

Article

Transnational Comparison of Sustainability Assessment Programs for Viticulture and a Case-Study on Programs' Engagement Processes

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Abstract: This article documents and compares the most prominent sustainability assessment programs for individual organisations in viticulture worldwide. Certification and engagement processes for membership uptake; benefits; motives; inhibiting factors; and desirable reporting system features of viticultural sustainability programs, are all considered. Case-study results are derived from nine sustainability programs; 14 focus groups with 83 CEOs, Chief Viticulturists or Winemakers from wine grape production organizations from five countries (Australia, Chile, New Zealand, South Africa and the United States); 12 semi-structured interviews with managers either currently or formerly in charge of the sustainability programs; researcher observations; and analysis of documents. Programs were categorized by their distinct program assessment methods: process-based, best practice-based, indicator-based and criterion-based. We found that programs have been created to increase growers' sustainability, mainly through the direct and indirect education they receive and promote, and the economic benefit to their business caused by overall improvement of their operations. The main finding from this study is that the success of each of these programs is largely due to the people driving the programs

(program managers, innovative growers and/or early adopters) and the way these people communicate and engage with their stakeholders and peers.

Keywords: sustainability program; assessment; certification; wine grape; viticulture; agriculture; engagement; self-assessment; focus group; comparison

1. Introduction

This article aims to document and compare the most prominent sustainability assessment programs for individual organisations in viticulture worldwide and their certification processes. Sustainability concerns have become increasingly important since the publication of the “Our Common Future” report by the United Nations Commission on Environment and Development (WCED) in 1987 [1]. Sustainable development was defined as “economic growth that meets the needs of the present without compromising the ability of future generations to meet their own needs” [2,3]. Since then many countries have developed sustainability initiatives to promote sustainable development. Many of these initiatives have in turn generated regulations, especially on the environmental and social aspects of sustainability. Harmful consequences of chemical inputs from agriculture have been a common driver of many agricultural sustainability initiatives [4]. Because of the high value of wine grapes [5], wine grape growing regions have developed some of the most complex sustainability assessments and certifications for individual agricultural organisations. Most of these assessment programs incorporate a triple-bottom line approach, which evaluates entire production systems considering the interrelationship of economic, environmental and social factors [6].

To the best of our knowledge, similar comparisons to this study have not been previously published in other peer-reviewed journals. This article seeks to fill this research gap by describing the following sustainability programs for wine grape growing: Lodi Winegrowing Commission (LWC) Sustainable Workbook/Lodi Rules; Vineyard Team/ Sustainability in Practice (SIP); Low Input Viticulture and Enology (LIVE); California Sustainable Winegrowing Alliance (CSWA)/California Sustainable Winegrowing Program (SWP); VineBalance, New York State’s Sustainable Viticulture Program/Long Island Sustainable Winegrowing (LISW); Sustainable Winegrowing (SWNZ) from New Zealand; Integrated Production of Wine (IPW) from South Africa; Sustainable Wine from Chile (SWC); and McLaren Vale Sustainable Winegrowing (MVSWSGA) from Australia. Where data are available, these descriptions include names of key individuals whose personal enthusiasm and motivation are perceived as essential for the program’s implementation.

Finally, this article presents an analysis of the engagement process of viticultural sustainability programs based on results derived from 14 focus groups with 83 top-level managers from wine grape production organizations. We discuss growers’ expected benefits and motives to become part of sustainability assessment programs as well as the main inhibiting factors and desirable reporting system features that can potentially contribute to program funding and membership uptake.

2. Methods of Measurement and Assessment in Sustainability Programs

Methods of measurement are likely to change over time because of the development of new technologies; however the fundamental principles of measurements and especially of validity are likely to remain the same. “Validity is an overall evaluative judgment, founded on empirical evidence and theoretical rationales” ([7] p. 33). The main validity concerns, within measurements, are “interpretability, relevance, and utility of scores, the import or value implication of scores as basis for action, and the functional worth of scores in terms of social consequences of their use” ([7] p. 33).

Sustainability programs have developed their own assessment methods, adopting and/or adapting other evaluation methods from other sustainability programs in viticulture, agriculture or from other fields such as education, accounting, and management. Minimum fundamental issues must be defined prior to the establishment of the assessment method, such as: a sustainability definition [8]; scope; context; objectives; and viewpoint of the assessment [9,10]. Having these issues defined, assessments must be constantly evaluated regarding their appropriateness, meaningfulness and usefulness [7]. Therefore, in the scope of this investigation, beneficial outcomes from inferences made from assessment results improve wine grapes growers’ sustainability.

Hansen [8] concluded that sustainability is crucial to guide change in agriculture. In order to be able to positively impact on agricultural systems, rapidly respond to the need for change, ensure viability of agriculture over time and be a useful criterion to guide changes, sustainability not only needs to be defined but its characterization should be literal, system-oriented, quantitative, predictive, stochastic and diagnostic. In a previous phase of this project, following focus group meetings, a *sustainable farm or vineyard* was defined as “one that is able to economically provide for the farmer while maintaining its ability to consistently produce and improve quality over time”. In a following phase, it was determined that *assessment for sustainability* must incorporate a triple bottom line including economic, environmental and social components.

Sustainability assessments roughly encompass four stages: (1) definition of assessment method; (2) definition of indicators; (3) attributed scores and weights or compliance and (4) certification (conformance). The term *indicator* is used broadly to indicate any direct, indirect, qualitative or quantitative defined measure of something to assess sustainability within a given system [11]. The assessment method determines which, and how, indicators are used. Scores and weights are subjective values attributed by the proponent of the assessment [12,13], usually based on scientific/expert knowledge and/or assessment goals and context. *Compliance* is related to fitness of the method and content and conformance is directly related to certification of compliance by an external authority [14].

We categorize assessment methods generally in four distinct types based on their overall focus (see Table 1): (1) process-based, (2) best practice-based, (3) indicator-based and (4) criterion-based. Each of these can be used individually or combined and each has weaknesses and strengths. Independently of chosen method, the establishment of benchmarks and performance measures is necessary [10,15] to assist wine growers to improve their sustainability by comparing to their peers and analysing their results and/or performance against program goals. Certification can be developed for any of these methods with a higher or lower degree of complexity; however, it is important to point out that the purpose of certification is marketing. It is to provide a seal of assurance [16] for society that the organisation conforms to a stated requirement [14].

Table 1. Methods of assessment of sustainability (examples from viticulture).

Assessment methods	Focus	Example
Process-based	process rather than the outputs of the activity	Is there is a plan to manage soil erosion?
Best practice-based	implementation of the task, therefore the output of the activity	Were cover crops planted to prevent erosion?
Indicator-based *	past input usage	Record of electricity usage
Criterion-based	compliance to a set of rules	Determines x% of the farm land dedicated to biodiversity

Note: * “indicator” as used in this table, is not understood as a broad concept as described in the text, but purely as a quantitative value.

Process-based assessments are usually based on the International Organisation for Standardization Standards (ISO) standards. In agricultural assessments, a typical example is the implementation of environmental management systems (EMS) through the ISO 14001 standard or through ISO-based locally developed guidelines. The greatest shortcoming of a process-based assessment is that it does not ensure performance outcomes [17,18]. The practical outcome of process-based methods is the production of written documentation (e.g., management plans). Furthermore, the ISO family of standards were developed mainly to provide a model for large enterprises to set and operate a management system. The ISO 14001 is a challenging [19] and costly task for small and medium size organisations [14].

The *best practice-based* assessment method’s strongest point is the practical and immediate pathway to objectively deliver net sustainability gains [20]. Education is a core component of this method [21]. Among the described methods, it seems to be the easiest to engage farmers because of its focus on the sustainability output. Gibson [22] argues that best practice systems should be implemented gradually but the process is not without risk(s). The greatest challenge of this method is to ensure that factors that are not priorities in conventional decision-making process are not left behind. In an example of environmental sustainability assessment, Gibson points out that the effects on the community might not be prioritised. To overcome the problem, definition, scope and trade-off rules must be clearly established prior to the development of the assessment.

Indicator-based assessments rely on reporting of numerical values related to past input use. The weakness of the system is related to the meaningless value of indicator collection when not linked to reference levels. When not related to reference levels, indicators become just a set of collected data [10]. Carbon/greenhouse gas accounting and water footprint methods are typical examples of indicator-based assessments. These examples of the usage of indicator-based assessments oversimplify life cycle assessment methods and are insufficient to understand the dynamics of the interrelationships of system outcomes and resource (inputs) use [23,24]. On the other hand, the strength of this method relates to the small time required for data recording and ability to readily compare data [24].

Criterion-based assessments are assessment methods focused on compliance with legislation or sets of rules from the sustainability assessment program employed [25]. The strength of the method seems to also be its weakness: the method clearly excludes non-compliant (with rules) participants and establishes a clear message of group exclusivity. However, the exclusion can undermine possible participation by growers who are in most need of help to improve their sustainability.

3. Research Method

3.1. Describing/Documenting Sustainability Programs

The most relevant sustainability programs for viticulture worldwide are documented in this article. The description of the programs is based on interviews, observations, and secondary sources. Between December 2011 to January 2014, 10 in-person semi-structured interviews and two semi-structured email interviews were conducted with people either currently or formerly in charge of the sustainability program described in this article. The names and characteristics of interviewees and participants are withheld to honour confidentiality commitments, except where specific permission has been given to reference them. All such references are cited throughout this text as “personal communication”.

Each interview followed a semi-structured schedule which commenced with demographic questions, and then progressed to key questions concerning the creation of the sustainability program they were involved with as well as its assessment methodology, original motivations, certification, engagement processes to maintain the program and strategies to engage new members. Thereafter, each interview focused on the specific responses of the participant. Interviewees also provided observations and opinions of the current situation of the programs. All interviewees were re-contacted in January 2014 to update program statistics and validate texts from their specific programs.

3.2. Expected Benefits, Engagement Strategies, Inhibiting Factors and Reporting Systems of Sustainability Programs

The results from this study are part of a larger 3-stage study in which stage (1) aimed to define sustainability through an Assisted Focus Group Method of Enquiry (AFGME) [9], stage (2) produce a list of indicators for sustainability assessment through an Adapted Nominal Group Technique (ANGT) [10], and stage (3)—reported in this paper—aimed at discussing the engagement process of viticultural sustainability programs through a traditional focus group approach and document and compare the most prominent sustainability assessment programs for individual organisations in viticulture worldwide. Table 2 outlines the questions used in the stage 3 focus group discussions.

Table 2. Focus group question: stage 3 used for this article.

(1) What potential benefits would induce you to participate in sustainability program? What benefits would you expect to receive for your business from participating in a sustainability program for your vineyard?
(2) What reasons would cause you to not participate in a sustainability program?
(3) If you were responsible for implementing a sustainability program, what would you do to engage growers to participate?
(4) Assuming that results oriented foundation is considering sponsoring your program. How would you convince them to fund the project?
(5) Assuming you are the external sponsor. What would you want to be measured?

The stage 3 group discussions were conducted from December 2011 to November 2012 with top-level managers (e.g., CEOs, Chief Winemakers and Chief Viticulturists) of grape growing organisations from five countries: Australia, Chile, New Zealand, South Africa and United States [9].

The countries were selected because of the existence of sustainability assessment programs for viticulture “at the farm-gate” (for individual organizations). This group of countries is known as “New World” wine countries. To the best of our knowledge, at the time of this investigation, there were no similar programs in “Old World” wine countries.

Multiple checks and balances were built into the research design to ensure validity and transferability of the study results [26]. Triangulation was achieved through use of multiple data sources including interviews, focus groups, participant observation, documentation and archival analysis. Cross-comparison analyses were conducted, and findings and results were presented to and discussed with industry and academic panels on multiple occasions.

4. Data Analysis

The program descriptions below were informed by the interview transcriptions and personal observations. Program websites and official program documents were also used as secondary sources to develop the information from the data gathered through the interviews. All data was then analysed in a three-phase process in which first-order analysis combined descriptive- and pattern-coding, second-order analysis for data-reduction using thematic-coding, then third-order analysis using *tag cloud* analysis, which is described in detail below. The coding process was aided by use of NVivo 10 [27], a qualitative data management software package.

Tag cloud analysis is usually used for indexing and searching websites [28]. This was adapted for this study, using tag clouds analytically to aid researcher evaluations of data emphasis and participants’ prioritization of benefits, hidden factors and critical values relating to the stage 3 questions.

Question content and moderators’ utterances were discharged from the coding which exclusively analysed participant responses. Four tag-clouds were created from the seventy most frequently occurring exact words. The tag clouds display the most frequently used words in larger fonts in a circular layout, randomly organized to optimize display space. Tag clouds are pictorial heuristic representations of text with the aim to present a problem in a simplified but sufficient way. Its interpretation is straightforward and requires little explanation [29]. It helps to find solutions to problems through the display of patterns of a given problem [30]. The tag clouds generated and used for analysis in this study are displayed in the Results and Discussion section of this paper.

5. Results and Discussions

5.1. Sustainability Assessment Programs for Individual Organisations in Viticulture

The first results presented here are the descriptions of the sustainability programs investigated for the study. They are presented in the order in which the initiatives for the programs commenced. There is a deliberate emphasis, where possible, on recognising the names of persons who were initiators and drivers of the programs. A finding arising from this research was that the individual persons who initiate and drive programs are critical to the process and its success. In other words, without the initiating and driving people, and the early adopters, it is unlikely these programs would exist as they are.

5.1.1. Lodi Winegrowing Commission Sustainable Workbook and Lodi Rules

Lodi Winegrape Commission (LWC) was created in 1991 with the core objective of promoting the Lodi wine region in California, United States and its wines [31]. At that time, Integrated Pest Management (IPM) was identified as one of the most important issues for wine grape growers. The Grassroots IPM program was launched in 1992 [3,32] and a consultant with a PhD in IPM conducted the group until 1995 when the Commission's budget was reorganized. An IPM organisation was contracted replacing the consultant and Dr Cliff Ohmart became part of the project with the objective to expand it. Ohmart, with a group of innovative growers, was the driving force behind the sustainability initiatives in Lodi. In 1995 the program had its objectives expanded by implementing and tracking the results of a series of sustainable winegrowing projects [33]. The first assessment methodology was based on the *Farm*A*Syst model*, developed by the United States Department of Agriculture (USDA) agencies, regional organisations, universities and local governments. The content of the model was tailored to fit Lodi's purposes [33].

By the end of its first year, 40 growers were directly involved with the project and monitored weekly. The group represented about 1000 hectares and 70 distinct vineyard sites. Many new topics beyond pest and disease management such as ecosystem management and human resources, among others, were included as well as incorporating the knowledge and data gathered from the demonstration vineyards' data [34]. The proposed content was reviewed by a committee of growers, vineyard consultants, University of California Farm Advisors and Scientists, vintners and a wildlife biologist [35]. The first edition of the assessment workbook was launched in 2000. The workbook was about growing quality wine grapes efficiently: the strategy was quality and sustainability was the means [34].

After the launch of the assessment methodology, 40 workshops were organised and scores from 265 growers were compiled in a system that became the basis for the database of the sustainability program. A second printed version of the workbook was published in 2008 and a third in 2013. The self-assessment workbook has the educational purpose of optimising wine grape quality and costs. The Lodi Rules, a third-party certification scheme, was launched in 2005 to respond to the growers' demand for a marketing application for the self-assessment workbook. The certification process encompasses two components: the Lodi Rules (practice standards), and a Pesticide Environmental Assessment System (PEAS), a risk assessment tool that measure the total impact of all organic and synthetic pesticides used during the year by each individual participant grower [36].

In the workbook, each self-assessment topic has four options (plus non-applicable). Self-assessment topics range from questions about soil and water management to ecosystem and human resources. The self-assessment options which range from 1 (least sustainable) to 4 (most sustainable) should be interpreted exclusively within each assessment topic. The Lodi Rules (certification) are designed to lead to measurable improvements in the health of the surrounding ecosystem, society-at-large, and wine quality. To achieve certification, growers must achieve 70% of the total possible (maximum) score plus at least 50% of the total score of each chapter. Protected Harvest, a third party non-profit organization, independently audits Lodi Rules. Vineyards must be audited annually through a rigorous process of in-site inspection prior to harvest and pesticide and nutrient usage post-harvest [35].

Lodi growers were surveyed by the LWC in 1998 and 2003. The surveys and data gathered from the growers' assessments helped the identification of winegrowers' regional strengths and weaknesses

and, therefore, educational needs. Ohmart is a believer of self-assessments for growers: “if you self-assess, you invariably learn something by doing it” [34].

5.1.2. Sustainable Winegrowing New Zealand—SWNZ

Sustainable Winegrowing New Zealand (SWNZ) has its origins in a pilot project started by a group of seven growers from the Hawke’s Bay Winegrowers Association in 1995 [37]. The original motivation was to assess vineyard chemical usage, inspired by international demands and constraints learned from fresh food exporters [37]. At that time, these growers had access to, and adopted, a system called the *Wäidenswil Integrated Production Scorecard* developed in Switzerland [38]. The idea spread rapidly among other wine grape regions and a working group was formed with the objective to develop a sustainability program. In 1997 the group had approximately 120 vineyards self-assessing their operations. Certifications by third party started in 2000. A wineries standard was introduced in 2002 [39]. In 2004, Ms. Sally van der Zijpp was employed as the National Coordinator for the program, a position that she still holds. The scorecard model was fully reviewed and changed in 2007 to embrace the reality of New Zealanders’ growers: new assessment areas were added and the scoring methodology was completely changed. The online system was launched in 2007.

The program defines sustainability as “delivering excellent wine to consumers in a way that enables the natural environment, the businesses and the communities involved, to thrive” [39]. The New Zealand Winegrowers’ Sustainability policy states that wine must be made from 100% certified grapes in fully certified winemaking facilities and certification must be through an independently audited third program (SWNZ or one of the recognized organic or biodynamic certifications). The program aims to provide a “best practice” model, and it is also a quality assurance scheme that addresses consumer concerns and aims to protect the market for wines from New Zealand [40].

To become part of the program members must self-assess their operations online annually and provide supporting documentation for their responses. There is also a data collection of indicators such as water and input use (electricity, fuel records and spray diary). As a premise, the program avoids collection of data that can be gathered through other sources such as government. It also avoids collecting data that will not be analysed or help growers to improve their sustainability in a practical manner. The SWNZ flexibly incorporates practices across a range of business sizes and regions and meets the International Organisation of Vine and Wine (OIV) and International Federation of Wine and Spirits (FIVS) guidelines, in spite of not being accredited by them. The decision not to be accredited is an on-going debate amongst growers because they are unsure about the direct benefits of such accreditations that would increase the program’s costs.

The program is based on three pillars: monitor, measure, and manage. Currently, the measures that SWNZ focuses on are water, energy and agrochemical use. Members are required to supply their spray diaries. Reports produced from growers’ data are analysed and reported back to growers and also used by New Zealand Wines to represent the industry needs, for research purposes and discussions with government.

The self-assessment consists of three sets of questions: major, minor and best practices: Majors are mandatory, minors are generally relevant practices and best practices are the next step up. Questions

can be answered in the following ways: yes or compliant; no or non-compliant and non-applicable (NA). Questions are followed by a list (to be ticked) of applied strategies, which growers select.

Compliance with all major questions and 80% of minor questions are required to achieve certification. If 100% of major questions are not achieved, corrective actions are required to pass. A second on-site inspection may or may not be requested, depending on each situation. Questions are supported by a guidance text and pertinent excerpts from the Standard. The program also sets maximum chemical sprays per target and demands comprehensive justification in case of extra spray needs [37]. Questions, results and benchmarks are not readily available to the external public but widely used in the NZSW's website texts including growers' individual profiles. The program is focused in engaging all members of the wine growing community.

Program auditors, from independent third-party organisations, work closely with the program managers. Vineyards need to meet the program requirements at an initial inspection in order to be certified, then are inspected again every three years. Auditors are encouraged to provide advice to growers to help them to meet the Standard's requirements. This is similar to the educational approach taken in the Integrated Production of Wine (IPW) program in South Africa (described below), but to a smaller extent. Certificates are issued by SWNZ based on inspection results. Certification is still voluntary [41,42], however since 2010, the New Zealand Winegrowers, the body responsible for promoting the brand New Zealand Wines, made vineyard and wine accreditation to the SWNZ (or one of the recognized organic or biodynamic certifications) a pre-requisite to participation in promotional events. As a result, 90% of the wines produced in New Zealand became part of the SWNZ.

5.1.3. Vineyard Team (Sustainability in Practice—SIP)

In 1994, a group of growers, wineries and service providers in California, in the United States volunteered to create the Central Coast Vineyard Team (CCVT). Two years later, the Positive Points System (PPS), a self-assessment on sustainable vineyard practices was launched and 20 vineyard assessments were performed. In 1999, their database had 200 growers. In 2000, the membership program began. The group grew steadily with a strategy of engaging the community and vineyard neighbours in informal meetings and viticultural educational initiatives [43].

In 2004, the CCVT began the development of a third party certification program called Sustainability in Practice (SIP) Certification. SIP Certification was designed to be a distinguishing program with requirements for certification, which authenticate vineyard practices and distinguish their wines in the market. According to the SIP Certification Manager, SIP it is not a certification that every vineyard can achieve. All of the questions are practice-, as opposed to process-, based and are auditable [44]. The *PPS* was used as foundation to the development of the certification. The pilot project for the certification program was launched in 2008 and 14 vineyards, representing 1200 hectares, became certified in the region. Certification is now extended to the whole state of California.

The program's standards are annually updated and peer-reviewed by a vast group of Universities, Government departments and industry associations. Currently, the program only assesses vineyards but wineries are able to certify their wines, which allows them to use a *SIP* Certified seal on a wine bottle provided that a chain of custody audit shows that the final product is made with at least 85% *SIP* Certified fruit. A certification for sustainable winery production is being developed. Certification

must be renewed annually in a three-year cycle: on-site inspection in the first year and evaluation of demanded records, a combination of paper audits, interviews, and on-site inspections in years 2 and 3 [43,45].

5.1.4. Low Input Viticulture and Enology (LIVE)

The creation of the Low Input Viticulture and Enology (LIVE) in Oregon, USA, has its roots in a mid -1990s presentation arranged by Dr Carmo Vasconcelos, a Portuguese researcher at the Oregon State University, and conducted by Dr Ernst F. Boller, a founding member of the International Organization for Biological and Integrated Control (IOBC). After Boller's presentation, a few individuals from the audience realised that they were already practising and sharing similar principles to those presented by Boller [46]. The creation of an official assessment program based on IOBC guidelines was initially proposed by a winegrower, Mr Al MacDonald, who was also involved with the University. Low Input Viticulture and Enology program (LIVE), a voluntary organization, was then established in 1997 by a group of Oregon winegrowers led by Mr Ted Casteel [47].

The pilot project started with about 20 vineyards and the group was voluntarily inspected through a partnership developed with the Oregon State University. The objective was to understand their level of compliance with the guidelines. In 1999 LIVE was incorporated and certified by IOBC to certify individual farmers. In the same year the inspections were conducted by independent third party contractors with IPM—integrated pest management expertise. In 2006, the program was expanded to include growers from Washington State. In 2007, LIVE hired Mr Chris Serra as a paid Program Manager who was promoted to Executive Director in 2011 (LIVE, 2013). All Board members and technical committee members were and still are volunteers.

The assessment system is freely available on-line on the LIVE website [47]. Transparency is the key part of their strategy to engage growers and consumers: the first to join the program and the latter to trust what the LIVE brand stands for [48]. Growers need to join the program to have access to a username and password to access all functionalities of the on-line system and to have their data saved and considered for inspection by the program management. All educational resources and administrative documents are available as well. The program has the objective of promoting viticulture in conjunction with environment preservation and conservation of the vineyard and surrounding areas, a farm's economic viability and support to its social, cultural and recreational aspects. Also, to sustain healthy and high quality grapes with great emphasis on minimizing pesticide residues, by encouraging biological diversity and use of natural regulating mechanics and unwanted side effects from agro-chemical handling.

The program assessment is comprised of mandatory record keeping (pesticide, fertilizer, and irrigation), 5% of farm area set aside as a biodiversity and ecological compensation zone and a checklist of 13 chapters, each one with a series of topics, called “control points” [48]. The approved pesticides lists are specific to two vineyard locations based on climate: Region I refers to cool-weather maritime climate and region II refers to warm-weather continental viticultural climate. The check list follows a colour scheme rationale where Red control points are 100% required, which means that full compliance is mandatory to become part of the program. LIVE requires 90% of the Yellow control point and 50% of the Green control points. The system was developed to avoid members concentrating too heavily on any one given area of assessment [47].

Certification is only achieved after completion of two years of farming under *LIVE* standards. Farmers have to be inspected in the first two years of the program. After passing the second year inspection, they can be certified by an independent third party, if program requirements are met. Certification must be renewed every three years but any member is subjected to random inspections at any time. Additionally, members certified or not, must submit their records every year.

5.1.5. Integrated Production of Wine (IPW)

The Integrated Production of Wine (IPW) scheme was promulgated by a South African governmental Act in November 1998. IPW is one of the three schemes managed by the Wine and Spirit Board of South Africa (WSB). WSB is also responsible for the Wine of Origin (WO) claims (origin, cultivar and vintage assurance) and the Estate Brandy Scheme [49]. The first IPW certifications started two years after the program's promulgation in 2000. The work developed by the Agricultural Research Council (ARC) was used as the background of the program content. As the main agricultural research organisation in the country, the ARC has been conducting and funding research as well as disseminating information and education since its establishment in 1990 [50].

The Wine of Origin (WO) scheme was mandatory, highly regulated and regimented at the time IPW started. According to Ms Sue Birch, former head of Wines of South Africa (WOSA), WO was not itself a marketing message for the wines produced in South Africa. Likewise, IPW did not have a strong marketing direction or intent. The WOSA, in collaboration with IPW, was behind the introduction and design of a new seal "integrity and sustainability guaranteed" in 2010, incorporating the WO seal's attributes. The new seal ensures not only origin but also 100% certification under the IPW program. This seal is voluntary. The WO seal still exists, for wine being currently bottled from vintages previous to 2010 or for wines that failed to meet the IPW requirements or blended with uncertified grapes [51]. Although the original driver for the program was not retailers' demands the seal [49,50] added integrity and a clear message about the wines produced for the retailers [52].

The IPW program is based on two main documents: the guidelines and the manual. The guidelines present recommendations of what should be done, as well as minimum standards and the manual is a practical document showing the pathways for the implementation of the guidelines and completion of the self-assessment for further third party auditing and WSB certification. The wine labels drive the certification process. Wineries must be compliant with the guidelines, as well as 100% of the grapes used to produce the wine. Each bottle has a seal, which is uniquely numbered [53] which ensures integrity and traceability of the process at the consumers' level through the South African Wine Industry Information and Systems (SAWIS) website [53].

The farm/vineyard component of the IPW program consists of a set of guidelines focused on critical aspects for good agricultural practices related to grape production [54] and minimum compliance with the South African legislation (environmental related issues, food safety, labelling and social aspects). Farms with vineyards are verified annually through the completion of the self-assessment and require farm and production records. The guidelines and manuals are reviewed and updated bi-annually. The program assessment is compliant with FIVS and OIV.

Growers must reach 60% of the total points of the program to comply and become *IPW* certified. The self-assessment is undertaken on an annual basis and independently audited on a spot check

basis [54]. Growers are allowed to score zero, two, three and five, in a scale of zero to five, for each criteria. Only auditors are allowed to score one or four. The self-assessment is then sent back through the online system with the pertinent documentation. One third of the wine producers are inspected annually, therefore all members are inspected in a three-year cycle [51]. The number of vineyard inspections will be driven by the origin of the grapes.

In South Africa, there are about 70 Producer Cellars, which are wineries that receive and process grapes on behalf of a group of wine grape growers [55]. Each Producer Cellar has an *IPW* coordinator, responsible for liaising with *IPW* and meeting the program requirements. The chief viticulturist usually fills this role. The Producer Cellars produce about 90% of the total wine in South Africa [50].

Enviroscientific, the auditing body for the WSB, conducts the audits and advises the WSB on who can/may be certified if/when found compliant. They are an independent group formed by scientists (with at least a Master's degree) with demonstrated field experience (at least 5 years). The auditors are not allowed to be involved in any agricultural products sales. Auditors are paid by *IPW*, unless the grower fails and needs to be re-inspected. In this case, the grower has to pay for the re-inspection. Additional supporting documentation is accepted by the auditing body after the initial audit, within a specific time frame, if this was the reason for failure. If inspected growers do not reach the pass mark by about 5%, a shorter re-audit can also be arranged. Unlike ISO14001 audits where auditors are not allowed to provide any advice, the *IPW* auditors point out pathways to reach the pass mark, provide information about minimum requirements of South African legislation used by the program assessment, share scientific knowledge and suggest training when the need is perceived. The core objective is to help growers to meet the requirements while ensuring credibility of the program [51]. The consultative audits, conducted as part of the South African *IPW* program, are one of the most complex and strict auditing processes of its kind.

In South Africa, two other schemes, created about 10 years ago, are also directly related to wine grape sustainability: Biodiversity and Wine Initiative (BWI) and the Wine and Agricultural Industry Ethical Trade Association (WIETA) Code. The first one is related to the conservation of the Cape Floral Kingdom (CFK), the richest and also the smallest plant kingdom on the planet [56] and WIETA is related to fair labour practices [57]. BWI requires *IPW* accreditation, as a condition to become part of the group. In the South African wine industry, “the ultimate goal is to have one seal, issued by the Wine and Spirit Board, that certifies the Wine of Origin information (vintage, date, variety), the environmental sustainability (*IPW*) and the ethical treatment of workers (WIETA)” [58].

5.1.6. California Sustainable Winegrowing Alliance—CSWA/California Sustainable Winegrowing Program (SWP)

In the late 1990s a group of the wine industry executives determined that sustainability was one of the important issues that needed to be addressed by the wine industry in California [59]. Several sustainability initiatives were already in place in wine regions such as Lodi and the Central Coast in California. The California Sustainable Winegrowing Program (SWP) was originated in 2001 through a partnership of the Wine Institute and the California Association of Winegrape Growers. The California Sustainable Winegrowing Alliance (CSWA) was formed in 2003, a year after the first edition of the SWP workbook was published, with the objective to implement the SWP [60]. Part of the Lodi and

Central Coast sustainability programs and other related regional and statewide efforts, were adapted and adopted by *CSWA* for use in its Code of Sustainable Winegrowing Program Self-Assessment Workbook [32]. The Certified *California Sustainable Winegrowing* program was launched in 2010 as a third-party certification to verify adoption of sustainable practices and continuous improvement. The *SWP* was developed as a statewide sustainability assessment program. It was felt that a state-wide program would create a common base for sustainability goals in the state and also promote sustainability of California vineyards and wineries as a group [59]. The statewide initiative also aimed to become an important educational channel for the wine industry providing an objective pathway to continuously improve organisations' sustainability through better operational and management practices.

The vision of the *SWP* is “the long-term sustainability of the California wine community”. To place the concept of sustainability into the context of winegrowing, the program defines sustainable winegrowing as “growing and winemaking practices that are sensitive to the environment (Environmentally Sound), responsive to the needs and interests of society-at-large (Socially Equitable), and are economically feasible to implement and maintain (Economically Feasible)” [61]. The program's development is guided by values such as to: increase and optimise grape quality; protect and conserve the environment; maintain the long-term viability of agricultural lands and community; ensure economic and social wellbeing of farmers and employees; and support research and education among others.

Currently the program encompasses two sets of assessments: indicator collection and the self-assessment workbook. The workbook assessment data is publically reported in statewide sustainability reports presenting counts of responses as percent distribution of responses. These reports are available on line and are an indication of the Californian self-assessment results for the workbook topics. The indicators, called “Performance Metrics”, are water use, energy use, greenhouse gas emissions and nitrogen use. At the time of publication reports on the performance metrics were still not available. However, benchmarks will be generated per acre and per ton of fruit production for vineyards, and per case for wineries, and will be available when they have sufficient data to produce statewide benchmarks. Most information regarding the assessment and administrative documentation is freely available on-line.

The current workbook version (3rd Edition) was released in January 2013. The online assessment is only available to California participants through a user name and password. The assessment topics are presented in increasing scenarios (options/categories) from 1 (least sustainable but within regulatory compliance, if regulations exist) to 4 (most sustainable). From the results of the self-assessment, growers are encouraged to produce an action plan to set their own sustainability goals for improvement. The workbook is available for sale through the website for non-participants. The key component of the engagement process for participants is education. More than four hundred seminars and workshops have been organized about vineyard and wineries issues throughout California to provide education on sustainability [59].

The program is described as having participants rather than members. Participants self-assess their operations and most of them report the results back to the *CSWA* to produce the program's sustainability reports emphasising strengths and weaknesses of the state. Most growers joined the *SWP* because of its educational benefits [59].

Many participants became certified to meet customer demand for sustainable certification including retailers, distributors, restaurants, and consumers. Independent third party auditors are accredited by

the CSWA to conduct audits. CSWA has a mix of practice-based and process-based certification centred on the continuous Plan-Do-Control-Act (PDCA) developed from Deming's Plan-Do-Study-Act (PDSA or Shewhart) improvement cycle [62]. To retain certification status, growers must pass the initial certification audit, update the online self-assessment and action plan annually (with targets and times), and complete an annual audit. In most cases the on-site audits are on a three-year cycle so, in intermediate years, auditors review annual SWP assessment and action plan during an off-site audit. The certification program also includes a minimum of 50 vineyard and 32 winery prerequisites that must be achieved. There are minimum scores and rules for each one of these prerequisites [61].

5.1.7. VineBalance, New York State's Sustainable Viticulture Program and Long Island Sustainable Winegrowing

The VineBalance program, launched in 2004 was a result of a series of initiatives, initially driven by water quality concerns in both the Finger Lakes and Long Island [63]. In 1997, Dr Tim Martinson, from Cornell University became the local extension educator with the Finger Lakes Grape Program. He was tasked with writing an "Agricultural Environmental Management (AEM)" worksheet for grape growing. The AEM for grapes was inspired by the work developed by dairy farms in reservoir watersheds in state of New York, particularly around Keuka Lake.

Meanwhile, in 1992, Long Island grape growers where developing management guidelines to emphasize good stewardship practices for the region [64]. The assessment developed by Martinson as well as the LIVE and Lodi programs inspired the development of the guidelines. In 2004, the initiatives developed by Martinson and Long Island growers merged.

At that time, Martinson was approached by the National Grape Cooperative to develop a sustainable practices workbook for grapes. The National Grape Cooperative is a subsidiary of the Welch Food Inc., that represents about 1300 members; producers of grape juice and table grapes [65]. The National Grape Cooperative has adopted VineBalance as their production standard [66]. The project was funded by a larger grant from the New York Farm Viability Institute and resulted in the VineBalance program, a joint initiative of the Finger Lakes Grape Program, Lake Erie Regional Grape Program and Long Island's Grape Extension Program.

VineBalance was developed to answer industry groups' demand to develop "an outreach and educational program to promote the adoption of sustainable viticultural practices in New York State's vineyards". The grower self-assessment workbook sections were developed using materials from two previous programs in New York: NYS Agricultural Environmental Management (AEM) worksheets and the Long Island Sustainable Practices Workbook. During the winter of 2005–2006, a steering committee composed of extension, research, industry and growers' representatives from National Grape Cooperative, Centerra Wine Co., as well as Finger Lakes and Long Island vineyards reviewed the original topics and added new content to the program to address the diversity of the distinct wine grape growing regions (Long Island, Lake Erie and Finger Lakes) in New York State. In 2006, 15 growers volunteered to become part of the pilot assessment using the new workbook. Feedback from growers was used to improve the content. In 2007, the VineBalance's New York Guide to Sustainable Viticulture Practices Grower Self-assessment Workbook was publically launched [67].

The workbook is the program's foundation. It has eight chapters containing 134 topics. Each topic has four options from 1 (most desired, most sustainable) to 4 (least desired, least sustainable) plus NA (non-applicable). Most questions have an explanatory section about the rationale used to develop the promoted practice plus additional resources for further education. It assesses a combination of specific production practices used to manage soil, vines, water, pest and disease and promotes education about sustainable options for improving growers' sustainability. The self-assessment is followed up by the production of individual action plans (with templates provided by the program) for the growers [67]. Martinson emphasises that the action plan, developed from self-assessment, is the key component to promote positive sustainability outcomes: "What should change? What can you afford to change?" [68].

Martinson defines himself as a "university extension person" and from their standpoint at the Cornell University; they felt that it was up to the industry groups to decide how they wanted to use the workbook developed by them to communicate with their consumers. For him, the success of VineBalance can be measured by the adoption of their assessment methodology by the industry. VineBalance does not have a certification scheme, as its main objectives are to educate and promote the adoption of sustainable practices. However two different groups, Welch's with the juice grape growers and Long Island Sustainable Winegrowing with high-end wine vineyards have adopted VineBalance using two different approaches. Since 2012, the Long Island Sustainable Winegrowing (LISW), a non-profit organisation started a certification process based on the VineBalance workbook [69]. The process was started by a group of four wineries, which worked with Alice Wise's team from the Cornell Cooperative Extension to write a specific code for certification [63]. Eleven growers were certified in the first year through independent third party audits [70].

The certification started in 2011. Initially, it only covered the Green chapter. By the end of 2012, the Red and Orange chapters were added to the certification process. Independent third party certifiers that are accredited by the program conduct the audits. A minimum three-month implementation period, prior to the first certification cycle is required. Certification must be renewed every two years. The process certifies the company's sustainable management from the winery's viewpoint, giving them the right to use the "Certified Sustainable Wine of Chile" seal. The certification has different rules depending on ownership, based upon the minimum percentage of total surface area included in the certification process, as the program distinguishes vineyards owned or long-termed leased (type A) by wineries and external vineyards (type B). The program stipulates a progressive increase in the proportion of total vineyard area under the certification process, required to reach certification [71].

5.1.8. Wines of Chile—Sustainability Program

In 2009, the Wines of Chile, a non-profit organisation representing 95% of the bottled wine exported from Chile, released the Wines of Chile Strategic Plan 2020. The Plan points out sustainability as one of its key principles and empowered the Consorcio Tecnológico (Technological Consortium)—the technical arm of the industry—to develop a sustainability program. Retailers' demands for sustainability initiatives and certification were the main drivers for the creation of the program [72].

A joint project between industry representatives and the University of Talca started the development of the Sustainability Code. The Code became the foundation of the Wines of Chile Sustainability Program, which encompasses a series of initiatives, with the objective of establishing a

sustainable wine industry in the country. The Code covers three areas: Vineyard (Green Area), Winery and Bottling plant (Red Area), and Social (Orange Area), and provides a checklist of control points and a compliance standard which establishes the requirements in the three areas. The green area focuses on natural resources, pest and disease, agrochemicals and job safety and has 18 critical points of assessment [71,73]. The red area contains chapters about energy, water management, contamination prevention and waste. Finally, the orange chapter considers all social issues and includes relationships with the workers, community, environment and clients.

The program accepts two levels of participation: Level 1 (training and education) and Level 2 (certification). The certification started in 2011. Initially, it only covered the Green chapter. By the end of 2012, the Red and Orange chapters were added to the certification process. Independent third party certifiers that are accredited by the program conduct the audits. A minimum three-month implementation period, prior to the first certification cycle is required. Certification must be renewed every two years. The process certifies the company's sustainable management from the winery's viewpoint, giving them the right to use the "Certified Sustainable Wine of Chile" seal. The certification has different rules depending on ownership, based upon the minimum percentage of total surface area included in the certification process, as the program distinguishes vineyards owned or long-termed leased (type A) by wineries and external vineyards (type B). The program stipulates a progressive increase in the proportion of total vineyard area under the certification process, required to reach certification [71].

5.1.9. McLaren Vale Sustainable Winegrowing Australia

The McLaren Vale Sustainable Winegrowing Australia (MVSWSGA) program has its origins in the early 2000s. Since that time, the McLaren Vale Grape Wine and Tourism Association (MVGWTA) developed a series of viticultural initiatives with the objective to improve viticultural practices, fruit quality and financial viability in the region. These initiatives included seminars and workshops; a growers' bulletin (CropWatch) providing information from nine weather monitoring stations and pest and disease alerts for the region, research trials and information days. The Association also released a Financial Benchmark for McLaren Vale growers in 2005, and a Pest and Disease Code of Conduct in 2006, which was voluntarily endorsed by the growers in 2007. In this same year the Soil Management, Water Management and Preservation of Biodiversity Codes were also released.

The program creation was influenced by a visit from Ohmart (who developed *Lodi Rules*) to McLaren Vale in the mid-2000s. Ohmart's visit was hosted by Mr James Hook, who was then employed by the MVGWTA. In 2008, the then-Chair of the Association, Mr Dudley Brown, formalized the project with the argument that: "while this (all viticultural activities promoted by the MVGWTA) yielded great on farm results, we were unable to measure and discuss the outputs of our investment with ourselves or the outside world because we were not measuring the results". From this realisation, the Generational Farming program was born with the purpose of monitoring and measuring results and promoting best viticultural practices based on sound science. Mr Jock Harvey, local grower and a former Chair of the MVGWTA was the project leader with the goal of developing Hook's outline into a regional sustainability program, including a certification scheme.

Ms Jodie Pain took on the Viticultural Officer role at the Association in 2008 and continued to develop the project. Pain developed the assessment book with the voluntary assistance of a group of growers put together by Harvey. In 2009, Generational Farming was officially launched and an assessment book (workbook) was made available for the growers in the region. Hook continued to contribute to the program, authoring two of its six chapters. At the time, about 50 growers decided to self-assess their operations. By the end of 2010, the MVGWTA decided they needed an employee dedicated to the Generational Farming program. Viticulturist Ms Irina Santiago was hired as a part-time employee for this role. The data from 41 growers (representing 56 vineyard sites) were collected in 2011 and Santiago reviewed and revised the assessment methodology and developed a reporting system. The workbook was re-written by local growers and the program was re-named to McLaren Vale Sustainable Winegrowing Australia (MVSWGA) to be more easily found by others searching for their program. Volunteer workbook authors were growers with either extensive experience and/or formal education in viticulture.

The new method of assessment is similar to that of the Lodi and CSWA workbooks, in that, it replaces yes/no questions with scenario questions ranging from zero (explicitly unsustainable) to four (most sustainable) as well as non-applicable (NA). This methodology differs from the Lodi and CSWA workbook methods with the addition of having a “zero” scoring option. Growers from McLaren Vale followed the methodology to develop program content based on assessment topics that most impacted their sustainability. The content of the assessment is updated annually and peer-reviewed by independent experts, mostly from universities and governmental departments recognised globally for excellence in the relevant fields.

The MVSWGA method of assessment has three main principles: (1) assessment over time; (2) grower sustainability levels identified on a continuum and not on a pass/fail basis; (3) the assessment and reporting system must be useful for the grower to understand their sustainability status and be able to improve it. In contrast to the other certifications which have a single category of compliance, the MVSWGA places growers into four certification categories: category 1—red, needs attention; category 2—yellow, good; category 3—green, very good; and category 4—blue, excellent. The sustainability level is determined by attributing a weight to each topic, section and chapter from the assessment method. It is expected that very few growers can reach the blue level in the program. The program’s content also changes annually to incorporate any relevant and commercially feasible scientific findings to the assessment. To continue in a certain category growers must update and improve their operations to align with the current content of the assessment of a certain category. This way, the workbook does not only show the pathway to improve sustainability in every assessment topic but also promotes continuing improvement through content update. The program assessment is compliant with FIVS and OIV [74].

Ten percent of program members are randomly selected annually and audited by a third-party. These audits are paid for by the MVGWTA, including the on-site inspections. Audits are in place to ensure credibility of the growers’ sustainability levels based on their responses. There are specific rules and penalties that, in extreme cases, can lead to a member’s exclusion in case of discrepancies between inspections and the self-assessment answers and data reporting. Audits are also available to members who wish to become certified. Certification audits are carried out every three years, whereas self-assessment, random inspection process and data reporting through the on-line system are annual.

The online system uses GPS coordinates to identify each vineyard block and relate it to the spray diaries. The reporting system cross-tabulates regional disease pressure on vineyards (*i.e.*, spray targets) and chemical usage, as data is entered.

The MVSWGA program uses a systemic assessment that combines relevant indicators and best-practices and processes to indicate a clear pathway for growers to improve their sustainability at their own pace, using a triple bottom line approach (economic, environment and social).

5.2. Comparison of Programs

The main characteristics of the most relevant sustainability programs for viticulture are displayed in Table 3. The programs from Chile, South Africa and New Zealand have a national scope while the others are regional. McLaren Vale Sustainable Winegrowing Australia is the only program that has its scope limited to a single wine region. All the other regional programs have at least a statewide scope. Lodi is the pioneer of sustainability initiatives among all programs and LIVE conducts the oldest certification scheme. VineBalance is the only program that does not hold a certification scheme but other initiatives that do lead to certification (such as newly started Long Island Sustainable Program) were derived from it.

Program website addresses, number of members, certified vineyards and area they represent is also shown in Table 3. All programs are voluntary. However, New Zealand Wine has a quasi-compulsory situation [42], as to be included in international marketing, promotional and awards events, wines from vintage 2010 onwards must be certified. This creates and helps explain the strong adoption rate (90%) in New Zealand.

Of the programs reported in this paper, South Africa's program is the only one that is regulated. South Africa's WO scheme was already in place and mandatory when the IPW started. When the IPW and WO scheme merged, IPW embraced the traceability and integrity features of WO and added legislation compliance and sustainability topics to the scheme/assessment. Wine grape growers in South Africa seem to be extremely conscious about the importance of preserving and conserving the natural resources of the country as well being able to ensure to (predominantly) international consumers that they are "doing the right thing". Because of the level of organisation of the wine industry, IPW also became one of the tools to enforce South African legislation for farms and wineries. In spite of not being mandatory, the big cooperatives, largely, only buy grapes that are certified. Also, it is currently difficult to sell wines from South Africa without the IPW seal. All of these factors helped the broad adoption (92%) of IPW by winegrowers.

The assessment types used by the sustainability programs for viticulture are not completely comparable against each other. However, even when it is not explicitly stated in a program's literature for "assessment topics and content" (e.g., IPW), it was apparent to researcher observation and through discussion regarding tacit embedded assumptions in articulated goals, that all programs embrace, to a certain extent, the triple bottom line approach (economic, environmental and social). For instance, in South Africa (IPW), an embedded protection system for chemical operators that is not explicated in the assessment literature is assumed knowledge and is fully assessed during the audits. Similarly, in South Africa, there is a stated intent for future purposes (see Section 5.1.5) to integrate the separate programs that will make these tacit assumptions more explicit.

Table 3. Wine growing sustainability programs comparison.

	Lodi Winegrowers' Workbook/ Lodi Rules	Sustainable Winegrowing New Zealand (SWNZ)	Vineyard Team/ Sustainability in Practice (SIP)	Low Input Viticulture and Enology (LIVE)	Integrated Production of Wine (IPW)	Sustainable Winegrowing Program (SWP) *	VineBalance	McLaren Vale Sustainable Winegrowing Australia (MVSWSGA)	Sustainable Wine Chile
Country	United States	New Zealand	United States	United States	South Africa	United States	United States	Australia	Chile
Scope	Regional, mainly Lodi but also California	National	Regional (California)	Regional (Oregon and Washington States)	National	Regional (California)	Regional (New York state)	Regional (McLaren Vale)	National
Year of establishment	1992 (as the Grassroots IPM program)	1995 pilot (commercially in 1997)	1996 (Positive Points System) 2008 (SIP)	1997 (pilot) 1999	1998	2003 (CSWA)/ 2002 (SWP)	2005	2009	2009
Year of establishment of certification	2005	2000	2008	1999	2010	2010	NA	2012	2011
Wineries certification	Yes **	Yes	No	Yes	Yes	Yes	No	No	Yes
Number of members/vineyards	Not available	94% of the total vineyards in New Zealand	300 (VT)	289	3000 farms —95% of the wines produced in South Africa	954 (SWP)—55% of statewide acres	75 (2008)	119 members 191 vineyards	79 (level 1 &2) vineyards or wineries
Vineyard area acres/hectares	Not available	33600 hectares	80,000 acres in Vineyard Team membership	10,639 acres	93,155.96 hectares (92.6% of total in South Africa in 2011)	293,404 acres—69% of statewide acres	6,560 acres	2929 hectares—39% of total area under vine in McLaren Vale	Not available

Table 3. Cont.

	Lodi Winegrowers' Workbook/ Lodi Rules	Sustainable Winegrowing New Zealand (SWNZ)	Vineyard Team/ Sustainability in Practice (SIP)	Low Input Viticulture and Enology (LIVE)	Integrated Production of Wine (IPW)	Sustainable Winegrowing Program (SWP) *	VineBalance	McLaren Vale Sustainable Winegrowing Australia (MVSWSGA)	Sustainable Wine Chile
Certified Vineyard area	25,709 (Lodi Rules)	33,600 hectares	31,600 acres	9342 acres	93,155.96 hectares (92.6% of total in South Africa in 2011)	62,455 (11.6% of statewide acres)	NA	Not available	Not available
Number of certified members/vine yards	72 members	1784	174	251	3000	187	NA	22	46 vineyards or wineries
Educational objectives	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Program content peer-reviewed	Yes	No	Yes	Yes	Yes	Yes	No	Yes	No
Different sustainability levels for certification	No	Yes	No	No	No	No	N/A	4 levels. Higher level demands 75% of available points	Yes
Prohibited chemicals list	PEAS requirements (Lodi Rules)	Yes, from New Zealand legislation	Yes (high risk pesticides are not allowed)	Yes. Two distinct lists based climate of vineyard location	Yes	No	NA	Yes, adopted from AWRI ***	Yes, for herbicides

Table 3. Cont.

	Lodi Winegrowers' Workbook/ Lodi Rules	Sustainable Winegrowing New Zealand (SWNZ)	Vineyard Team/ Sustainability in Practice (SIP)	Low Input Viticulture and Enology (LIVE)	Integrated Production of Wine (IPW)	Sustainable Winegrowing Program (SWP) *	VineBalance	McLaren Vale Sustainable Winegrowing Australia (MVSWSGA)	Sustainable Wine Chile
Certification	Pass or fail (must exceed 70% of the overall points available plus at least 50% in every chapter)	Pass or fail (must reach 100% of major questions and 80% of minor questions)	Pass or fail (Participants must meet 75% of total points including all requirements)	Pass or fail. 100% (Red control points) + 90% (Yellow control points) + 50% (Green control points) +5% farm area set aside for biodiversity	Pass or fail (must reach at least 60%)	Pass or fail. Certification requires scoring a 2 or higher for specific criteria, or have an action plan in place to improve performance *	NA	Sustainability level validation: Red (from 0 to 25%), Yellow (from 25.1% to 50%), Green (from 50.1% to 75%) and Blue (more than 75.1%)	Pass or fail (must reach 100% of critical points and at least 60% of the score)
Assessment type	Best practice-based + indicator based	Best practice based + indicator based	Best-practice based + indicator based	Best practice-based + indicator based + criteria based	Best-practice based + criteria based + indicator-based	Process-based	Best practice-based	Best practice-based + process based + indicator based	Best-practice based
Promotion of viticultural training	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Third party certification	Yes (Lodi Rules)	Yes	Yes (SIP)	Yes	Yes	Yes (Certified SWP)	No	Yes	Yes

Notes: * California Sustainable Winegrowing Alliance ** Lodi wineries' certification only on the change of custody (proof of segregating certified from non-certified grapes); *** list from AWRI [75].

Table 4 summarizes program content and the number of assessment topics of programs and/or certification. The economic component is directly evaluated by Lodi, SIP and SWP in their business management chapters. All the best practice-based programs assess economic sustainability through the analysis of the adoption rate of best practices and the potential to reduce costs by optimizing resource use and fruit quality. Economic sustainability is understood through a diverse correlation of data from best-practices benchmarks.

Many programs analyse economic sustainability using value indicators to understand measurable outcomes (e.g., yield/area and inputs/area). MVSWGA reports this type of data and SWP is currently developing such correlations. Economic sustainability is also evaluated through regional socio-economic indicators such as average grape price per ton per variety, land price, wine bottle prices from the region, new planting areas, planted area, longevity of current vineyards, and similar measures. The governments of Australia, New Zealand, United States and South Africa collect and publish this sort of data which is used by the programs.

Programs located in countries with no specific chemical usage legislation (allowed, restricted and prohibited inputs as well as withholding periods) for wine grape growing, usually developed their own chemical list. These lists, in turn, became a requirement to meet their sustainability standards. Australia seems to have one of the strictest chemical usage legislation specific to vineyards and based on a sum of all export markets requirements. “Agrochemicals Registered for Use in Australian Viticulture” [75] is published annually by the Australian Wine Research Institute (AWRI) and distributed for free for all members of the wine industry and also as an insert in a trade magazine. This resource is also publically available online [75].

All programs use best-practice assessments, however, they use it in different combinations, as demonstrated in Table 1. While all programs have sustainability focus, motivations and outcomes vary. Some are driven primarily by education, others by certification. Most have a combination of these two goals in some form. For instance, VineBalance is a program with no certification, but Long Island adopted the VineBalance program and standards and used them to develop a certification scheme. IPW, LIVE and SWNZ are certification schemes in nature but enable participation, education and support without certification for wine growers who are unable to meet (or are in process of meeting) certification standards. Some programs may or may not lead to certification by the individual wine grower’s choice—CSWG, Lodi, SWC and Vineyard Team. These programs have a certification scheme in place but certification is independent of sustainability program participation. Similarly, MVSWGA also has optional certification. However, all members (certified or not) are subject to random third-party audit to validate responses from self-assessment. MVSWGA is the only program that embraces four different levels of sustainability certification.

Overall, the idea of creating each one of these programs came from a group of progressive/innovative growers who were aware of the need for operational improvement of their activities. Certifications were developed to ensure external credibility (marketing) of what was happening in their vineyards. For those programs that developed sustainability assessment for wineries, the main driver was to communicate (or, market) the sustainability message in a more systemic way. Increasing environmental concerns, as expressed through large retailers’ demands, were also taken into consideration. It is important to raise the issue that certification only attests to compliance with the standard of a nominated program, and makes no claims to individual standards of vineyards that have chosen not to participate or certify.

Table 4. Sustainability programs for viticulture: number of assessment topics and content.

	Lodi Winegrowers' Workbook/ Lodi Rules	Sustainable Winegrowing New Zealand (SWNZ)	Vineyard Team/ Sustainability in Practice (SIP)	Low Input Viticulture and Enology (LIVE)	Integrated Production of Wine (IPW)	Sustainable Winegrowing Program (SWP) *	VineBalance	McLaren Vale Sustainable Winegrowing Australia (MVSWSGA)	Sustainable Wine Chile
Number of Assessment topics	125 (Lodi Rules) 160 (Lodi Workbook)	80	225	190	Approx. 120 **	191	134	165	228 topics (Green and Orange Area), 35 critical points ***
Assessment topics	Business Management	Organisation Management	Conservation and Enhancement of Biological Diversity	Farm Records, Self-Inspection, Training and Traceability	IPW Training	Sustainable Business Strategy	Soil Management	Soil Health, Nutrition and Fertilizer Management	Soil evaluation and management
	Human Resources Management	Resources Management	Vineyard Acquisition/Establishment and Management	Biodiversity, Ecological Infrastructures	Conservation and Improvement of Farm and Vineyard Environment	Viticulture	Nutrition Management	Pest and Disease Management	Design, planting and care of the ecosystem.
	Ecosystem Management	Soils and Nutrient Management	Soil Conservation and Water Quality	Site Selection	Soil and Terrain	Vineyard Water Management	Vineyard management	Biodiversity Management	Vegetable material for planting.
	Soil Management	Frost Protection	Water Conservation	Site Management	Cultivars	Soil Management	Irrigation Management	Water Management	Weed management
	Water Management	Ground Cover Management	Energy Conservation and Efficiency	Varieties, Rootstock, Sowing/Planting Aspects	Rootstocks	Pest Management	Weed Management	Waste Management	Nutrition and vigour management

Table 4. Cont.

	Lodi Winegrowers' Workbook/ Lodi Rules	Sustainable Winegrowing New Zealand (SWNZ)	Vineyard Team/ Sustainability in Practice (SIP)	Low Input Viticulture and Enology (LIVE)	Integrated Production of Wine (IPW)	Sustainable Winegrowing Program (SWP) *	VineBalance	McLaren Vale Sustainable Winegrowing Australia (MVSWSGA)	Sustainable Wine Chile
Assessment topics	Pest Management	Water Management	Air Quality	Plant Nutrition and Fertilizer Use	Vineyard Layout	Wine Quality	Pest Management	Social (Work, Community and Wineries relations)	Pest management
	Vineyard Establishment and Replanting (LWW)	Plant Protection	Social Equity	Irrigation	Cultivation Practices	Ecosystem Management	Pesticide Management		Disease management Training
	Viticulture (LWW)	Spills and Emergency Procedures	Pest Management	Integrated Plant (Crop) Protection	Nutrition	Energy Efficiency	Continuing Education		Handling, storage and application of agrochemicals
	Shop and Yard Management (LWW)	By Product Management	Continuing Education	Harvesting and Food Safety	Irrigation	Winery Water Conservation And Quality			Vigour management
	Wine Quality and Customer Satisfaction (LWW)	Energy	Product Assurance and Business Sustainability	Animal Density and Welfare On Mixed Farms With Livestock	Pruning, Training and Trellising	Material Handling			Handling loads Working life quality
		Contractors		Worker Health and Safety	Crop and Canopy Management	Waste Reduction And Management			Care of water sources and watering management

Table 4. Cont.

	Lodi Winegrowers' Workbook/ Lodi Rules	Sustainable Winegrowing New Zealand (SWNZ)	Vineyard Team/ Sustainability in Practice (SIP)	Low Input Viticulture and Enology (LIVE)	Integrated Production of Wine (IPW)	Sustainable Winegrowing Program (SWP) *	VineBalance	McLaren Vale Sustainable Winegrowing Australia (MVSWSGA)	Sustainable Wine Chile
Assessment topics		Conservation		Salmon-Safe Whole-Farm Protocols	Growth Regulators	Environmentally Preferred Purchasing			Records
		Logo			Integrated Pest Management	Human Resources			Marketing and commitment with consumers
					Handling Chemicals	Neighbours and Community			Energy and fuel use
					Record Keeping	Air quality			Waste management
									Biodiversity
									Ethics
									Environment
									Community

Note: * California Sustainable Winegrowing Alliance ** IPW bases its audits on its guidelines. 120 represents an estimation of minimum number of assessment topics based on the guidelines. The number might be greater as some questions are complex. *** Some of these topics might refer to the winery's assessment, therefore, number of assessment topics for vineyard matters might be smaller.

The sustainability programs that are currently in place, with great membership uptake, have a strongly motivated and technical manager with a powerful interpersonal network. The importance of the interpersonal networks in innovation adoption (sustainable practices in the context of this investigation) is exhaustively discussed by Rogers [76]. This is the case in New Zealand, Lodi, McLaren Vale and Oregon for instance. These program managers seem to be strongly supported by the wine grower community. It was observed that this situation seemed to be driven by growers' perception of their program managers' strong technical skills in viticulture and ability to manage all aspects of the program. The important role of these program managers can also be perceived as their greatest weakness, as it is uncertain the direction such programs will take when these manager are not in their roles anymore. Succession planning was never discussed during this study, so retirement or withdrawal of entrepreneurial and driving leaders is likely to have a severe negative effect on program performance, similar to the negative effects of a lack of succession planning in private businesses [77,78].

5.3. Creation of Sustainability Assessment Programs in Viticulture: Engagement Processes; Enabling and Inhibiting Factors

Third order analysis of the focus group discussions used a qualitatively analysed and content-analysis driven visualisation that resulted in four tag clouds that were subsequently analysed in three segments that are described in the following sections: benefits; inhibiting factors; and engagement process.

5.3.1. Benefits (Question 1 from Focus Group)

Eighty-three top-level managers from the wine industry from five countries were asked in 14 focus group sessions about the potential benefits to induce their participation in a sustainability program. They were also asked to list specific benefits they would expect to receive from a chosen program. The qualitative analysis of the transcripts shows that the educational aspect is the most important benefit gained by participants in sustainability programs and one of the core reasons for participation. Education was expressed as an objective opportunity to self-improve (Figure 1a). According to participants, education is the main consequence of the sustainability self-assessment and benchmarks derived from the collection of their peers' results as well as interaction with peers and training promoted by the program's management. This result endorses the viewpoint of Ohmart who emphasises the improvement opportunity growers receive by just being part of sustainability programs [34]. All programs listed in this article had origins directly related to the need to promote operational improvement in their vineyards.

There was a limitation in the analysis software that originally made it difficult to align quantitative results with the qualitative results. This was significant in the results on the topic "education" as seen in Figure 1a, which displays the tag cloud created in Nvivo10, from Stage 3, question 1 of the focus group discussions. The term "education" only appears as the 32nd most recurrent word in the analysis of all transcripts and is displayed in very small font on the bottom left of the tag-cloud—a result inconsistent with the clearly established importance of education in all other findings, which is why the qualitative results are critical in understanding the focus group results. Content analysis methods and the role of the investigator in making analytical choices to produce meaningful results have been widely studied in the academic literature [79–81]. If a qualitative analysis of the transcript was not

conducted, and the results relied solely on the tag-cloud interpretation, it could lead to a misinterpretation of the results.

Figure 1. (a) Benefits and **(b)** inhibiting factors for growers' participation in wine growing sustainability programs.



The qualitative analysis of the transcripts showed that many displayed words were directly expressing educational aspects, such as “better”, “practices”, “standards”, “vineyard”, “improve”, “improvement”, “information”, “knowledge”, “technical”, “benchmarks”, among others—giving us a deeper and richer insight into the importance of education to the participants of this study. Each content analysis must be seen as a unique situation, and tag-clouds are still powerful displays of contents [28,29,82], so are used here to display these results.

The term “people” is the most recurrent term followed by “marketing”. In the context of the interviews, “people” represents program managers, program peers and community members where vineyards are located as well as consumers. This result seems quite understandable as programs are created for people (in the context of this investigation, wine growers) by people to promote sustainability in vineyards. Sustainability encompasses the economic (business, quality, practices, product, fruit, buy, wineries, amongst others), environmental and social (community, region, people) components. Marketing helps to create the bridge between the winegrowing/making processes with the external world, to assure consumers. The qualitative analysis also pointed out marketing as the second most expected benefit. The terms “marketing”, “market”, “wine”, “certified”, “certification”, “endorsement”, “buy”, “credibility” and “story” are intrinsically related to public external validation, and therefore the accountability of sustainability assessments. All the terms displayed in the tag-cloud are intrinsically related, intersecting many of the benefits listed by participants. All these tag-cloud results align consistently with, and highlight the key factors brought out in the qualitative analysis—that educational focus, people, and marketing are core drivers and benefits for participation in sustainability programs.

5.3.2. Inhibiting Factors (Question 2 from Focus Group)

The inhibiting factors for participation are presented in Figure 1b. “People” is displayed as the most important factor to drive wine growers away from a sustainability program. In this context, “people” represented two very specific situations directly related to the credibility of the program: (1) the program managers, if they are seen as someone that lacks appropriate background or experience to run the program, or be able to interact or provide any technical benefit for the wine growing community; and (2) program peers, when they are not really sustainable but try to use the (good) perceived image of other members to increase their own value, compromising the credibility of the group as a whole. Participant 56 says: “I could be practicing a very high level of sustainability and because I’m practicing in a very high level and someone is just saying they’re sustainable...they’re benefiting from the kind of practices that I’m utilising but they are not really doing anything...” Participant 40, from another group says: “Accreditation (to a program) is often a risk...you have people who abuse the system and if there is a scandal involved with accreditation then you’re all painted with the same brush...in our business, we try as much as possible to put maximum effort in between all accreditations so that our customers will entrust (sic) us rather than our accreditations”[83].

In summary, the other inhibiting factors are cost; time consuming paperwork; lack of appropriateness (and a low bar) of the assessment; lack of useful information provided back to growers; absence of business improvement or marketing benefit, programs that are too prescriptive; and confusion between sustainability and farming system choices (e.g., organic). There are many pathways to achieve sustainability in winegrowing, which is a context-dependent situation. Not all innovations (in this context, sustainable practices) are desirable for all situations. In agriculture, for instance, the needs and reality of small-sized organisations differ greatly to the ones from large commercial farms [76]. We suggest that the role of sustainability programs should not be telling growers how to grow grapes but contribute to their education to help them to optimize quality and costs, comply with legislations, minimize impacts on environment and ensure a healthy working environment for employees.

The prescriptive factor that might inhibit growers to become part of the sustainability program was discussed by Andrew Jefford in the *Decanter Magazine*, when writing about a visit to a traditional French vineyard where the owner, Jean Orliac, expresses deep dissatisfaction about certifications in general: “For us, agriculture is an *art modeste*, needing lots of experience and reflection... The role of the winegrower is to be in some sense a free man.” Jefford states: “a small-scale, independent winegrower in almost any country on earth is an unusually free individual—meaning that, once debt is repaid, they are economically beholden only to themselves, and that their work involves making decisions (key to existential notions of freedom) rather than conforming to a pattern of behaviour acquired from or imposed by others” [83].

5.3.3. Engagement Process (Question 3 Focus Group)

Just as the major strengths in programs and leaders tend to be the greatest weaknesses, in the same way, the factors that promote sustainability programs and participation are also the same factors that inhibit wine growers participation. The balance between cost and time vs. benefits and credibility will

drive wine growers' participation in sustainability assessments. Figure 2 shows the tag-cloud created from the third question of this section of the discussion. For example, when growers were asked about the strategies they would use if in charge of engaging other growers to become part of a sustainability program, the majority of the growers referred to the benefits they had listed before. Additionally, they would emphasise success stories from members involved with sustainability programs.

Many participants mentioned that current members should be the main focus of the program management. Participants pointed out that their stories and the changes promoted by adoption of sustainable practices would drive the engagement of new members. Furthermore, it was emphasised that it was important to demonstrate that the group is stronger than individual growers. For instance, among the economic benefits, accreditation of the program with wineries and retailers and a consequent payment of a bonus price for the grapes would contribute to membership uptake.

Figure 2. Engagement process for growers' participation in wine growing sustainability programs.



5.3.4. Reporting and Sponsorships (Questions 4 and 5)

When asked about how the program should report results to obtain funding from external sponsors, including government(s), “benefits to people” was the most important outcome that should be demonstrated through measurements (Figure 3). Not only benefits to the growers themselves, through the perpetuity of their businesses, but especially social benefits promoted by the program to their employees and community. The direct and indirect social-economic impact of the grape-growing activity as well as the benefits to the environment should be used as the main reasons to attract sponsorship. According to participants, the benefits to the environment could be demonstrated through preservation and conservation actions, including water as well as chemical reduction from vineyard

management practices improvement. Program popularity among growers, measured through membership in relation to the total number of growers, should also be taken into consideration when approaching sponsors for the program. When programs are voluntary, membership and acreage numbers seem to be the most direct measurement of program relevance for growers.

Figure 3. Suggested results reported by wine grape growers to obtain funding for wine growing sustainability programs.



6. Conclusions

Most research on sustainability emphasises the environmental impacts of productive processes. However, environmental issues were not the main drivers for the conception of sustainability assessment programs for viticulture. The environmental aspect is incontestably important and all programs have embraced environmental sustainability as part of their assessments. Nevertheless, successful programs like those described in this study have been created to increase growers' overall sustainability, mainly through the direct and indirect education they promote and the overall economic benefit to their business caused by overall improvement of their operations. The universities involved played an essential role in the development of these programs aiming to improve grape growers' sustainability. Ultimately, viticultural research should be driven by the need to keep the wine industry alive, over time, or in other words sustainable.

This study lays the foundation for multiple avenues of future research. A deliberately imposed limitation of this study included the exclusion of "old world" wine growers as there was no known

relevant sustainability assessment program for viticulture at the individual organisational level. Therefore, there is clearly a need for investigation into issues of “old world” wine growing sustainability.

Opportunities to further develop the research reported here exist in two dimensions: linearly within the wine industry chain or laterally within other agricultural pursuits or other fields. The linear dimension could be developed to further look mainly at: (1) the impact and usefulness of sustainability programs on improving growers’ sustainability; and (2) the impact at the farm level of the increasing demand for sustainable schemes by retailers as a requirement for wine purchase and exports. The lateral dimension could be similarly developed as the linear dimension, but from the development of a sustainability definition and elaboration of appropriate and meaningful indicators in other agricultural crops or other fields where sustainability programs are being implemented or reviewed. These two dimensions would contribute to the sustainability of world agriculture.

Agriculture is the cultivation and harvesting of crops [84] and the primary purpose of agriculture is to meet the demand for agricultural products, mainly food, but also raw materials for fibre production [85] to maintain and enrich life. In the context of this study, the purpose of wine grape growers is to produce grapes to produce wines and to do so sustainably; *i.e.*, “be able to economically provide for the farmer while maintaining its ability to consistently produce and improve quality over time”[9]. The main finding from this study is threefold: that the success of each of these programs is largely due to the people driving the programs (program managers, innovative growers and/or early adopters); the way these people communicate and engage with their stakeholders and peers; and the usefulness of the developed program to improve sustainability. This is consistent with the findings from a study conducted in 2009 by Gabzdylova *et al.* [86] in New Zealand, which suggested that “people” is one of the main drivers of sustainability initiatives in the wine industry.

Sustainability assessment programs in viticulture only make sense if they are useful to help growers to improve their sustainability in the context of the community and environment in which they are located.

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Author Contributions

Irina Santiago-Brown organized the focus groups, performed interviews, organised and interpreted data and wrote the manuscript. Andrew Metcalfe, Cate Jerram and Cassandra Collins supervised the development of work, helped in data interpretation, manuscript evaluation and edits.

Conflicts of Interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication with the following exception: Irina Santiago-Brown has participated in research collaboration with some of the informants in this study and also manages and has developed the McLaren Vale Sustainable Winegrowing Australia program.

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