A Nuffield Farming Scholarships Trust Report

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UK Viticulture:
Sustainable growth in a changing climate

Cameron Roucher

July 2018

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A Nuffield (UK) Farming Scholarships Trust Report

"Leading positive change in agriculture. Inspiring passion and potential in people."

Date of report: July 2018

Title	UK Viticulture: sustainable growth in a changing climate
Scholar	Cameron Roucher
Sponsor	East Sussex NFU
Objectives of Study Tour	- To investigate how premium wine regions have managed to grow sustainably in marginal climates - To determine how a UK winegrower can compete as the industry grows and becomes a significant international player. - To identify best practices in cool climate viticulture, particularly in the development of new vineyards.
Countries Visited	Australia, Canada, France, UK, Germany, Holland, Belgium
Messages	- Winegrowing in the UK climate is a marginal proposition despite global warming - Good site selection is the first step in achieving a successful vineyard - Vineyards are incredibly capital intensive; accept that the nature of the wine business is not just farming - Understand the market and develop a plan for where the final product will go

EXECUTIVE SUMMARY

The UK vineyard area has grown immensely in recent years and as an industry it needs to be aware that there are dangers and consequences of growing too big, too fast. Due to a high quality product the UK wine industry has an enviable position in the wine world. Demand is currently exceeding supply with a ready domestic market for sales. However as more newly-planted vineyards begin to bear fruit the competition will increase, and a robust business model will be imperative. The wine industry is a global market and the challenges of competing at that level are many; but UK wines, particularly sparkling, have a solid reputation and base to work from.

This study was undertaken to see how winegrowers in marginal and challenging climates are adapting to climate change and what strategies have been used in recently developed and developing regions to ensure success. Cool climate regions were chosen due to the climate challenges that they face, and/or the success in growth they have shown in recent history. Particular standouts were Tasmania, and the Okanagan valley, British Columbia. These two areas have both proven that growth can happen sustainably and profitably, without losing value in land, product value or marketability of the regional brand.

Climate is a bigger issue and one that we cannot predict. Local climate is considered the most significant influence when determining winegrowing suitability and even though the climate is generally changing, making grape growing in the UK more reliable, it is the impact of shorter term weather events such as frost and rainfall that continue to impede vineyard production. It is these events along with the establishment of fruitfulness that are affecting yield variability in UK vineyards and, as such, profitability of wine businesses. Rigorous site selection goes a long way to recognise and/or mitigate some of these issues and can significantly increase the chances of success. The best vineyards have done their homework, studied the site in minute detail, and had a clear plan for where the fruit or wine was to be sold and at what price point.

The future growth of the UK vineyard area in a sustainable manner is down to a number of factors. Climate is just one of these, but probably the key to the physical area of vineyards planted. The climate in the UK is marginal for wine grape production and this has direct effect on yields, but we can learn from what others have done overseas to ensure sustainable yields and profitability. Planning and the importance of detailed site assessment prior to planting will ensure the productivity of new vineyard plantations. If new vineyards are not planned out in advance and do not have a clear route to market, they will fail to be sustainable. Planning is everything.

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1. Personal Introduction

As a child I was adamant I wouldn't be a farmer. I was always told by my father, a stud Poll Dorset sheep farmer in New Zealand, that I would return to the land one day. Animals were of no interest, but growing things was - it was the wine industry which brought me back to the land.

I have spent my entire working life in the wine industry. I began work in a winery, doing the evening shift after I had finished studying for the day. Once I had graduated from Hawkes Bay's Eastern Institute of Technology I went to work for Morton Estate, one of New Zealand's most respected Chardonnay producers. I had a number of roles there, initially in the winery, but it was the days spent inside cleaning tanks that made me yearn for the outdoors once more.

Figure 1: Cameron Roucher, viticulturist and author of this report

An opportunity to manage the company nursery presented itself which a few years later led me to Australia to manage Australian Quality Vines, a subsidiary of Casella Wines. During the big planting boom in the mid 2000s, Australian Quality Vines was one of the largest grapevine nurseries in Australia and part of one of Australia's most successful wine companies.

As the boom started to die off I moved back to New Zealand to a small family company, Dolbel Estate. While there I was placed in the Hawkes Bay Young Viticulturist of the Year award 3 years in a row eventually taking the regional title and runner-up in the national New Zealand Young Viticulturist of the Year competition. I stayed at Dolbel Estate right up until it was sold in 2011 in the middle of another wine industry glut.

This prompted the move to England to develop Rathfinny Wine Estate in East Sussex where I have been for the last 7 years. The opportunity to be involved in a large-scale vineyard project from the ground up anywhere in the world is fairly rare these days. The move in 2011 with a young family and my wife Nikki wasn't without its challenges but I can safely say that I wouldn't change it for the world. We are all now firmly entrenched in life here in the UK.

2. Background

I had considered applying for a Nuffield Farming Scholarship for some time, but either the time wasn't right, or I struggled to come up with a subject that I was enthused by. I felt I needed to present something that was relevant and would help both the wider industry and my career in general. The UK is now the third wine industry that I have been involved in during a large-scale expansion, and while this is an exciting prospect, it is also daunting to know that we need to find a market for all these grapes that will soon come into production.

Although grapes have been grown in the UK since Roman times, it is not until recent times that winegrowing has become more consistently viable. Up until the mid 1980s most UK vineyards would have been planted with German Riesling-based cross breed varieties. Muller Thurgau, Reichensteiner, Bacchus and Schonburger dominated the landscape along with Seyval Blanc. A change in consumer tastes over the years has seen a lot of these type of varieties lose favour; however Bacchus is continuing a strong showing in the UK with some even hailing it as England's answer to New Zealand Sauvignon Blanc. *(www.drinksbusiness.com*)

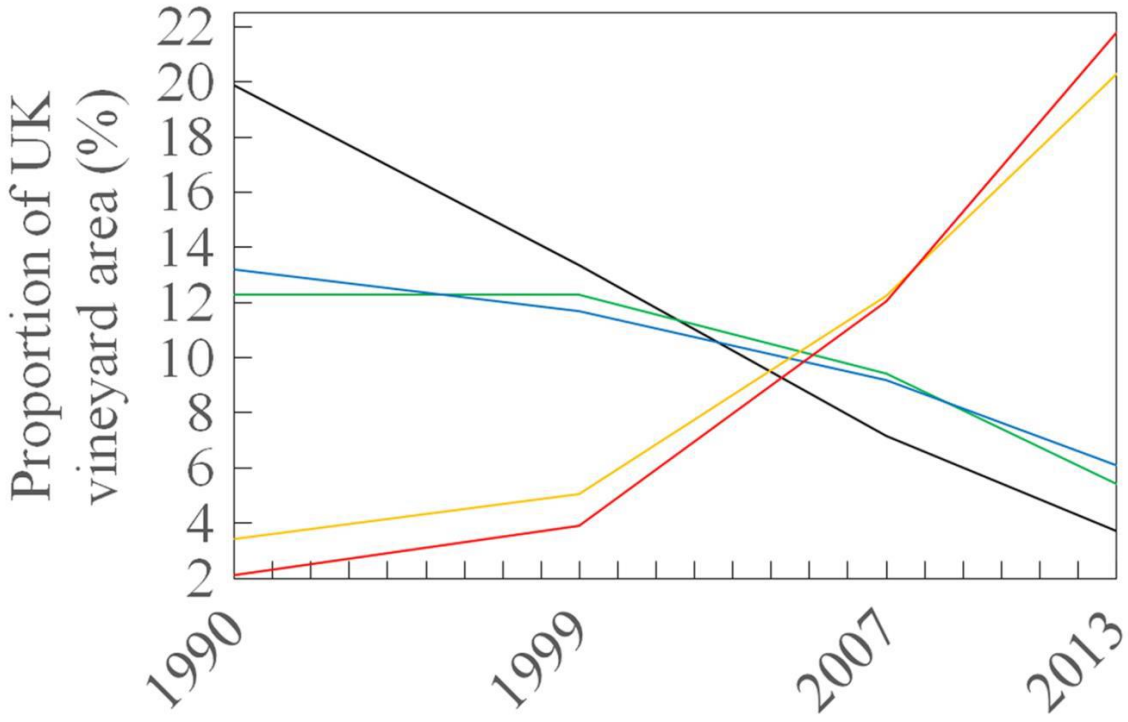

Figure 2: Changing distribution of dominant (by volume) cultivars between 1990 and 2013: Muller Thurgau (black line), Reichensteiner (green line), Seyval Blanc (blue line), Pinot Noir (yellow line) and Chardonnay (red line) in the UK, as a proportion of total vineyard area. *(Figure from: Nesbitt et al., 2016).*

It is the classical sparkling varieties of Chardonnay, Pinot Noir and Meunier that are finding favour, especially with new plantings. In fact, these 3 varieties make up over half the UK planted area (*Wine Standards Branch of the FSA 2017*). The growth, particularly in the last ten years, has been exponential. More and more vines are being planted each year, with 1 million going in the ground in 2017, and an

estimated 1.5 million in 2018. (*Wine GB*). If recent years' plantings are anything to go by, the area under vine in the UK is currently expanding at a rate of around 15% year-on-year since 2015. The area under vine is approximately 2500 ha, equating to around 700 vineyards, 540 of which are commercial, and approximately 160 wineries. Two well respected Champagne houses now have vineyards in the UK: Taittinger and Pommery. Interest from further overseas investment is only a matter of time.

The trouble with rapid expansion is the rush to get vines in the ground, without too much thought given to where the fruit or wine will end up, or even having at outlet for the product.

The trouble with rapid expansion is the rush to get vines in the ground, without too much thought given to where the fruit or wine will end up, or even having at outlet for the product. Sustainable growth can only be achieved through careful considered planning from the very beginning. There have been many examples over the past 20 or so years from countries and regions that have failed; and indeed others that have prospered, some of which are highlighted in this report.

3. Where did I go and why?

I travelled to **Australia, Canada, France, Germany, Holland, Belgium and** within the **UK.**

Within Australia, I focussed on two wine regions, Tasmania and Mornington Peninsula, both of which are known for some of the best cool climate wines in the world. Both have some fairly large challenges to growing, similar to those in the UK: spring frosts, rain at flowering, and in some cases wind exposure.

The north of Tasmania in particular has a very similar climate to that of the UK and so there are a lot of parallels to draw from here. While much of mainland Australia struggled through a wine glut due in part to oversupply and the race to the bottom in terms of pricing, the Tasmanian wine industry has maintained its place and, in particular, price point in the world wine market, through collaboration of Government, industry and growers.

I travelled to a number of regions in Canada, most notably Nova Scotia, Okanagan Valley and Vancouver Island, British Columbia. Many are surprised that Canada even produces wine, the rational belief being that it is too cold. While the winters are extreme in certain areas, the growing season for most regions is much warmer than that of other regions at similar latitudes such as Champagne and parts of Germany. The focus on these three regions was chosen because of a number of factors: Nova Scotia due to its developing industry and short growing season: Okanagan Valley due to its fascinating and complex mix of soil formations and climate variables within such a short distance of one another (1,155 growing degree days (GDD) at Kelowna to only 100km south where it reaches 1,535 GDDs): and Vancouver Island for its moderate, maritime climate much like the UK's.

The initial focus of my study was solely on climate, but as I went along I discovered that anyone growing in a region deemed marginal had similar problems - mainly how to make the business viable long term.

A variety of French regions was visited as well as parts of Germany, to give some perspective to winegrowing and look at the challenges that climate is throwing at them. Holland and Belgium were also visited to see how producers in new and developing Old World winegrowing regions are managing to get started and build a business when, for years, consumers have been told they couldn't grow wine in these countries.

The initial focus of my study was solely on climate, but as I went along I discovered that anyone growing in a region deemed marginal had similar problems - mainly how to make the business viable long term. Part of my focus has therefore looked at the viability of grape growing and what measures need to be in place to achieve this.

4. Viticulture in a changing climate

Climate change is not the same as weather. Weather is over a short time: a day, a week, or a couple of months. Climate is long term. The standard minimum for defining climate is 30 years. Climate change is undeniable, and while there may be political motivations to proving or disproving global warming, the climate is certainly changing both here in the UK, and worldwide.

The life cycle of a vine is generally accepted to be around 30-40 years, often more if well looked after. This long-life span can mean that it's growth habits and even suitability for a certain region can be altered over the course of its life.

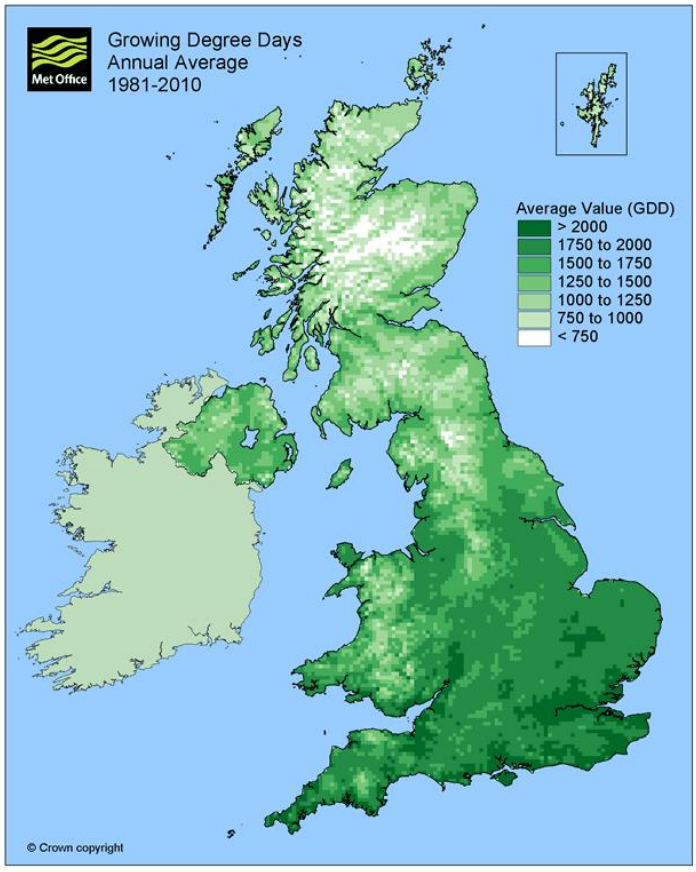

Figure 3: Growing Degree Days Annual Average 1981-2010.
(Source Met Office, 2018)

We have heard time and time again that global warming is now making it possible to regularly ripen grapes in the UK climate, which now enjoys the climate that Champagne did 20 years ago. Generally, this refers to growing season temperature (GST). The climate in the south-east and south-central UK, and more widely in other parts of England and Wales, has reliably exceeded the 13°C GST base of a cool climate maturity grouping since 1993. (*Nesbitt et al, (2016))* Moreover in the period 1989-2013, 40% of growing seasons in southern England had an average temperature exceeding 14°C - similar to that of the Champagne region between 1961-1990. GST or Growing degree days (GDD) do not always equate to viticultural suitability; however, they do go a long way to defining the potential to

adequately ripen grapes. The real issue with ongoing reliability in the UK climate is spring frosts and cool wet weather at flowering.

Vineyards are now being planted in regions and countries that in the past would otherwise be seen as too cold, too wet, too high and with too short a growing season. Generally speaking it is accepted that vines are best grown between the latitudes of 34 and 49 degrees in both the southern and northern hemisphere. However we are now seeing that Sweden, Denmark, Belgium, Holland, parts of Canada and, indeed the United Kingdom, which were all once deemed to be unsuitable for the growing of quality grapes for wine, are now planting more and more vineyards. Even countries that have a rich recent history in winegrowing have been expanding further up valleys, and into cooler parts of the country: Tasmania, Australia, and parts of Marlborough, New Zealand, are prime examples of areas that were once considered too cold, too windy, and too wet. In fact, it was only in 1975 that the first vines were planted in Marlborough, and if we look back to the 1971 edition of the World Atlas of wine, New Zealand as a whole wasn't even mentioned.

The past 30 to 40 years have seen a huge upsurge in plantings worldwide, a lot of which have been planted into what were what once perceived to be cooler areas. While climate has a major role in this development, so too does technology and information. The information relating to weather data available has now become so accurate and advanced that is making the choosing of new vineyard sites much easier and no longer a gamble. Twelve years ago, Belgium's vineyard area covered just 72 hectares; last year it was up to 343 hectares.

There are 3 general scales of climate generally recognised: Macroclimate, Mesoclimate, and Microclimate.

> **Macroclimate** relates to the suitability of a region; commonly these figures will come from a major town or city that has long official records. Caution should be taken when looking at generalisations from these however; they are often affected by their own effects on the climate. We can however look at some of this data and know straight away that Yorkshire is going to be a lot less favourable than Kent for growing vines.
>
> **Mesoclimate** relates to the climate of the site as influenced by its local features, whether they be altitude, topography, or exposure. It can extend over a wide area dependent on the uniformity of slope and topography. Other than altitude, air drainage is a major contributing factor to mesoclimate suitability. The ability for land to drain cold air away on frost events is crucial to its suitability for grapes. Cold air will flow like water, so any obstructions will impede the flow and "dam" up cold air, exacerbating the area affected by frost.
>
> **Microclimate** refers to very localised conditions within the vineyard which may have a positive or negative effect. For example next to a building or windbreak where vines may have less exposure and are potentially exposed to higher temperatures.

Despite the change in temperatures now experienced in the UK the biggest risks to grape growing haven't gone away; spring frost and poor weather at flowering still pose a threat in addition to more extreme weather events which have been happening more frequently across the world's wine regions. 2018 saw floods and heavy rain across much of Europe when they wouldn't normally expect to have much at all. 7,100 ha of vines in Bordeaux were affected by hail. In Cotes de Bourg the area worst

affected saw 40% or 2,500 ha badly damaged. In the Blaye appellation, 1,000 ha were decimated by the hailstorms, resulting in them having no crop at all this year, and affecting next year's harvest as well. This is on top of the bad frosts they received last year affecting their production. It is clear that, with the UK's low yields, repeated events such as this would be dire for most producers.

The essence of the challenge presented by cool climate viticulture is that of growing where the weather restricts the ability to ripen grapes and/or there is a threat of serious damage to the vine in winter.

Figure 4: Frosted vines in northern Tasmania, November 2017

5. New vineyard sites

Vineyard site selection has been crucial both in Europe and the new world, with Europe mainly by trial and error over the centuries and, with the latter, generally with a more measured approach. Productivity plays a large role in the sustainability of a vineyard - if it can't reach sustainable levels then it may fail to truly succeed, and a number of factors contribute to its ability to achieve sustainable yields.

5a. Site

One aspect that is critical in the establishment of a new vineyard and wine brand is the actual site of the vineyard. Often little thought is given to site selection, and it is an all-too-common story to see new vineyard owners plant on an existing owned property because they wanted to look out onto the vineyard from their home. Unless the property was bought specifically for this purpose and the site has been assessed for its potential beforehand this is a mistake easily made. While vineyards can be very beautiful to look out on and some sites will be suitable, thought must always be given to whether or not a better piece of land can be had nearby or indeed on the same property. Achieving an average of 8 tonnes per hectare (t/ha) is crucial for long term sustainability, and site selection plays a large role in achieving this. All too many sites highlight just how marginal the UK really is for viticulture. You only have to look at the average yield for the past 10 years to see the industry average yield is generally well behind that of other regions worldwide (*Wine Standards Branch of the FSA 2017*).

While vines will grow almost anywhere in the UK, and on a number of different soil types, it is maximising the potential on the investment that is key.

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Weather plays a large part in the viability of growing grapes particularly in the UK climate. On any given site we can see huge variances in temperature over a couple of hundred metres and this is true for other regions as well. Spring frost damage is a major limiting factor to the potential sustainability of a vineyard. Frosts during spring - when vines have new growth – and, if severe enough, while they are still dormant, will lead to lower yields. Of most concern under normal UK conditions are frosts that occur shortly after bud-burst where the actively growing shoots are vulnerable to freezing temperatures resulting in the loss of the shoot. Economically this can be devastating and can drastically reduce average yields. Tasmania has a similar yield history to that of the UK: much variability year on year mostly due to frost events and poor weather at flowering.

Geographic modelling tools and services such as those provided by Climate Wine now take a lot of the guesswork out of choosing a vineyard site and determining the suitability of a certain parcel of land specific to meso and micro climate. It would be wise to use such services to best ascertain the ideal site on existing land or, furthermore, the suitability of a new site for vines.

The use of an Electromagnetic Conductivity Mapping (EM) survey, which is used widely across many farming systems, has the potential to not only improve wine quality but profitability as well. Soil variability is a key parameter to understand prior to planting. Therefore it is important to ground-truth any electronic survey, but this is easily done with soil pits. An important factor to note is that EM surveys will be disrupted by electromagnetic noise, such as that caused by metal posts and or wire in the vineyard. Therefore it is always best practice to conduct such surveys prior to installation of the vineyard trellis. The ability of EM testing to "zone" blocks - if even only into "high" and "low" potential vigour areas - can have a large benefit by enabling more even growth within a block.

5b. Soils and land preparation

Correct soil preparation is arguably the biggest factor affecting vine establishment. The reason is that the establishment of vines is dependent on root growth and, without the correct soil preparation, roots just will not grow or will not grow well. Often vineyards with a yield problem can trace the issues back to poor soil management in the years before and just after planting. Critically, once vines are planted it is very difficult to influence the conditions of the soil where the roots are, therefore leading to problems down the line.

Vines ideally like free draining soils, even though some rootstocks such as 3309 or 420A are well adapted to growing in damp conditions. While vines on the right rootstock will grow in heavier soils, it is more the soil management prior to planting and during the establishment phase that has a bigger role to play. This is true too for those soils which are more suited to grapes - such as greensand and chalk - as found commonly in the South East of the UK.

Figure 5: A new vineyard site in the Okanagan Valley, B.C, Canada. Previously EM-scanned, problem trees removed, and contoured prior to planting

Soil maps such as those on the Landis soil portal (**http://www.landis.org.uk**) will give a rough idea of the variability of soils on the site, but taking soil samples from different areas that were identified with EM scanning can give a better representation of the site. It is only through sampling that a better understanding of the site can be had.

Like any plant, vines need certain amounts of, and balance between, different nutrients to enable sufficient shoot growth and fruit maturity. Soils should be tested for nutrient availability, and again if needed use an expert to interpret results. Don't just rely on the traffic light system that a lot of soil analysis laboratories use as this can sometimes be misleading. Nutrient deficiencies should be dealt with prior to planting, likewise with pH adjustments. However these are often very difficult to change. Normally Phosphorous (P), Potassium (K) and Magnesium (Mg) are most likely to need some

adjustment prior to planting. Also ensure sufficient Nitrogen(N) in the first development years as this will encourage strong growth and maximise leaf area.

While not an issue for sites that have been chosen with free draining soil, drainage is key for some of the heavier soil types. The heavier clay soils can easily become waterlogged, suffocating the roots of the vines with the lack of oxygen and, as a result, the vines die. While this won't always be the case, vines that are made to struggle in their early years rarely do well. Likewise, with drainage, air penetration is crucial to enable new root growth of the new vines. A good soil structure is vitally important for establishment. There is no "one size fits all" methodology as all soils are different and their past crops will be different. A new vineyard planting on ex arable land will be certainly different to one going into former pasture, and it will be different if the land has been ploughed regularly as opposed to minimal tillage having been practised. Generally speaking a cover crop should be planted in the field that will be vineyard. Something deep rooting like mustard can be a good choice, fast growing with lots of organic matter that can be worked into the soil prior to planting. Green manure crops like this have a number of benefits: they improve soil structure especially those with a deep root system: they help break weed cycles, and prevent erosion which is vitally important in any farming system. Erosion is not limited to vineyards planted on lighter soils, and it can be exacerbated by poor practice.

Many vineyards are now moving towards mechanical weeding rather than the use of herbicides. While this is seen as the sustainable option, it is not necessarily so for the life of the soil. Protecting the soil from erosion is essential to the life of the vineyard. Erosion not only causes issues with the physical properties of the soils and potential problems with moving machinery around but, most importantly, it can have a large impact on nutrient availability and therefore growth and productivity of the vines. The bulk of the soil's organic matter, nitrogen and phosphorous are located in these upper few centimetres and can easily and quickly be depleted. Management systems that maintain some vegetation without disturbing the soil can effectively control a lot of any potential erosion problems.

5c. Planting material

As with any farming the excellence of the end product depends much on what you begin with. In vineyards that is the quality of the planting material. Unfortunately, the vines that are planted may not always be of the best quality, and often, without knowing what to look for, quality is difficult to assess. It is important for new entrants to research from whom and where the best vines are coming from.

Most regions of Canada have been plagued by poor quality vines over the years. This has come about from importing vines from overseas that unknowingly were affected by trunk disease. The product delivered often looked physically fine. However, several years into the lifecycle of the vineyard the problems started to show, sometimes sooner than that. Luckily, there is a wonderful grower extension program across all the Canadian provinces that is educating growers on how to look out for problems in new vine stocks, plus what can be done to alleviate ongoing issues in the vineyard. Trunk disease is an ugly reality in viticulture and the sooner that people understand the risks and are able to act the better.

5d. Scale

What is the optimum scale for a vineyard? This is an age-old question and can only really be answered by the person or people wanting to plant their first vines. How much work is the owner willing to do themselves? Will they be doing all the work with some contract labour to help during peak periods? Labour is a big issue and often a large part of the outgoings of the vineyard.

The financial position of those embarking on planting a vineyard has a major part to play in how viable the business will be. All too often we find new entrants unprepared for the ongoing costs of vineyard ownership. The 2017 NZ benchmarking survey shows that those in the lower income tier of $0 -1.5m have only a 1% return on assets, while those in the $20m+ bracket have an 8.6% return. There are a number of factors to consider when planting a vineyard but the underlying deciding factor of the long-term viability of the venture is the profitability of the business.

5e. Mechanisation

Mechanisation in relation to scale is another factor to consider. The larger the vineyard the more mechanised it has to be to be able to cover the area more efficiently. Often smaller vineyards aren't of a size that warrants the purchase of equipment. In fact in the Okanagan Valley, B.C., one viticulturist considered a vineyard of under 10 acres not even worth owning a tractor. However, many of these issues can be overcome and generally most, if not all, vineyards will have at least one tractor.

Figure 6: A 3 row, 3,000 litre vineyard sprayer on Mornington Peninsula, Australia

However, it is the other more specialised equipment such as leaf-pluckers and trimmers that can prove costly and are often only used for a few weeks of the season. As the industry matures in the UK we are starting to see machinery companies that will hire equipment on day rates, and while this may make sense to begin with, the cost of hiring may outweigh the benefit gained to a small producer. A smarter way of working may be to band together with other similar sized producers in the area to purchase equipment together that would otherwise be too costly. Collaborative sharing of specialist machinery was seen in many countries where smaller growers were grouped together.

Robotics and autonomy are the next step for vineyards, and while the uptake is slow in the wine industry compared to other areas of agriculture, there are certain aspects that are starting to gain traction. To maintain the UK's position of an up and coming wine region it needs to keep up with the

shifts in technology. There are driverless tractors already available within the UK and being put to good use in top fruit. As most vineyards are planted employing GPS it makes it easy to be able to use these tools. The appeal of driverless tractors and autonomy is the potential cost savings, plus the ability to lower costs and quickly complete tasks when needed. During operations in the field good operators are doing more than just driving; they also scout crops and act upon that. The next step will be where monitoring systems and autonomous operations act on this data - much like in broad scale arable with applying different fertiliser levels to certain areas.

How will the public perceive farming with autonomous tractors? Given that there is a move to buy local and support the local farmer, will those using robotics and automation be seen as too corporate? So far, the reactions have been positive. The public realise that farming sometimes has very tedious laborious jobs that are nevertheless necessary. If a tractor can go off by itself and mow for 8 hours (or even overnight) this will free up the grower to do other things and improve their business. The cost and time savings are potentially huge, so that one driverless tractor could soon pay for itself.

Case Study: The Chase Wines/O'Rourke Family Vineyards, Lake Country, Okanagan Valley, British Columbia, Canada

Figure 7: View from the top of O'Rourke Family Vineyard's new vineyard

Situated in Lake Country, the coolest of the Okanagan sub-regions, it is a wonderful example of planning and vision on a new vineyard site. Like many vineyards in the Okanagan this is a stunning site for a vineyard, but it is the planning, vision and design that sets this place apart from others. There are 240 ac of land of which about 100ac are planted. The entire vineyard was cleared of forestry and orchard and then EM conductivity-scanned prior to planting, resulting in a well-designed block and irrigation layout based around the soils.

Rather than following row or vine lines the site was deep ripped in a “flat x” design, to encourage the vine roots to explore more than just where the drip irrigation is watering. Irrigation all comes from Lake Okanagan visible in the photo above. It is pumped to a 2,000,000-litre reservoir at the top of the property, situated at 530m, then filtered and gravity fed with 7 different pressure reducing valves throughout the vineyard. Roughly half of the vineyard is dedicated to Pinot Noir and Chardonnay, with the other half made up of Pinot Gris, Gewürztraminer, Riesling, and Gruner Veltliner. Each varietal and clonal mix has been carefully selected to match the soil properties and eventual targeted wine style and price point from $20 CAD through to $90 CAD.

Glacial deposited silt and clay from the Great Penticton Glacial Lake dominates the lower parts of the block, from 370m down near the road up to the transition zone at 455m. The upper part of the vineyard with less silt and more visible granite is dedicated to Pinot Noir, Riesling, Gruner Veltliner and Chardonnay for their more premium wines, with some Pinot Noir for Rosé around the transition zone. The clay and silt land has been planted in Pinot Gris and Gewürztraminer. This is quite a challenging site with many steep slopes and a huge variance of sub-soil matter across the site. Some areas of the land were deemed too lean and too rocky to plant, and in some cases had to be blasted to create an environment for vines to grow in.

Figure 8: Variations in the granite subsoil clearly evident in this cutting

Beyond the vineyard the future winemaking facilities and visitor experience has been rigorously thought through. 12,000 square ft of caves have been dug and blasted into the granite to create a network of tunnels some 300m long.

Underground the temperature of the caves maintains a constant 10 degrees Celsius, meaning that wines can evolve in barrels at a very stable temperature enabling greater control of their development. Further to this it creates a unique visitor experience quite unlike any other in the Okanagan valley. By creating the "wow factor" it goes a long way to convincing people that the wine will be good, even before a drop has even touched their lips.

Figure 9: It's hard to believe that the house in the foreground was once surrounded by forest

There isn't a one size fits all for the wine industry, but it is true that profitability of a vineyard and wine business is directly linked to the size and revenue-making ability of the property.

Scale plays a part in all businesses, none more so than the wine business, and it is common in the wine industry for corporate takeovers to occur. What I encountered in both Canada and Australia was examples of smaller wine businesses and vineyards being taken over or bought out by larger companies as the industry grows - and this is the key point: growth.

What I encountered in both Canada and Australia was examples of smaller wine businesses and vineyards being taken over or bought out by larger companies as the industry grows - and this is the key point: growth.

The UK is growing at a very rapid rate, much like that of many of the New World wine producing countries have done in the past. Like British Columbia in Canada, the UK vineyard area has in the past been dominated by many smaller growers of hybrid varieties. This will change as the industry matures.

France, and particularly Champagne, is an exception to this rule with many small growers acting as contract growers, or selling to co-operatives. Could this model work within the UK climate? Possibly, but only time will tell.

Planting of a vineyard is extremely capital intensive; it is often overlooked just how much money will be required to get a product to market. Therefore, site is key. A poor or even less desirable site will in fact require more inputs and often give less return.

Preparation and planning are key to achieving greatness.
This is what makes site selection of a new vineyard so important.

6. Market opportunity and business sustainability

Business sustainability in the wine industry is much like that of any other farming operation in that it is a multi-generational model, particularly with larger vineyards and wine companies where the capital investment is so great that returns may not be seen for generations.

The UK has an unusual situation with a large number of small vineyards planted and very few contract growers. Whilst this is changing it should be an area to consider for those looking to get into the industry, especially those with an existing farm and looking to diversify. While wine company purchasing contracts may be structured somewhat differently to what growers and famers may be used to, the basic idea is the same. Unlike arable farming where the product is a commodity, or top fruit where the product is affected by world markets, wine companies will look to enter into long term contracts, usually for at least 3 years if not more.

Case Study: Tasmania

Some of the biggest issues facing the Tasmanian industry are the volume-to-supply ratio. Much like the UK there are a lot of small vineyards - the median vineyard size is 3ha (*Paul Smart, Wine Tasmania*). Most have their own labels but may sell on any excess yield to some of the bigger corporate companies. There are very few contract growers - in stark contrast to the mainland. However, I was told by one member of the wine industry there that to be competitive outside the state the vineyard area needs to be 10 to 15 ha.

This is where the economies of scale come into play once more, and there are a number of factors affecting Tasmanian vineyard profitability. The reasoning behind why a small vineyard can actually be profitable in Tasmania is down to tourism. It is not just a matter of the wine industry driving tourism, it is working with Tourism Tasmania to send a clear unified message. Tasmania has always sold the story of rich soil, pure air and clean water, and what better way to do this than with a product of the land, wine? All literature pertaining to Tasmania and Tasmanian wine has very considered wording, mentioning the purity of the soil and air, elegance and freshness.

For those vineyards of a larger scale transport becomes a bigger issue, and something a lot of growers mentioned as one of their big costs. While the UK has more infrastructure than Tasmania, there are some similarities to draw between the two. Both are islands, so transport will always be an issue for finished product. However the UK industry has the advantage of Europe on its doorstep which means goods and products needed for production are less expensive. Tasmania has no glass production in the state, therefore all bottles need first to be imported from the mainland and then for some of them to be shipped back as finished product.

This is partially why they have such a strong focus on tourism, with over a ¼ of a million cellar door visits per annum and an on-farm gate value of $42 million. This is growing by 4 to 5 % per annum *(Wine Tasmania*).

Wine producers have developed a scheme whereby tourists can purchase wine to send home, therefore circumventing excess baggage charges. It is known as the Tasmanian mixed dozen freight scheme. This allows consumers to purchase a bottle or two from different vineyards as they travel around the state and then have the wine dispatched to home once they have reached a dozen (or multiple of).

This may well be something that could work well for producers in the UK, not only for international visitors but domestic consumers as well. This is yet another example from Tasmania of collaboration with other vineyards. The Tasmanian industry not only works with each other but other primary industries to develop tourism. The Tasmanian Seafood Trail, developed in conjunction with the Tasmanian Seafood Industry Council, allows visitors to discover not only the wines of the region but also the best seafood to pair with them at restaurants, pubs, bars retail outlets and through tour operators. This was apparent not only in collaboration with food producers but with other drinks producers as well. Spirits and beer were also included in a lot of literature and present at cellar doors too. Rather than being seen as competition, they are helping one another with a "local produce" feel to operations.

Another way of boosting business that was evident in all the regions I visited was creating a reason for the consumer to visit that wasn't just about the vineyard and wine. Beautiful and unusual buildings, artwork, complementary products and restaurants on site are all part of selling the brand or selling the story. Many will use these as a drawcard. Previously-mentioned O'Rourke Family vineyards in British Colombia, Canada, have embarked on an ambitious visitor-drawcard project underground.

The UK has an enviable position in the wine world, in that it has a ready-educated wine market at home without the need to incur the high shipping costs many producing regions have to. The key to tapping this market, and selling UK wine, lies in the education of the public.

Figure 10: The Devil's Corner cellar door on the east coast of Tasmania overlooking the spectacular Freycinet Penisula has amazing views and is right on the tourist route. Although impressive this is actually quite a basic set up utilising shipping containers as buildings

7. What can be done to drive the industry and individual businesses further?

7a. Funding and Research

Funding is essential to the growth of an agricultural industry. Now that the UK is leaving Europe it will be essential for industry to drive research.

The Tasmanian industry, whilst smaller than that of the UK, covers around 1,880 ha across 230 vineyards (*Wine Tasmania)* yet still manages to attract significant funding from government. It is their ability to show contribution to the economy and having effective lines of communication with premiers and ministers that has maintained this trend over the years. Wine Tasmania as the industry body represents 95% of the vineyard area; however, a pre-requisite of membership is that the producer must be commercial. This is what is needed in the UK, to differentiate between those whose wine growing is a hobby or lifestyle, and those for whom it is a business. Sure, there is a place for the smaller grower; however, in order to truly represent the industry, the industry body needs to represent those producing wine to make a living.

In order to facilitate quality research, it is imperative that a levy is put on all grapes as happens in other wine producing countries. The Department of Agriculture and Water Resources in Australia has nearly $5AUD per tonne going to research and development. Meanwhile British Colombia in Canada has the highest levies of any in the world, at $10CAD per tonne. Yet because there is a huge collaboration between growers, industry, government and scientists in both countries, not one person that I spoke to in either region had anything bad to say about the levies, and most were at least happy with the research that was being conducted.

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7b. Engaging the customer

Many vineyards I visited were very focussed on selling their story, engaging the customer to buy not just on the day of visiting but to make repeat purchases. Wine Clubs are a way of driving sales. How they work is that the customer commits to buying a certain amount per annum - usually a case or multiples thereof. Much like a vegetable box scheme, but with wine, they usually come with notes from the winemaker or owner and food pairing recommendations.

7c. Tourism

This is really an underdeveloped part of the UK wine industry that needs to be developed more. The wine industry covers all aspects of economies, both primary, secondary and tertiary. It is generally the last that is the most neglected. People often grow the grapes, make the wine, then either can't sell the wine or have nowhere to sell it. Common amongst all the regions I visited is the visitor experience,

creating an experience that is something a customer won't forget and will make them buy into the brand.

Ontario, Canada has around 2 million visitors per annum just for wine tourism, and around 165 wineries, over half of which sell only through their cellar door. This is a phenomenal statistic presented at the Atlantic Canada Wine Symposium by Magdalena Kaiser, from the Wine Marketing Association of Ontario. By using the Vintners Quality Alliance (VQA) appellation system to guarantee the origin of wines, this has helped to sell the story of a "sense of place". Much like the recent Sussex PDO (Protected Designated Origin) or the DOC system used in Spain and Italy, this regulatory system uses not only regional boundaries but also quality parameters for the wine. It is important that the UK develops further PDO regions and sub regions like those used overseas, or at least have recognised regional areas. At present there is little to guide the wine tourist.

It is important that the UK develops further PDO regions and sub regions like those used overseas.

7d. Education and extension

Grower education and extension is a major part of the growth of an industry. A common theme with regions that had successfully developed into a thriving industry is the education of growers and the ongoing development of their skills. This comes back to funding and research but it's one thing doing research, it's another getting that information to growers.

What many consumers often ask is: why is wine grown in the UK so expensive? It actually isn't, it's the perception and expectation that is the stumbling block. Using sparkling wine as an example, the wines produced in England and Wales are mostly made using the Champagne method, which takes time and is laborious. Couple this with historically low yields and it becomes very expensive to produce; however the quality is still there. Often if you compare these wines to Champagne of a similar price point the quality is far superior. The trouble is the UK market is accustomed to drinking Prosecco, which is produced in a much cheaper and completely different way to the traditional methods, which is why it is so much cheaper than other sparkling wines.

Education of not just growers but the public is crucial to growth in the industry as a whole.

8. Discussion: Can the UK vineyard area continue to expand sustainably?

The current growth of the UK industry is such that there is almost a rush to get vines in the ground. This has happened many times in many regions across the world, often to the detriment of the industry. Usually it is the speculators who ruin it for everyone: those who plant a vineyard with no real thought as to where the fruit will end up or where they will sell their wine, which creates a spot market for fruit which drives down the overall price for everyone. Selling fruit or wine too cheaply is dangerous and bad for everyone in the industry and not at all a sustainable model, especially in the UK with its historically low yields.

8a. Growth without losing value

The growth of Ontario, Canada, could be a good benchmark. In 1990 there were 23 wineries there. By 2017 this figure had increased to 160. As an industry they have managed to grow - and to keep their price point, image, and reputation intact.

Tasmania, although smaller than the UK, is another example of how a region has managed to keep its price point intact.

The wine sector has been recognised as an important part of the Tasmanian economy not only in terms of agricultural production but also tourism. As a result the Tasmanian State Government has invested in identifying potential sites to expand the wine industry, and this has led to vineyard sites in Tasmania increasing by 25% (500ha) in the past 5 years (*Wine Tasmania 2016*). Site selection in vineyards has become the main focus there, not only to achieve consistent yields but also quality. This has cemented the Tasmanian reputation for high quality wines and enabled them to maintain a higher price point than those from the mainland.

Figure 11: Infographic source: Wine Tasmania (2018)

The stark contrast between the Tasmanian price point and those on the Australian mainland endorses the need for the UK industry to look after its brand. The change to merging the United Kingdom Vineyards Association (UKVA) with English Wine Producers (EWP) to form WineGB is a fantastic leap forward for the industry and sends a clear message to the wine world that it is an organisation that means business. The merging of the 2 bodies has meant there is now one face to approach government, rather than one for growing and one for marketing. By having an industry body led by an experienced team it is able to drive the organisations.

8b. Labour

Currently the wine industry in the UK has approximately 2,100 full time-equivalent employees, with an estimated 30,000 by 2040. (*Wine GB*) That date is not that far away, and plans need to be put in place now to ensure the future supply of labour both by the industry and by individual wine companies. Due to the labour-intensive nature of the business, labour in vineyards is a huge issue worldwide Often this is migrant contract labour and a reliable supply of this needs to be secured through free movement of workers by government. It needs to be clear that such people generally aren't here to stay, they are here to work and not immigrate.

In Tasmania a lot of the labour comes from backpackers who, after having worked for a period of time on farms in a remote area, qualify for a 2-year visa extension. The entire state of Tasmania is classified as "remote" by the Federal Government. Most will stay in nearby towns or, in the case of southern vineyards, in Hobart city. Some more remote areas such as the east coast of Tasmania have to bus people in. This labour source is very temporary and fickle, and with different people turning up each day it is hard to maintain quality of work. Currently the Tasmanian Institute of Agriculture is researching the future of Tasmania's Agrifood sector to better understand labour needs. Early reports suggest that the challenge being faced is finding good staff who have the skills and are willing to learn and commit to a longer-term career. Support of staff to grow their knowledge and skills is key in growing a reliable workforce.

As with other horticultural industries that require a large number of people seasonally, UK vineyards can't find them all within a local workforce. Some can certainly be sourced locally, and many vineyards do use a local workforce wherever possible, but it is the peak periods that cause the problem.

Hand harvesting in vineyards is incredibly labour intensive and the sheer volume of people needed to harvest the nation's vineyards as the industry grows is going to increase dramatically. It won't be filled by local labour. Vineyard harvest generally only lasts for about 4 to 6 weeks. However with more and more sparkling varietals being planted this will be further compressed - to more like 2 to 3 weeks - as these varieties generally ripen all at the same time.

Could robotic or machine harvesting be an option in the future? Certainly, for still wines, where the need to separate juice fractions isn't such an issue, machine harvesting is an option and will drastically reduce labour costs and time to harvest. It is only a matter of time, as the industry grows, before we see contract services providing machine harvesters. They will be necessary to bring in the crop as the industry grows. Robotic systems are being worked on and certainly robotics for general machinery tasks are beginning to gain traction, but the development of robotic harvesting of fruit is a long way off, as mentioned earlier in the report.

It is not only the *access* to labour but the quality of that labour.

8c. Yield

Wherever any crop is grown, yield is discussed. It is the same in the wine industry. However, unlike commodity crops, which are harvested on tonnage, figures for wine grapes are more complex. Yield is indeed needed to sustain a robust business, but it is hitting the correct yield/quality parameters that matters. For too long the UK has struggled with low yield. This is mostly due to weather and climate, generally linked to site. We have to remember that the UK is at the climatic margins of suitability for growing wine grapes commercially, and robust site assessment needs to be completed to determine suitability before venturing into winegrowing.

Fruitfulness is the major measure of potential yield. As a result training and pruning systems need to be established to maximise this potential. Particularly important in the UK climate is the exposure to light of developing buds during their formative time in and around flowering. Over-vigorous canopies causing shading at this stage can have an adverse effect on the potential for the following season's crop as this is when that year's fruit begins to develop inside the compound bud. Young vines in particular need careful attention during the establishment phase to ensure they are not pushed too soon to crop, as this can cause the vine undue stress.

Most of the yield issues in the UK come down to the weather during two growth stages in the season: frost in spring when the vine shoots are susceptible, and rain at flowering in July when the potential fruit is being set. Spring frosts, specifically during April and May, will drastically affect yields. This has been an issue for many developing regions, none more so than Tasmania; however, in recent years most newer plantings have had fewer problems. Better selection of suitable sites has driven this and, with the work that has been carried out on climate mapping over the years, the ability to find a site with less frost risk is easier. This has brought competition from other crops though, notably cherries and apples.

8d. Mitigating local climate

It is simple to use frost mitigation strategies to improve the viability of a site - both passive and active. Frost fans and overhead irrigation as seen in the image on the next page are common throughout vineyards in New World countries. These would work under most circumstances in the UK, but with its high population density it becomes an issue of public opinion. How well would frost fans that start up in the middle of the night go down with the majority of a population that is disconnected from agriculture? Planning regulations in the UK are much stricter than in a lot of these countries, and it would be difficult to get planning approval to install frost fans. Inverted heat sinks may be a better option and are less intrusive.

Many UK growers currently use heaters or bougies (small paraffin wax heater pots). These work on a basic principle of enhancing heat to increase the temperature under frost conditions. However the systems are relatively inefficient due to the loss of energy and their labour-intensive nature when employed to cover large areas.

Figure 12: Frost fans and overhead irrigation in a vineyard in British Columbia, Canada

Windbreaks can have a major effect on the local climate in a vineyard by slowing down windspeeds. Their use will help increase the ambient temperature of a site particularly in spring when the winds are generally cooling. This will have a knock-on effect with yield and ability to ripen.

Figure 13: Windbreaks in Northern Tasmania to alleviate the effect of prevailing winds

Polytunnels and cloche systems have been trialled and used by some growers in the UK for a number of years now to help improve yields. Their use has proven to increase yield and bring forward ripening in most years.

Figure 14: Pallet wrap cloche system on Vancouver Island

On my travels I saw a couple of vineyards on Vancouver Island that make use of a similar system using pallet wrap, a cheap alternative that is left on the vines up until just before flowering to increase growth. The technique acts in a similar way to cloches, behaving like mini greenhouses that trap the heat and speed up growth. One grower claimed that the final price of the bottle of wine easily paid for the cost of using them, for they enable grapes to ripen to a higher quality and command a premium in the finished product. The only issue is disposal, especially given the growing movement to lessen dependence on plastic - for the pallet wrap, once used, is not reusable.

8e. Processing

In the recent trade survey from WineGB it was estimated that the UK will be producing 40 million bottles by 2040. Where, and how are all these bottles of wine going to be produced and stored? The capacity of current production facilities needs to be drastically expanded, especially as a large percentage of the production will be sparkling. Sparkling wine is generally aged on lees[1] for upwards of 18 months, so capacity and suitability of storage is something that needs to be considered. Future proofing is essential.

Not only bottle storage but processing facilities need to be expanded. It is one thing to grow the fruit, but it needs to be handled and dealt with in a timely manner. The ability to process close to where the vines are grown is ideal and will maintain the quality; however, this won't be an option for some due to planning restraints or space. The industry needs more contract processing facilities in suitable locations to cope with new plantings.

8f. Incentives

Some countries and regions have incentivised planting of vineyards - and replanting of older vineyards with higher quality varieties - to encourage growth of the industry. The "great vine pull" in New

[1] Lees are essentially the dead yeast cells, left over from the fermentation process. They are left in contact with the wine to enhance complexity.

Zealand in the 1980s is one such example. The government of the time paid growers to pull vines to address an excess that was damaging the industry. In fact, what actually happened is most growers pulled out their older, less profitable and less fashionable varieties, and replanted with more in-demand varieties such as Chardonnay and Sauvignon Blanc.

Nova Scotia has in recent years introduced incentives to plant more vineyards. With increased recognition for their high-quality wines both in Canada and overseas, the Nova Scotian provincial government introduced the Vineyard Development and Expansion Program. The program aims to help ensure the on-going viability of the wine industry in rural Nova Scotia. This is achieved by supporting the industry to *"increase production, enhance competitiveness and capture new markets"*. By providing 50% funding up to a maximum of $6,550 CAD/acre, it is drastically reducing the cashflow burden on newly planted vineyards. It is estimated that this will at least cover the cost of tile drainage, vines and the trellis, reducing the per-acre establishment cost by 17%. Given the capital-intensive nature of vineyards this should significantly alter the economic outlook for any new vineyard.

Figure 15 : New Vineyard planting in Nova Scotia

The sustainable growth of the UK vineyard area lies not only with industry bodies but also individuals to form a plan for the next 10/20/30 years to try and work through an outcome to becoming a mature, respected industry. The position the UK wine industry is in at present is difficult, due to the number of different factors affecting it. Will the changing climate benefit the UK industry? Most likely so in terms of grape growing but it will bring other challenges. What other crops will begin to compete for land?

The financial risk is large with any winegrowing business due to its capital-intensive nature. This poses further questions that cannot be explored here, such as the volatility of finance in the future, and its impact on the growth of vineyard plantings.

9. Conclusions

1. Climate change affects wine growing more so than any other agricultural crop. A means of managing and adapting must be worked through.
2. Site selection is the single most important decision facing new vineyards. This will determine the future profitability of the venture.
3. UK viticulture faces some substantial challenges in the future. Those who are planting new vineyards shape the future for the whole industry.
4. Industry collaboration is key to growth. Growers and wine companies need to work with one another, as well as with industry bodies, and research and training organisations.
5. Diversification is key to maintaining a robust business model.

10. Recommendations

1. New vineyards must be planted on only the best sites. Do not settle for a second-class site.
2. Preparation from the outset is key to the ongoing production of the vineyard.
3. Look after the soil, it is the key to increasing and maintaining yields.
4. Plan for the future. Focus. Where is the fruit going to be processed, and who will drink the final product?
5. Industry bodies must continue to work with government to safeguard the labour supply that vineyards will need.
6. Fight to be able to process on site and sell at the farm gate, planning restrictions can hinder growth. Wine is an agricultural product.

11. What's next

During my Nuffield Farming Scholarship travels I visited three different continents to look at developing vineyards and vineyard industries. More importantly than looking and seeing, was talking to those whose lives the industry affected day to day, and finding out what measures or mitigation strategies they have put in place to deal with the problems they have. I met with some fantastic viticulturists, some real characters, and now some lifelong friends. By taking time out from the day-to-day running of things here at Rathfinny I was able to gain a different perspective on both growing and the industry.

Being able to visit other newly developed wine regions has confirmed my beliefs of the overriding necessity of perfect site selection; this goes a long way to ensuring the long-term viability of the vineyard. Furthermore, the correct varietal/rootstock mix for the site is essential; there is no point in trying to grow something that will never ripen. The efficiency of the vineyard in relation to timing of management practices is crucial in order to produce a premium quality, healthy crop year on year.

A key part of my experience as a Nuffield Farming Scholar is that it has given me the confidence to stand behind my convictions and also given me greater enthusiasm to be more involved within the wider industry. I am now a member of two WineGB working groups, and a member of the Wine Curriculum advisory panel for Plumpton College. As a result of my travels I found that some of my theories and strategies for development and growing have been confirmed. I am spending more time on areas that need improvement and have renewed enthusiasm for those areas that are performing well.

I have learnt a lot in my travels, but it was heartening to see that, not only was I already heading in the right direction, but so is the UK industry as a whole.

Cameron Roucher

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