The Profitability of Regenerative Viticulture in Sonoma County, California

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The transition to regenerative agriculture is gaining attention for its potential to enhance sustainability, but questions remain about its economic feasibility. Using data from four Sonoma County vineyards, we show that regenerative agricultural practices such as no tillage, compost use, and livestock integration result in similar degrees of farm-level profitability over a 30-year horizon relative to conventional practices, if we assume no change in yields.

Regenerative agriculture has become increasingly popular in recent years. At the 28th U.N. Climate Change Conference in 2023, over 130 countries, representing a significant portion of the world's food producers, pledged a transition towards regenerative agriculture on a global scale. Yet its impact on yields, quality, and profits is uncertain.

Regenerative agriculture refers to a set of agricultural practices and principles that seeks to restore and preserve biodiversity and soil health. Regenerative principles, such as maintaining living roots, diversifying organic matter contributions, maximizing biodiversity, and minimizing soil disturbance, aim to reduce dependency on synthetic inputs and enhance the soil's capacity for carbon sequestration, water retention, and resilience to extreme weather. In practice, regenerative management may involve cover cropping, the integration of livestock to crop cultivation, compost use, and reduced or no tillage.

While regenerative practices can entail higher costs, they may offer meaningful long-term benefits, including reductions in operational expenses, enhanced soil health, and additional revenue streams from sheep grazing integration. It is not always clear to growers before adopting regenerative agriculture if the transition will pay off.

We study the farm-level financial implications of the adoption of regenerative practices in the viticulture sector in California's North Coast region, specifically Sonoma County. Regenerative practices are increasingly relevant in viticulture due to the industry's growing emphasis on sustainability and long-term stewardship. Wine grape production offers a useful case for assessing regenerative agriculture's economic feasibility in the context of a high-value crop with a long productive lifespan, in an industry facing rising pressure to reduce input reliance and improve soil health.

Sonoma County Vineyards

Through a partnership with a global wine producer—Jackson Family Wines—we were able to obtain detailed data on farm-level costs and revenues for four vineyards in Sonoma County. These vineyards are part of a broader research initiative in partnership with Jackson Family Wines aimed at investigating the environmental and economic impacts of regenerative viticultural practices.

In each vineyard, experimental plots were established through a randomized block design to compare

Table 1. Comparison of Conventional Versus Regenerative Agriculture in Four Vineyards

1a. Characteristics of the Four Vineyards in 2023

Characteristics	Vineyard 1	Vineyard 2	Vineyard 3	Vineyard 4
Grape Cultivar	Pinot noir	Chardonnay	Cabernet sauvignon	Chardonnay
American Viticultural Area (AVA)	Russian River Valley	Russian River Valley	Alexander Valley	Russian River Valley
Soil Type	Yolo silt loam	Yolo clay loam	Positas gravelly loam	Yolo sandy loam
Vine Age (Years)	11	6	23	34
Vine Density (Vines/hectare)	5,382	3,588	3,076	1,122
Average Yield (Mg/hectare)	11.6	19.3	7.03	9.7
Average Price Per Megagram	$3,750	$2,500	$3,000	$2,500

1b. Key Practices in Alleyways

Key Practices	Conventional	Regenerative
Tillage	Alternate, every other year	No tillage
Mowing	2 times/year	No mowing
Compost Application	No	Yes (9.8 Mg/ha/year)
Cover Cropping	Forage mix	Sheep forage mix
Livestock Integration	No	Sheep grazing
Herbicide Use (Under Vine)	Yes	No

Source: Authors' calculations.

Note: We calculated costs and revenues from four vineyards under both conventional and regenerative practices. Yields are measured in megagrams (Mg) per hectare (ha).

regenerative and conventional agricultural management practices under similar site conditions. We worked with vineyard managers to gather data on all capital costs, operational expenses, and revenues associated with production on each of these vineyards and in each type of system (conventional and regenerative). Data gaps were filled in with information from the University of California Cooperative Extension (UCCE) cost and return studies.

As shown in Table 1 (on page 5), these four case studies capture the variability in management practices, inputs, and outputs of three different grape varieties widely grown throughout the world: cabernet sauvignon, pinot noir, and chardonnay.

Benefits and Costs

We conducted a farm-level cost-benefit analysis of transitioning from conventional to regenerative viticultural practices, including no tillage, compost application, and contracted sheep grazing. Note that what we call conventional here already reflects some agricultural practices that are considered more sustainable than standard conventional practices, such as cover cropping and alternate tillage (tillage implemented every other year).

Primary benefits and costs from the adoption of regenerative agriculture stem from changes in equipment needs and operational expenses associated with the new management practices. Tables 2 and 3 list these benefits and costs, respectively. Benefits from regenerative agriculture derive from savings on certain equipment and inputs like fertilizer, chemicals, and labor. Benefits from soil erosion control and carbon credits begin in year 3, reflecting the time required for soil cover establishment and measurable carbon accumulation.

The long-term benefits to soil health are important yet complex to quantify. These enhancements may lead to healthier crops with better quality and improved resilience to climate change, although evidence is still limited. Some studies suggest that the initial adoption of healthy soil practices might reduce yield, at least in the short term. Consequently, we assume that the long-term benefits to soil health will offset any decrease in yield, leading to a long-term projection of no changes in yield between conventional and regenerative agriculture scenarios.

Costs of adopting regenerative agriculture stem from the application of compost, which requires new equipment, labor, and inputs. Sheep grazing adds expenses as well, in addition to the more expensive cover crop seed that is needed for sheep grazing.

Table 2. Benefits of Regenerative Viticulture

	Year Benefits Realized	Benefits
Mower	1	Savings on equipment that is not required when integrating sheep grazing.
Disc Implement	1	Savings on equipment that is not needed when reducing soil disturbance.
Nutrient Inputs	2–30	Savings on fertilizer due to compost and manure.
Soil Erosion Control	3–30	Reduced soil erosion due to cover crops and no tilling.
Carbon Credits	3–30	Carbon sequestration value of compost and manure.
Herbicides	2–30	Savings on chemicals and spray costs.
Mowing	2–30	Savings on labor and equipment maintenance costs.
No Tilling	2–30	Savings on labor and equipment maintenance costs.

Source: Authors' calculations.

Table 3. Costs of Regenerative Viticulture

	Year Costs Incurred	Costs
Compost Spreader	1	Investment in equipment to broadcast compost.
Cover Crop Seed	2–30	Added cost of sheep seed mix.
Compost	3–30	New input costs.
Compost Application	3–30	Labor costs to spread compost.
Sheep Grazing	2–30	Annual event lasts 3–4 days with a 20 sheep flock on 0.4 hectares.

Source: Authors' calculations.

Results

Using a discount rate of 2.5%, we estimated the net present value (NPV) of profits (the cumulative sum of revenues and costs in today's dollars) under each management practice over a 30-year vineyard lifespan, which reflects the typical period of consistent productivity before decline. Revenues, determined by yield and grape prices, were assumed to be identical for both regenerative and conventional agriculture scenarios. However, costs varied under the two scenarios as shown in Tables 2 and 3.

Our analysis, summarized in Table 4, indicates that regenerative agriculture management generally provides financial outcomes that are competitive with conventional agriculture management, with small differences in NPV percentages across vineyards over the 30-year evaluation period. Given these assumptions about constant yields and prices, the difference in NPV between regenerative agriculture and conventional agriculture remained less than 2% across all four vineyards.

Assumptions About Yield and Quality

One major concern regarding the adoption of regenerative agriculture is its potential impacts to both yield and quality. If regenerative agriculture were to negatively impact yields or quality, affecting the grape price, then profitability of regenerative agriculture could look quite different. Our research team has been conducting field trials to investigate this. Results from the first couple years have shown mixed results with respect to yields.

Yield performance varied across sites and years following the introduction of regenerative management in 2023. Figure 1 (on page 8) plots the average difference in per-acre yields between treated (regenerative) and control blocks (conventional) relative to the year prior to treatment across all four vineyards. The experiment used a randomized complete block design, with each vineyard divided into three blocks. Within each block, the team established one regenerative agriculture plot and one control block, resulting in three replicate plots per treatment. We measured yield in each plot from 10 marked vines, using cluster count and weight at harvest.

No statistically significant differences in yields were observed in vineyards 2 and 4 (both chardonnay). However, statistically significant decreases in yields were observed for regenerative vineyard blocks in vineyard 1 in 2023 and in vineyard 3 in 2024. While substantial, these yield changes are not atypical for a transition period to a new practice. Yields may stabilize in the long term once the system is fully transitioned.

Our findings suggest that, while regenerative practices can be economically viable and within 2% of conventional profits, success heavily depends on maintaining yields and securing price premiums. We conducted a scenario analysis to test the sensitivity of the results to varying assumptions on yield and prices. Informed by studies on winegrape pricing, we considered a 20% change in prices, which reflects both typical market variability and the potential for regenerative agriculture to influence grape quality and value. If small yield decreases are incurred (-10%) but offset by price premiums (+20%), then regenerative agriculture can be more profitable than conventional. If, however, larger yield decreases are experienced without receiving higher prices, then the NPV for regenerative agriculture across all four sites is substantially smaller than that of conventional agriculture.

External Benefits

Regenerative practices provide environmental benefits that extend beyond the vineyard, e.g., via carbon sequestration and enhanced biodiversity. Our study treats carbon sequestration as a private benefit through carbon credits. However, valuing it at the social cost of carbon (SCC)—which estimates the public economic damages from CO_2 emissions—suggests a higher overall benefit. For instance, with an SCC estimate of $185 per metric ton of CO_2, a vineyard sequestering one metric ton per hectare of CO_2 annually could generate significant long-term value for both the vineyard and society.

Additionally, this study omits the valuation of other environmental benefits, such as reduced dust and air pollution from no-till practices, which can have significant public health implications. Reduced air pollution, for example, has been linked to lower healthcare costs and improved quality of life, benefits that are not accounted for in the current analysis. These unvalued benefits suggest that the true economic and environmental impact of regenerative agriculture may be understated, underscoring the need for policy frameworks to recognize and incentivize these external benefits.

Table 4. Comparative Analysis of Regenerative Versus Conventional Agriculture Over a 30-Year Period

Vineyard (Grape Variety)	Planted Area (Hectare)	Scenario	Initial Investment (Dollars)	Annual Operating Costs (Dollars)	Annual Revenue (Dollars)	Net Present Value (NPV/Hectare)	NPV Change (Percent)
Vineyard 1 (Pinot Noir)	2.04	CV1	$260,042.61	$23,847.68	$43,500.00	$128,613.71	-1.39
		RA1	$257,396.10	$23,976.01	$43,500.00	$126,821.75	
Vineyard 2 (Chardonnay)	6.13	CV2	$250,439.68	$19,645.43	$48,250.00	$306,966.07	-0.54
		RA2	$247,793.17	$19,773.75	$48,250.00	$305,321.51	
Vineyard 3 (Cabernet Sauvignon)	4.11	CV3	$227,659.17	$18,194.20	$21,090.00	-$146,363.83	-1.63
		RA3	$226,148.18	$18,305.09	$21,090.00	-$148,748.70	
Vineyard 4 (Chardonnay)	13.6	CV4	$207,515.14	$11,805.58	$24,250.00	$54,972.24	-1.20
		RA4	$205,874.15	$11,836.47	$24,250.00	$54,313.90	

Source: Authors' calculations.

Note: CV = conventional agriculture, RA = regenerative agriculture, and NPV = net present value.

Scale of Analysis

One major consideration for the interpretation of this study is the scale of the analysis. Environmental benefits and costs often extend beyond the farm level and can be regional or global, as in the case of carbon. This is particularly relevant when we consider the potential yield reduction under regenerative practices. If regenerative agriculture leads to lower yields, market forces may incentivize more land to go into production, which could come at an environmental cost. On the other hand, sheep integration has the potential to work in the opposite direction by increasing land use efficiency if it displaces sheep grazing elsewhere. When we move beyond the vineyard level, the economic and environmental net benefits become more ambiguous. This highlights the importance of evaluating regenerative practices at broader scales across landscapes to fully understand their effects.

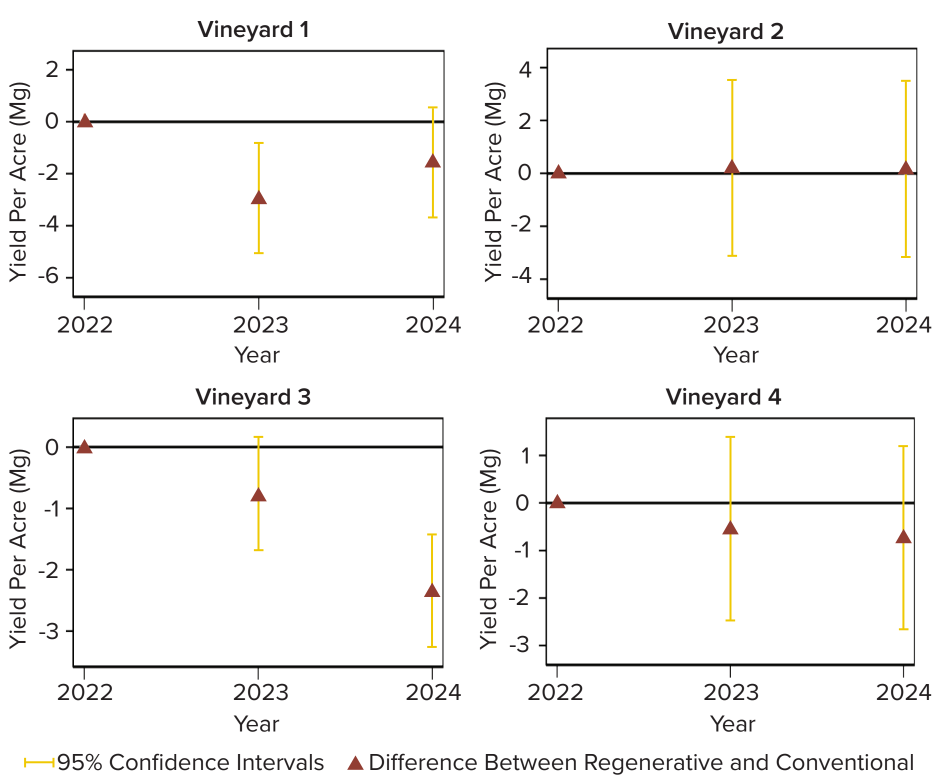
Concluding Remarks

This study demonstrates that regenerative practices in viticulture can be a financially viable approach when grape yields are preserved or when price premiums compensate for yield reductions. However, the profitability of regenerative agriculture depends on site-specific factors, grape variety, and tailored management practices and requires careful management of yield impacts.

If we are interested in increasing the prevalence of regenerative practices, then policy changes may be necessary to encourage growers to transition. Our work suggests that profitability alone will be unlikely to draw growers to regenerative agriculture. A certification for regenerative agriculture, akin to those for organic and non-GMO products, may lead to price premiums if customers understand the new label and are willing to pay more for it. Alternatively, internalizing the social benefits and costs associated with regenerative practices (such as a tax on carbon) would increase the profitability of regenerative agriculture relative to conventional practices and lead to increased adoption.

Further research is needed to identify optimal regenerative agriculture practices for different vineyard conditions. Additionally, there is a role for future research to investigate the potential effects of these practices on grape quality, a major determinant of prices, and the impacts on yields in the long run.

Figure 1. Difference in Yield Between Regenerative and Conventional Viticulture



Source: Authors' calculations.

Note: Each estimate represents the difference in yields between blocks with conventional and regenerative agricultural practices in each year, minus the same difference in 2022, the year before regenerative agriculture blocks started receiving the treatment.

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For additional information, the authors recommend:

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