed that if waste is not measured or explained, it is more challenging to improve. It seems that while wine waste is a growing concern at consumer level in the world and in South Africa, most wine consumers do not value this as a serious matter compared to similar issues.

To conclude, this report has contributed to filling the knowledge gap brought up in Chapter One which introduces the topic. The insufficient information regarding this topic limited the ability to reach a valid conclusion or result. People in the industry are aware of the existence of wine waste at consumer level but it had never been evaluated for South Africa.

This report has also shown that there are interesting openings for future research in this field. It would be relevant to reiterate this research on a longer duration, whilst using more advanced methods like a household waste diary. On-trade businesses would also be included in this study, measuring the volume of wine wasted rather than the value. Another way to investigate a more accurate amount of wine wasted at this level would be by following innovations in the field which would enable measuring liquid waste. Additionally, it would be of interest to further research ways to avoid wine waste from a consumer point of view and from an on-trade business point of view, whilst including anti-waste campaign research. This would help find new ways to rewrite the wine value chain over time.

With environmental issues as daily headlines, change implies not only awareness, but new methods in everyone's production system, lifestyle and consumption.

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Appendix A

Form for survey

(Will be posted on Google Forms)

- Age
- Sex: F/M/Other
- Status: Student/Working/Retired
- Location/Province: Western Cape/Gauteng/KwaZulu-Natal/Free State/Mpumalanga/Limpopo/Northern Cape/Eastern Cape/North West Province
- How often do you consume wine?: less than 1x per week/1x per week/2x per week/less than 4 times per week/more than 5 times per week
- What type of wine do you consume? Red/white/rose/sparkling
- When you open a bottle, do you finish it every time? Yes/No/Not sure
- How much wine do you think goes to waste weekly in your household?

- On which occasions do you waste the most wine?

Meal/Party/Cooking/Casual/Other:detail

- What are the reasons for this waste?
- Are you aware of any solutions that can be used to avoid this?

Appendix B

Interview

- What is the name of your business?
- What type of restaurant and what type of customer profiles?
- How do you manage your wine menu?
- Do you offer wine by the glass?
- How do you choose your wines by the glass?
- How often would you estimate someone orders a wine by the glass?
- How often do you have to open a new bottle by the glass?
- When is wine by the glass more popular (season)?
- How would you quantify the amount of wine that you waste yearly because of your wine by the glass offering?
- Are you aware of any solutions and do you already use one

Appendix C

Excel file results WineX survey

Age	Gender	Status	Location	Wine consumption frequency	Type of wine	When you open a bottle, do you finish it every time?	Amount wasted weekly	Waste occasions	Reasons	Solution awareness	What solution
21F	STUDENT	GAUTENG	GAUTENG	2X PER WEEK	SPARKLING	YES	I DON'T KNOW	MEAL	I DON'T KNOW	YES	PRESERVER
23F	STUDENT	GAUTENG	GAUTENG	LESS THAN 4X PER WEEK	WHITE	NO	ONE GLASS	PARTY	HAD ENOUGH	YES	VINEGAR
21F	STUDENT	GAUTENG	GAUTENG	2X PER WEEK	SPARKLING	NO	A COUPLE OF GLASSES	CASUAL	HAD ENOUGH	YES	PRESERVER
26F	STUDENT	GAUTENG	GAUTENG	MORE THAN 5X PER WEEK	ROSE	NO	BOTTLE ENDS	CASUAL	HAD ENOUGH	YES	VINEGAR
24F	STUDENT	GAUTENG	GAUTENG	2X PER WEEK	SPARKLING	NO	I DON'T KNOW	CASUAL	I DON'T KNOW	NO	
29F	WORKING	KZN	KZN	LESS THAN 4X PER WEEK	RED	YES	NONE	CASUAL	TOO MUCH	NO	
45F	WORKING	KZN	KZN	MORE THAN 5X PER WEEK	WHITE	YES	I DON'T KNOW	CASUAL	TOO MUCH	YES	PRESERVER
43F	WORKING	GAUTENG	GAUTENG	MORE THAN 5X PER WEEK	ROSE	NO	A COUPLE OF GLASSES	MEAL	TOO MUCH	YES	VINEGAR
21F	WORKING	GAUTENG	GAUTENG	LESS THAN 4X PER WEEK	RED	YES	NONE	CASUAL	I DON'T KNOW	NO	
22F	WORKING	GAUTENG	GAUTENG	2X PER WEEK	RED	NO	ONE GLASS	CASUAL	I DON'T KNOW	NO	
22F	WORKING	GAUTENG	GAUTENG	LESS THAN 4X PER WEEK	RED	NO	ONE GLASS	PARTY	HAD ENOUGH	NO	
44F	WORKING	GAUTENG	GAUTENG	2X PER WEEK	RED	NO	ONE GLASS	PARTY	TOO MUCH	NO	
25F	WORKING	GAUTENG	GAUTENG	2X PER WEEK	SPARKLING	YES	I DON'T KNOW	PARTY	I DON'T KNOW	NO	
23F	WORKING	GAUTENG	GAUTENG	2X PER WEEK	WHITE	NO	I DON'T KNOW	COOKING	I DON'T KNOW	NO	
26F	WORKING	FREE STATE	FREE STATE	2X PER WEEK	SPARKLING	NO	BOTTLE ENDS	MEAL	HAD ENOUGH	NO	
56F	WORKING	GAUTENG	GAUTENG	LESS THAN 4X PER WEEK	ROSE	NO	BOTTLE ENDS	CASUAL	I DON'T KNOW	YES	PRESERVER
67F	RETIRED	LIMPOPO	LIMPOPO	2X PER WEEK	SPARKLING	NO	BOTTLE ENDS	CASUAL	TOO MUCH	YES	VINEGAR
66F	RETIRED	KZN	KZN	MORE THAN 5X PER WEEK	RED	YES	ONE GLASS	CASUAL	I DON'T KNOW	YES	VINEGAR
65F	RETIRED	KZN	KZN	LESS THAN 4X PER WEEK	WHITE	YES	I DON'T KNOW	CASUAL	BAD WINE	YES	PRESERVER
62F	RETIRED	GAUTENG	GAUTENG	LESS THAN 4X PER WEEK	ROSE	NO	I DON'T KNOW	CASUAL	I DON'T KNOW	NO	
21M	STUDENT	FREE STATE	FREE STATE	2X PER WEEK	RED	YES	ONE GLASS	MEAL	I DON'T KNOW	YES	PRESERVER
22M	STUDENT	GAUTENG	GAUTENG	2X PER WEEK	RED	NO	A COUPLE OF GLASSES	CASUAL	I DON'T KNOW	YES	PRESERVER
24M	STUDENT	GAUTENG	GAUTENG	2X PER WEEK	RED	NO	BOTTLE ENDS	CASUAL	BAD WINE	YES	PRESERVER
22M	WORKING	MPUMALANGA	MPUMALANGA	MORE THAN 5X PER WEEK	SPARKLING	NO	I DON'T KNOW	COOKING	I DON'T KNOW	NO	
44M	WORKING	GAUTENG	GAUTENG	LESS THAN 4X PER WEEK	WHITE	NO	NONE	MEAL	I DON'T KNOW	NO	
25M	WORKING	GAUTENG	GAUTENG	LESS THAN 4X PER WEEK	SPARKLING	NO	BOTTLE ENDS	CASUAL	HAD ENOUGH	NO	
23M	WORKING	GAUTENG	GAUTENG	2X PER WEEK	ROSE	NO	A COUPLE OF GLASSES	COOKING	I DON'T KNOW	YES	VINEGAR
26M	WORKING	LIMPOPO	LIMPOPO	2X PER WEEK	ROSE	NO	NONE	CASUAL	TOO MUCH	YES	VINEGAR
56M	WORKING	KZN	KZN	MORE THAN 5X PER WEEK	SPARKLING	NO	ONE GLASS	MEAL	I DON'T KNOW	NO	
47M	WORKING	KZN	KZN	LESS THAN 4X PER WEEK	WHITE	YES	I DON'T KNOW	CASUAL	BAD WINE	NO	
35M	WORKING	GAUTENG	GAUTENG	2X PER WEEK	ROSE	NO	I DON'T KNOW	CASUAL	I DON'T KNOW	NO	
22M	WORKING	GAUTENG	GAUTENG	LESS THAN 4X PER WEEK	RED	NO	I DON'T KNOW	CASUAL	HAD ENOUGH	YES	PRESERVER
44M	WORKING	GAUTENG	GAUTENG	LESS THAN 4X PER WEEK	RED	NO	BOTTLE ENDS	PARTY	I DON'T KNOW	YES	PRESERVER
25M	WORKING	GAUTENG	GAUTENG	MORE THAN 5X PER WEEK	RED	NO	ONE GLASS	CASUAL	I DON'T KNOW	NO	
23M	WORKING	LIMPOPO	LIMPOPO	LESS THAN 4X PER WEEK	RED	NO	NONE	CASUAL	I DON'T KNOW	NO	
26M	WORKING	FREE STATE	FREE STATE	2X PER WEEK	WHITE	YES	I DON'T KNOW	COOKING	TOO MUCH	YES	PRESERVER
26M	WORKING	FREE STATE	FREE STATE	2X PER WEEK	WHITE	YES	I DON'T KNOW	CASUAL	I DON'T KNOW	YES	PRESERVER
47M	WORKING	GAUTENG	GAUTENG	2X PER WEEK	ROSE	NO	A COUPLE OF GLASSES	MEAL	TOO MUCH	NO	
62M	RETIRED	FREE STATE	FREE STATE	2X PER WEEK	SPARKLING	NO	ONE GLASS	CASUAL	I DON'T KNOW	NO	
55M	RETIRED	GAUTENG	GAUTENG	LESS THAN 4X PER WEEK	RED	YES	I DON'T KNOW	CASUAL	HAD ENOUGH	YES	VINEGAR
57M	RETIRED	KZN	KZN	MORE THAN 5X PER WEEK	WHITE	NO	BOTTLE ENDS	CASUAL	I DON'T KNOW	NO	
67M	RETIRED	GAUTENG	GAUTENG	LESS THAN 4X PER WEEK	ROSE	NO	I DON'T KNOW	CASUAL	TOO MUCH	YES	PRESERVER
68M	RETIRED	GAUTENG	GAUTENG	2X PER WEEK	RED	NO	NONE	CASUAL	I DON'T KNOW	YES	PRESERVER
20 OTHER	STUDENT	GAUTENG	GAUTENG	2X PER WEEK	RED	NO	BOTTLE ENDS	PARTY	I DON'T KNOW	NO	
19 OTHER	STUDENT	NORTHERN CAPE	NORTHERN CAPE	2X PER WEEK	RED	NO	A COUPLE OF GLASSES	PARTY	HAD ENOUGH	NO	

Appendix D

Google forms extract

Wine waste

As a student in international beverage business, I am carrying out a study on wine waste at consumer level in South Africa and how it can be measured.

***Obligatoire**

What is your age? *

Votre réponse _____

What is your Gender? *

F

M

Autre : _____

What is your Status? *

Student

Working

Retired

Autre : _____

Location/Province *

Western Cape

Gauteng

KwaZulu-Natal

Free State

Mpumalanga

Limpopo

Northern Cape

Eastern Cape

North West Province

How often do you consume wine? *

Less than 1x per week

1x per week

2x per week

less than 4x per week

more than 5x per week

Never

What type of wine do you consume? *

Red

White

- Rosé
- Sparkling
- Autre : _____

When you open a bottle, do you finish it every time? *

- Yes
- No

How much wine do you think goes to waste weekly in your household? *

Votre réponse _____

On which occasions do you waste the most wine? *

- Meal
- Party
- Cooking
- Casual
- Autre : _____

What are your reasons for wasting? *

- Party
- Cooking
- Casual
- Autre : _____

What are your reasons for wasting? *

Votre réponse _____

Are you aware of any solutions? *

- Yes
- No

Which solution? *

Votre réponse _____

Envoyer

N'envoyez jamais de mots de passe via Google Forms.

Ce contenu n'est ni rédigé, ni cautionné par Google. [Signaler un cas d'utilisation abusive](#) - [Conditions d'utilisation](#) - [Règles de confidentialité](#)

Appendix E

Excel file results Google Forms

Age	Gender	Status	Location	Wine consumption frequency	Type of wine	When you open a bottle, do you finish it every time?	Amount wasted weekly	Waste occasions	Reasons	Solution awareness	What solution
24	F	STUDENT	GAUTENG	2X PER WEEK	SPARKLING	YES	IDON'T KNOW	MEAL	IDON'T K	YES	PRESERVER
23	F	STUDENT	GAUTENG	LESS THAN 4X PER WEEK	WHITE	NO	ONE GLASS	PARTY	HAD ENO	YES	VINEGAR
55	F	WORKING	GAUTENG	2X PER WEEK	SPARKLING	NO	A COUPLE OF GLASSES	CASUAL	HAD ENO	YES	PRESERVER
43	F	WORKING	GAUTENG	1X PER WEEK	ROSE	NO	BOTTLE ENDS	CASUAL	HAD ENO	YES	PRESERVER
37	F	WORKING	GAUTENG	2X PER WEEK	SPARKLING	NO	IDON'T KNOW	CASUAL	IDON'T K	NO	
26	F	WORKING	KZN	LESS THAN 4X PER WEEK	RED	YES	NONE	CASUAL	TOO MUC	NO	
27	F	WORKING	KZN	MORE THAN 5X PER WEEK	WHITE	YES	IDON'T KNOW	CASUAL	TOO MUC	YES	VINEGAR
29	F	WORKING	WESTERN CAPE	MORE THAN 5X PER WEEK	ROSE	NO	A COUPLE OF GLASSES	MEAL	TOO MUC	YES	VINEGAR
45	M	WORKING	WESTERN CAPE	1X PER WEEK	RED	YES	NONE	CASUAL	IDON'T K	NO	
43	M	WORKING	EASTERN CAPE	2X PER WEEK	RED	NO	ONE GLASS	PARTY	IDON'T K	NO	
21	M	STUDENT	WESTERN CAPE	LESS THAN 4X PER WEEK	RED	NO	ONE GLASS	PARTY	TOO MUC	NO	
22	M	STUDENT	WESTERN CAPE	2X PER WEEK	RED	NO	ONE GLASS	PARTY	TOO MUC	NO	
22	F	STUDENT	MPUMALANGA	2X PER WEEK	SPARKLING	YES	IDON'T KNOW	PARTY	IDON'T K	NO	
22	F	STUDENT	GAUTENG	2X PER WEEK	WHITE	NO	IDON'T KNOW	COOKING	IDON'T K	NO	
44	F	WORKING	GAUTENG	2X PER WEEK	SPARKLING	NO	BOTTLE ENDS	MEAL	HAD ENO	NO	
25	F	WORKING	GAUTENG	LESS THAN 4X PER WEEK	ROSE	NO	BOTTLE ENDS	CASUAL	IDON'T K	YES	PRESERVER
23	F	WORKING	LIMPOPO	1X PER WEEK	SPARKLING	NO	BOTTLE ENDS	CASUAL	TOO MUC	YES	VINEGAR
26	F	WORKING	KZN	MORE THAN 5X PER WEEK	ONE GLASS	YES	ONE GLASS	PARTY	IDON'T K	YES	PRESERVER
56	F	WORKING	KZN	LESS THAN 4X PER WEEK	WHITE	YES	IDON'T KNOW	PARTY	BAD WIN	YES	PRESERVER
47	F	WORKING	WESTERN CAPE	LESS THAN 4X PER WEEK	ROSE	NO	IDON'T KNOW	CASUAL	IDON'T K	NO	
35	M	WORKING	WESTERN CAPE	2X PER WEEK	RED	YES	ONE GLASS	MEAL	IDON'T K	YES	PRESERVER
34	M	WORKING	WESTERN CAPE	2X PER WEEK	RED	NO	A COUPLE OF GLASSES	CASUAL	IDON'T K	YES	PRESERVER
21	M	STUDENT	WESTERN CAPE	1X PER WEEK	RED	NO	BOTTLE ENDS	CASUAL	HAD ENO	YES	VINEGAR
22	M	STUDENT	EASTERN CAPE	MORE THAN 5X PER WEEK	SPARKLING	NO	IDON'T KNOW	COOKING	TOO MUC	NO	
22	F	WORKING	NORTHERN CAPE	1X PER WEEK	SPARKLING	NO	NONE	MEAL	IDON'T K	NO	
22	F	STUDENT	MPUMALANGA	LESS THAN 4X PER WEEK	WHITE	NO	BOTTLE ENDS	CASUAL	IDON'T K	NO	
42	F	WORKING	GAUTENG	LESS THAN 4X PER WEEK	SPARKLING	NO	A COUPLE OF GLASSES	COOKING	HAD ENO	YES	PRESERVER
32	F	WORKING	GAUTENG	2X PER WEEK	ROSE	NO	NONE	CASUAL	IDON'T K	YES	PRESERVER
32	F	WORKING	MPUMALANGA	1X PER WEEK	SPARKLING	NO	ONE GLASS	MEAL	HAD ENO	NO	
31	F	WORKING	KZN	MORE THAN 5X PER WEEK	RED	YES	IDON'T KNOW	CASUAL	TOO MUC	NO	
27	F	WORKING	KZN	LESS THAN 4X PER WEEK	WHITE	YES	NONE	CASUAL	TOO MUC	NO	
27	F	WORKING	NORTH WEST PR	2X PER WEEK	ROSE	NO	IDON'T KNOW	CASUAL	TOO MUC	YES	VINEGAR
46	M	WORKING	WESTERN CAPE	LESS THAN 4X PER WEEK	RED	NO	IDON'T KNOW	PARTY	TOO MUC	YES	VINEGAR
43	M	WORKING	WESTERN CAPE	LESS THAN 4X PER WEEK	RED	NO	BOTTLE ENDS	CASUAL	IDON'T K	NO	
25	M	STUDENT	WESTERN CAPE	MORE THAN 5X PER WEEK	RED	NO	ONE GLASS	CASUAL	IDON'T K	NO	
25	M	WORKING	EASTERN CAPE	LESS THAN 4X PER WEEK	RED	YES	NONE	COOKING	HAD ENO	YES	PRESERVER
22	OTHER	STUDENT	WESTERN CAPE	1X PER WEEK	WHITE	YES	IDON'T KNOW	CASUAL	TOO MUC	YES	PRESERVER
22	OTHER	STUDENT	GAUTENG	2X PER WEEK	SPARKLING	NO	A COUPLE OF GLASSES	MEAL	IDON'T K	NO	
23	OTHER	STUDENT	GAUTENG	2X PER WEEK	ROSE	NO	IDON'T KNOW	CASUAL	IDON'T K	NO	
26	F	WORKING	NORTH WEST PR	2X PER WEEK	SPARKLING	NO	ONE GLASS	CASUAL	HAD ENO	YES	VINEGAR
26	F	WORKING	NORTHERN CAPE	LESS THAN 4X PER WEEK	RED	YES	IDON'T KNOW	CASUAL	IDON'T K	NO	
56	M	WORKING	KZN	MORE THAN 5X PER WEEK	WHITE	NO	BOTTLE ENDS	PARTY	TOO MUC	NO	
45	F	WORKING	EASTERN CAPE	LESS THAN 4X PER WEEK	ROSE	NO	IDON'T KNOW	COOKING	IDON'T K	YES	VINEGAR
45	M	WORKING	WESTERN CAPE	2X PER WEEK	RED	NO	NONE	CASUAL	BAD WIN	YES	VINEGAR
32	M	WORKING	WESTERN CAPE	2X PER WEEK	RED	NO	BOTTLE ENDS	COOKING	IDON'T K	NO	
21	M	STUDENT	GAUTENG	2X PER WEEK	RED	NO	A COUPLE OF GLASSES	CASUAL	IDON'T K	NO	
33	M	WORKING	GAUTENG	1X PER WEEK	RED	YES	NONE	PARTY	IDON'T K	YES	PRESERVER

Appendix F

Excel file results ON-Trade interview

Name	Type	Location	Customer profile(s)	Wine menu	BTG?	Choice BTG	Frequency BTG	Popularity BTG (Season)	New bottle BTG	Waste?	Solution awareness	Which solution
De Grendel	Winery Restaurant	Cape Town		NEVER CHANGE	YES	ACCORDING TO DEMAND	A COUPLE PER SERVICE	ALL YEAR	EVERY DAY	10%	YES	PRESERVER
Aubergine	Fine Dining	Cape Town	HNWI	EVERY YEAR	YES	ACCORDING TO DEMAND	RARELY	SUMMER	EVERY OTHER DAY	NEGLECTABLE	YES	PRESERVER
Publik Wine Bar	Wine Bar	Cape Town and Johannesburg	Wine connoisseurs	EVERY SEASON	YES	ACCORDING TO DEMAND	A COUPLE PER SERVICE	SUMMER	EVERY OTHER DAY	5%	YES	SERVING FRIDGES
Thief	Wine Bar/Restaurant	Sandton, Johannesburg	Middle-High Class	RARELY CHANGE	YES	ACCORDING TO DEMAND	A COUPLE PER SERVICE	ALL YEAR	EVERY DAY	5%	YES	SERVING FRIDGES
Hussar Grill	Franchise/Casual	Sandton, Johannesburg	Middle Class	EVERY SEASON	YES	ACCORDING TO DEMAND	MOST CUSTOMERS	ALL YEAR	EVERY DAY	10%	NO	
Eatalian	Casual	Sandton, Johannesburg	Middle Class	EVERY YEAR	YES	ACCORDING TO DEMAND	A COUPLE PER SERVICE	SUMMER	EVERY DAY	10-15%	NO	
Marble	Fine Dining	Sandton, Johannesburg	HNWI	EVERY YEAR	YES	ACCORDING TO DEMAND	RARELY	SUMMER	EVERY OTHER DAY	NEGLECTABLE	YES	SERVING FRIDGES
Mosaic	Fine Dining	Pretoria	HNWI	RARELY CHANGE	YES	ACCORDING TO DEMAND	RARELY	ALL YEAR	EVERY OTHER DAY	NEGLECTABLE	YES	PRESERVER
Tashas	Franchise/Casual	Cape Town and Johannesburg	Middle-High Class	RARELY CHANGE	YES	ACCORDING TO DEMAND	MOST CUSTOMERS	ALL YEAR	EVERY DAY	10-15%	NO	

Appendix G

Map of South Africa

Source: Alexander, M., South Africa Info, 2019



Appendix H

Google alerts example

The image shows two screenshots of the Google Alerts interface. The top screenshot displays a list of six alerts: 'wine consumer', 'waste model', 'wine waste', 'south africa', 'vin', and 'wine'. Each alert has edit and delete icons. The bottom screenshot shows the configuration page for the 'wine waste' alert. It includes a search bar with 'wine waste' and a list of settings: 'How often' (As-it-happens), 'Sources' (News, Blogs, Web, Video, Books, Dis), 'Language' (Any Language), 'Region' (Any Region), 'How many' (Only the best results), and 'Deliver to' (thsamoran@gmail.com). There are 'Update alert' and 'Hide options' buttons. Below the settings is an 'Alert preview' section showing a news snippet from 'The Drinks Business' about sustainability targets in wineries.

Alerts
Monitor the web for interesting new content

🔍 Create an alert about...

My alerts (6)

- wine consumer
- waste model
- wine waste
- south africa
- vin
- wine

Alerts
Monitor the web for interesting new content

🔍 wine waste

How often: As-it-happens

Sources: News, Blogs, Web, Video, Books, Dis

Language: Any Language

Region: Any Region

How many: Only the best results

Deliver to: thsamoran@gmail.com

[Update alert](#) [Hide options](#) ▲

Alert preview

NEWS

Ramón Bilbao 'well on the way' to smashing sustainability targets
The Drinks Business
"We have intelligent irrigation in the vineyards to control the water-stress of each vine which helps avoid waste, but inside the winery is the biggest ..."

Appendix I

Decision Tree for choosing adapted waste measurement method

Source: National Zero Waste Council, 2018

