

4-2018

Discussions on Increasing the Sustainability of Perennial Crops Through Informed Precision Decision-Making

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Recommended Citation

Ebert, David, PhD; Yau, Calvin; Valero, Andres; Karimzadeh, Morteza; Guo, Jingjing; Asimont, Lise; and Butzke, Christian, "Discussions on Increasing the Sustainability of Perennial Crops Through Informed Precision Decision-Making" (2018). *Purdue VACCINE workshop reports*. Paper 1.
<https://docs.lib.purdue.edu/purvacwr/1>

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Discussions on Increasing the Sustainability of Perennial Crops Through Informed Precision Decision-Making

Post-Workshop Event Report

David S. Ebert, Calvin Yau, Andres Valero, Morteza Karimzadeh, Jingjing Guo, Lise Asimont, and Christian Butzke

I. Overview

In order to better understand the struggles and practices of growers in improving sustainability, two one-day workshops were conducted in California in April, 2018. The workshops brought together local growers, academic research groups, local, regional, and state agencies, and sustainability groups to discuss practical ways to increase sustainability, economic, environmental, and community, through the adoption of new technologies (see appendix for a list of attendees). All attendees were knowledgeable about the concept of sustainability in growing perennial crops. For readers who might be less familiar with the concept, here, we provide an exemplar definition by the California Sustainable Winegrowing Alliance: “The vision of the Sustainable Winegrowing Program 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).”

Discussion Goals:

1. Engage growers, large and small producers, community leaders, sustainability associations, resource control organizations, technology researchers, and academics to identify key barriers, gaps, and opportunities that can be addressed to improve economic and ecological sustainability and policy development.
2. Determine what is needed to help all community members to work together to understand the issues, business, and policy implications of field-level decisions to community-level and state-level decisions.
3. Use concerns, resource availability, emerging opportunities, and forecasts for the current growing season as a discussion platform to focus ideas, critical gaps, and future directions.
4. Evaluate where emerging science and technology may help with sustainability.

Initial Key Questions That Were Addressed:

1. Where is this region in achieving its sustainability goals, and what are the issues, problems, and concerns that have arisen?
2. What are the most pressing community and watershed sustainability needs/issues, and how can these be balanced with small and large growers' economic sustainability?
3. How can we determine the most effective sustainability-supporting policies with active and positive engagement of the entire community?
4. How can a grower determine the economic tradeoffs of deploying new technology and traditional management practices?
5. Will new technology and scientific research help achieve these goals, and what are the impediments to making them work for growers and community members?

II. Executive Summary of Key Findings

The workshop included local growers, sustainability workers, and researchers from the region who each have their own understanding of and approach to sustainability. The two workshops provided a chance for conversations among the different groups and identified the below challenges in adopting new sustainability-focused technologies. **A fundamental, overarching need that permeated all discussions was the need to evaluate and understand the return on investment of new technologies, their impact on labor needs, costs, crop quality and yield.**

- **Sustainable Labor in the Future:** Growers are concerned with the lack of incentive for low-skilled workers to join the vineyard workforce. Because of the 'long hours and low pay' reputation of farming (which is not always an accurate description, but remains common), younger generations are less willing to begin a farming career. The current workforce will soon reach retirement age, and there may not be enough new workers to support farming in its current form. Unfortunately, the contribution of labor to the final cost of the product remains unclear. New technologies may reduce the need for low-skilled labor, but will require proper training of the new and the current labor forces.
 - **Key point: Sustainable labor is a growing major struggle for farming in both the short-term and long-term and automated technologies to address this issue have to be investigated in terms of cost, implementation, workforce retraining, and crop yield and quality. Labor impact of any sustainability practices need to be analyzed and considered.**
- **Understanding and Trusting New Technologies:** There is an overwhelming amount of data generated and collected, and the producers are interested in better utilizing this data. However, they lack the proper tools to effectively and efficiently distill this flood of data into relevant and actionable information. Growers are not opposed to the idea of adopting new technologies to support such tasks. However, options are simply overwhelming. Growers face difficulty in understanding the time, economic, and

environmental costs and benefits of investing in these new technologies. Moreover, they have been continuously presented with new technology companies trying to sell them the next game-changing solution and not all such technologies have proved reliable, resulting in wariness to the newest solutions.

- **Key point: There needs to be a better way for the growers to understand and compare different pieces of technology offered to them. Tools/packages and possibly standard metrics and scales of cost/benefits need to be developed to increase the adoption of technology to improve sustainability.**
- **Water Usage Policies:** Growers predict new and stricter regulations related to water usage in the future and anticipate adverse effects on their farms; local growers are often not involved in policy-making related to water, and most decision-makers do not fully understand or consider the impact that new policies may have on growers and smaller farms. Moreover, both groups often lack a science-based understanding of the impacts of such policies. The changes in water-related policies along with climate change mean that many of the older farming practices will no longer be valid, which increases uncertainty regarding the future for the growers.
 - **Key point: Evolving water-use policies need to be science-based, informed by local and regional practice, environment, and economic factors, and developed collaboratively by grower associations, policy boards, and the research community. This will result in the most beneficial community-wide, regional, and statewide policies to achieve sustainability.**
- **Knowledge Gaps and Training:** Growers and developers of new technologies have very different domain knowledge. Growers often encounter technologies or research results that suggest methods that are contradictory to their own experience and their understanding of their land. This firsthand knowledge is rarely collected, shared, or taken into account when it comes to new policies or technologies. Collaboration between developers and growers is needed to create effective solutions for sustainability. Additionally, growers often lack the training to utilize potential new technologies. Training programs should consider different stakeholders. For example, the implementation of a new technology normally not only requires changes to field activities, but also changes in management and decision-making.
 - **Key point: Growers' experiences need to be incorporated into the development of newer technologies, and training should be included as part of the package when offering a new technology.**
- **Barriers to Incorporating Precise Agriculture Techniques:** Growers, especially in the central region, see staff time for training and adoption of new technologies as a major impediment. Growers, especially small growers, do not have time to understand and evaluate all of the developing new technologies on the market, how they can be integrated into the workflow and practices, and if there is a positive return on investment of implementing the new technology. Growers understand the benefits and drawbacks of their old practices, but do not always have access to this information when it comes to new options.
 - **Key point: Expected return on investment and adoption/implementation time for precision agriculture technologies needs to be able to be evaluated and clearly understood by growers. The performance of the technology needs to be evaluated for the region, crop characteristic, production goals and business profile (small, medium or large producer).**

- **Key Point: Unclear Return on Investment and business impact of new technologies are a major impediment for the adoption of new technologies.**
- **Sustainability - Economics is a key component:** Growers expressed that they do care deeply about their land and ecological sustainability; however, their main priority remains profitability. With limited time and resources, growers often cannot afford to put extra effort into increasing ecological sustainability, especially if they do not understand the economic sustainability impact or it may not positively affect it.
 - **Key point: When developing/promoting new technologies that advance sustainability, it is important to address the economical benefits too.**

III. Detailed Recommendations for Addressing the Identified Challenges

In this section, we provide conclusions and recommendations resulting from the panel discussions and working groups.

Start by Having the Conversation

- The first step towards being more sustainable is simply being aware of the issue - having the conversation. It is important for the growers to agree to what it means to be sustainable, understanding the importance of sustainability not only to the environment but also to their business. Through self-assessments and increased awareness, growers can better understand their current practices regarding sustainability as well as identify areas for improvement. For an issue of this scale it is also beneficial for growers and sustainability experts to establish channels for communication and ideally collaboration.

Provide Education and Training

- Education is fundamental to the success of any program or implementation of precise agricultural techniques. Initially, a pilot experience in the region is an excellent way to show neighboring farmers how the system works and the results and benefits of its use. Such pilot showcases can also give farmers important first-hand experience operating the technology and integrate it into existing setups for their specific needs. Workshops also play an important role in generating awareness around new technologies and can serve as initial training, while follow-ups are key to ensuring continued and successful use of the new technology.
- For many growers, limited time is a major barrier to understanding, installing, and adapting to a new technology or practice. Providing hands-on training and easily understandable material on the methods and science can increase grower adoption.
- Crop advisers, sustainability association representatives, and extension personnel are a valuable source that can provide education to growers to better understand the options they have, the impact, outcomes, and ROI of sustainability technologies and practices. Trust and unbiased evaluation/discussions (e.g., not promoting/selling a specific product) are keys to the success.

Start Small and Simple

- Researchers and technologists presenting new options to growers should be mindful of the cost and effort required to implement each technology. For small farmers, having access to affordable technology is very important for the implementation of precision agriculture. In addition, the technology needs to be integrated into tasks that the farmer is already performing, rather than requiring new time-consuming steps. The interface of the technology needs to be able to not just improve data collection, but integrate and still information to relevant and actionable information. Moreover, these solutions need to also generate reports in a format farmers can then present to the appropriate agencies.
- The financial investment of purchasing new equipment and the energy and time commitments required to learn and implement new practices contribute to the difficulties growers often face when adapting to new technologies. It may be an easier transition in starting to adopt precision agriculture practices to start small. Starting with simpler equipment/changes makes for a smaller commitment and enables the growers to better understand the new changes/equipment, their impact, the improvements to their practices immediately.

Engage in Regulation and Policy Making

- State-level regulations are not always suitable for regional practices due to lack of communication. At the moment, growers feel they do not have enough voice to influence the policies. However, this situation will benefit from better collaboration between grower-regulatory interface groups and the general grower community.
- Each region will need to develop a monitoring scheme to generate relevant information addressing the most important concern of its producers and vineyard managers. This information will be essential, both for research and to support the positions of small farmers in a policy-making environment. Without reliable base information, it will be difficult for producers and managers to convince officials to oppose or promote a specific policy based on its effects on their farms.

Encourage Systematic Collaboration with Other Local Growers

- Local growers in the region have often worked on their land for generations, making their experience with the land invaluable, but their experiences and insights are never collected together. One growers' concern is that a technology useful for another field may not work for theirs. Collecting growers' knowledge on how their land respond to their practices and the local weather could better validate the potential impact of new technologies/practices and enrich the scope of a system.
- Another concern when integrating new technologies is the new technology's interaction with existing systems and how much of the original system will need to be completely replaced. By understanding better what local growers current operations, crop advisers and researchers can identify technologies or systems that provide an easier transition for growers who work in similar environments. Currently, growers already share their struggles, experiences, and suggestions in community meetings (even though they rarely share actual data from their fields); a systematic community knowledge pool should be a reasonable and achievable next step.
- It is important to find small projects on which neighboring farmers can collaborate to produce results that benefit all of them. After a successful experience, they may be

willing to increase collaboration on another project. For example, a platform could be generated through which neighboring farmers can share information about a pest they have discovered, or alternatively, about a specific treatment they plan to use on their vineyard. This information contributes to improving efficient pest management in the region, reducing the spread of pests and possibly even cutting off a localized infestation before it evolves into a region-wide problem. Generating this kind of geospatial connection can contribute to building a key metric for individual and regional decision-making.

Develop Performance Metrics in Context

- **Labor:** Due to the increased risk of an unsustainable labor force for farms, it is key to develop a regional metric that allows farmers to understand the contribution of the time (man-hours) of each operation in the field to the value of the final product (tons of grapes or bottles of wine). It is also important to understand the cost of a specific operation along with its importance to the final product. This information will be essential when it comes to evaluating the costs and benefits of automatization or changes in the size of operations. The labor costs/impacts of any new sustainability technology/practice need to be clearly defined and evaluated for successful adoption.
- **Local issues:** Environmental sustainability goals/metrics need to be defined according to a regional context. Before developing a metric, it is necessary to define the goals and scope regarding sustainability (independently of the formal definition of sustainability). These goals should be set after a regional analysis that helps identify the highest environmental risks. Sustainability and practice analysis should also consider more than just growing the crop but also the entire business production (for integrated winegrowing/making) to its overall environmental impact. Finally, key performance indicators should be built and then simplified as much as possible, allowing growers to easily pursue each goal.
- **Precision:** An important part of bringing a new technology into a region is to produce appropriate metrics to support decision-making regarding the implementation of such new technologies. The performance of new techniques needs to be evaluated for each region, as it can be difficult to determine whether or not the efficiency achieved by the technology in one specific region or context will have the same effect in a different environment. Extension programs play a significant role in this. Moreover, it is important to not only evaluate the improvements to the specific operation involved, but also the impact on labor, any changes to the yield and quality of the final product, and the effect on the environment.

Approach Through Trusted Growers

- Because of the high potential for conflict of interest, growers are often skeptical of commercial companies who are trying to sell their products. There is rarely evidence the new product will be suitable for the growers' specific practices and location, and occasionally new research behind the product can present methods that are in opposition to practices growers have found useful or beneficial in the past. Engaging trusted/influential growers in a region in piloting and adoption of new practices/techniques uses community relationships and trust to increase sustainability. It can also be helpful for the new technology to be evaluated by an extension program or

an independent board, as this builds trust with the growers while simultaneously demonstrating the technology's potential.

Unify Certifications

- Because of the lack of a unified definition of sustainability, multiple certifications exist, making it complicated and troublesome for growers to obtain all the ones they need. In order to create one comprehensive formal certification, growers, researchers, and sustainability experts need to better understand the ways in which different certificates overlap, as well as which certificates are similar enough to be considered interchangeable.

Outsource Tasks to Specialized Contractors

- An idea proposed and expected by a local grower from the north region is to outsource specific tasks on the farm, such as harvesting or pruning, to specialized contractors who invest in state-of-the-art equipment and the knowledge and skills needed. This can increase the cost to individual growers of new automated technology (e.g., mechanical harvesters).

IV. Workshop Format

The workshop was open to the entire community: local growers, researchers, community organizations, government organizations, and sustainability workers were invited through emails and word-of-mouth. The agenda (see Appendix) outlines the format of the workshops that were held in Paso Robles and Santa Rosa, California. Local growers, sustainability experts, and researchers discussed challenges and opportunities in sustainable farming through multiple panel discussions and working groups. These resulted in findings that form the basis of this report of recommendations.

V. Appendices

Agendas
Sponsors
Attendees

Agendas

Wednesday, April 4th, 2018 at J. Lohr Winery (Paso Robles)

- 8:30 AM** Registration and continental breakfast.
- 9:00AM** Introduction; Technologies Overview and Outcomes of NSF Workshop.
- 9:30 AM** Sustainability Progress and Conditions for This Growing Season Panel.
- 10:30 AM** Break.
- 10:45 AM** Grower Issues and Resource Concerns Panel
- 11:45 AM** Breakout Instructions
- 12:00 PM** Working group discussions and working lunch
- 1:30 PM** Report Back and Outline Roadmap.
- 2:30 PM** Capstone by Steve Lohr
- 3:00 PM** Wine Reception.

Thursday, April 19th, 2018 at Santa Rosa Junior College Shone Farm

- 8:30 AM** Registration and continental breakfast.
- 9:00AM** Introduction; Technologies Overview and Outcomes of NSF Workshop.
- 9:30 AM** Sustainability Progress and Conditions for This Growing Season Panel and Discussion.
- 10:30 AM** Break.
- 10:45 AM** Grower Issues and Resource Concerns Panel and Discussion.
- 11:45 AM** Breakout Instructions.
- 12:00 PM** Working group discussions and working lunch.
- 1:30 PM** Report Back and Outline Roadmap.
- 2:30 PM** Capstone by Dr. Greg Jones, Linfield College.
- 3:00 PM** Wine Reception.

Sponsors

Purdue University
Santa Rosa Junior College
Fresno State University
California Polytechnic State University, Luis Obispo
University of California, Los Angeles, Linfield College
Oregon State University
California Sustainable Winegrowing Alliance
J. Lohr Winery

Attendees

Wednesday, April 4th, 2018 at J. Lohr Winery (Paso Robles)

Name	Position	Place of Employment
Andres Valero	Research Student	Purdue University
Ann F Fitzgerald	owner	Cloud 9 vineyard
Ben Burgoa	Program Engineer and CCA	Resource Conservation District Monterey County
Beth Vukmanic Lopez	SIP Certified Manager	Vineyard Team
Colin Brown	President	TracMap Inc
David	Vineyard Manager	Daou
David Ebert	Professor	Purdue University
Fritz Helzer	Ranch Manager	Mesa Vineyard Management
Joe Irick	Vice President	Independant Grape Growers of Paso Robles Area
Lee Nesbitt	General Manager	Windfall Farms
Lise Asimont	CEO	VinSense
Lowell Zelinski	Owner, Precision Ag Consulting: President, IGGPRA	Precision Ag Consulting
Mark Houser	Vineyard Manager	HOCV-AVV Joint Venture
Megan Nunes	Founder	Vinsight
Melissa Egger	Assistant Viticulturist	Treasury Wine Estates
Micaela Mellein	Environmental Resource Specialist	Coastal San Luis Resource Conservation District
Michael Parola		Valley Farm Management
Morgan Brett	Grower Relations	Coppola
Nathan Dorn	CEO	Food-Origins
Randy Heinzen	President	Vineyard Professional Services

Thursday, April 19th, 2018 at Santa Rosa Junior College Shone Farm

Name	Position	Place of Employment
Aaron Stainthorp	Sustainability Specialist	Jackson Family Wines
Allison Jordan	Executive Director	California Sustainable Winegrowing Alliance
Andres valero	Research MS student	Purdue university
Ann F Fitzgerald	owner/grower	Cloud 9 vineyard
Brent Young	Vineyard & Ranch Manger	JVW Corp.
Calvin Yau	Research Assistant	Purdue University VACCINE Center
Cameron Mauritsen	Managing partner	Mauritsen farms
Carolyn Cook	Sr. Environmental Scientist Supervisor	Ca Department of Food and Agriculture
Chris Younger	Viticulturist	Vino Farms
Christian Butzke	Professor	Purdue University
Dana Cappelloni	Consultant	Independent
Darrell G. Schulze	Professor of Soil Science	Purdue University
Darren Drewry	Scientist	Jet Propulsion Laboratory / UCLA
David Ebert	Professor	Purdue University
Doug Hill	Vineyard Management and vineyard owner	Oak Knoll Farming
Emily Schmidt	Specialist, Agricultural and Environmental Affairs	Almond Board of California
Greg Jones	Professor	Linfield College
Jack Sporer	Assistant	Bucklin - Old Hill Ranch
Jim Cuneo	Asst. Manager	Robert Young Vineyards

Kate Piontek	VP, Operations	Sonoma County Winegrowers
Katie Leveroni	Grower Relations Technician	Rodney Strong Vineyards
Keith Abeles	Water Resources Specialist	Sonoma Resource Conservation District
Lisa Francioni	Program Director	California Sustainable Winegrowing Alliance
Lise Asimont	CEO	VinSense Technology
Mark Greenspan	President	Advanced Viticulture
Mark Houser	Vineyard manager	HOCV-AVV Joint Venture
Matthew Reilly	PRESIDENT	M.S.R. VITICULTURIST
Michael Parola		Valley Farm Management
Michelle Novi	Industry Relations Manager	Napa Valley Vintners
Miranda Bruehl	Student	
Robert Creekmore		S.R.S.C
Ruby Stahel	Project Manager	California Land Stewardship Institute
Sanliang Gu	Professor of Viticulture	California State University - Fresno
Serhat Asci	Assistant Professor	California State University, Fresno
Srini Konduru	Associate Professor	California State University, Fresno
Susan Ebert		Purdue University
Ted Grafe	Director	Moss Adams - CPAs & Consultants
Toby Halkovich	Director of Vineyard Operations	Cakebread Cellars
Tyler Klick	Viticulturist	Redwood Empire Vineyard Management