Strengthening Legal Regimes to Support Science-Based Biodynamic-Regenerative Viticulture:

How can we restore soil health and help foster a global shift to agroecology?

John W. Head *

Abstract

While most of the world's foodcrops come from grasses such as wheat, maize, and rice, many important foodcrops come instead from woody plants that provide seeds and fruits used in human diets. As part of a wider research agenda that focuses on woody perennial agricultural in general, I concentrate in this article on viticulture (production of grapes). Although viticulture is an ancient form of agriculture, we now see it experiencing a transformation (and restoration) toward certain science-based biodynamic and regenerative practices that promise great rewards for soil health — that is, a reversal of the soil degradation that has become a plague on planet Earth. Legal and policy reforms in some jurisdictions have encouraged this shift toward biodynamic and regenerative viticulture. I survey such reforms here — involving subsidies, certifications, research support, tax incentives, and the like — to help chart a course for robust government support of a growing shift to natural-systems viticulture, not just regionally but also globally … and with hopes of hastening the adoption of natural-systems agroecology more generally.

Key words: law / viticulture / biodynamic / regenerative agriculture / soil health

---

* John Head is the Robert W. Wagstaff Distinguished Professor of Law at the University of Kansas and has written widely on issues of international and comparative law, agricultural reform, and environmental protection. The author gratefully acknowledges the help provided by Namisha Kaur Ajit, Claire Burns, Emma Dipoto, Emily Gay, Joshua Lollar, and Grace Wyatt for their extensive research in preparing this article, as well as the explanations offered by the author's immediate family members regarding the operation of Estelbrook Farms & Vineyard, a certified Biodynamic and Regenerative Organic vineyard in the Columbia Gorge region of southern Washington State.

= = = = = = =

Outline

= = = = = = =

I. Introduction: questions, perspective, synopsis

When I mentioned to my friend Tim Crews, a plant scientist and director of research at The Land Institute, that my wife and I do lots of volunteer work at a biodynamic vineyard, Tim's eyes narrowed. He asked if I knew about the "pseudoscience" or outright quackery that has made many scientists skeptical or even dismissive of biodynamic agriculture generally. I told Tim that my upbringing on a northeast Missouri grain-and-cattle farm in the 1960s — in the excitement of the Green Revolution — had helped instill in me a strong respect for science-based analysis. Even though I chose law (not science) for my career path, my high regard for science and my love of soil ("the skin of the earth," as some observers have called it[1]) have prompted me to write this article.

IA. Specific questions

My aims in this article are modest: I wish to address three questions. First, what is "biodynamic-regenerative viticulture," and how does it differ — particularly in terms of its scientific basis and its certification standards — from "organic viticulture" and related terms and practices? Second, why should we care? Might an energetic shift to biodynamic-regenerative viticulture (and therefore away from using conventional "industrial" agricultural methods in vineyards) help address the global soil-degradation crisis? Third, if biodynamic-regenerative viticulture *does* promise to help address the soils crisis, how can official public support — especially legal, financial, commercial, and research support — be directed toward fulfilling that promise?

Readers of the *Kansas Journal of Law & Public Policy* might have a further question of their own: why would the *Journal* publish an article on wine, inasmuch as Kansas is much better known for wheat fields than for vineyards? I can offer two reasons. First, Kansas does in fact have a strong history of wine and a climate generally amenable to viticulture. A 2023 "farm winery report" prepared by the Kansas Department of Agriculture gives this account:

> Kansas has a rich history of growing grapes and producing wine. In the 1800s, European immigrants traveling west began establishing vineyards along the Missouri River. Modern-day western Missouri and eastern Kansas became a wine mecca as native and French varieties flourished under the experienced watch of these viticulturalists. Around 80% of U.S. wine originated from this region

[1] For a recent use of this metaphor, *see Soil, the Earth's Living, Breathing Fragile Skin*, BRIT. SOC. SOIL SCI. (Jun. 1, 2022), https://soils.org.uk/news/soil-the-earths-living-breathing-fragile-skin/ [https://perma.cc/8BR8-MNY4]. The metaphor also appears as the title of Chapter Two ("Skin of the Earth") in DAVID R. MONTGOMERY, DIRT: THE EROSION OF CIVILIZATION (2007). *See also* WILLIAM BRYANT LOGAN, DIRT: THE ECSTATIC SKIN OF THE EARTH (2007).

> by the end of the 19th century. In 1900, there were over 5,000 acres of vineyards in Kansas. Most of this acreage was concentrated in the northeast and near urban centers, with the counties of Wyandotte (583 acres), Sedgwick (404 acres), and Doniphan (351 acres) leading at the turn of the century. Successful wineries and support businesses such as rootstock breeding thrived alongside. However, the temperance movement changed the industry's trajectory. In 1880, Kansas was the first state in the union to pass a state constitutional amendment prohibiting the manufacturing and sale of alcohol, as well as subsequent laws creating misdemeanors for its manufacture. Producers endured this environment by selling their grapes out of state or producing wine clandestinely. Once the Volstead Act and Prohibition took effect nationally, vineyards drastically decreased as the production of wine also declined in Kansas. After federal Prohibition ended in 1933, Kansas retained constitutional prohibition for 15 more years. Strict alcohol production and sale laws remained even after prohibition was repealed in the state, preventing the industry from rebounding in the decades to follow. In 1983, Kansas passed the Kansas Farm Winery Act, which established guidelines for farm wineries and allowed for wine to once again be produced in Kansas. The state began to slowly return to the wine industry, with 13 licensed farm wineries producing grapes on 170 acres by 2005. Production has continued to grow since.[2]

Building from that rich history of viticulture in Kansas, a nonprofit organization applied in 2022 for distinction as the first American Viticultural Area ("AVA") in Kansas:

> The KAW Valley AVA includes 33 currently established Kansas Farm Wineries and Kansas Vineyards on the list to receive recognition. An AVA is a delimited grape-growing region with specific geographic or climatic features that distinguish it from the surrounding regions and affect how grapes are grown. Using an AVA designation on a wine label allows vintners to describe more accurately the origin of their wines to consumers and helps consumers identify wines they may purchase.[3]

---

[2] *Kansas Farm Winery Report*, KAN. DEP'T OF AGRIC. 6 (Jan. 8, 2024), https://www.agriculture.ks.gov/home/showpublisheddocument/8050/638518832993930000 [https://perma.cc/2LLK-2BNR].

[3] *Home*, KAN. VITICULTURE & FARM WINERY ASS'N, www.kansasfarmwineries.com [https://perma.cc/TTD5-8U6C]. The same website gives a history of viticulture in Kansas. *Kansas Wine History*, KAN. VITICULTURE & FARM WINERY ASS'N, www.kansasfarmwineries.com/kansas-wine-history/ [https://perma.cc/F3DD-8Z98].

This AVA designation process has not yet been completed,[4] but its sponsoring organization provides a map of the proposed AVA and promotes the "Kaw Valley Wine Trail," including 16 wineries.[5] Although the Kansas Department of Agriculture "farm winery report" cited above explained that "the Kansas grape and wine industry has a positive outlook,"[6] the industry is faced with a variety of barriers — including the problem of chemical drift from neighboring agricultural operations — and is therefore grouped with "Emerging" U.S. states for expanding its grape and wine production.[7]

However, the questions I address in this article relate to Kansas also in a second, much broader, fashion: they might bear on the long-term prospects for agriculture more generally, which sits at the very center of the state's economy and culture. Allow me to expand on that topic.

IB. Viticulture as a harbinger for agroecological reform

In other writings, I have emphasized the profound degradation that modern agriculture has caused to the soils all around the Earth, but especially in those vast ecoregions that were covered until relatively recently with temperate grasslands.[8] Most of the world's grasslands have been converted to agricultural production. This production takes the form predominantly of annual monoculture crops — that is, crops such as maize, wheat, and rice that are used for human food

---

[4] For a chronological listing of the officially-designated AVAs in the United States, *see* ALCOHOL & TOBACCO TAX & TRADE BUREAU, *List of AVAs by Establishment Date*, U.S. DEP'T OF THE TREASURY (Oct. 2, 2025), https://www.ttb.gov/regulated-commodities/beverage-alcohol/wine/ava-establishment-dates [https://perma.cc/5C6Q-5LCX]. The proposed Kaw Valley AVA is in a "pending" category, per the U.S Department of the Treasury Alcohol and Tobacco Tax and Trade Bureau (TTB). The TTB defines the "pending" category as "accepted as perfected," meaning the proposed AVA meets the federal requirements necessary for AVA designation, but the TTB does not guarantee their creation. *See* ALCOHOL & TOBACCO TAX & TRADE BUREAU, *List of Pending American Viticultural Areas Petitions*, U.S. DEP'T OF THE TREASURY (Aug 8, 2025), https://www.ttb.gov/regulated-commodities/beverage-alcohol/wine/list-of-pending-american-viticultural-areas-petitions [https://perma.cc/TC4B-U6MH].

[5] *See Kaw Valley AVA*, KAN. VITICULTURE & FARM WINERY ASS'N, www.kansasfarmwineries.com/kaw-valley-wine-trail/ [https://perma.cc/7Z9V-YJRA].

[6] *Kansas Farm Winery Report*, *supra* note 2, at 5. That report notes that "there is an estimated 566 acres of grapes [grown] in Kansas …. Seventy different varieties of bearing grapevines can be found in 40 Kansas counties. In 2022, approximately 1,036 tons of grapes were harvested from these vines . . . . [with] [t]he vast majority going into the wine supply chain." *Id.* at 7.

[7] *Id.* at 5.

[8] *See generally* JOHN W. HEAD, GLOBAL REGIMES TO PROTECT THE WORLD'S GRASSLANDS (2012) [hereinafter GRASSLANDS]; JOHN W. HEAD, INTERNATIONAL LAW AND AGROECOLOGICAL HUSBANDRY (2017) [hereinafter AGROECOLOGICAL HUSBANDRY], and JOHN W. HEAD, A GLOBAL CORPORATE TRUST FOR AGROECOLOGICAL INTEGRITY (2019) [hereinafter GLOBAL TRUST].

(or feed for livestock) and grown in single-crop fields, so that they must be planted and harvested anew every year.[9]

The soil degradation coming from these practices has reached crisis proportions. At the same time that our global human population — and therefore global agricultural-production demand — continues to grow rapidly, the Earth's capacity to grow annual crops in monoculture is declining through a combination of soil erosion, soil poisoning, soil exhaustion, and the like.[10]

As I have pointed out in earlier publications, the picture might be quite different if human food production were to rely *not* on annual monocultures but on perennial polycultures. In this connection, I have drawn special attention to the work of The Land Institute, which is headquartered in Salina, Kansas, but coordinates with research stations all around the world. A central aim of The Land Institute is to develop foodcrops that rely on *perennial* grains suitable for growing and harvesting, with commercial viability, in *polycultures* … that is, mixtures of crops in the same field so as to maximize the use of natural nitrogen-fixing capacity of legumes.[11]

In this article, I take a different perspective by looking at a *different* kind of perennial polyculture. Instead of focusing on *herbaceous* plants, I consider *woody* plants that produce food for humans. Granted, many of the world's key foodcrops come from grasses. Wheat, maize, and rice are prime examples. These are herbaceous in character and produce seeds that humans use for food. However, some of the world's foodcrops come instead from *woody* plants — that is, trees and woody vines. In those cases, humans use the seeds and fruits for food. Important treecrops, for instance, include: (i) stone fruits (also called drupes),[12] such as

---

[9] For detailed explanations of this conversion of grasslands to agriculture, *see* AGROECOLOGICAL HUSBANDRY, *supra* note 8, at 78–83; GRASSLANDS, *supra* note 8, at 43–45.

[10] For highlights of the soil-degradation consequences of modern agriculture, *see* AGROECOLOGICAL HUSBANDRY, *supra* note 8, at 89–91. I also offer below (in subsection IIIA) more details about how the global soils crisis relates to viticulture.

[11] For specific details on the perennial-polycultures approach, and the work of The Land Institute to develop that approach, *see* AGROECOLOGICAL HUSBANDRY, *supra* note 8, at 148–152; GRASSLANDS, *supra* note 8, at 217–223. For The Land Institute's own account of its crop-research work, including a summary of its "international initiative" and a world map showing affiliated research efforts in many countries for over a dozen types of crops, *see* THE LAND INST., www.landinstitute.org [https://perma.cc/FUN9-JCU3].

[12] For more details on stone fruits, *see Stone Fruit*, UNIV. OF FLA. (May 7, 2025, 3:44 PM), https://hos.ifas.ufl.edu/stonefruit/ [https://perma.cc/GH82-AC3H] [hereinafter *Stone Fruit*]; *Western Washington Tree Fruit and Alternative Fruits: Stone Fruit*, WASH. STATE UNIV., https://extension.wsu.edu/maritimefruit/tree-fruit/stone-fruit/ [https://perma.cc/7U87-M32K] (stone fruits in western Washington); Emily Hoover, Emily Tepe & Doug Foulk, *Growing stone fruits in the home garden*, UNIV. OF MINN. EXTENSION (2024), https://extension.umn.edu/fruit/growing-stone-fruits-home-garden [https://perma.cc/HQV4-KGQ3] (stone fruits in Minnesota); *Stone Fruit Propagation*, UNIV. OF CAL. AGRIC. & NAT. RES., https://ucanr.edu/sites/btfnp/fruitnutproduction/Stone_Fruit_Propagation/ [https://perma.cc/T96Q-FAGP]. As noted in the first source cited above, stone fruits "feature a layer of fleshy, edible pulp surrounding a relatively large, hard pit (the 'stone') that shields and protects a seed." *See Stone Fruit*, *supra*.

peaches, apricots, plums, cherries, nectarines, and dates; (ii) pome fruits,[13] such as apples, pears, loquats, and quince; and (iii) nuts, such as chestnuts, hazelnuts, and pecans.[14] (Other foods that we typically think of as "nuts," such as almonds, cashews, and peanuts, are not nuts in the botanical sense: almonds and cashews are stone fruits, and peanuts are legumes.[15])

As part of a wider research agenda that focuses on woody perennial agricultural foodcrops in general, I examine in this article just one form in particular: viticulture, which is the production of grapes.[16] Like the treecrops mentioned above, grapes come from woody perennials, but these woody perennials take the form of *vines* rather than trees. Also like the treecrops mentioned above, the product of the vine that is of human interest for food is the fruit, which in the case of viticulture takes the form of berries.[17] My hope is that an examination of

---

[13] For more details on pome fruits, *see Fertilizing for High Yield and Quality Pome and Stone Fruits of the Temperate Zone*, INT'L POTASH INST. (2009), https://www.ipipotash.org/uploads/udocs/296-IPI-Bulletin-19.pdf [https://perma.cc/GDV6-2XF2] (international overview of pome (and some stone) fruits); *Apples, pears and other pome fruit*, NEW S. WALES GOV'T, https://www.dpi.nsw.gov.au/agriculture/horticulture/pomes [https://perma.cc/K8UZ-B88A] (pome fruits in New South Wales, Australia) [hereinafter *Apples, etc.*]; *Growing and Care of Pome Fruits*, UNIV. OF CAL. AGRIC. & NAT. RES., https://ucanr.edu/sites/hdnmastergardeners/Resources_for_Home_Gardeners/Fruit_Trees_Berries_and_Grapes/Pomes/ [https://perma.cc/3DXW-PZ6K] (growing pome fruits in home gardens). As noted in the second of the three sources cited above, "[p]ome fruits are … fruits that have a 'core' of several small seeds, surrounded by a tough membrane [which is] encased in an edible layer of flesh." *See Apples, etc.*, *supra.*

[14] For details on nuts, *see* U.S. Forest Service, *Nuts*, USDA, https://www.fs.usda.gov/wildflowers/ethnobotany/food/nuts.shtml#:~:text=Chestnuts%2C%20hazelnuts%2C%20pecans%20and%20walnuts,like%20a%20plum%20surrounds%20almonds [https://perma.cc/PGC3-Y4NW].

[15] *See* Caitlin Bard, *Cashews and almonds aren't technically nuts. So what are they?*, MCGILL OFF. SCI. & SOC'Y. (July 10, 2020), https://www.mcgill.ca/oss/article/nutrition-did-you-know/cashews-and-almonds-arent-technically-nuts-so-what-are-they#:~:text=Some%20examples%20of%20true%20nuts,a%20seed%20on%20the%20inside [https://perma.cc/VUN6-BVF6].

[16] Grape production is called viticulture, reflecting the Latin word for vine: *vitis*. The species of grapevines most commonly used for making wine is *vitis vinifera*. HUGH JOHNSON, THE STORY OF WINE 17 (2nd ed. 2005). Grape production for "table grapes" and for jams and juices sometimes also relies on *vinis vinifera* but can involve other species such as *vitis labrusca*, which is native to the American Northeast, and *vitis rotundifolia*, which is native to the American South. *See* KAREN MACNEIL, THE WINE BIBLE 58 (2nd ed. 2015) (*vitis labrusca*); Doris Stanley, *America's First Grape: The Muscadine*, USDA AGRESEARCH MAG. (Nov. 1997)., https://agresearchmag.ars.usda.gov/1997/nov/musc [https://perma.cc/PA24-6ZSZ] (*vitis rotundifolia*, also known as "muscadine"). Karen MacNeil's work is a valuable general source about viticulture and wine. She sets the tone of her book with this assertion: "*Vit*, the Latin root of the word *viticulture*, is also the source of *vita* — life itself." MacNeil, *supra* at 16.

[17] From a botanical perspective, a berry is a fruit whose seeds and pulp derive from the ovary of a flower. These include grapes, currants, tomatoes, bananas, pumpkins, avocadoes, and cucumbers,

viticulture, and how it can be used to fight the soils crisis rather than contribute to it, might serve as a harbinger for broader reforms in other types of agriculture. I use "harbinger" here in the sense of "something that foreshadows a future event" or "something that gives an anticipatory sign of what is to come," or something "that initiates a major change."[18]

IC. Structure of this article

As I explain below in section II, the cultivation of grapevines is an ancient form of agriculture that is today undergoing a dramatic transformation — or perhaps it is better seen as a restoration. After several decades of expanding use of innumerable biocides (insecticides, herbicides, fungicides), many vineyards and wineries are changing course, or at least trying to do so. Some take the steps necessary to qualify as "organic" operations, but a few aspire to follow practices that meet an even higher standard described (inconsistently) as "biodynamic viticulture" or "regenerative viticulture." Subsections IIC through IIF describe these practices, and subsection IIG offers a wrap-up on what I call "science-based biodynamic-regenerative viticulture" ("SBBRV").

A key aim of this article is to explore, from a legal and policy perspective, the standards and the challenges of SBBRV and to consider how we can and should provide a broad range of support — and especially public-sector support — to quicken the pace of the transformation currently underway. It is, after all, a transformation that (according to its proponents) promises great rewards for soil health — a reversal of the soil degradation that has become a plague on the planet.

But what is "soil health"? Section III of the article gives close attention to this question, showing how the concept of "soil health" (or, as it is sometimes termed, "soil quality") stands as an overarching value that SBBRV aims to serve. Giving attention to some scientific aspects of soil health, and especially mycorrhizal network health, that section of the article explores the inter-related topics of *terroir* (localized biogeographical characteristics of vineyard ecosystems), soil health, and SBBRV. In doing so, section III both (i) summarizes some recent scientific research regarding SBBRV's impact on soil health and also (ii) identifies the *destination(s)* that are to be reached through various forms of legal and policy support for SBBRV.

Section IV then focuses on such support currently in place in various jurisdictions. Specifically, given the potential significance of these reforms and concepts — that is, the shift toward biodynamic practices and the "soil health" that those practices can improve — the article moves in section IV to an illustrative

---

but do not include strawberries, blackberries, mulberries, or raspberries. *See* Ada McVean & Cassandra Lee, *Bananas are Berries. Raspberries are Not.*, MCGILL OFF. SCI. & SOC'Y (Dec. 6, 2017), https://www.mcgill.ca/oss/article/did-you-know/bananas-are-berries-raspberries-are-not [https://perma.cc/L5LS-MF9M].

[18] For these Merriam-Webster definitions of "harbinger," *see Harbinger*, MERRIAM-WEBSTER, https://www.merriam-webster.com/dictionary/harbinger [https://perma.cc/N78C-534U].

survey of six political jurisdictions. Two are the nation-states of Chile and Italy. Three are U.S. states, specifically California, Washington, and Oregon (three of the largest wine-producing states in the United States[19]), and the last one is the province of British Columbia (one of the two largest wine-producing provinces in Canada[20]). For each of these, I offer a vignette of the official public support for a "de-industrialization" of viticulture. Such support typically takes the form of subsidies, research funding, certifications, and tax incentives.

Although my examination of these issues can be no more than preliminary in the context of this article, I offer in section V a few concluding observations about encouraging government support of a growing shift to the "natural-systems" approach that SBBRV represents. Given the global character of the soil-degradation crisis, I also call for international initiatives that could facilitate reforms in this regard.

II. Biodynamic-regenerative viticulture in a grapeseed

The small vineyard where my wife and I work in the Columbia Gorge AVA is certified as Biodynamic, Regenerative Organic, and Organic (NOP).[21] Our daughter-in-law carried most of the load in earning these certifications, and it was a big load indeed. In the following paragraphs I try to untangle the meanings of the designations and the related certifications. For each term, I give special consideration to (i) how old and well-established the designation is, (ii) how detailed its certification standards are, (iii) how much of a science-based

---

[19] For details on top wine-producing U.S. states, *see* Nat'l Ass'n Am. Wineries, *United States Wine and Grape Industry FAQs*, WINEAMERICA (2018), https://wineamerica.org/policy/by-the-numbers/ [https://perma.cc/S4UX-YT3R]. *See also* Wash. State Wine Comm'n, *Fast Facts*, WASH. WINE, https://www.washingtonwine.org/fast-facts/#:~:text=Washington%20is%20the%20second%2Dlargest,annual%20in%2Dstate%20economic%20impact [https://perma.cc/MWY3-DU8F].

[20] For details on wine production in Canadian provinces, *see Explore the Best Wineries in Canada*, WINETOURISM, https://www.winetourism.com/wine-country/canada/#:~:text=Ontario%20is%20Canada's%20largest%20wine,Noir%2C%20and%20the%20distinctive%20Icewine [https://perma.cc/NF5F-KUPM] (noting that Ontario and British Columbia are the top two wine-producing provinces).

[21] For details of the Columbia Gorge American Viticultural Area, which straddles the Columbia River about an hour's drive east of Portland, Oregon, *see Columbia Gorge AVA*, WASH. WINE, https://www.washingtonwine.org/resource/columbia-gorge/ [https://perma.cc/VB62-74W6]. For information about the vineyard itself, *see* ESTELBROOK FARM & VINEYARDS, https://www.estelbrook.com [https://perma.cc/LZY9-C2JG] (showing certifications for CCOF Organic, Demeter Certified Biodynamic, and Regenerative Organic Certified (Silver)). Expressed in their trademark forms, these certifications carry initial capital letters (as shown in the preceding sentence). Throughout this article, however, I have for simplicity used all-lower-case for the terms organic, biodynamic, and regenerative — all of which will be further explained below — because most references I make here are general, not trademark-specific.

perspective (as opposed to "pseudoscience" or spiritual or "woo-woo" perspective) it involves, (iv) how widespread its acceptance has become (global versus only local), and (v) whether the relevant certification process is primarily facilitated through private organizations or under the legal control of state authorities. I start, though, by explaining how these designations and certifications fit into a larger trend favoring natural-systems approaches both to agriculture in general and viticulture in particular.

IIA. The overall context: organic agriculture and "natural-systems" restoration

The last few decades have seen a surge in demand for "natural" and "organic" foods. (I use quotation marks to emphasize the fact that these terms carry widely variable meanings, as explored more fully below.) For example, in 2000, foods characterized as "organic" accounted for US$18 billion in sales on the global food market. In 2022, global sales of organic food reached nearly US$135 billion.[22] In 2023, the organic food market reached US$177 billion, and that value is projected to grow annually by about 12% through 2032.[23] In Europe, organic foods claimed over 44% of the food market in 2023,[24] while in the United States, sales of certified organic products exceeded US$71 billion in 2024.[25] Consumers have cited various reasons for preferring "organic" products, including their personal health, the lack of pesticides in organic foods, and the perception that organic foods are better for the environment.[26]

Like the demand for "organics," consumer choices have also shifted to show a preference for products with other certifications and characterizations: regenerative, "natural-systems," non-GMO, and some others likewise intended to distinguish such food products from those produced with more conventional "industrial" agricultural practices. The market size of regenerative agriculture worldwide is expected to have an annual growth rate of about 18% from 2025 to 2030.[27] The global market for non-GMO food is expected to have an annual

---

[22] *Worldwide sales of organic food from 1999 to 2023*, STATISTA (Feb. 2025), https://www.statista.com/statistics/273090/worldwide-sales-of-organic-foods-since-1999/ [https://perma.cc/2JXJ-FGKN].

[23] *Organic Foods Market Size, Share & Industry Analysis*, FORTUNE BUS. INSIGHTS (Oct. 20, 2025), https://www.fortunebusinessinsights.com/industry-reports/organic-foods-market-101470 [https://perma.cc/GJJ9-LSCU].

[24] *Id.*

[25] Sandy Pfaff, *Organic Trade Association reports sales of organic products at $71.6 billion with growth rate more than doubling overall marketplace*, ORGANIC TRADE ASS'N (Apr. 23, 2025), https://ota.com/about-ota/press-releases/growth-us-organic-marketplace-accelerated-2024 [https://perma.cc/KR8V-UW8N].

[26] Raghava R. Gundala & Anupam Singh, *What motivates consumers to buy organic foods? Results of an empirical study in the United States*, NAT'L LIBR. MED. (Sep. 10, 2021), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8432837/ [https://perma.cc/NN5E-5Q26].

[27] *Global Regenerative Agriculture Market Size & Outlook*, GRANDVIEW RSCH., https://www.grandviewresearch.com/horizon/outlook/regenerative-agriculture-market-size/global [https://perma.cc/3UYU-EAAF].

growth rate of nearly 12% from 2024 to 2032.[28] All in all, there is a general move toward higher demand for products seen as better for, or at least less damaging to, the environment.

Therefore, before focusing on viticulture specifically, let us orient ourselves on the landscape of agricultural techniques (and mindsets) more generally. For starters, I can offer these simplified definitions of some of the terms noted above, as drawn from various sources — bearing in mind that several of the terms, particularly in the specific context of viticulture, will be examined more closely from a regulatory standpoint in subsections IIC through IIF, below. Indeed, the definitions in the following list for "biodynamic agriculture" and "regenerative agriculture" will be significantly fine-tuned in those later subsections to explain why I have settled on the hybrid term that I propose in subsection IIG: "science-based biodynamic-regenerative viticulture."

- *Natural-systems agriculture*, according to The Land Institute, is a practice that "uses perennial polycultures and mutually beneficial relationships to increase the health and productivity of crops. This strategy takes advantage of benefits found in natural systems, such as pest control, fertility and nutrient cycling, erosion control, drought resistance and water management, and carbon sequestration."[29]

- *Agroecology* "refers to a way of practicing agriculture that attempts to balance environmental and economic risks of farming while maintaining productivity over the long term."[30] It is mindful of the ecological, health, social, and economic factors that are implicated in the design and activity of agriculture systems.[31]

- *Regenerative agriculture*, according to the Natural Resources Defense Council, "asks us to think about how all aspects of agriculture are connected through a web — a network of entities who grow, enhance, exchange, distribute, and consume goods and services — instead of a linear supply chain." Thus, regenerative agriculture is

---

[28] *Non-GMO Food Market Size, Share & Industry Analysis*, FORTUNE BUS. INSIGHTS (Oct. 20, 2025), https://www.fortunebusinessinsights.com/non-gmo-food-market-106359 [https://perma.cc/JAR5-Q2CZ].

[29] Biomimicry Inst., *Sustainable Industrial Agriculture Inspired by Prairie Ecosystems—The Land Institute*, ASKNATURE, https://asknature.org/innovation/sustainable-industrial-agriculture-inspired-by-prairie-ecosystems/ [https://perma.cc/6A85-SF37].

[30] JOHN W. HEAD, DEEP AGROECOLOGY AND THE HOMERIC EPICS 68 n.15 (2021) (quoting FREDERICK L. KIRSCHENMANN, CULTIVATING AN ECOLOGICAL CONSCIENCE: ESSAYS FROM A FARMER PHILOSOPHER 51 (2010)) [hereinafter DEEP AGROECOLOGY].

[31] *See* Rachel Kerr, Sidney Madsen, Moritz Stuber, Jeffrey Liebert, Stephanie Enloe, Noelie Borghino, Phoebe Parros, Daniel Mutyambai, Marie Prudhon & Alexander Wezel, *Can agroecology improve food security and nutrition? A Review*, 29 GLOB. FOOD SEC. 1, 1 (2021).

"about farming and ranching in a style that nourishes people and the earth, with specific practices varying from grower to grower and from region to region." The principles underlying regenerative agriculture are therefore "meant to restore soil and ecosystem health, address inequity, and leave our land, waters, and climate in better shape for future generations."[32] According to another entity focusing on regenerative agriculture — the Regenerative Organic Alliance[33] — regenerative agricultural practices build on generations of organic-agriculture farmers and visionaries to promote holistic agricultural practices that increase soil organic matter, sequester carbon, improve animal welfare, and provide economic stability and fairness for farmers.[34]

- *Organic agriculture* produces food without the use of synthetic fertilizers or pesticides.[35] The organization IFOAM–Organics International defines organic agriculture as "a production system that sustains the health of soils, ecosystems, and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects." In these ways, organic agriculture "combines tradition, innovation, and science to benefit the shared environment and promote fair relationships and good quality of life for all involved."[36] The U.S. Department of Agriculture (USDA) organic-agriculture standards "require operations to use practices that cycle resources, conserve biodiversity, and preserve ecological balance."[37]

- *Biodynamic agriculture* "follows a sustainable, holistic approach which uses only organic, usually locally-sourced materials for fertilizing and soil conditioning, views the farm as a closed, diversified ecosystem, and [at least for those who hew most closely to the views expressed a hundred years ago by Rudolf Steiner] often

---

[32] *Regenerative Agriculture 101*, NAT'L RES. DEF. COUNCIL (Nov. 29, 2021), https://www.nrdc.org/stories/regenerative-agriculture-101 [https://perma.cc/J2PP-XSMP].
[33] *See Framework for Regenerative Organic Certified*, REGENERATIVE ORGANIC ALL. (June 27, 2023), https://regenorganic.org/wp-content/uploads/2023/03/Regenerative-Organic-Certified-Framework.pdf [https://perma.cc/7YU6-6PVZ] [hereinafter *ROC Framework*].
[34] *Id.* at 3. For another definition of regenerative agriculture, *see* Cheyanne Lepird, *Grapes with Wrath — How Sustainable Viticulture Can Save Winemaking for Generations to Come*, 28 DRAKE J. AGRIC. L. 117, 126 (2023) (Lepird quotes from a New York Times article in defining regenerative agriculture as "a way of farming that emphasizes rebuilding, restoring, and supporting the organic matter that composes healthy soils").
[35] *See Organic Farming*, U.S. EPA (Mar. 14, 2025), https://www.epa.gov/agriculture/organic-farming [https://perma.cc/Q3JL-3MW8].
[36] *Definition of Organic Agriculture*, IFOAM–ORGANICS INT'L (2024), https://www.ifoam.bio/why-organic/organic-landmarks/definition-organic [https://perma.cc/2Q5Z-LS6N].
[37] *See* Agric. Mktg. Serv., *USDA Certified Organic: Understanding the Basics*, USDA, https://www.ams.usda.gov/services/organic-certification/organic-basics#:~:text=What%20is%20organic%3F,biodiversity%2C%20and%20preserve%20ecological%20balance [https://perma.cc/XD3A-WX8Y].

bases farming activities on lunar cycles."[38] As expressed by the Demeter organization (discussed at length below), "[b]iodynamics is a holistic, ecological, and ethical approach to farming, gardening, food, and nutrition."[39]

- *Sustainable agriculture* has been given a wide range of definitions, but in general it seeks to produce food and fiber for textiles in a way that meets current needs without hindering future generations from meeting those same needs.[40] Specifically, it seeks to build healthy soils and prevent erosion, to protect water supplies, to limit air pollution, and to promote biodiversity.[41] Beyond these environmental elements, sustainable agriculture is also said to promote practices that allow small farms to be profitable and productive in their local economies, that encourage inter-generational as well as racial justice and equity, and that give access to nourishing food to everyone.[42]

- *Industrial agriculture* focuses on high volumes of production, typically resorting to fossil-carbon fertilizers to increase yields, biocides to limit pests, and genetic modification of crops so that they can resist these biocides. Industrial agriculture is characterized by the attempt to overwhelm perceived limitations of natural systems to force production, regardless of what a particular landscape can bear.[43]

As should be clear from the above definitions, "industrial agriculture" (sometimes called "conventional agriculture") flies in the face of most of the other terms listed there. For reasons I have explored in depth elsewhere, "industrial agriculture" — which I have also characterized more precisely as "traditional extractive fossil-carbon-based industrial agriculture" of the sort that has emerged following the so-called Green Revolution of the twentieth century[44] — stands in

---

[38] Jeanine Davis, *Biodynamic Agriculture*, NC STATE EXTENSION (June 2025), https://horticulture.ces.ncsu.edu/horticulture-organic-production/biodynamics/ [https://perma.cc/VC9T-8CFD] (quoting definition in the Merriam-Webster Dictionary).
[39] *See Biodynamics*, BIODYNAMIC FED'N DEMETER, https://demeter.net/biodynamics/ [https://perma.cc/8ESA-SHZC].
[40] Univ. Cal. Sustainable Agric. Rsch. & Educ. Prog., *What is Sustainable Agriculture?*, UNIV. CAL. AGRIC. & NAT. RES. (Aug. 3, 2021), https://sarep.ucdavis.edu/sustainable-ag [https://perma.cc/KX3E-VFMM].
[41] *What is Sustainable Agriculture?*, UNION CONCERNED SCIENTISTS (Mar. 15, 2022), https://www.ucsusa.org/resources/what-sustainable-agriculture [https://perma.cc/2M4X-LYSB].
[42] *Id. But see infra* note 48 and accompanying text for a critique of the concept of "sustainable agriculture."
[43] *See* AGROECOLOGICAL HUSBANDRY, *supra* note 8, at 14–16.
[44] *See id.* at 15–17.

sharp contrast to most of the means listed above by which humans interact with the Earth's natural landscapes in order to secure food to keep our species alive.[45]

The role of fossil carbon in modern agriculture warrants special attention. In two principal respects, the "industrial agriculture" that dominates production of food, feed, and fiber in today's world is heavily dependent on fossil carbon. First, fossil *fuel* is essential to the production and use of heavy agricultural equipment and to the processing of the grains and legumes that provide roughly two-thirds of global human caloric intake.[46] Second, fossil carbon in the form of petroleum and natural gas serves as the feedstock (starting ingredient or raw material) in the formulation of chemical fertilizers and pesticides of various kinds.[47]

Curiously, and unfortunately, the next-to-last term on the list I offered above — "sustainable agriculture" — has come to have a distorted (some would say badly tarnished) definition. Whereas the first several terms on the list emphasize the importance of evaluating agricultural techniques on the basis of how well they integrate human need for food into natural ecosystems without negatively impacting those ecosystems except temporarily, the term "sustainable agriculture" has in many contexts (as reflected in the definition offered above) assumed a connotation that implies a competition between human interests and non-human interests, in which the human interests must prevail.[48] (As noted below in subsection IIF, British Columbia presents a counter-example to this, in which the term "sustainable" has, at least in the context of viticulture, evolved differently.)

In a recent article, I explained how the same thing has happened to the concept of "sustainable development" (as distinct from "sustainable agriculture"). That concept has evolved to assume that human interests in economic and structural development must prevail over natural systems and processes — which, in their subsidiary status, need be given only that minimal amount of protection that is necessary to keep them supplying the needs of our own species. In that connection, I have urged the rejection of any such balancing test in which human interests prevail; I propose that the concept of "sustainable development" as it has

---

[45] *See 10 things you should know about industrial farming*, UN ENV'T PROGRAMME (July 20, 2020), https://www.unep.org/news-and-stories/story/10-things-you-should-know-about-industrial-farming [https://perma.cc/2QPU-WNGL] (describing the negative effects of industrial agriculture on ecosystem and human health).

[46] For a description of how modern agriculture depends on the *burning* of fossil fuels, particularly oil and gas, *see* AGROECOLOGICAL HUSBANDRY, *supra* note 8, at 13–17.

[47] For details, *see id.*

[48] For a pointed criticism of the term "sustainable agriculture" from this perspective, *see* GRASSLANDS, *supra* note 8, at 214 n.79. For a recent explanation of how the term "sustainable agriculture" has been subjected to "greenwashing" (or "farm washing"), *see Farm Washing: Exposing the Greenwashing of Agriculture*, THE PEOPLES HUB (June 1, 2025), https://thepeopleshub.org/news/farm-washing-exposing-the-greenwashing-of-agriculture/#:~:text=Exposing%20the%20Greenwashing%20of%20Agriculture%20in%20a%20Supermarket%2DDominated%20World,practices%20through%20their%20purchasing%20demands [https://perma.cc/7WE3-6YL2].

evolved in recent years be discarded and replaced with a concept of "process-relational restoration."[49]

In sum: Recent years have seen an explosion in the demand for "organic" food, and therefore both an urge and an opportunity for drastic reforms in agriculture. Numerous definitions and ultimate aims have emerged for these reforms, as evidenced by the rise of such terms as "sustainable," "organic," "biodynamic," "regenerative," and others. All of these reflect a rejection of certain "industrial" agricultural practices that became popular (and possible) only in the last several decades but that rely on extractive and damaging processes, and especially on fossil-carbon inputs. It is within the context of these developments that change also has come to one specific sector of agriculture: viticulture.

IIB. The viticulture sector: industrialization and its discontents

For thousands of years, humans have been growing grapes for wine-making. Archeologists have uncovered evidence of a 6,000-year-old winery in Armenia[50] and a 7,000-year-old jar in Iran containing wine residue.[51] *Vitis vinifera*, the grape species used most often in wine production, has been cultivated in the Middle East since at least 4,000 BCE, and possibly earlier.[52]

Throughout most of history, the growing of grapes for wine was necessarily "natural," with various practices used to beat back pests of all sorts and to make the vines as strong and resilient as possible. Cato the Elder, writing his work *De agri cultura* in Roman times, instructed his readers to "sow clover if the soil [in a vineyard] is lean … and around the roots apply manure, straw, grape dregs, or anything of the sort, to make it stronger" and "if a vine is unhealthy, cut its shoots into small bits and plough or spade them in around it."[53] While Cato's work does not suggest any means of pest control, Marcus Terentius Varro's *De Re Rustica* warns readers that, where grapevines are grown in beds on the ground,

---

[49] *See generally* John W. Head, *Planetary Health in Times of Converging Crises: Reflections on Stockholm, decolonization, restoration, and global ecological governance*, 19 L., ENV'T & DEV. J. 284, 285 (2023) [hereinafter *Planetary Health*]. For the discussion of "process-relational restoration," *see id*. at 290-295.

[50] James Owen, *Earliest Known Winery Found in Armenian Cave*, NAT'L GEOGRAPHIC (Jan. 12, 2011), https://www.nationalgeographic.com/culture/article/110111-oldest-wine-press-making-winery-armenia-science-ucla [https://perma.cc/SG5F-VCEC].

[51] Mark Berkowitz, *World's Earliest Wine*, ARCHAEOLOGY (Sep./Oct.1996), https://archive.archaeology.org/9609/newsbriefs/wine.html [https://perma.cc/M3D7-SQNU].

[52] Maynard A. Amerine, *Wine*, ENCYCLOPEDIA BRITANNICA (Aug 25, 2025), https://www.britannica.com/topic/wine [https://perma.cc/SN56-CAX8]. For another historical account of viticulture, *see* Lepird, *supra* note 34, at 115–120.

[53] MARCUS CATO, ON AGRICULTURE 49, 53 (William Davis Hooper trans., Harvard University Press 1935).

"[t]he foxes often share the harvest with man … and if the land breeds mice the yield is cut short unless you fill the whole vineyard with traps."[54]

The 17th, 18th, and 19th centuries saw the expansion of winemaking — and thus viticulture — into new territories. Spanish missionaries began planting grapes in California; the British brought vines to Australia and New Zealand; and the Dutch brought grapes to South Africa as early as 1654.[55] However, the 19th century also saw the emergence of two blights accidentally imported from the United States that nearly destroyed the wine industry.[56]

First, in the 1850s, European vineyards were suffering from a fungal blight known as oidium or "powdery mildew." Farmers involved in the field-operations aspects of growing grapes for wine successfully treated the plants with sulfur (sulphur) compounds, which had already been found effective in earlier centuries as a form of pest management.[57] Then in the 1860s, the Phylloxera bug — a small insect that, upon piercing the roots of grapevines to feed on the plant fluids, can allow bacteria to infect those roots — emerged and decimated the European wine industry.[58] Eventually, the European vines were grafted onto the heartier American roots, leaving them less vulnerable to the insects.[59]

Beginning roughly a century ago, the landscape of viticulture changed. Vineyard operations and wine-making techniques adopted many of the hallmarks of "industrial agriculture" as defined above — specifically the development of equipment operated by fossil fuel. After all, tractors and cultivators of various forms can be useful in vineyards, and the first tractors specifically designed for vineyard use were introduced in Europe in the 1920s.[60] More specific equipment also emerged: the 1960s saw the introduction of the mechanical grape harvester.[61] This allowed grapes to be harvested more quickly and lowered the cost of human labor, but those mechanical harvesters — along with the use of gas- or diesel-powered equipment more generally — increased the greenhouse gas emissions coming from vineyards.

Modern grape-growing has seen other technological innovations that also reflect the industrialization of agriculture more generally. These include the use of satellite imagery and drip irrigation. More offensive in the minds of some people,

---

[54] MARCUS TERENTIUS VARRO, ON AGRICULTURE 159, 201 (William Davis Hooper trans., Harvard University Press 1935).
[55] Amerine, *supra* note 52.
[56] For a more detailed account of the two blights summarized below, *see* MacNeil, *supra* note 16, at 30-31.
[57] *See* MARY LOUISE FLINT, INTRODUCTION TO INTEGRATED PEST MANAGEMENT 51–52, 58–59 (1981).
[58] *Id.* at 58–59. For details on the process by which Phylloxera led to grape plant root damage, *see* Ric Bessin, *Grape Phylloxera*, UNIV. OF KEN. DEP'T ENTOMOLOGY, (Sep. 2017), https://entomology.ca.uky.edu/ef222 [https://perma.cc/9XWR-WN9B].
[59] Flint, *supra* note 57, at 58–59.
[60] *Horses vs. Tractors for Vineyard Farming*, THIS DAY IN WINE HIST. (Feb. 29, 2024), https://thisdayinwinehistory.com/horses-vs-tractors-for-vineyard-farming/ [https://perma.cc/L7V7-7547].
[61] *See* Amerine, *supra* note 52.

though, has been the growing use of other chemical products, especially pesticides, that have emerged only in the past few decades. These include boscalid, penconazole, pyrimethanil, and fludioxonil; these are all pesticides — specifically fungicides — used primarily for addressing such problems as black rot, powdery mildew, and gray mold. According to a study by the U.S. National Institutes of Health, these are the most common pesticide residues identified in conventionally-grown grapes.[62] Moreover, multiple sources document the presence of pesticide residue in grapes and wine from various geographic areas.[63]

Globally, the California Department of Pesticide Regulation (CDPR) has the "largest and most complete database on pesticide use."[64] A study of the CDPR's Pesticide Use Reports (PUR) reveals a steady increase in pesticide use between 1935 and 2016.[65] Recently, however, CDPR's PURs indicate a decrease in chemical pesticide use, both in agriculture generally and for producing table, raisin, and wine grapes.[66] Experts in California-based vineyard management support a mix of chemical and organic pesticide practices, demonstrating the shift towards organic viticulture. For instance, Madeleine Rowan-Davis, a senior viticulturist with Atlas Vineyard Management, notes that operators in that company "use chemicals and management practices that are permitted in organic farming, even in [their] conventionally farmed properties."[67] Similarly, Mark Greenspan of Advanced Viticulture, Inc., explains that company's finding that "a mix of 'chemical' and organic materials is often the best approach."[68] This increasingly mixed-use approach demonstrates that organic methods are no longer

---

[62] Dana Schusterova, Jana Hajslova, Vladimir Kocourek & Jana Pulkrabova, *Pesticide Residues and Their Metabolites in Grapes and Wines from Conventional and Organic Farming System*, 10 FOODS 307, 311 (2021).

[63] *See*, *e.g.*, *id.* at 307–08 (United States); Ozgur Golge & Bulent Kabak, *Pesticide Residues in Table Grapes and Exposure Assessment*, 66 J. AGRIC. & FOOD CHEM. 1701, 1701–13 (2018) (Turkey); A. Bouagga, H. Chaabane, K. Toumi, A. Hamdane, B. Nasraoui & L. Joy , *Pesticide Residues in Tunisian Table Grapes and the Associated Risk for Consumer's Health*, 12 FOOD ADDITIVES & CONTAMINANTS: PART B 135, 135–44 (2019) (Tunisia); and *Agrochemicals Registered For Use in Australian Viticulture*, AUSTRALIAN WINE RSCH. INST. (Sep. 15, 2025), https://www.awri.com.au/wp-content/uploads/agrochemical_booklet.pdf [https://perma.cc/H8SG-KZFF].

[64] *See* Larry Wilhoit, *History of Pesticide Use Reporting in California*, AM. CHEM. SOC. 1, 1 (2018), https://pubs.acs.org/doi/10.1021/bk-2018-1283.ch001 [https://perma.cc/4MXN-FM9H].

[65] *Id.* at 12.

[66] *Pesticide Use Annual Report — 2022 Data Summary*, CAL. DEP'T OF PESTICIDE REGUL. (July, 2024) https://www.cdpr.ca.gov/wp-content/uploads/2024/12/pur_2022_data_summary.pdf [https://perma.cc/PS32-4FTT].

[67] Cheryl Gray, *Pest and Disease Control: Industry Specialists Help Vineyard Protect Their Most Valuable Commodities*, GRAPEVINE MAG. (Jan. 5, 2021), https://thegrapevinemagazine.net/2021/01/pest-disease-control/ [https://perma.cc/K9DC-HQCP].

[68] *Id.*

a niche alternative but rather a favored practice in reducing reliance on chemical pesticides.

For the title of this subsection, I used this formulation: "*The viticulture sector: industrialization and its discontents.*" Just as with modern agriculture more generally, viticulture has widely adopted a suite of innovations that were impossible until the past several decades. The development of fossil-carbon sources of energy and of chemical production has transformed some aspects of viticulture into an industrial-agriculture model.

At the same time, some producers have resisted these developments, and in recent years they have started reaping rewards as consumers have expressed their own discontent with the industrialization of wine-growing and wine-making. For purposes of this article — focusing as it does on soil health — the practices used in *growing* grapes for wine should occupy our attention more than the practices used in *making* wine from grapes. However, the two processes (growing and making) are perhaps largely indistinguishable in the minds of many consumers.

How, and to what extent, have consumers expressed discontent with "industrial" vineyard operations and a preference for natural-systems viticulture? Here are some statistics and illustrations:

- Globally, younger generations are more likely to pay a premium for organic wines, due in part to having "more exposure to organic foods as children" and being "more aware of environmental issues from their primary education."[69]

- Italian consumers are more likely to purchase organically certified wine as a gift than for themselves, demonstrating a perception of a higher-quality product.[70]

- Increasing public interest in natural-systems viticulture practices recently prompted a survey of over 1,500 U.S. wine consumers to study the "motivations and purchasing habits" of such consumers. The survey results "show that many younger consumers give concerns about personal health as a reason to buy eco-friendly wines; whereas for older and more frequent wine consumers it's dominated

---

[69] Daniel Moscovici, Jeff Gow, Adeline Ugaglia, Rana Rezwanul, Lionel Valenzuela & Radu Mahailescu, *Consumer preferences for organic wine - Global analysis of people and place*, 368 J. CLEANER PROD. 1, 8 (2022), https://www.sciencedirect.com/science/article/pii/S0959652622028025#sec4 [https://perma.cc/QMC6-XD8M].

[70] Fabio Boncinelli, Andrea Dominici, Francesca Gerini & Enrico Marone, *Consumers wine preferences according to purchase occasion: Personal consumption and gift-giving*, 71 FOOD QUALITY & PREFERENCE 270, 272, 275 (2019).

by concern for the environment."[71] Other U.S. wine-industry experts echo the same points about "increasing market demand for sustainably produced wine," explaining that "[a]s the value of sustainability in the marketplace flourishes, growers and vintners across the U.S. are increasingly embracing sustainable winegrowing practices."[72]

- Most Canadian wine consumers report being in a transition state towards sustainable wine practices, indicating a need for further education and easily interpreted, sustainable certifications for consumers.[73] Wine Intelligence surveys suggest American wine

---

[71] *See Why Consumers Really Buy Eco-Friendly Wines: New WMC Study Uncovers Surprising Insights*, WINE INDUS. NETWORK (Jun. 2, 2025), https://wineindustryadvisor.com/2025/06/02/why-consumers-really-buy-eco-friendly-wines/ [https://perma.cc/CU85-3TJR] [hereinafter *Surprising Insights*] (quoting the president of the Wine Market Council). The same observer noted that "the number one motivation for both groups to purchase eco-friendly wines is to support the farmers and producers of these types of wines." *Id*. The same survey revealed gaps in consumer understanding of various types of designations and certifications that I explore in this article: "The study found that consumers are more familiar with the definition of wine made with organic grapes 'Organic grapes' (73%), 'Organic wine' (63%), and 'Sustainably produced,' (56%). Only 25% claimed they understood the term, 'Regenerative', while 'Biodynamic' scored at 36% and 'Natural' wine at 41%." *Id*.

[72] *Consumer & Trade Research Shows Increased Demand for Sustainably Produced Wine*, WINE INST. (Jun. 9, 2020), https://wineinstitute.org/press-releases/consumer-trade-research-shows-increased-demand-for-sustainably-produced-wine/ [https://perma.cc/K67Q-TRNG] [hereinafter *Consumer & Trade Research*].

[73] Gary J. Pickering, *Consumer engagement with sustainable wine: An application of the Transtheoretical Model*, 174 FOOD RSCH. INT'L 1, 1 (2023). For other analytical reviews of growing consumer interest in natural-systems viticulture, *see generally* Mark A. Bonn, Joseph Cronin, Jr. & Meehee Cho, *Do Environmental Sustainable Practices of Organic Wine Suppliers Affect Consumers' Behavioral Intentions? The Moderating Role of Trust*, 57 CORNELL HOSP. Q. 21 (2016); Sujaya Mendon, Meghana Salins, Kavyashree K., Ashwini V., Shilpa K. & Sharmila Shetty, *Customers Expectation towards Factors Driving Sustainable Choice: A Study on Organic Wine Consumption in Developed Economy*, 43 BULL. PURE & APPLIED SCI. - ZOOLOGY (ANIMAL SCIENCE) 1531 (2024); *Sustainably Produced Wine (US Market)*, WINE INTEL. (Jun. 2019), https://wineinstitute.org/wp-content/uploads/2019/12/Wine-Intelligence_US-Sustainability-Consumer-Research_June-2019.pdf [https://perma.cc/6STM-Z42J] [hereinafter *Sustainably Produced Wine*]; Giovanni Sogari, Cristina Mora & Davide Menozzi, *Sustainable Wine Labeling: A Framework for Definition and Consumers' Perception*, 8 AGRIC. & AGRIC. SCI. PROCEDIA 58 (2016) (reporting on a study emerging from the fact that "the wine sector has seen the growth of 'environmentally-friendly' and ethical claims according to specific eco-certification schemes and labelling programs."); *See also Global Wine Consumption Trends: The Shift Toward Sustainability, Quality, and Younger Consumers*, WINE INTEL. (Nov. 20, 2024), https://wine-intelligence.com/blogs/wine-news-insights-wine-intelligence-trends-data-reports/global-wine-consumption-trends-the-shift-toward-sustainability-quality-and-younger-consumers [https://perma.cc/H9U2-DTJB] (noting that a survey of wine-industry experts indicates that "[a] growing percentage of wine drinkers are making sustainability a priority [and that] … [n]early 85% of those surveyed believe organic wine will lead consumption growth").

> consumers are in a similar change state, with 71% of participants reporting that they would consider purchasing sustainably produced wine.[74]

As might be obvious from some of those illustrations, the distinctions between "biodynamic," "organic," and other labels or claims are fuzzy in the minds of consumers,[75] or at least in the minds of observers reporting on consumer sentiments. To examine what legal or policy reforms might be involved in responding to the pro-"natural" consumer sentiment, we need to define the relevant terms more precisely, especially as they apply in legal and regulatory settings.

In her popular book *The Wine Bible*, Karen MacNeil offers this account under the heading of "Sustainable and Organic: A Farm for the Future": "In the first decade of the twenty-first century, the movement toward eco-friendly grape-growing accelerated worldwide."[76] For MacNeil, "[g]reen viticulture … generally falls under one of three concepts: sustainable, organic, or biodynamic."[77] For reasons that I noted above in subsection IIA, I would exclude "sustainable" from the mix, and indeed MacNeil acknowledges that "sustainable viticulture has no single definition or legal requirements."[78]

The other two categories MacNeil identifies — "organic" and "biodynamic" — *do* have legal and certification requirements, and it is those two categories that, together with a third category of "regenerative viticulture," that will hold our attention for the remainder of this survey. I start with "biodynamic viticulture" and the specific normative requirements that have been established for that designation. Most of those requirements date back roughly a century. Then I turn to the more recently established designations of "organic viticulture," "regenerative viticulture," and a few other similar labels. I end the survey in subsection IIG with an explanation of my term "science-based biodynamic regenerative viticulture."

IIC. Biodynamic viticulture

Karen MacNeil offers this general description of biodynamic agriculture, focusing especially on its historical and theoretical underpinnings and the natural-systems approach that its earlier pioneers had in mind:

> While biodynamic methods have been used by farmers for centuries, the term *biodynamics* came into use in the 1920s and was based on the teachings of the Austrian philosopher Rudolf Steiner and his student Maria Thun. Sometimes described as a "spiritual science," biodynamic farming involves managing a farm holistically as a regenerative living organism. Vines are

---

[74] *Consumer & Trade Research*, *supra* note 72.
[75] *See, e.g.*, *Surprising Insights*, *supra* note 71.
[76] MacNeil, *supra* note 16, at 35.
[77] *Id.*
[78] *Id*.

> fertilized using compost created on the farm, and soils are regenerated naturally through the waste droppings of farm and ranch animals. Harmful pests are controlled by encouraging a population of beneficial pests that feed on them, creating a "living balance." Biodynamic practioners [*sic*] envision plants as existing in a "middle kingdom" influenced from below by the forces of the earth and governed from above by solar and astral forces. Thus, vineyard practices such as pruning are done according to the movement of the moon through the twelve houses of the zodiac. The goal of biodynamics is to align all of the forces of Nature, creating a natural harmony.[79]

This synopsis by MacNeil needs unpacking in two respects. First, a distinction should be made between (i) the so-called "spiritual science" (or anthroposophy) attributable to Steiner and Thun (those are the aspects of biodynamic agriculture that so bothered my friend Tim Crews) and (ii) the specific practices that biodynamic agriculture actually encompasses, based on the purported benefits of those elements. Second, we should focus on the detailed certification requirements promulgated by the Demeter organization, technically titled The Biodynamic Federation Demeter International.[80] Doing so will reveal why only a few viticulture operations have earned Demeter's official certification as "biodynamic" under that system, even though a much larger number of viticulture operations are certified as "organic" under U.S. and European standards.

The Steiner lectures, presented in 1924, make for fascinating but frustrating reading because they blend the so-called "spiritual" features of biodynamic farming with the specific practices that Steiner urges farmers to follow. To a modern reader, the spiritual features seem about 90 percent "woo-woo speculation" that is patently unscientific. Steiner offers almost no factual data or disciplined observation as authority for most of the propositions he offers.

Therefore, in composing this article, I faced a conundrum: Should I provide selected representative excerpts from Steiner's lectures — reflecting the fact that Steiner is universally acknowledged as the founding voice for biodynamic

---

[79] *Id*. at 34.

[80] As explained by one source, there are two systems for biodynamic certification: The Demeter system, "[n]amed after the Earth Mother in Greek Mythology … is overseen by The Biodynamic Federation Demeter International…" which was formed in 2020 from a merger of two other organizations and which dates back to the teachings of Rudolf Steiner, and Biodyvin, which is an "alternative certification [system] … run by a group of over 200 member wineries," mostly in France but with some members also in several other European countries. *See* Tom Jarvis, *Certified Biodynamic Wine*, WINE-SEARCHER (Dec. 9, 2024), https://www.wine-searcher.com/certified-biodynamic-wine?srsltid=AfmBOortVbsPbyzPM7PMk22PtmPUwqMNdGW-Tti8aQzH0wXKlqGCe2TX [https://perma.cc/9PMH-R9DZ].

agriculture — or should I offer only a tiny synopsis? I have split the difference. In the Appendix to this article I provide a few pages of representative excerpts, and I offer here a bare-bones bullet-point synopsis[81] of the assertions Steiner made in his lectures,[82] delivered just a year before he died in 1925:

- For Steiner, the *placement of the planets* and moon in relation to the earth is of utmost significance because of the roles of silicon and limestone in any cultivated field. He refers first to what he calls "the life of the siliceous substance in the world" and says that this substance contains forces that come not from the Earth itself but from Mars, Jupiter, and Saturn.

- Especially for plants used for food (rather than those which Steiner says "do nothing but reproduce themselves"), *silicon is especially important because it "opens up the being of the plant to the expanses of the Universe*, … so that it absorbs the formative forces bestowed by [those] planets" (Mars, Jupiter, Saturn).

- Water is also essential in agriculture, and "[t]here is much more hidden in water than appears in the chemical properties of hydrogen and oxygen. *Water by its very nature … distributes the lunar forces throughout the earthly realm*."

- The Moon also has an effect on water in the plant kingdom. Indeed, "the *forces coming from the Moon* when it is full causes [*sic*] something tremendous to happen on Earth." Those forces "*shoot right into the whole growing forces of the vegetable kingdom*," at least if there has been a rainy spell before the full moon.

- The basis of all agriculture, though, "is the soil of the earth." Soil is more than just mineral supplemented with other organic substances. Instead, soil "is a kind of organ within that organism which manifests itself wherever the growth of Nature appears." For Steiner, "*[t]he earth surface is really an organ … which … you may compare with the human diaphragm*" with the head of the body underground and the bowels up above the ground, so that "[o]n a farm, we are walking about inside the belly, and the plants grow upwards within this belly."

---

[81] I thank Lucia Orth (who, like Tim Crews, is certainly no enthusiast for Steiner) for generating this synopsis.

[82] For a full English version of the lectures' transcripts (first prepared in 1929), *see generally* Guenther Wachsmuth, *The Agriculture Course*, RUDOLF STEINER ARCHIVE, https://rsarchive.org/Lectures/GA327/English/RSPC1938/Ag1938_index.html [https://perma.cc/UJH4-KDPF]. All specific citations to quoted material in the following bullet-points appear in Appendix A. In the following bullet-points, all added emphasis is my own.

- *Cosmic forces from planets and the Moon interact with plants through clay*, which "is the mediator through which the cosmic activity in the soil is enabled to work from below upwards."

- Rich soil (humus) is best for this uptake process because "*when the seed is placed in the soil it is … filled with the longing to deny the cosmic forces*, in order that it may spread and grow in all directions." We need to "introduce[e] into the plant some form of living earthly matter which has not reached the state of chaos and seed formation, life which has been held up in a plant before the seeds have been formed."

- The emphasis Steiner places on certain minerals and on introducing "living earthly matter" into plants seems consistent with the instructions he gives farmers for creating special mixtures ("preparations") and then spraying them "over tilled land so [they] can get thoroughly into the soil." Some of these preparations involve pressing manure into a cow-horn and burying for a period of time, then liquefying it for spraying. Other preparations involve quartz or flint buried in a cow-horn and later spraying the results (liquified and diluted) on the land.

Looking quickly at these key assertions from Steiner's lectures or reviewing the longer excerpts that I provide in the Appendix to this article reveals just how odd or even inscrutable his assertions look to us as modern readers. In this regard, we can take some comfort in the reactions offered by Steiner's audience from a hundred years ago:

> When one reads the translated full text of the lectures, along with the interspersed question and answer discussions, one is reminded of the comments of others on reading Steiner's work. 'Tough going' and 'impenetrable' … ; "difficult" … ; "daunting", "confusing", and "bewildering" … ; and "irritatingly incomprehensible" … are typical comments of those who have studied Steiner in depth.[83]

I would offer three conclusions that I draw from my own survey of Steiner's teachings. *First*, Steiner engaged in what seems patently unscientific. Indeed, I find the term some observers offer — "spiritual science" — to be overly generous in describing Steiner's teachings, which seem to have precious little foundation in science of any sort.

---

[83] Andrew Chalk, *What Did Rudolf Steiner Actually Say?*, CHALK REP. (Dec. 2, 2022), https://www.thechalkreport.com/post/what-did-rudolf-steiner-actually-say [https://perma.cc/W9ZU-J987].

Second, Steiner seems to have been disengaged from the practice of farming itself — so disengaged, in fact, that one might ask just what Steiner's qualifications were for formulating and explaining a new discipline of "biodynamic agriculture." One observer, writing particularly from a viticulture perspective, offers this skeptical response:

> [W]here Steiner had the most impact for wine industry participants was the creation of what came to be called biodynamic agriculture (often called biodynamics). Given this, it seems remarkable that Steiner's life [… had] so little involvement with agriculture, agronomy, other agricultural scientists, botanists, or biology. Certainly, he came across biology in his reading of Goethe, but this would have been mainly confined to morphology. Rather, the source of the comprehensive system of agriculture that Steiner presented is something of a mystery.[84]

Third, despite how unscientific — even alien — some of Steiner's views might seem, he does posit numerous fundamentals that ring true, such as his assertion that "[t]he basis of all Agriculture is the soil of the earth"[85] and his statement that "the forces coming from the Moon when it is full causes something tremendous to happen on Earth."[86] The latter of these points (the significance of lunar phases) inspired Maria Thun (1922-2012), a German farmer, to study how lunar movements affected the growth of plants. One source offers this summary of her work:

> Rudolf Steiner had pointed out the connection between cosmic forces and the growth of plants. Maria Thun began studying the astronomical calendar … and discovered that every two or three days the moon passed into in a different constellation of the zodiac. This made her decide to study astronomy more intensively. She discovered that radishes acquired a different form and size depending in which constellation they were planted.
>
> Maria Thun continued experimenting with sowing during the 1950s with almost all types of crops to see whether the movement of the

---

[84] *Id.* That same source explains the setting for Steiner's lectures, which evidently did attract some practicing farmers: "The actual delivery of [Steiner's views on] biodynamics was over 10 days in a series of 8 lectures in Koberitz, Silesia (now Kobierzyce, Poland), from the 7th to the 16th June, 1924. The audience of just over 100 consisted of farmers and members of the Anthroposophical Society." *Id.*

[85] *See infra* text accompanying note 309.

[86] *See infra* text accompanying note 307. The moon's effect on tides is well known, but "Isabella Guerrini, at the University of Perugia, is one of the many researchers studying the effects of the moon on plants. Her studies show that plant sap moves and changes in intensity according to the phases of the moon." Anna Buzzoni, *The Moon in History and Biology*, STUDIO MEDULLA (Feb. 26, 2021), https://studiomedulla.com/the-moon-in-history-and-biology/#:~:text=Isabella%20Guerrini%2C%20at%20the%20University,the%20phases%20of%20the%20moon [https://perma.cc/CD6C-JC38].

> moon had the same effect on all crops. From her observations she divided passage of the moon through the zodiac into four: root days, leaf days, fruit days and flower days, each indicating which type of plant is best sown on each specific day ….
>
> The news of the results of [Maria Thun's] trials spread quickly through the biodynamic movement and The Biodynamic Sowing and Planting Calendar has been published annually for the last 50 years. As the extent of the trials expanded, so did the calendar and early on it was translated into French and Finnish, and today it is available in 27 languages.[87]

With these observations as background to the historical and spiritual foundations of biodynamic agriculture in general, I turn to this more specific two-part question: How much of Steiner's teachings, and how much of Maria Thun's calendar, have found their way (i) into the actual practices of "biodynamic viticulture" and (ii) into the specific normative requirements that have been established for a formal "biodynamic" designation under the Demeter standards?

I would answer the first part of the question with "it depends." A few small vineyard operations do explicitly embrace Steiner's teachings and/or Maria Thun's calendar vigorously,[88] while others do little more than acknowledge their debt to some fundamental principles emphasized by Steiner and Thun.[89] The

---

[87] *See Maria Thun Biography*, FLORIS BOOKS, https://www.florisbooks.co.uk/authors/maria-thun.php [https://perma.cc/S96Z-3AT6].

[88] *See, e.g.*, *Biodiversity*, AGRICOLA FORADORI, https://www.agricolaforadori.com/biodiversita/ [https://perma.cc/VFC2-7WVC] (giving prominent attention to Steiner, including a three-page excursus on his philosophy, as being central to the viticulture operations of the Foradori vineyards near Trento, Italy — but with no mention of Maria Thun). *See also About Us*, TOJAK PENDITS, https://pendits.com/en/about-us/ [https://perma.cc/2B7U-8PDG] (noting this Hungarian winery's adherence to the biodynamic planting calendar); *see also* https://chateaumonty.com/pendits/ (citing Maria Thun specifically);*Biodynamics,* CULLEN WINES, https://cullenwines.com.au/pages/biodynamics [https://perma.cc/3V3H-W264] (offering a "Self-Guided Spiral Garden Biodynamic Tour" in which visitors to this Australian vineyard operation can learn about Steiner's practices); and *Frequently Asked Questions*, ROXANICH, https://www.roxanich.com/faq [https://perma.cc/82EF-QTSZ] (relying on Steiner and Thun's work for the basis of the practices of this Croatian vineyard). For other winery websites mentioning Steiner but not Thun in its praise of their biodynamic viticulture operations, *see* l'Univers M. Chapoutier, *Biodynamics*, https://www.chapoutier.com/en/the-maison/biodynamics/ [https://perma.cc/LCR8-BPVU]; *Biodynamic: A Way of Life*, FREY VINEYARDS, https://www.freywine.com/demeter-biodynamic [https://perma.cc/42BL-6ZJW] (quoting Steiner but without referring to Thun).

[89] *See, e.g.*, *A Soulful Approach*, ANALEMMA WINES, https://analemmawines.com/a-soulful-approach/ [https://perma.cc/C2Q2-2B7W] (mentioning the word Demeter once but with no mention of Steiner or Thun as relevant to the operations of Analemma viticulture operations

answer to the second part of the question, however, seems clear: the Demeter standards require that in order to gain official certification as "biodynamic," their operators must follow a fairly definite set of prescribed practices, including the use of "preparations" of the sort espoused by Steiner himself, but the Demeter standards give little attention to the Maria Thun calendar.

As noted above, Steiner's instructions (delivered to the farmers listening to his 1924 lectures) regarding "preparations" involve the use of buried cow-horns — some stuffed with manure, some with other ingredients — and spraying a diluted liquid that results from that process.[90] These instructions have been adopted in part by the Demeter biodynamic-certification system. Under the English version of the international standards,[91] Demeter certification of a vineyard requires application of certain compost preparations and certain cow-horn manure preparations.[92] The general rationale for these requirements is as follows:

> The biodynamic compost and spray preparations (= "preparations") created out of natural and organic substances are used in minute doses to enhance soil life, plant growth and quality and animal health. They act as a kind of "bio regulator", forcing the self-regulation of biological systems, e.g. the farm's whole biological cycle.

---

headquartered in Mosier, Oregon, in the Columbia Gorge AVA); *see also What is Biodynamic Farming?*, HEDGES FAM. EST., https://hedgesfamilyestate.com/the-land [https://perma.cc/QV4E-FQHC] (displaying the Demeter certification design but with no mention of Steiner or Thun as relevant to the operations of Hedges Family Estate viticulture operations headquartered Benton City, Washington, in the Red Mountain AVA); *see also Farming*, QUIVIRA WINE, https://quivirawine.com/farming/ [https://perma.cc/EH39-DXK5] (maintaining biodynamic practices while moving away from Demeter Biodynamic Certification, noting that many required practices had no beneficial effects); *Who We Are*, SUMMERHILL PYRAMID WINERY, https://www.summerhill.bc.ca/us/who-we-are/#planet [https://perma.cc/4RYZ-2JK4] (briefly describing biodynamics as "the most holistic" without mention of Steiner); *Certifications*, BENZIGER FAM. WINERY, https://www.benziger.com/certifications/ [https://perma.cc/2EBL-EFSE] (discussing an overview of the practices of this California vineyard without mention of Steiner); and *see Domaine de l'Octavin*, MYSA NAT. WINE, https://mysa.wine/collections/domaine-de-loctavin?srsltid=AfmBOoqaz-9cC5_ICxCmirGI3xhYY0QMQiCjl2_d5K3qH0kg1sIxyW18 [https://perma.cc/QAD5-QR7S] (in the Jura region of France, noting this vineyard's Demeter certification but with no mention of Steiner or Thun).

[90] *See* the last bullet-point in the list following note 82, *supra.* For the excerpt from Steiner's lectures relating to "preparations," *see* the last entries in the Appendix to this article.

[91] The four language versions of the Demeter standards are in English, Spanish, German, and French, although "in case of unclarity the English version is the deciding one." *See The Demeter Standard: The Strictest Standard for Organic Agriculture Worldwide*, BIODYNAMIC FED'N DEMETER, https://demeter.net/certification/standard/ [https://perma.cc/9564-SXEV]. The version used in the following discussions is the first of these; *see Production, Processing, and Labelling: International Standard for the use and certification of Demeter, Biodynamic and related trademarks (as of: September 2024)*, BIODYNAMIC FED'N DEMETER (Sep. 2023), https://demeter.net/wp-content/uploads/2024/10/2025_Int_Dem_bio_Standard_eng.pdf [https://perma.cc/42GQ-UTRZ] [hereinafter Demeter-English].

[92] *See* Demeter-English, *supra* note 91, at 76.

> They are essential to biodynamic agriculture and their use is a recognised requirement of the International Demeter Biodynamic Standard.
>
> The production of preparations takes place on the farm. The method of production involves taking certain plant materials (e.g. camomile flowers, grated oak bark and dandelion flowers), cow manure or quartz meal, placing them in selected animal organ parts and fermenting them in the soil for certain period of time, usually half a year.[93]

As a practical matter, the details on how to *make* the preparations are of little concern to many Demeter-certified vineyards, because the viticulturalists can *purchase* the preparations required in the Demeter standards.[94] More significant to most Demeter-certified vineyards would be the requirements on how to *apply* the preparations, including these details:

> Cow-horn manure or prepared cow horn manure (500P) is to be spread at the start of the vegetative phase, or after harvest of the certified crop, but in any case at least once a year at a rate of at least 50 gr/ha. Horn silica is to be sprayed as the plant stage of development dictates,

---

[93] *Id*. at 131.

[94] *See Ask Jim*, DEMETER ASS'N, INC. (2013), https://www.demeter-usa.org/for-farmers/for-farmers-archive/biodynamic-preparations.asp ("Beyond making the [Preparation] 500 oneself, … the 500 can be purchased from the Josephine Porter Institute (JPI) or from one of the numerous groups making the preparations across America"); *See also Biodynamic Preparations*, JOSEPHINE PORTER INST., https://jpibiodynamics.org/collections/biodynamic-preparations [https://perma.cc/FAZ3-XLH5]. The blogpost offers this counterpoint to the view that the use of preparations involves pseudoscience or poppycock:

> While some like to poke fun at a Biodynamic practitioner's use of preparations made in cow horns, the material that results is uber-biological, teeming with beneficial soil-based flora and fauna. If understanding the 500 only from a mechanical cause and effect point of view it can be understood as a soil inoculant. But anyone with a background or understanding of homeopathy can see a more holistic reality and view it as homeopathic medicine for the earth. The 500 and all the Biodynamic preparations medicinally treat the Earth as a living organism much like naturopathic medicines treat us. In fact it is a principle of homeopathy that very small amounts of material, when rhythmically potentized, are much more potent than large amounts of material. While a strange new world for some, it is an intrinsic element of Biodynamic agriculture.

Ask Jim, DEMETER ASS'N, INC. (2013), https://www.demeter-usa.org/for-farmers/for-farmers-archive/biodynamic-preparations.asp [https://perma.cc/EX3Q-LN36].

> preferentially during the intensive growth stage and imperatively between growth stage and harvest, at a rate of at least 2.5 g/ha. … The spray preparations must be applied with clean equipment. … All organic manures (stable manure, compost etc.) are to be treated with the compost preparations.[95]

In addition to the requirement for the use of certain compost preparations and certain manure preparations, the Demeter standards include provisions on:

- *Non-contamination*. "At all stages of production and processing there must be protocols in place to ensure that contamination of Demeter products is actively excluded (this includes cleaning products and protocols, separate production runs for Demeter products and other strategies to actively avoid mixing and substitution with uncertified materials)."[96]

- *Origin of raw material*. Subject to some exceptions, "[p]rocessed Demeter products can only include agricultural products (including animal products) which originate from certified biodynamic farms (with a Demeter contract) which have been processed with Demeter approved aids and additives."[97]

- *Labeling*. "The Biodynamic trademarks … can only be used to label ingredients, materials and products that meet [the Demeter] standard, by an organisation that has Demeter certification … ."[98] Regarding wine in particular, "[i]f wine is made from Demeter certified grapes and meets the [International Demeter Biodynamic Standard], it may be labelled with the Demeter trademark logo … ."[99]

- *Genetically modified organisms*. "Seed, propagation and plant material of genetically modified varieties (GMO) including protoplasm and cytoplasm fusion techniques may not be multiplied or sown on Demeter enterprises."[100]

- *Fertilization*. Subject to certain exceptions, "[t]he total amount of nitrogen applied from all types of fertilisers used, may not exceed …

---

[95] *See* Demeter-English, *supra* note 91, at 76.
[96] *Id*. at 18.
[97] *Id.* at 22.
[98] *Id.* at 36.
[99] *Id.* at 45. Other labeling rules apply to wines that use Demeter certified grapes but are processed using the EU organic wine standards instead of the Demeter standards; these wines can be labeled "Wine made from Demeter Grapes." *Id*. For a summary of EU organic agriculture standards, *see infra* subsection IID.
[100] *Id.* at 55. Beyond prohibiting GMOs, the Demeter standards also prohibit the use of "material produced by new plant breeding techniques," including through cisgenesis and CRISPR technology. *Id*. at 55–56.

50kg N/ha/y for viticulture (calculated as an average over three years) … ."[101]

- *Irrigation water*. "The water must not be contaminated with pesticide residues, disease causing bacteria or parasites, or contaminate the end product in any way. If surface water is used for professional irrigation the water quality must be monitored through regular analyses."[102]

- *Livestock*. Although exemptions are available, "Demeter certification of agricultural enterprises without the incorporation of animals on the farm is [typically] not possible"[103] The number of "livestock units" per acre is smaller for agricultural operations under 40 hectares than it is for larger operations.[104]

- *Sulfur*. As noted above, sulfur (sulphur) compounds have been used in viticulture for several centuries and for various purposes.[105] The Demeter standards impose limits on its use on any type of farm (not just a vineyard) wishing to qualify for biodynamic certification. For instance, lime sulfur qualifies as an "allowable aid" that can be used as a fungicide, insecticide, or acaricide.[106] Sulfur can also be used as a cleaning agent[107] and as a fertilizer or soil conditioner if "the results of soil testing, tissue/leaf analysis or other deficiency symptoms demonstrate the need [for such use]."[108]

---

[101] *Id.* at 59. "If [a biodynamic farm's] own farmyard manure is not sufficient to cover the nitrogen demand, other fertilisers may be imported," but only from organic sources. *Id*.

[102] *Id.* at 71.

[103] *Id.* at 77. In order to meet the livestock requirements, a Demeter-certified farm can enter into cooperative arrangements with another biodynamic or organic farm. *Id.* at 79. Conditions for managing the livestock "must be organised such that the animals can express normal behavioural characteristics and movement; e.g. they must be able to stand and lie down unhindered, and have a dry resting place." *Id.* at 80.

[104] In general, a farm involving less than 40 hectares must have at least 0.1 livestock units (defined differently for different types of livestock) per hectare, whereas a larger farm requires 0.2 livestock units per hectare. *Id.* at 77–78.

[105] *See supra* text accompanying note 57.

[106] Demeter-English, *supra* note 91, at 125. The Demeter standards explicitly permit use of wettable sulfur in case of a "fungal attack," but only … in "cases of proven need, and only if the biodynamic measures (e.g. rhythmical use of horn silica for insect control, peppering) cannot bring the problem under control." *Id*. 123–124. *See also Biodynamic® Farm Standard*, DEMETER ASS'N, INC. (March 2023), https://www.demeter-usa.org/downloads/Demeter-Farm-Standard.pdf [https://perma.cc/87SM-BBX4]. In the winemaking process, as distinct from vineyard operations, sulfur dioxide can also be used as an additive or processing aid. Demeter-English, *supra* note 91, at 30.

[107] Demeter-English, *supra* note 91, at 53.

[108] *Id*. at 120–121.

It is important to understand that the Demeter standards include both mandatory *rules* and (more extensive) *guidelines* that are characterized as "a recommendation only."[109] The standards I have highlighted above — for instance, requiring the use of certain types of preparations, prohibiting GMOs, and limiting the use of sulfur — all qualify as *rules*. Among the many other provisions of the 204-page International Demeter Biodynamic Standard" document are *guidelines*. Some of these relate to the preferred processes for formulating the preparations,[110] but more generally they take the form of entreaties to farmers to act responsibly within the overall philosophy and aims of biodynamic agriculture:

> The aim is always to practise agriculture in such a manner that structuring the farm as an integrated unit results in productivity and health, and that those inputs needed for production are generated out of the farm itself. If one however wants to use these standards in such a way as is often the case with laws, that the only concern is with adherence to formalities, or loopholes are sought for economic advantage, one should practise agriculture in some other fashion.[111]

However, as I have emphasized above in subsection IIA,[112] the wave of consumer enthusiasm for "organic" and other natural-systems products is strong. Viticulture operations wishing to ride that wave need to consider the benefits of Demeter biodynamic certification. It is by far the oldest certification system for biodynamic operations, including vineyards, dating back to the 1920s.[113] Even if the Steiner-Thun foundations of biodynamics trigger suspicion or rejection, the actual *rules* prescribed in Demeter certification standards reflect a serious commitment to responsible vineyard operations aimed at long-term stewardship of ecosystems (and especially soils) by environmentally-conscious farmers of the 2020s. Those rules carry almost no visible mark of the Steiner "woo-woo" of the 1920s.

I will offer another way of emphasizing this distinction between (i) the spiritual or "woo-woo" aspects of the Steiner-Thun version of biodynamic farming (especially as applied to viticulture) and (ii) all the *other* aspects of biodynamic viticulture as enumerated in the bullet-point list I offered above.[114] Not a single item on the bullet-point list carries the Steiner-Thun spiritual or "woo-woo" elements of what we might call "orthodox" biodynamic agriculture. Instead, all of

---

[109] *Id.* at 131.
[110] *See id*.
[111] *Id*. at 11–12.
[112] *See supra* text accompanying notes 22–28.
[113] *See Certification*, DEMETER ASS'N, INC., https://www.demeter-usa.org/certification/#:~:text=It%20is%20part%20of%20a%20world-wide%20organization%2C,the%20USA%20as%20a%20non-profit%20in%201985 [https://perma.cc/98W6-ZRRN] ("Demeter International … was first formed in 1928 … to advocate Biodynamic agriculture and to certify Biodynamic farms. Demeter remains the oldest ecological certification organization in the world, active in fifty countries around the globe").
[114] *See supra* text accompanying notes 96–108.

the items on the bullet-point list — even its rules on limiting the use of sulfur[115] — would be unsurprising to any farmer familiar with agricultural realities before the introduction of fossil-carbon inputs, especially in the forms of petroleum-based fuels and synthetic fertilizers and pesticides. Expressed differently, what we might call "secular biodynamic agriculture" (including viticulture) strips out the spiritual or "woo-woo" elements to create an approach that resembles solar-based agriculture as practiced by humans for several thousand years. This "secular biodynamic agriculture" is (i) based mainly on energy from the sun, (ii) is conducted largely free of exogenous inputs and contaminates, and (iii) has emerged from generations of careful, broad-based experience-informed assessment of what techniques best serve the long-term interests of soil health (a term I define below in subsection IIIA). The only significant "residual" element from Steiner-Thun "orthodox biodynamic agriculture" showing up in the Demeter certification rules relates to the "preparations"; they remain as requirements even though their practical value has not yet been proven through broadly-accepted scientific inquiry and analysis — a matter I mention below in subsection IIIB.

In short, the Demeter approach to biodynamic approach is *not* Steiner's sophomoric anthroposophy, infused with spiritual and "woo-woo" elements. To reject the tenets of biodynamic viticulture on grounds of "guilt by association" with Steiner or Thun is tantamount to throwing out the baby with the bathwater; doing so would also fly in the face of the reality that Karen MacNeil reminds us of: "biodynamic methods have been used by farmers for centuries."[116]

One of the most important prerequisites to earning the Demeter biodynamic certification is that the farming operation first meets the relevant standards for "organic" production. Accordingly, let us turn to those standards.

IID. Organic viticulture

The pertinent passage in the Demeter standards emphasizes that "[a]ll labels that use the Biodynamic trademarks must also meet all … current regulations for labelling of organic agricultural products (e.g. EU organic regulation, NOP, etc.)."[117] In this context, "NOP" stands for the National Organic Program of the United States.[118] Moreover, although products coming from a Demeter-certified operation typically need to use raw materials that *also* come from a Demeter-certified operation, an exception is available: the Demeter-certified operation can draw some of its raw materials from an external operation that meets the "organic" certification requirements.[119]

---

[115] Demeter-English, *supra* note 91, at 120–121. *Also see* text accompanying note 108.
[116] *See* MacNeil, *supra* note 16, at 34.
[117] Demeter-English, *supra* note 91, at 35.
[118] *Id*. at 21.
[119] *Id.* at 22 (specifically citing the National Organic Program administered by the USDA).

In the context of a U.S. viticulture operation, then, the Demeter requirements constitute an "overlay" on the U.S. NOP requirements. That is, a vineyard in the United States wishing to gain certification as a biodynamic farm — and eligible therefore to display the official Demeter label — must first meet the organic-agriculture requirements of the NOP as administered by the USDA.

Meeting those NOP standards is challenging. They require, for instance, that crops not be genetically modified; they prohibit the use of most synthetic pesticides and fertilizers; growth hormones and sewage sludge are also prohibited.[120] Furthermore, seeds used to grow organic products must be organic themselves if possible, and must not be treated with fungicides.[121] Organic farms must implement crop rotation and must follow so-called "PAMS" pest control strategies, with the term "PAMS" referring to prevention, avoidance, monitoring, and suppression.[122] This approach favors prevention but allows the use of pesticides as a last resort, so long as they are approved by the organic certifier.[123] Farmers may not apply any prohibited substances to land that is to be used for organic farming for three years before the resulting product can be labeled "USDA Organic."[124] Any application of a prohibited substance — even if done unintentionally — triggers the suspension process, and the three-year wait must begin again.[125]

Europe has its own regime of organic-agriculture standards. Most of those standards appear in EU Regulation 2018/848, adopted in 2018, but amended several times since then.[126] Many of the EU standards resemble those of the USDA's NOP. For example, the EU standards (like the U.S. standards) require a three-year transition period to gain organic certification.[127] Genetically modified

---

[120] *Allowed and Prohibited Substances*, USDA (July 1, 2013), https://www.ams.usda.gov/sites/default/files/media/Allowed-Prohibited%20Substances.pdf [https://perma.cc/9PJK-GRSE].

[121] *Introduction to Organic Practices*, USDA (Sep. 11, 2015), https://www.ams.usda.gov/sites/default/files/media/Organic%20Practices%20Factsheet.pdf [https://perma.cc/253Q-B2K2].

[122] *Id*.

[123] *Id*.

[124] *Id*.

[125] *Id*.; *See also* Lepird, *supra* note 34, at 128 (noting that even after meeting the three-year requirement, a vineyard is subject to yearly inspections and that "[t]his constant oversight coupled with an uncertain cost, on top of an already steep entry level investment to begin a vineyard, has caused some viticulturists to be reluctant to become certified").

[126] Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 on Organic Production and Labelling of Organic Products and Repealing Council Regulation (EC) No. 834/2007, 2018 O.J. (L 150) 1 [hereinafter EU Regulation 2018/848]. According to the European Commission's website, this 2018 regulation "is the applicable legislative act, also known as the basic act, laying down the rules on organic production." *Legislation for the Organics Sector*, EUR. COMM'N, https://agriculture.ec.europa.eu/farming/organic-farming/legislation_en [https://perma.cc/E6SB-LDDL].

[127] EU Regulation 2018/848*, supra* note 126 art. 10; *id.* annex II, point 1.7.1.

organisms ("GMOs") are prohibited.[128] Strict limits are imposed on any non-natural method of pest management.[129]

The demanding standards imposed by the EU rest on a remarkably ambitious set of objectives, including these as announced in the 2018 regulation:

- contributing to protection of the environment and the climate;
- maintaining the long-term fertility of soils;
- contributing to a high level of biodiversity;
- substantially contributing to a non-toxic environment;
- contributing to high animal welfare standards and, in particular, to meeting the species-specific behavioural needs of animals[130]

According to the EU organic-agriculture regulation, meeting these objectives will require applying certain general principles, such as "respect for nature's systems and cycles," "preservation of natural landscape elements," "responsible use of energy and natural resources," and "the use of precautionary measures and preventive measures."[131] Having announced these general principles, the relevant EU regulation focuses more specifically on standards for organic-agricultural *production* (as distinct from the *processing* of organic foods). The first item on the list of those standards elaborates on the need for strict attention to soil health — the topic I focus on in this article. According to the EU regulation, "organic production shall" give specific attention to:

> … the maintenance and enhancement of soil life and natural soil fertility, soil stability, soil water retention and soil biodiversity, preventing and combating loss of soil organic matter, soil compaction and soil erosion, and the nourishing of plants primarily through the soil ecosystem.[132]

What does the 2018 EU regulation say about viticulture in particular? Very little. Part VI of the regulation does address wine, but it runs only a page and a half in a 134-page document, and it applies mainly to (i) winemaking processes rather than to (ii) viticultural practices (that is, the production of the grapes as a matter of agricultural production).[133] The same emphasis on winemaking

---

[128] *Id*. art. 5(f)(iii).
[129] *Id.* annex II, point 1.10.1.
[130] *Id.* art. 4(e). Other objectives refer to preserving "rare and native breeds in danger of extinction" and maintaining a supply of "diverse plant genetic material." *Id* art. 4(g)–(i).
[131] *Id*. art. 5(a)–(c).
[132] *Id*. art. 6(a).
[133] *See id*. Part VI.

(oenology, or enology) instead of grape-production (viticulture) appears in three other EU instruments dating from 2009[134] and 2013.[135]

One particular winemaking matter — the use of sulfites, mainly for reducing oxidation — receives different treatment in the EU organic-wine regulations from the treatment it receives in U.S. organic-wine regulations. A 2020 law-journal article describes the key difference: in general, EU organic-wine regulations permit winemakers to use sulfites in concentrations up to 100 parts per million (ppm) for red wines and up to 150 ppm for white wines, whereas U.S. organic-wine regulations *prohibit* the use of sulfites as additives.[136] That law-journal article proposes an international system for handling this U.S.-EU difference. However, because the sulfite issue does not directly relate to the vineyard-operations aspects of viticulture, it lies beyond the scope of my attention here.

Other key EU regulations regarding wine — both in terms of vineyard operations and in terms of winemaking processes — give special attention to labeling, including geographical indications. One online source (provided by a company advising participants in the wine industry) offers this specific explanation of how the 2018 EU organic-agriculture regulation bears on organic wine: "Organic wines must comply with Regulation (EU) 848/2018, which includes requirements for organic production and the EU Ecolabel. Biodynamic wines must comply with Demeter or Biodyvin standards, two of the main biodynamic certifications recognised in the EU."[137]

---

[134] *See* Commission Regulation (EC) 606/2009 of July 10, 2009, Laying Down Certain Detailed Rules for Implementing Council Regulation (EC) No 479/2008 as Regards the Categories of Grapevine Products, Oenological Practices and the Applicable Restrictions, 2009 O.J. (L 193) 1. *See also* Commission Regulation (EC) No 607/2009 of July 14, 2009, Laying Down Certain Detailed Rules for the Implementation of Council Regulation (EC) No 479/2008 as Regards Protected Designations of Origin and Geographical Indications, Traditional Terms, Labelling and Presentation of Certain Wine Sector Products, 2009 O.J. (L 193) 60.

[135] *See* Regulation (EU) No 1308/2013 of the European Parliament and of the Council of Dec. 17, 2013, Establishing a Common Organisation of the Markets in Agricultural Products and Repealing Council Regulations (EEC) No 922/72, (EEC) No 234/79, (EC) No 1037/2001 and (EC) No 1234/2007, 2013 O.J. (L 347) 671.

[136] Ryan Puszka, *Reds, Whites, and Sulfites: Examining Different Organic Wine Regulation Practices in the United States and the European Union*, 40 NW. J. OF INT'L L. & BUS. 251, 266–269 (2020). In explaining these details, Puszka relies on a 2017 research paper reporting various permissible concentrations of sulfite under organic, biodynamic, and conventional methods. *See* Geoffrey Jones & Emily Grandjean, *Creating the Market for Organic Wine: Sulfites, Certification, and Green Values* 29 (HARV. BUS. SCH. WORKING PAPER 18-048, 2007). Puszka also describes the intense debate occurring within the U.S. wine industry that led to the prohibition on sulfite additives as well as how the "Equivalency Agreement" negotiated between U.S. and EU authorities on organic products excluded coverage of wines. Puszka, *supra*, at 264–269. He also points out that "*all* wine unavoidably contains some level of naturally occurring sulfites" and that "conventional wine standards dictate a sulfite limit of 350 parts per million." *Id*. at 268, 269 (respectively).

[137] *New Wine Labelling Regulations: Everything You Need to Know*, WINEFO, https://www.winefo.eu/post/new-wine-labelling-regulations-everything-you-need-to-know [https://perma.cc/G2CN-RTHA]. *See* BIODYVIN, https://www.biodyvin.com/en/biodyvin-

The reference in that online source to "biodynamic wines" raises this question: Does the 2018 EU organic-agriculture regulation say anything at all about biodynamic viticulture? Almost nothing. The long list of definitions at the beginning of that regulation does define the term "biodynamic preparations" (as simply "mixtures traditionally used in biodynamic farming") and then uses that term just once in the main text, saying only that "[b]iodynamic preparations may be used" for purposes of soil management and fertilization. Using a digital search function of the regulation, I find it completely devoid of any references to Steiner or Thun. It seems, then, that the connection between "organic" and "biodynamic" in Europe resembles the situation in the United States. That is, Demeter certification requires satisfaction of the official "organic agriculture" standards, but those official "organic agriculture" standards do not impose additional biodynamic-viticulture requirements of the sort required for Demeter certification.

One reason I have given a brief survey of the EU regulatory approach to organic agriculture is that European policies favor it so strongly. Under the European "Green Deal," "the European Commission has set a target of [having] 'at least 25% of the EU's agricultural land [placed] under organic farming … by 2030'."[138] Europe has already built momentum toward that goal in recent years: according to the European Commission, "[t]he area under organic farming has increased by almost 66% in the last 10 years — from 8.3 million hectares in 2010 to 13.8 million hectares in 2019. It currently accounts for 8.5% of the EU's total 'utilised agricultural area'."[139]

The preceding discussions, focusing on biodynamic viticulture and on "organic" viticulture, highlight the relationship between those two categories. Specifically, the Demeter standards provide that vineyards wishing to gain official Demeter "biodynamic" certification must meet the organic-agriculture requirements laid out by national or regional authorities — and then the Demeter standards impose additional requirements as well regarding the practices used in the vineyard to protect the natural systems. In addition, though, to operational requirements of the sort described above — application of special manure and compost preparations, for instance — Demeter certification also extends to issues

---

approval.html [https://perma.cc/XKN2-BF8M], for details on the standards imposed by Biodyvin (Syndicat International des Vignerons en Culture Bio-dynamique). *See also Biodyvin Approval*, BIODYVIN, https://www.biodyvin.com/en/the-union/presentation.html [https://perma.cc/VSX5-RW33] (The Biodyvin entity is "a union of winegrowers who apply biodynamic techniques throughout their property").

[138] Eur. Comm'n, *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Action Plan for the Development of Organic Production,* COM (2021) 141 final/2 (Mar. 25, 2021) (corrigendum Apr. 19, 2021).

[139] *Id*.

having a wider scope. These include, for instance, (i) biodiversity enhancement more generally (requiring that 10% of a farm qualify for a "biodiversity reserve"[140]) and (ii) social responsibility (as prescribed in the Demeter "Social Responsibility Standard").[141]

Given all the requirements involved in securing Demeter certification, it is hardly surprising that relatively few vineyards in the world have qualified or even applied for the official "biodynamic" designation. Even "organic" vineyards (under either the U.S. NOP system or the relevant EU regulations) constitute a small minority of viticulture operations worldwide. Although firm statistics are difficult to establish, the following figures give an impression of how rare these designations are:

- Demeter sources suggest that as of early 2024, 1,439 wineries had earned — or were in the process of *conversion* to — "biodynamic" certification, representing a total "vineyard space" of just under 27,000 hectares.[142] Other sources give smaller figures of fully certified "biodynamic" operations.[143] Perhaps more vineyards could, if they applied, qualify for the official Demeter "biodynamic" certification. This would still, however, leave the number of biodynamic viticulture operations at a scale that pales in comparison to the total number of wineries and vineyards in the world, which is estimated at tens of thousands, perhaps even 100,000,[144] occupying a total vineyard surface area of about 7.2 million hectares.[145]

---

[140] Demeter-English, *supra* note 91, at 72.

[141] *Social Responsibility Standard*, BIODYNAMIC FED'N DEMETER, https://demeter.net/wp-content/uploads/2024/02/2024-02_BFDI_Standard_socialrespons_englVersion_changesaccepted_final_abb.pdf [https://perma.cc/3RSD-39N3]. In addition, rules for fighting corruption have been adopted. *BFDI Anti-Corruption Policy*, BIODYNAMIC FED'N DEMETER, https://demeter.net/wp-content/uploads/2023/02/BFDIAntiCorruptionPolicy_23-02-23.pdf [https://perma.cc/Q237-R9G4].

[142] *Demeter Wineries Worldwide*, BIODYNAMIC FED'N DEMETER (2024), https://demeter.net/wp-content/uploads/2024/04/2024_Demeter-wineries-worldwide.pdf [https://perma.cc/Z6YU-78J4]. A total of 27,000 hectares would equal just under 67,000 acres.

[143] *See, e.g.*, *Biodynamic Wine*, BIODYNAMIC-UK ASS'N, https://www.biodynamic.org.uk/farm/biodynamic-wine/ [https://perma.cc/923W-D3LP]. (giving a figure, evidently dating from about 2021, of "over 600 Demeter certified biodynamic vineyards [including] over 250 in France and Italy, 75 in Germany, over 40 in Switzerland, [and] 49 in New Zealand").

[144] Arielle Rose, *Global Wine Manufacturing – Market Research Report 2015-2030*, IBIS WORLD (2025), https://www.ibisworld.com/global/industry/global-wine-manufacturing/410/.

[145] *State of the World Vine and Wine Sector in 2023*, INT'L ORG. OF VINE & WINE (Apr. 2024), https://www.oiv.int/sites/default/files/2024-04/OIV_STATE_OF_THE_WORLD_VINE_AND_WINE_SECTOR_IN_2023.pdf [https://perma.cc/H62K-CRAL]. For an explanation of the character of the International Organisation of Vine and Wine, *see id.* A total of 7.2 million hectares would equal nearly 18 million acres. *Id.*

- Although firm numbers are difficult to find, USDA sources show that as of 2016, roughly 600 wineries had qualified for the "organic" designation under the NOP.[146]

- According to EU sources, an estimated 19,000 vineyards have qualified for the "organic" designation under the applicable EU regulations.[147]

IIE. Regenerative viticulture

Having examined the categories of biodynamic viticulture and organic viticulture, I turn to another category of natural-systems viticulture and the standards that apply to it. That category is "regenerative viticulture," as part of a larger system of "regenerative agriculture." For the latter term, a useful starting point is this description offered by the Regenerative Organic Alliance (ROA):

> As agricultural practices continue to evolve, it is imperative that approaches to land management and associated processes are focused on contributing to the health of ecosystems, including human communities. Regenerative Organic Certified® builds upon and furthers the near 100-year legacy of organic movement visionaries like J. I. Rodale, Lady Eve Balfour, Dr. Rudolf Steiner, Sir Albert Howard, and the knowledge of generations of diverse, holistic producers — including native and Indigenous Peoples — that they channeled for inspiration and direction.
>
> The goal of Regenerative Organic Certified® is to promote holistic agriculture practices in an all-encompassing certification that:
> - Increases soil organic matter over time and sequesters carbon below and above ground, which could be a tool to mitigate climate change;
> - Improves animal welfare; and
> - Provides economic stability and fairness for farmers, ranchers, and workers.

---

[146] *Organic Integrity Database: NOP Taxonomy - Categories & Items*, USDA (Nov. 23, 2016), https://www.ams.usda.gov/sites/default/files/media/INTEGRITY%20Categories%20and%20Items.pdf [https://perma.cc/UFU6-87M8]. In July 2025, searching the database for "wine" resulted in nearly 1,000 hits. The USDA database varies nearly day to day and does not distinguish clearly between wineries and vineyards. For a current database, *see Organic Integrity Database*, USDA (2025), https://organic.ams.usda.gov/integrity/ [https://perma.cc/5AEU-MKQ5].

[147] *Fully Organic Farms in the EU*, EUROSTAT (2020), https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Fully_organic_farms_in_the_EU#:~:text=Of%20the%20additional%20135%20000,cereal%2C%20oilseed%20and%20protein%20crops [https://perma.cc/U794-LDFZ]. This report shows 245,000 fully organic farming operations in 2020, of which 7.8% were vineyards, leading to the calculation of about 19,000 organic vineyards.

> Regenerative Organic Certified® consists of three pillars: Soil Health & Land Management, Animal Welfare, and Farmer & Worker Fairness. Regenerative Organic Certified® has three levels: Bronze, Silver, and Gold. Each requires a different number and scope of regenerative organic practices used.[148]

Although the ROA description offered above shifts quickly to the matter of *certification*, let us dwell further on the *concept* of regenerative agriculture. As noted above, the shorthand version of the concept of regenerative agriculture (as offered by the ROA) is that it "builds upon [the work of several] organic movement visionaries … and the knowledge of generations of diverse, holistic producers" to "promote holistic agriculture practices that can increase soil organic matter, sequester carbon, improve animal welfare, and provide economic stability and fairness for farmers.[149] Further rationale for regenerative agriculture appears in the ROA's insistence that "[g]rowing food and fiber through industrial methods has devastated our soil and climate. Forecasts have predicted that global topsoil will deplete in 60 years at our current rate, while studies have proven that conventional, industrial agriculture contributes up to 25% of the emissions driving the climate crisis."[150] However, "there is hope … [because with] regenerative organic agriculture, we can rehabilitate soil, respect animal welfare, and improve the lives of farmers. We can sequester carbon, build healthier communities, and reap more nutritious and abundant yields."[151]

In sum, "[r]egenerative organic agriculture is a collection of practices that focus on regenerating soil health *and* the full farm ecosystem. In practice, regenerative organic agriculture can look like cover cropping, crop rotation, low- to no-till, compost, and zero use of persistent chemical pesticides and fertilizers."[152] The ROA website emphasizes the historical foundations of regenerative agriculture: "Both the term 'regenerative agriculture' and the practices that define it are not modern creations. … [Indeed,] it is imperative to always note that regenerative agriculture practices draw from Indigenous wisdom and practices."[153]

---

[148] *ROC Framework*, *supra* note 33, at 3. The website of the Regenerative Organic Alliance itself, a nonprofit organization, provides further information. *See Home*, REGENERATIVE ORGANIC ALL., https://regenorganic.org/ [https://perma.cc/G9SY-GMLK]. The ROA was "[f]ounded by the Rodale Institute, Dr. Bronner's, and Patagonia, [and] other members of the alliance include Compassion in World Farming, Fair World Project, and the Textile Exchange." *Why Regenerative Organic?*, REGENERATIVE ORGANIC ALL., https://regenorganic.org/why-regenerative-organic/#regen-organic-certified [https://perma.cc/7UGR-4PVV] [hereinafter "*Why RO*"?]. The same page of the ROA website explains that "[t]he term regenerative agriculture was first introduced by Dr. George Washington Carver, and was popularized by Robert Rodale of the Rodale Institute, who coined the term 'regenerative organic' to distinguish a kind of farming that goes beyond sustainable." *Id*.

[149] *ROC Framework*, *supra* note 33, at 3.

[150] *Why RO?*, *supra* note 148.

[151] *Id*.

[152] *Id*.

[153] *Id*.

In order to encourage all these practices, the ROA manages a certification system — the Regenerative Organic Certification (ROC) system mentioned above — with three levels (Bronze, Silver, Gold) reflecting varying degrees of adherence by a farming operation to the ROC standards. The standards themselves resemble those of the Demeter certification system. Like the Demeter approach, the ROC approach to certification requires that an agricultural operation first secure certification as meeting the applicable "organic" requirements, such as those enumerated in the U.S. and EU regulations discussed above in subsection IID.

Beyond that threshold requirement (of meeting "organic" agriculture standards), the ROC system involves several steps for an applicant to achieve ROC certification.[154] In general, these involve (i) submitting information about the applicant's existing operations and steps the applicant will take toward implementing a customized Regenerative Organic System Plan ("ROSP"); (ii) working with an ROA-approved certifying body (over a dozen such entities exist, with varying geographical coverages[155]), which will undertake an onsite review and report to the ROA. If the review is favorable, the application for ROC certification will be approved, permitting the applicant to display the official ROC label on its farm and its products.

Several hundred operations have gained the ROC certification,[156] including Estelbrook Farms & Vineyard (owned by my son and daughter-in-law in southern Washington State). Of those, only about 30 operations (again, including Estelbrook) have ROC certification for "grapes" as a crop.[157]

In addition to the ROA system of certifying agricultural operations (and products) as "regenerative" in character, several other systems also have emerged in recent years. The Regenerative Viticulture Foundation has compiled a list of the most prominent of these, summarized in this table:

---

[154] For details on these steps, *see Steps to Becoming Regenerative Organic Certified®*, REGENERATIVE ORGANIC ALL., https://regenorganic.org/becoming-regenerative-organic-certified/ [https://perma.cc/CE3F-NYD9].

[155] Certifying bodies operating in North America, for instance, include Ecocert Environnement, CCOF, SCS Global, and others. *See Regenerative Organic Alliance - Approved Certifying Bodies*, REGENERATIVE ORGANIC ALL. (Sept. 16, 2025), https://regenorganic.org/wp-content/uploads/2024/11/ROA_Approved_Certifying_Bodies.pdf [https://perma.cc/6E79-2HDX]. For further information on CCOF, *see infra* text accompanying notes 260–261.

[156] For a list and accompanying world map, *see Certified Farm & Ranch Directory*, REGENERATIVE ORGANIC ALL. (2025), https://regenorganic.org/certified-farm-ranch-directory/ [https://perma.cc/GBZ4-RGBA].

[157] *Id*. *See also Certification*, REGENERATIVE VITICULTURE FOUND. (Aug. 28, 2025), https://www.regenerativeviticulture.org/toolkit/certification/ [https://perma.cc/YAA7-8DB3]. ("Around 25 vineyards worldwide have now been [ROC] certified, mostly in the USA, but rapidly expanding globally.").

Name	specific to viticulture?
Certified Regenerative	No
details at https://agreenerworld.org.uk/certifications/certified-regenerative/	
Regenerative Viticulture Alliance	Yes [158]
details at https://www.viticulturaregenerativa.org/en/rva-certification	
ROC	No
details at https://regenorganic.org/get-started/	
Regenified	No
details at https://regenified.com/regenerative-agriculture-certification/	
Regenagri	No
details at https://regenagri.org/	
Land to market	No
details at https://www.landtomarket.com/	

Surely one reason for the relatively small number of vineyards that have thus far achieved any of these "regenerative" certifications or designations is that the standards of review are high. If some vineyard operators were to do a Google search for "typical provisions of a Regenerative Organic System Plan for viticulture," they would probably see a long list of requirements reflecting the overarching principles described above. Those requirements might announce the following specific details on the issue of soil health and land management:

- Minimizing Soil Disturbance (No-till/Low-till): Practices that minimize or eliminate soil turning (tillage) are crucial to preserving soil structure, reducing erosion, and enhancing microbial communities.

- Cover Cropping: Planting various crops between vines or in rows to protect the soil, improve fertility, suppress weeds, enhance biodiversity, and sequester carbon. Examples include using legumes for nitrogen fixation or flowering plants to attract beneficial insects.

- Composting: Utilizing on-site compost, often from grape pomace and other organic materials, to enrich the soil with nutrients and improve its structure.

- Organic Matter Incorporation: Boosting soil organic matter and moisture retention by incorporating crop residues and other organic materials.

- Biodiversity Enhancement: Promoting diverse plant species, beneficial insects, and wildlife corridors within and around the vineyard to support natural pest control, pollination, and nutrient cycling.

---

[158] The Regenerative Viticulture Foundation highlights the fact that the Regenerative Viticulture Alliance has the "only scheme specific to viticulture" and explains that it was "founded by the Regenerative Viticulture Association with Familia Torres" and that it has "a strong Spanish language focus." *See Certification*, *supra* note 157.

- Water Management: Implementing efficient irrigation systems, like drip irrigation, and considering rainwater capture to conserve water and improve soil moisture retention.

- Reducing/Eliminating Synthetic Inputs: Prioritizing the elimination of chemical pesticides, herbicides, and synthetic fertilizers in favor of natural alternatives and integrated pest management.[159]

IIF. Other forms and designations of natural-systems viticulture

The foregoing discussions of biodynamic, organic, and regenerative viticulture — focusing especially on the standards and certification processes relating to vineyard operations — still do not plumb all the depths. To bring this survey to a close, let us look briefly at two other categories.

One such category is "natural wine," a designation that has brought a crescendo of conflict in recent years. An April 2022 article titled "Certification of Natural Wine"[160] highlights the conflict in Europe, including inter-country and intra-agency fallings-out, some of which have involved pleas to EU authorities. The article explains that "[o]n March 25 2020, natural wine (NW) obtained legal recognition for the first time in France under the designation *vin méthode nature*, opening the way for similar initiatives worldwide."[161] The article surveys various possible responses to this development, but for now the future of a "natural wine" designation remains uncertain.

---

[159] This list emerged from my own Google search for "typical provisions of a Regenerative Organic System Plan for viticulture." According to the ROC standards for certification, the operator seeking ROC certification initiates the preparation of basic documentation about the operation, after which "the ROA will send operation a customized Regenerative Organic System Plan (ROSP) based on an equivalency analysis of the applicant's operation and current certifications." *See Program Manual*, REGENERATIVE ORGANIC CERTIFIED (2023), https://regenorganic.org/wp-content/uploads/2023/03/Program-Manual.pdf. [https://perma.cc/B9G7-LWLH]. For a standard template used in seeking ROC designation, *see Regenerative Organic System Plan (ROSP),* REGENERATIVE ORGANIC ALL., file:///C:/Users/johnhead/AppData/Local/Microsoft/Windows/INetCache/Content.Outlook/TT7VQ0XZ/ROC_QMS_FR_ROSPSHNOP_v1.1.pdf. Some of the requirements included in the above bullet-point list would likely fall outside the scope of the ROSP. As my daughter-in-law has explained, "[w]hile the ROSP is [our] foundational document [for ROC certification], there are many supporting documents that go along with it — material applications, seed searches, contracts with employees, payment logs, receipts for all material inputs, compost logs, etc." E-mail exchange with Shahnnen Elizabeth Head, Jul. 1, 2025 (on file with author).

[160] *See* Pablo Gonzalez, Eva Dans & Rosan Fernádez, *Certification of Natural Wine: Policy Controversies and Future Prospects*, FRONTIERS SUSTAINABLE FOOD SYS., 2022, at 1–3.

[161] *Id.* at 1.

By contrast, the future seems much less uncertain for a viticulture designation recently introduced in British Columbia. As noted above, the term "sustainable agriculture" has been used (or mis-used) so much as to have lost much of its meaning in defining specific practices and standards. However, the term "sustainable viticulture" is still used with some specificity in the context of Canadian regulations. This is significant because Canada has a globally important wine industry, including a growing organic wine market,[162] and Canada's viticulture sector also has special requirements and designations relating to operations that follows natural-systems principles. Such requirements typically lie more at the provincial level than at the federal level, and in British Columbia a vineyard can earn certification under the "Sustainable Winegrowing British Columbia" (SWBC) Program,[163] which was established in 2011 by the British Columbia Wine Grape Council to offer independent "sustainable" certifications to wineries and vineyards.[164] In fact, the SWBC Program distinguishes between vineyard operations and wine-making operations. "The Program offers two different certification standards: the SWBC Sustainable Vineyards Standard, applicable for grape growing operations; and the SWBC Sustainable Wineries Standard, applicable for wine making operations."[165]

The more relevant of the two for purposes of this article is the Vineyard Standard. It runs 70 pages and prescribes specific requirements in four areas: (i) watershed management and conservation (including erosion control and biodiversity conservation), (ii) soil nutrition management (involving extensive soil analysis to design and implement a soil management plan), (iii) irrigation management (avoiding backflows, testing water quality, measuring usage, etc.), and (iv) social equity (involving worker training, compensation, and safety as well as community engagement).[166] Vineyard operators are expected to use prescribed templates for tracking their progress in meeting quantifiable targets on electricity consumption, on waste reduction and disposal, on ecologically-appropriate pest-management practices, and so forth.[167]

---

[162] The Canadian organic wine market totaled US$922.9 million in 2023 and is expected to grow by 10% by 2030; measured in terms of revenue, "Canada accounted for 8.5% of the global organic wine market in 2023." *See* Grand View Rsch., *Canada Organic Wine Market Size & Outlook, 2024-2030*, GRAND VIEW HORIZON, https://www.grandviewresearch.com/horizon/outlook/organic-wine-market/canada [https://perma.cc/4DTK-YTS7].

[163] *See 2023 Vineyard Standard*, SUSTAINABLE WINEGROWING B.C. (2023) https://sustainablewinegrowingbc.ca/wp-content/uploads/2023/03/SWBC-Vineyard-Standard-2023-ver.-2-Interactive.pdf [https://perma.cc/6954-YGYG]. [Hereinafter *BC Standards*]. I thank Allan Spahr, Wade Martin, and other friends at La Stella vineyards, near Osoyoos, British Columbia, for helping me learn about the SWBC Program and about the sustainable-viticulture practices that the La Stella operators follow. For information about La Stella, *see* LA STELLA, https://lastella.ca [https://perma.cc/B97B-JWQA]. I also thank Chris Bouzanis, a central player in SWBC operations, for explaining SWBC's philosophy and success.

[164] *See About*, SUSTAINABLE WINEGROWING B.C., https://sustainablewinegrowingbc.ca/about/ [https://perma.cc/LW2A-PGWB].

[165] *See BC Standards*, *supra* note 163, at 8.

[166] *Id.* at 16–52.

[167] *See Resources*, SUSTAINABLE WINEGROWING B.C., https://sustainablewinegrowingbc.ca/resources/ [https://perma.cc/57L9-KXCY].

Given the stringency of the SWBC Program, it is no surprise less than two dozen vineyards have earned the right so far to use the "Sustainable Winegrowing BC" label.[168] By contrast, the Demeter Canada organization lists only a single Demeter-certified biodynamic winery in British Columbia: the Summerhill Pyramid Winery.[169]

IIG. A summing-up on key categories of natural-systems viticulture and their standards

Four main points emerge from the discussion in the foregoing paragraphs. *First*: the term "biodynamic viticulture" is itself vague. It can refer to the Steiner-Thun pseudo-science and "anthroposophy" — what I have referred to above as the spiritual, "woo-woo," or "orthodox" version of biodynamic viticulture — *or* it can have a primarily science-based perspective that largely disregards the astrological elements posited by Steiner and Thun but still prescribes strict environmental-protection practices. In that more "secular" *non*-Steiner-Thun version, biodynamic viticulture encompasses a highly developed set of standards requiring vineyards to undertake their operations in a holistic manner. The aim of this approach is to treat a vineyard as a natural and closed system from which practically all synthetic inputs are excluded. Those standards themselves reflect a science-based perspective in the sense that they have emerged not from external spiritual inspiration but from generations of careful, broad-based experience-informed assessment of what techniques best serve the long-term interests of soil health. Given the stringency of the standards, only a few vineyards worldwide have achieved official Demeter certification.

Second: the much younger notion (and label) of "regenerative viticulture" shares many features with biodynamic viticulture. It promotes holistic agricultural practices aimed at increasing soil organic matter, sequestering carbon, improving animal welfare, and providing economic stability and fairness for farmers. Although it does not involve the use of "preparations" of the sort prescribed by Rudolf Steiner, the demands of regenerative viticulture (like those of biodynamic viticulture) are so rigorous that very few vineyards have earned any level of ROC

---

[168] *See Membership*, SUSTAINABLE WINEGROWING B.C., https://sustainablewinegrowingbc.ca/membership/ [https://perma.cc/FM9P-3VYU]. Only about a half-dozen wineries have earned such certification. *Id.*

[169] *See Our Certified Farms*, DEMETER CAN., https://www.demetercanada.ca/certified-farms/ [https://perma.cc/SU67-3VET] (listing three other Demeter-certified farms in British Columbia, all of which produce organic vegetables but not wine grapes). For details about the Summerhill Pyramid Winery, where my wife and I were warmly greeted in June 2024 by Stephen Cipes, Michael Alexander, and others, *see* SUMMERHILL PYRAMID WINERY, https://www.summerhill.bc.ca/us/ [https://perma.cc/6VT8-J6AZ].

designation — Bronze, Silver, or Gold as described above.[170] As members of my immediate family have seen in establishing and operating their vineyard, pest management in particular can prove much more difficult without the range of synthetic insecticides, rodenticides, fungicides, and other non-organic products that modern extractive agriculture has developed since the Green Revolution introduced those products. Both Demeter and ROC standards prohibit the use of nearly all such products in vineyards, which attract wasps, birds, voles (gophers), powdery mildew, and various other life forms eager to feast upon the leaves, roots, and fruit that grapevines offer them. Even sulfur compounds, which have been used in viticulture for several centuries,[171] can be used only sparingly.[172] Notwithstanding these challenges, the vineyard where my wife and I work part-time is one of the few vineyards worldwide — less than a dozen — that have earned both Demeter (biodynamic) and ROC (regenerative) designations.[173]

Third: certification of a vineyard's operations (or outputs) as "organic" also requires careful exclusion of many synthetic fertilizers and similar inputs that "industrial agriculture" would otherwise offer. However, both U.S. and EU standards for organic viticulture are *less* demanding than the Demeter biodynamic standards or than the ROC standards in practically all respects[174] — and are in fact prerequisites for either biodynamic or regenerative certification. Significant differences exist between the EU and the U.S. organic-viticulture regulations — both of which are now several decades old — but they resemble each other in the important respect that they are official government-created and government-operated systems.

Fourth: some other classifications and terms — "natural" and "sustainable" and the like — have been proposed or attempted, and even used successfully in British Columbia, but they have thus far not gained much traction more generally. Many other classifications and certifications exist that lie beyond the scope of this survey.[175]

---

[170] *See supra* text accompanying note 148.

[171] *See* Flint, *supra* text accompanying note 57.

[172] *See, e.g.*, *supra* text accompanying note 108 (relating to sulfur use under the Demeter standards).

[173] This assertion emerges from a comparison of lists showing what operations have received "regenerative" and "biodynamic" certifications. The list found at https://regenorganic.org/certified-farm-ranch-directory/ [https://perma.cc/P48C-MC9H] shows that many farms have obtained regenerative certification, but only about 30 of them are vineyards. Estelbrook Farms & Vineyard, referred to *supra* note 21, appears on that list. Estelbrook also appears on the list of U.S. operations with Demeter-certified biodynamic grapes, at https://biodynamicfood.org/ [https://perma.cc/JPJ5-DU2M]. For a series of lists showing Demeter-certified operations in other countries, *see* https://bfdi.demeter.net/operators.

[174] As noted above, one aspect of the NOP system that makes it more stringent than the EU "organic" regulations, the Demeter requirements, or the ROC standards relates to the use of sulfites in wine-making. *See* Puszka, *supra* note 136, at 255, 272 and accompanying text. However, my focus in this article is on vineyard operations, not on wine-making.

[175] One example of another certification system is found in the so-called "LODI rules." One source explains that under these rules, originating from efforts made by grape growers in California, "a vineyard must meet six sustainability standards: business management, human

At the outset of this section II, I promised to try untangling the meanings of the various designations discussed above, giving special attention to (i) how old and well-established each such designation is, (ii) how detailed its certification standards are, (iii) how much of a science-based perspective (as opposed to a "pseudoscience" or spiritual or "woo-woo" perspective) it involves, (iv) how widespread its acceptance has become (global versus only local), and (v) whether the relevant certification process is primarily facilitated through private organizations or under the legal control of state authorities. Here's what I can deliver on that promise, confining myself just to the three principal designations discussed above:

Demeter biodynamic viticulture:
- (i) about 100 years old and well recognized[176]
- (ii) detailed in its certification standards
- (iii) in its current post-Steiner-Thun version, highly science-based in its perspective (on par with regenerative and organic), but with a lingering "stain" in the eyes of some observers, especially regarding "preparations" requirements
- (iv) global in reach, not nationally- or regionally-based
- (v) certification via private entities only

Organic viticulture:
- (i) a few decades old[177] and well recognized in the United States and Europe

---

resources management, ecosystem management, soil management, water management, and pest management." Lepird, *supra* note 34, at 131. In terms of implementation, "a third-party, Protected Harvest, which is a board of environmentalists and pesticide risk scientists … conducts all annual audits to ensure quality of the vineyards and to reduce the risk of a conflict of interest." *Id.*

[176] For a timeline of developments regarding the Demeter standards and structure, *see History*, BIODYNAMIC FED'N DEMETER INT'L, https://demeter.net/about/history/ [https://perma.cc/APQ9-CBRC]. As of 1999, Demeter had reportedly become "the biggest provider of organic goods world-wide." *Id.*

[177] In the United States, the NOP was established under the Organic Food Production Act enacted in 1990. *See* Nat'l Inst. of Food & Agric., *Organic Agriculture Program*, USDA (July 7, 2025), https://www.nifa.usda.gov/grants/programs/organic-agriculture-program [https://perma.cc/HZ8K-BY8W]. Similarly, "[o]rganic farming and production has been regulated at the EU level since 1991," *Organic Food in the EU*, EUR. CT. OF AUDITORS (Feb. 2018), https://www.eca.europa.eu/lists/ecadocuments/bp_organic_food/bp_organic_food_en.pdf [https://perma.cc/SX7G-CCA2], and "[i]n March 2002 the European Commission issued an EU-wide label for organic food" produced in accordance with the regulations — similar to the NOP program in the United States. Jacomijn Schravesande-Gardei, *Organic Certification in the European Union*, ME. ORGANIC FARMERS & GARDENERS (2019), https://www.mofga.org/resources/international/organic-certification-in-the-european-union/ [https://perma.cc/Q2V7-XJG4].

(ii) detailed in its certification standards
(iii) highly science-based in perspective
(iv) not global in reach — national applicability for the U.S. NOP and European applicability for the EU regulation[178]
(v) certification by public agencies or by private agencies under public-agency supervision

Regenerative viticulture:
(i) about five years old and becoming more recognized[179]
(ii) detailed in its certification standards
(iii) highly science-based in perspective
(iv) purportedly global in reach, not nationally- or regionally-based, but with limited applicability thus far
(v) certification via private entities only

To conclude this survey: If we wish to provide a phrase or label to identify the most demanding of the standards used in the certification process for viticulture operations, while still leaving aside the astrological or pseudo-science that Steiner and Thun proposed in their version of "biodynamic agriculture," we could usefully settle on the label I have introduced above, which is "science-based biodynamic regenerative viticulture," or "SBBRV." Emphasizing the highly-demanding standards of SBBRV — as shown in those of the Demeter organization and the ROA — could provide the "language" for hastening the shift away from industrial viticulture.

But why should we care about this? That is, why might we wish to encourage a hastening of momentum away from industrial viticulture and toward SBBRV? These questions return us to the overall theme of this article: soil health.

III. "Soil health" and biodynamic-regenerative viticulture

Karen MacNeil's *Wine Bible* offers this enchanting narrative about the relationship of soil to viticulture:

> The ground has always been seductive — the smell of it, the feel of it, the sight of it, and certainly the possession of it. The history of civilization is in large part a running commentary on

---

[178] For a discussion of the 2018 EU regulation, *see* European Commission, *supra* notes 126–139 and accompanying text.

[179] For details on the ROC certification system, *see* subsection IIE, *supra*. As one source explains, "[t]he ROA introduced the world's first Regenerative Organic Certification scheme (ROC) in 2019." Simon J. Woolf, *Digging into Regenerative Organic Agriculture*, THE MORNING CLARET (June 12, 2024), https://themorningclaret.com/p/digging-into-regenerative-organic-agriculture [https://perma.cc/4BR2-LWPK]. An especially famous wine expert, Jancis Robinson, has asserted that "[r]egenerative is the new buzzword in wine-growing circles." Jancis Robinson, *Farm Like There's No Tomorrow*, JANCISROBINSON.COM (Mar. 11, 2023), https://www.jancisrobinson.com/articles/farm-theres-no-tomorrow [https://perma.cc/T9GH-V2RK] [hereinafter Robinson 2023].

> man's relationship to the land. Soil's allure is very evident in the world of wine. There is something strangely beautiful about the white chalk of Champagne, [which is] the legacy of ancient seabeds and sea fossils; or the jet-black, pitted stones of Santorini in Greece, [which are] the relics of a massive volcanic explosion; or the cool, blue-gray slate shards of the Mosel in Germany, [which are] remnants of the path of glaciers. Remarkably, vines grow contentedly in all of these.[180]

MacNeil highlights an important feature shared by these diverse settings for viticulture: "Most viticulturalists today believe that the most important soil characteristic is its capacity to drain water. Nothing could seem less exciting," McNeil says, but "good drainage is critical in viticulture, ensuring that vines push their roots deep into the ground (sometimes 20 feet/6 meters or more) to find a stable source of water and nutrients."[181] Perhaps reflecting this deep rooting of viticulture in the soils that support it, MacNeil portrays soil as "undoubtedly the soul of wine,"[182] comprising particles of various sizes and composition which, taken in aggregate "help create the delicate balance of water drainage versus water retention" and that "aerate the soil and contribute minerals and nutrients."[183]

A key criticism leveled at industrial agriculture, though, is that it *degrades* soil. Soil degradation will be the topic of subsection IIIA, along with a definition of "soil health" (or "soil quality") and why it matters. Subsection IIIB will then narrow the focus to viticulture and examine how biodynamic-regenerative operations enhance soil health.

IIIA. "Soil health" and the global soil-degradation crisis

As alluded to briefly in subsection IB above, modern agriculture has caused soil degradation all around the Earth, especially in those vast ecoregions that were covered until relatively recently with temperate grasslands.[184] In order to drive home the significance of this degradation, I offer the following bullet-point illustrations, some of which relate specifically to how viticulture can contribute to soil degradation:

- According to a late-2024 summary of information in a "soil atlas" document from an EU-affiliated source, "[s]oil degradation is a major but largely neglected global problem that threatens agricultural productivity, food security, and ecosystem health. Around one-third of soils worldwide

---

[180] MacNeil, *supra* note 16, at 26–27.
[181] *Id.* at 27.
[182] *Id.* at 28.
[183] *Id.* at 27.
[184] *See* AGROECOLOGICAL HUSBANDRY, *supra* note 8. *See also* text accompanying note 10.

are degraded,"[185] through such factors as "erosion, salinisation, acidification, compaction, nutrient depletion, and contamination by heavy metals."[186] Just the first of these alone (soil erosion) "leads to the loss of an estimated 75 billion tonnes of soil a year, which in turn causes financial losses of around 400 billion US dollars annually."[187] Improper agricultural methods contribute to the land degradation, and 38 percent "is subject to overgrazing that exceeds the land's capacity to recover and maintain its productivity."[188]

- June 2024 saw the release of a "new map from the Save Soil movement — backed by the UNEP, UNCCD, UNFAO, WFP, and IUCN among others — illustrat[ing] the shocking percentage of global soil degradation predicted by 2050."[189] An account of the map explains that "[d]egraded soil, resulting largely from intensive farming practices, is low in 'organic matter,' which means it does not retain water as effectively, making us vulnerable to climate shocks such as droughts, wildfires, and water shortages."[190] The account quotes an official of Save Soil as urging that "[r]egenerative agriculture can help bring the organic matter, or the 'life and health' back into soil, reversing degradation, preventing droughts and saving lives on every continent."[191]

- A five-decade survey of soil-erosion research specifically in vineyards found that "soil erosion rates in vineyards are higher than those in other land uses and represents a worldwide threat to sustainability in vineyards. This is due to intense tillage [and the] planting of vineyards on steep slopes and in poor soils."[192] The report of that survey noted that although "[s]tudies of soil erosion in vineyards have primarily focused on [the] three specific countries [of] France, Italy and Spain … vineyards are widespread worldwide and the environmental problems they cause are also widespread."[193] The authors of the report conclude that "[t]here is a need to find management practices that … will achieve sustainability through reduction of soil losses via nature-based solutions."[194]

---

[185] Harun Warui, *Soil Degradation: The Silent Global Crisis*, HEINRICH-BÖLL-STIFTUNG (Nov. 12, 2024), https://eu.boell.org/en/SoilAtlas-soil-degradation [https://perma.cc/9CQE-4D5S] (quoting information on the website of the Heinrich-Böll-Stiftung, a German political foundation affiliated with the German Green Party).
[186] *Id.*
[187] *Id.*
[188] *Id.*
[189] Save Soil, *95% of the Earth's Soil on Course to Be Degraded by 2050*, EARTH.ORG (June 17, 2024), https://earth.org/95-of-the-earths-soil-on-course-to-be-degraded-by-2050/ife [https://perma.cc/UY9X-8MZE].
[190] *Id.*
[191] *Id.*
[192] Jesús Rodrigo-Comino, *Five Decades of Soil Erosion Research in "Terroir": The State-of-the-Art.*, 179 EARTH-SCI. REV. 436, 436 (2018).
[193] *Id.*
[194] *Id.*

- A 2022 conference of the Regenerative Viticulture Foundation highlighted specific ways in which viticulture contributes to soil degradation, focusing especially on tillage (plowing), removal of plant cover more generally, and compaction.[195]

By what standards do we make these assessments of soil degradation? Expressing this question differently: what do we mean by "soil health" or by "soil quality" — the quality, that is, that is purportedly being degraded?

Soil quality, a term that first emerged in the 1990s, has been defined by some early sources as the capacity of soil to function with respect to three components: "sustained biological productivity, environmental quality, and plant and animal health."[196] The term emerged in part because of the lack of legislative standard to define or regulate soil quality (unlike air and water quality standards).[197] The term "soil health" is often used interchangeably with "soil quality," but by some accounts the two terms are distinct, with soil quality focusing on the functions of soil that directly and indirectly impact humans and soil health "extend[ing] beyond human health to broader sustainability goals that include planetary health."[198]

In my view, we should remain skeptical about any anthropocentric implications of those definitions. If we take an "inter-species equity" approach, as I have urged in several publications,[199] we should emphasize the value of soil *per se* — that is, for its own sake regardless of what specific benefits it provides to humans as a single species among millions of species. Hence, focusing on productivity of soil for providing food for humans should not, in my view, dominate an evaluation of soil health or quality. Instead, from a natural-systems perspective, soil health should be assessed in a more neutral (less anthropocentric) manner that examines its resilience to stress, its fullness, the density and diversity

---

[195] *See* Tamlyn Currin, *Regenerative Viticulture is a Dirty Subject*, JANCIS ROBINSON (May 9, 2022), https://www.jancisrobinson.com/articles/regenerative-viticulture-dirty-subject [https://perma.cc/B28Y-PXQ4].

[196] D.L. Karlen, M.J. Mausbach, J.W. Doran, R.G. Cline, R.F. Harris & G.E. Schuman, *Soil Quality: A Concept, Definition, and Framework for Evaluation*, 61 SOIL SCI. SOC'Y AM. J. 4, 4 (1997).

[197] *Id.*

[198] Johannes Lehmann, Deborah Bossio, Ingrid Kogel-Knabner & Mathias Rillig, *The Concept and Future Prospects of Soil Health*, 10 NATURE REV. EARTH & ENV'T 544, 545 (2020), https://pmc.ncbi.nlm.nih.gov/articles/PMC7116140/pdf/EMS94256.pdf [https://perma.cc/7HDP-MPXN].

[199] *See Planetary Health*, *supra* note 49, at 287. *See also* John W. Head, *International Law and Species Diversity: An Immodest Proposal for Implementing a Progressive 30x30 Natural Restoration Initiative in the Great North American Prairies,* 33 KAN. J. L. & PUB. POL'Y 141, 187–188 (2024).

of individual organisms that are living within it, and the degree to which the soil itself might be regarded as a living thing.

In a 2020 science-journal article, Johnannes Lehmann and three colleagues proposed a revised mechanism for defining and measuring soil health, starting with a survey of the history behind the term itself:

> The burgeoning broad public interest in the soil health concept is largely grounded in historical development. Even though the term 'soil health' has been more regularly used in the scientific and popular literature only since the early 2000s, the analogy of the soil ecosystem to an organism reaches far into the past. Soil is frequently part of creation myths, and humans have always had deep spiritual connections with soil, as shown in songs, fine [arts] and performing arts.
>
> Since the 1700s, scientists have introduced the notion of biological processes in the formation of soil, and [the fact] that soil ecosystems are endangered as much as any other ecosystem provided a foundation for [assessing] soil health. The 1979 Gaia concept popularized the view of nature as a planetary-scale self-regulation system, explicitly including soil ecosystem concepts and going beyond soil services solely for humans. Appreciation for soil biological processes was largely enabled by significant advances in analytical capabilities since the 1980s, including global mapping of soil biodiversity during the 2010s. The formulation of the UN's Sustainability Development Goals in 2015 provided a need to align soil functions with sustainability that makes soil health a suitable platform.
>
> The soil health concept emerged from soil quality in the 1990s, and initially met with considerable criticism. More recently, policy makers have embraced the concept, exemplified by India distributing soil health cards to 100 million farmers and major companies starting programs on soil health to manage their supply chains more sustainably. Including carbon sequestration in soils as a main approach in the UNFCCC process to withdraw atmospheric carbon dioxide enhanced the political urgency to implement suitable soil health practices on a global scale. The rapid adoption of the soil health concept after 2010 may partly be rooted in its flexibility and thereby the ability by different stakeholder[s] to use it in their own way.[200]

With this historical background, Lehman and his collaborators survey a great variety of existing definitions and tests for soil health. They offer this summary:

---

[200] Lehmann et al., *supra* note 198, at 546 (endnotes omitted).

> In total, more than two thirds of soil health test frameworks currently include the traditional quantification of soil organic matter, pH, and plant-available phosphorus and potassium, and more than half [of the soil health test frameworks] include water storage and bulk density. A third of tests also recommend measurements of soil respiration, microbial biomass or nitrogen mineralization to characterize biological properties, as well as structural stability. Chemical indicators make up at least 40% of the indicators in 90% of the soil health assessment schemes …, underscoring the continued importance of chemical properties in soil health quantification and the long-standing emphasis on plant production. Indeed, the most advanced analytical schemes currently, such as the Soil Management Assessment Framework, focus on indicators for sustainable crop production. However, the EU Commission recently recommended inclusion of soil biodiversity as one of six indicators of soil health.[201]

In calling for "a new generation of indicators" for soil health, Lehman and his colleagues "suggest [that] additional measurements, especially biological assessments, be added" when evaluating soil health. Specifically, they urge that "aggregation, infiltration, earthworm abundance, organic C and N fractions should be more widely adopted in soil health testing …, and N-mineralizing enzyme activity be added for soil health assessments for plant production."[202] They also urge that for some purposes "several new indicators that are mainly geared towards non-agricultural soil services, such as human health and water quality, need to become part of routine soil health testing."[203]

For reasons noted above, I am skeptical about including the anthropocentric indicators that Lehmann and his colleagues suggest at the end of that quoted passage. Still, the overriding theme of their article is valid and valuable: a much more detailed, science-based, and consistent set of standards should be established for quantifying soil health and thereby facilitating an urgent shift toward global environmental restoration, including an improvement in agricultural operations.

Lehman and his co-authors close their article with suggestions that carry legal and institutional implications both at the global level and at regional and local levels:

> Because of soils' broad environmental and societal functions, soil health should be legally recognized as a common good. The

---

[201] *Id.* at 548–49 (endnotes omitted).
[202] *Id.* at 49 (endnotes omitted).
[203] *Id.* (endnotes omitted).

> development of soil health quantification standards should be spearheaded by governmental or intergovernmental organizations such as the Global Soil Partnership. International standards have to be developed for suitable type of indicators, their methodological details[,] and their integration into indices. Such a comprehensive soil health index should then be referenced by local, regional or national jurisdictions and organizations to guide decisions that impact soil and its functions to benefit sustainability goals.[204]

IIIB. Observations on the restorative practices of biodynamic-regenerative viticulture

The preceding discussion has explained that although the standards for measuring "soil health" or "soil quality" are not nearly as clear and settled as we might wish, modern agriculture has caused soil degradation all around the Earth. Now let us look at the other side of the coin.

Evidence has grown recently for the proposition that science-based biodynamic-regenerative viticulture — which I have abbreviated above as SBBRV — does enhance soil health based on some of the key criteria explained above. The following research results, presented for brevity in bullet-point form, indicate that SBBRV shows enough promise to warrant further study on two subjects: (i) on how soil health should most appropriately be defined and measured in the specific context of viticulture operations and (ii) on how (and how much) SBBRV methods have yielded better results for soil health than do the methods used in conventional viticulture or even in organic viticulture.

- In a four-year study of conventional, biodynamic, and organic grape growing conditions, researchers found that soil quality was higher in organic and biodynamic operations and that "biodynamic management resulted in a morphology favouring production of high-quality grapes."[205] The researchers studied almost identical plots (in the same vineyard) over 4 years from 2006 through 2009, using GAP (good agricultural practice), organic, and Demeter biodynamic standards. The researchers found that "winegrowers have reported remarkable positive influences of biodynamic practices on soil quality, grapevine development, plant health and wine quality"; in particular, earthworm abundance was higher in biodynamic and organic plots than in the others.[206]

---

[204] *Id.* at 544 (endnote omitted). Although Lehman and his colleagues say that soil should be legally recognized as a "common good," their description suggests that it might be further recognized as part of the "common heritage of mankind" (CHM), a concept that dates back over half a century and already has legal heft and familiarity. For a historical survey of the CHM concept, *see generally* John E. Noyes, *The Common Heritage of Mankind: Past, Present, and Future*, 40 DENV. J. INT'L L. & POL'Y 447 (2011).

[205] Georg Meissner, Miriam Athmann, Jurgen Fritz, Randolph Kauer, Manfred Stoll & Hans Schultz, *Conversion to Organic and Biodynamic Viticultural Practices: Impact on Soil, Grapevine Development and Grape Equity*, 53 OENO ONE 639, 639 (2019). The OENO One journal is managed by the International Viticulture & Enology Society.

[206] *Id.* at 640, 646.

- A 2020 science-journal article reports similar results in studying organic and biodynamic viticulture operations. Noting that although longer-term tests are needed (since the first few years after switching from conventional to organic or biodynamic viticulture can have slow or maybe even opposite effects on soil quality), most of the researchers' studies "showed a clear increase in biodiversity under organic and biodynamic viticulture."[207] The authors explain that "[t]he purpose of this study was to review evidence comparing effects of conventional, organic, and biodynamic viticulture on soil properties, biodiversity, vine growth and yield, disease incidence, grape composition, sensory characteristics, and wine quality."[208] They assert that their "meta-analysis provides helpful guidance for defining further research in organic agriculture on perennial, but also on annual, crops."[209]

- A 2022 study coming from northern Italy distinguished specifically between organic viticulture and biodynamic viticulture, albeit on a small scale. Its authors explain: "As organic and biodynamic farming systems are increasingly becoming the subject of public debate, we considered it appropriate to investigate and compare the relative environmental performances of these two agricultural practices when it comes to wine production."[210] Therefore, a cradle-to-gate "life-cycle assessment" method was used to assess "the environmental profile of two organic and two biodynamic wines, produced by four small wineries in two areas of Northeast Italy, a region historically devoted to wine production."[211] The study concludes in favor of the biodynamic approach: "On the whole, biodynamic products seem to have a lower impact than organic ones, regardless of the grape variety and geographical area analyzed. Results obtained from taking only the 'viticulture stages' into consideration once again suggest biodynamic production causes less environmental impact than organic."[212]

---

[207] Johanna Döring, Cassandra Collins, Matthias Frisch & Randolph Kauer, *Organic and Biodynamic Viticulture Affect Biodiversity and Properties of Vine and Wine: A Systematic Quantitative Review*, 70 AM. J. ENOLOGY AND VITICULTURE 221, 238 (2019), https://vinosa.it/wp-content/uploads/2020/12/221.full_.pdf [https://perma.cc/X3TG-34PP].
[208] *Id.* at 221.
[209] *Id.*
[210] Paola Masotti, Andrea Zattera, Mario Malagoli & Paolo Bogoni, *Environmental Impacts of Organic and Biodynamic Wine Produced in Northeast Italy*, 14 SUSTAINABILITY 6281, 6283 (2022).
[211] *Id.*
[212] *Id.* at 6293. For another comparative study of organic versus biodynamic viticulture practices, dating from 20 years ago, *see generally* Jennifer Reeve, L. Carpenter-Boggs, John Reganold, Alan York, Glenn McGourty & Leo McCloskey, *Soil and Winegrape Quality in Biodynamically*

In addition to the relatively recent studies I have mentioned here, the Demeter Association cites several other studies in the "Science" section of its website.[213] The account there seems to acknowledge a key feature that distinguishing biodynamic farming from organic farming — that is, the use of biodynamic "preparations" — has not been fully proven to be beneficial:

> One of the chief differences between the USDA's requirements for organic certification, and Demeter's requirement for Biodynamic certification, is Demeter's requirement for the use of eight preparations. These preparations (numbered 500 through 508) are made from animal manure, minerals, and herbs, and are applied in homeopathic quantities to soil, foliage, and compost piles. Anecdotal evidence and the strong growth of Biodynamic farms worldwide speak to the perceived benefit of the preparations, which were designed to promote nutrient and energy cycling in the soil and above ground. However, the mechanisms of action for the preparations, as well as the full extent of their abilities, are still not fully understood. While a reductionist scientific approach can explore some of the cause and effect that results from the preparations' use, a holistic approach to scientific investigation of Biodynamic agriculture has also been utilized over the past 90 years to attempt to better understand them.[214]

What about regenerative viticulture: do the claims that it contributes to soil health stand up under scientific scrutiny? A very recent meta-study suggests that they do, at least as compared to conventional (industrial-style) viticulture:

> The purpose of this review was to evaluate the literature concerning individual, yet often interconnected components of, and approaches to RV [regenerative viticulture], including soil management, cover crops, weeds, pests and diseases, and livestock integration, to establish current knowledge and inform future research opportunities. … The review found literature and science supporting viticulture's potential

---

and Organically Managed Vineyards, 56 AM. J. ENOLOGY & VITICULTURE 367 (2005). That study, conducted in California, found no differences in soil quality in the first six years, and the researchers commented that these "results are consistent with the literature in that responses to the use of the biodynamic preparations have been seen in some situations but not others." *Id.* at 367, 371.

[213] *See Science*, DEMETER ASS'N, INC., https://www.demeter-usa.org/for-farmers/science.asp#:~:text=In%20comparing%20biodynamically%20and%20organically,conventionally%20managed%20yields%20are%20down [https://perma.cc/BMY3-Q6EK].

[214] *Id.* For a 2021 report on carbon sequestration capacities of soil under regenerative viticulture operations, *see* Jessica Villat, *Down to Earth: Identifying and Promoting Regenerative Viticulture Practices for Soil and Human Health*, HARV. LIBR., (2021), https://dash.harvard.edu/entities/publication/054174c8-dbf3-4bc9-9678-789acd1d61c4 [https://perma.cc/CYB7-WVL7]. The author concluded that after studying yearly soil carbon sequestration of regenerative vineyard practices versus other techniques, "soil regenerative practices can be beneficial when applied holistically and in concert with one another … but [t]here was no significant difference between the N= 345 measures of soil C sequestration … across seven practices in viticulture." *Id.*

> for: soil and biodiversity regeneration, carbon sequestration, land cooling, ecological enhancements, and soil water holding capacity improvements. There is less consensus regarding the impact of RV approaches on grape yield, wine quality and greenhouse gas (GHG) emissions, as well as a lack of vineyard-based evidence demonstrating the efficacy of biostimulants and Biological Control Agents (BCAs).[215]

IIIC. Some open questions: soil health, wine quality, **terroir,** *and mycorrhizal networks*

One phrase in the preceding quoted paragraph prompts me to take a brief detour that emphasizes the character of what we do *not* know. The quoted paragraph noted that no full consensus has emerged "regarding the impact of R[egenerative] V[iticulture] approaches on … wine quality." This strikes me as an understatement, since no full consensus has emerged even on how (or if) *terroir* itself affects wine quality. One of today's most famous judges of wine quality, Jancis Robinson, has addressed this issue by acknowledging that "those who really understand geology are increasingly insistent that, despite the suggestions given by much wine literature and many a tasting note, there can be no direct relationship between what is below the vineyard and what is in the glass."[216] Indeed, Robinson continues, "one of the most wine-aware academic geologists [has written in the *Oxford Companion to Wine* that] '[a]necdotes

---

[215] Flora O'Brien, Belinda Kemp, Alistair Nesbitt & Rebecca Sykes, *Regenerative Viticulture and Climate Change Resilience*, 59 OENO ONE 1, 1 (2025). Results from another recent study — this one on regenerative agriculture generally, not just regenerative viticulture — have led to similar claims. A "pilot study encompasss[ing] 78 regenerating farms across 14 EU countries, covering over 7,000 hectares . . . [and] conducted by 11 researchers with institutional support" found that "regenerating farmers delivered 33% higher RFP [Regenerating Full Productivity] on average" compared with neighboring fields using conventional farming practices. *Farmer-led Research on Europe's Full Productivity: The Realities of Producing More and Better with Less — Place-based Innovation for the Good of All,* EUR. ALL. FOR REGENERATIVE AGRIC. (June 2025), https://eara.farm/wp-content/uploads/EARA_Farmer-led-Research-on-Europes-Full-Productivity_2025_06_03.pdf [https://perma.cc/6LFH-AUDE]. The Regenerating Full Productivity Index used in the study is referred to in the report as "a multidimensional performance metric developed by farmers, researchers and agronomists to capture the full spectrum of land stewardship outcomes: agronomic, ecological, and economic." *Id.* at 4. As for agroecological factors, the study found that "[c]ompared to neighbouring fields, regenerating farms achieved over 25% higher photosynthesis, 24% higher soil cover and 16% higher plant diversity" over five years, yielding "better soil health." *Id.* at 4. As for productivity, the study found that "[r]egenerating farms achieved, on average, only a 2% lower yield … while using 61% less synthetic nitrogen fertilizer and 75% less pesticides and making 20% higher gross margin per hectar[e]." *Id.*

[216] Jancis Robinson, *Holes in the Ground, and in our Knowledge*, JANCIS ROBINSON (Jun. 20, 2015), https://www.jancisrobinson.com/articles/holes-ground-and-our-knowledge [https://perma.cc/D62K-Y65U] [hereinafter Robinson 2015].

notwithstanding, vineyard geology cannot — in any direct, literal way — be tasted in wine.'"[217]

Robinson remains curious and pushes back against such a purely scientific analysis:

> And yet, and yet. Those of us who taste thousands of wines a year find inescapable the fact that wines from different places taste different in what seem like predictable ways. And many of us with tasting experience can see relationships between wine character and vineyard soil types. A wine grown in sandy soil will invariably taste lighter and softer than one grown next door on clay. The Rieslings of the Mosel grown variously on blue/grey and red slate taste very obviously different. Wines grown in the Achleiten vineyard by those naughty Austrians, and the most characteristic reds of Priorat in north-east Spain, for instance, are grown on very particular rock formations and, in their very different ways, they taste perceptibly distinctive.[218]

Central to Robinson's observations, of course, is the notion of *terroir*. As I noted at the very beginning of this section III, viticulture takes place on a remarkably broad variety of soils, from chalky to stony to volcanic to glacial.[219] Indeed, winemakers often tout the peculiar features of their own soil and setting — usually summed up in the term *terroir* — in explaining the special characters of their wines. One source offers this explanation:

> Terroir is a French word that means "earth" or "soil" in everyday speech, but the term has been adopted in the wine trade to refer to something else entirely: sensory traits in wine that are location-specific. … The word was first used in this sense by medieval monks in the Burgundy region seeking to describe the noticeable differences found in wines grown in different sites. … If wine were a piece of music, terroir wouldn't be a melody or arrangement as much as the distinctive acoustics of a specific performance venue, like the famed resonance of Carnegie Hall.[220]

From this notion of *terroir*, and from Jancis Robinson's reluctance to accept the assertion that *terroir* definitely *cannot* (as a scientific matter) have any direct effect on the taste of a wine, I wish to build an analogy between (i) soil's effect on wine's taste (and wine's other sensory features) and (ii) SBBRV's effect on soil health. As for the first of these, Robinson offers this conclusion: "something seems to be going on, even if for the moment it cannot fully be explained scientifically," regarding the effect of *terroir* on the taste of

---

[217] *Id.*
[218] *Id.*
[219] *See* MacNeil, *supra* note 16, at 26–27. *See also* text accompanying note 180.
[220] Marnie Old, *Why Vineyard Soil is So Important for Terroir*, BEVERAGE DYNAMICS (Sep. 12, 2021), https://bevinfogroup.com/2021/09/12/vineyard-soil-terroir-wine-meaning-definition/ [https://perma.cc/YN5A-KJWZ].

a wine. Perhaps, she surmises, "it may be that there is simply a missing link in our knowledge" about the "precise influences on the flavour and texture of wines."[221]

This brings me to the second half of my analogy. Even though the research efforts described above in subsection IIIB have not led (yet) to a broad scientific consensus as to how various natural-systems viticultural practices — biodynamic, organic, regenerative — affect soil health, there may simply be (in Robinson's words) "a missing link in our knowledge" on this point thus far. After all, "[t]he ecosystems of healthy soils are alive, extremely active, vastly complex and poorly understood."[222]

Indeed, it should come as no surprise that the complexity of the notion of *terroir* will complicate the scientific discernment of SBBRV's effects on soil. Research into these effects will need to be conducted individually, in many settings and types of *terroir*. One source has explained this specificity and how it might be addressed:

> Because terroir is a multifactor concept, no general quantitative relationships between one or more soil properties and the distinctive characteristics of wine from a particular site have been identified; rather a unique combination of soil factor values interacts with local climate, grape variety, vintage, canopy management, and winemaker technique to determine a site's terroir. However, with modern methods of sensing spatially referenced values of environmental and other variables at high resolution, terroirs can be mapped. This provides a platform for monitoring terroirs over time and recording how they respond to changes in environmental factors or to manipulations in the vineyard and winery.[223]

Accordingly, the deeper research that I suggest for determining and maximizing the benefits of SBBRV will surely prove to be increasingly feasible

---

[221] Robinson 2015, *supra* note 216. In another article, Robinson makes the same general point regarding the effect that *biodynamic* viticulture can have on wine quality: although she acknowledges that biodynamics "means being guided by the phases of the moon, burying homeopathic doses of special 'dynamised' (stirred) preparations in cow horns at propitious times and generally seeming pretty deranged," the fact remains that "all over the world producers of some of the most admired wines follow biodynamic principles more or less, with *a demonstrably beneficial effect on vine health and wine quality*." Robinson 2023, *supra* note 179 (emphasis added).

[222] Currin, *supra* note 195.

[223] Robert E. White, *The Value of Soil Knowledge in Understanding Wine Terroir*, 3 FRONTIERS ENV'T SCI. 1, 1 (2020). White advocates the use of "terroir maps at an appropriate scale [that] can be updated and hence used to monitor changes in the underlying variables in response, for example, to climate change. The information provided can then inform changes in viticultural management practices." *Id.* at 2.

with new technology. Employing new technology might well teach us much more than we know now about a second point I wish to highlight in concluding this section: the importance of mycorrhizal networks. These are underground fungal networks or systems of interaction among roots of plants.[224] As one source explains, "[s]everal studies have shown that these networks can influence plant establishment, nutrition, productivity and defense, nutrient distribution and storage, and multitrophic interactions."[225] The same source explains, however, that "many of these studies have focused on the importance of common mycorrhizal networks in [natural and largely undisturbed] ecological contexts and there has been less emphasis [on how mycorrhizal networks operate] in managed systems."[226]

The significance of mycorrhizal networks in the context of viticulture lies in the fact that conventional viticulture practices create disturbances that injure soil health. One study demonstrates how "low-intervention practices (organic and biodynamic managements) promoted densely clustered [mycorrhizal] networks, describing an equilibrium state based on mixed collaborative communities" while conventional vineyards had "highly modular sparser communities."[227] Another study concludes that overlap of grapevine and cover-crop roots may lead to development of a common mycorrhizal network that, in turn, may facilitate direct nutrient transfer from cover crops to grapevines.[228] In short, one key focal point of further research into the effects that SBBRV methods can have on soil health should be the specific impact those methods have on mycorrhizal networks.

IV. A faint constellation of official public support for biodynamic-regenerative viticulture

If, as I have suggested above, a biodynamic-regenerative approach to viticulture can help address the global soils crisis and provide a model for agricultural reform more generally, then a pair of questions arises. First, what should be the role, if any, for official public support in encouraging such a

---

[224] For a lively podcast about CMNs, featuring references to the "Wood Wide Web" and a "fungal freeway system connecting one tree to the next to the next to the next," *see From Tree to Shining Tree*, RADIOLAB (July 30, 2016), https://radiolab.org/podcast/from-tree-to-shining-tree [https://perma.cc/6B8U-VGCS].

[225] Pierre-Louis Alaux, Yaqian Zhang, Lucy Gilbert & David Johnson, *Can Common Mycorrhizal Fungal Networks be Managed to Enhance Ecosystem Functionality?*, 3 PLANTS, PEOPLE, PLANET 433, 433 (2021).

[226] *Id.* The authors of this article go on to explain that common mycorrhizal networks can help with plant nutrition and in "improving plant resistance and tolerance to abiotic [stresses such as drought] and biotic … stresses. Thus, there is growing evidence of the multifunctional effects of CMNs across ecosystems involving different types of mycorrhizal fungi." *Id.* at 435.

[227] Rüdiger Ortiz-Álvarez, Hector Ortega-Arranz, Vicente Ontiveros, Miguel de Celis, Charles Ravarani, Alberto Acedo & Ignacio Belda, *Network Properties of Local Fungal Communities Reveal the Anthropogenic Disturbance Consequences of Farming Practices in Vineyard Soils*, MSYSTEMS, May 4, 2021, at 1.

[228] Xiaomei Cheng & Kendra Baumgartner, *Arbuscular Mycorrhizal Fungi-Mediated Nitrogen Transfer from Vineyard Cover Crops to Grapevines*, 40 BIOLOGY & FERTILITY OF SOILS 406, 407 (2004).

biodynamic-regenerative approach — what I have abbreviated thus far as SBBRV (science-based biodynamic-regenerative viticulture)? Second, what types of support do some governmental systems already provide in various jurisdictions around the world? I examine those two questions in this section IV.

The heading I use for this section refers to "a faint constellation" of public support for SBBRV. As described below, even though some aspects of agriculture — especially those involving staple annual grains such as maize and wheat — do receive a broad range of subsidies, the same is not true of natural-systems viticulture. Like scattered points of lights in an evening sky, the public support for SBBRV is largely disorganized and hard to discern; only by straining can we imagine this public support constituting a faint constellation.

Subsection IVA will identify several *categories* of possible public support, using conventional extractive agriculture (annual foodgrains) as illustrative of subsidies, tax breaks, research funding, and the like. Subsections VB through VG will then focus on viticulture; it will offer details from several jurisdictions to illustrate how paltry the public support is thus far for SBBRV.

IVA. Subsidies for agriculture generally — broad programs but narrow focus

In order to generate a bird's-eye summary of how conventional agriculture gets supported through various types of government programs, I decided to see what kind of Artificial-Intelligence (AI) response would emerge from a Google search asking this question: "What are the main types of subsidies provided to agriculture in the U.S. and the EU?" I was rewarded with this AI answer:

> In the US and the EU, agricultural subsidies take various forms, including direct payments to farmers, price supports, and support for specific practices like conservation or disaster relief. Both regions also use border measures like tariffs and import quotas to protect their domestic markets.

This AI-generated synopsis is borne out by more official (and reliable) sources providing such details as these regarding both the U.S. federal system and the EU Common Agricultural Policy ("CAP"):

- The U.S. system of agricultural subsidies includes "monetary payments and other types of support … to farmers or agribusinesses. While some subsidies are given to promote specific farming practices, others focus on

research and development, conservation practices, disaster aid, marketing, nutritious assistance, risk mitigation, and more."[229]

- Although the specific forms and amounts of U.S. agricultural subsidies vary over time, a USDA webpage explains that the most recent legislation appears in "[t]he *American Relief Act, 2025*, signed into law on December 21, 2024, [which] extended the *Agriculture Improvement Act of 2018* (also known as the 2018 Farm Bill) for one year through Sept. 30, 2025."[230] That 2018 Farm Bill, in turn, provides "safety-net programs," "price support programs," and crop insurance, which "is one of the programs that is permanently authorized and does not expire."[231]

- Although the EU CAP subsidies are now in a state of transition, with the EU "drawing up plans to simplify rules governing its huge farming subsidy programme,"[232] EU farming subsidies are currently "worth around a third of [the EU's] 2021-2027 budget, or around 387 billion euros ([US]$399 billion) in payments to farmers and rural development."[233]

One survey of agricultural subsidies provided by various national governments emphasizes three key points. First, such subsidies have been used for decades: "Since the early 1930s, governments of wealthier countries around the world have used a dizzying array of schemes to support and subsidize farmers."[234] Second, some countries provide very large agricultural subsidies: "Among OECD members (a group of high-income countries), 'producer support estimate' rates average about 31 percent of total revenue for the main grain, oilseed, sugar, and

---

[229] *See* Nat'l Agric. Libr., *Agricultural Subsidies*, USDA, https://www.nal.usda.gov/economics-business-and-trade/agricultural-subsidies#:~:text=The%20government%20provides%20agricultural%20subsidies,data%2C%20and%20other%20pertinent%20resources [https://perma.cc/84DN-L4HN].

[230] *Farm Bill*, USDA, https://www.farmers.gov/working-with-us/farm-bill#available [https://perma.cc/FAR8-ZAR6].

[231] *Id.*

[232] Kate Abnett, *EU Plans Simpler Rules for Billions Worth of Farm Subsidies, Draft Shows*, REUTERS (Feb. 10, 2025, 10:19 AM), https://www.reuters.com/world/europe/eu-plans-simpler-rules-billions-worth-farm-subsidies-draft-shows-2025-02-10/#:~:text=The%20EU's%20Common%20Agricultural%20Policy,need%20to%20start%20your%20day [https://perma.cc/FF4X-488Q].

[233] *Id.* The same reporter explains that some of the CAP reforms involve weakening some of "the environmental conditions tied to the EU's huge farming subsidy programme … as part of plans to cut back regulations and paperwork for farmers." Kate Abnett, *EU Proposes Curbing More Green Rules on Farming Subsidies,* REUTERS (May 14, 2025, 9:44 AM), https://www.reuters.com/sustainability/climate-energy/eu-proposes-curbing-more-green-rules-farming-subsidies-2025-05-14/ [https://perma.cc/2MKD-XQTG**].**

[234] Daniel A. Sumner, *Agricultural Subsidy Programs*, ECONLIB, https://www.econlib.org/library/Enc/AgriculturalSubsidyPrograms.html#:~:text=The%20main%20forms%20of%20subsidy,price%20supports%20or%20other%20programs **[**https://perma.cc/P2ZE-7QM7]. The article, written by a former assistant secretary for economics at the USDA, appears on the website of the Library of Economics and Liberty, based in Indiana. *See* ECONLIB, https://www.econlib.org/ **[**https://perma.cc/8KHV-LAJB].

livestock products,"[235] and that "[t]he highest national average support equivalent rates, across all major commodities, are offered in Norway, Switzerland, and Iceland, with average subsidies of about 65–75 percent of the value of production. … The average support rate in the European Union is about 35 percent of the value of production."[236] Third, the forms of subsidies and support are extremely diverse: they include "(1) direct payments to farmers and landlords; (2) price supports … ; (3) regulations that set minimum prices by location, end use, or some other characteristic; (4) subsidies for such items as crop insurance, disaster response, credit, marketing, and irrigation water; (5) export subsidies; and (6) import barriers."[237] Moreover, "the governments of most wealthier nations provide aid for agricultural research and development, promotion, and some agricultural and rural infrastructure."[238]

In focusing specifically on the U.S. farm-subsidies programs, the same source emphasizes the fact that these supports are highly selective by commodity: "The U.S. government heavily subsidizes grains, oilseeds, cotton, sugar, and dairy products. Most other agriculture — including beef, pork, poultry, hay, fruits, tree nuts, and vegetables (accounting for about half of the total value of production) — receives only minimal government support."[239]

In a 2017 book, I explained that U.S. government subsidies have contributed to a severe concentration of types of grains and other agricultural products produced by U.S. farmers. The extent of this concentration is arresting:

> As Jason Clay has observed, 90 percent of the world's food today comes from 30 crop species, even though about 7,000 crop species exist. Moreover, … corn (maize), wheat, and rice account for 89 percent of all cereal produced worldwide." … A key economic *cause* for this concentration of farm production in a small number of species — for the USA, the list includes corn, soybeans, wheat, rice, cotton, barley, sorghum, and oats, which together account for a very high proportion of US agricultural production — is that these are the crops most heavily subsidized. Indeed, in the USA, nearly all US government agricultural subsidies go to those eight crops, and 90 percent of the funding is concentrated in the first five [of these].[240]

---

[235] *Id.* The author explains that the term "producer support estimate" is intended to "aggregate into a single index a large range of government programs, including price supports and trade barriers, that transfer benefits to farm producers and landlords." *Id.*
[236] *Id.*
[237] *Id.*
[238] *Id.*
[239] *Id.*
[240] AGROECOLOGICAL HUSBANDRY, *supra* note 8, at 58.

In the same book, I pointed out that conventional (industrial) agricultural production in the United States benefits not only from the direct subsidies summarized above but also from an indirect subsidy represented by official support for the fossil-carbon industry:

> From a farmer's perspective, it is an *indirect* subsidy because it is paid not to farmers themselves but rather to participants in the fossil-carbon extraction and processing industry. To the extent that the extraction and processing of such fossil carbons as coal, oil, and natural gas receive financial benefits from governments subsides of various sorts … the agriculture sector also benefits indirectly … [because] fossil-carbon inputs figure prominently in farm production [under modern industrial agricultural practices].[241]

In sum: many governments around the world provide an extensive array of subsidies to certain forms of agriculture. Such subsidies, though, are highly selective by sector (that is, by the types of products involved) and are most valuable to an industrial approach to agricultural operations. The question then arises: what are some illustrations of the sorts of official support offered to the viticulture sector, and specifically for encouraging environmentally conscious approaches to growing grapes for wine?

In the following subsections I offer a six-jurisdiction set of case studies to compare and contrast the level of governmental support for viticulture, coming mainly in the form of subsidies, research funding, certification processes, and tax incentives. In general, these case studies reveal that some jurisdictions do provide significant public support for viticulture. Such support seems less common, however, in the United States than in some key wine-producing states elsewhere in the world. In the United States, there is more likely to be funding from a private sector or a non-profit organization, as will be discussed when looking at funding pay structures for viticulture in California, Washington, and Oregon.

The United States is also unusual in another way: although the United States in general has certification processes and regulations to follow, some states create their own more rigorous rules and procedures that farmers must follow to obtain state-specific certification status — such as "Washington Certified" or "California Certified" — in an attempt to set themselves apart in the wine industry. Finally, it is important to note the difference between (i) organic status and (ii) either biodynamic status or regenerative status. As explained earlier, Demeter is the non-government entity in charge of biodynamic status (and has significant control over the term),[242] and the Regenerative Organic Alliance is the non-

---

[241] *Id.* at 60. As explained in that book, I use the term "fossil carbon" in this context, instead of the term "fossil fuel," to reflect the fact that the extraction and processing of oil, natural gas, coal, and other hydrocarbons that exist in fossilized form are not always undertaken for the creation of *fuel*. For instance, when natural gas, such as methane, is used in the creation of synthetic ammonia (widely used as fertilizer in modern agriculture), it is not used as a fuel but instead as a component in the chemical process that results in ammonia. *Id.* at 60 n.50.

[242] *See supra* subsection IIC.

government entity that has assumed responsibility for ROC certification and standards (in these still-early days of formalizing regenerative-viticulture status).[243] By contrast, organic-viticulture standards and certifications fall within the purview of a governmental agency's duty, as in the United States and the EU.[244]

The following illustrative survey is limited in scope. It focuses only on Italy, California, Chile, Washington, Oregon, and British Columbia.[245] These jurisdictions are important for viticulture because all of them have important wine industries (along with the tourism that frequently accompanies viticulture).

IVB. Italy

Italy's wine industry is worth more than US$10 billion, accounting for 17% of the world's wine production.[246] Reflecting the importance of viticulture to the Italian economy, a review of the Italian wine industry — focusing both on the agricultural practices used and the wine business — reveals significant amounts of public-funded financial support coming from the Italian government and the EU. Although distinctions are not consistently drawn for these purposes between what is described above as "industrial" versus "organic" (or biodynamic) practices, recent steps by Italian authorities show that the distinction is increasingly important and that organic practices are indeed receiving some special attention and support. The following developments and data illustrate these points:

---

[243] *See supra* subsection IIE.

[244] *See supra* subsection IID.

[245] Naturally, other jurisdictions and regions would warrant similar examination. For a brief treatment of New Zealand's sustainable viticulture program, *see* Lepird, *supra* note 34, at 126–127. That program "began in 1995 and was one of the first to be recognized on an international level as a sustainable option for viticulture" with now "96% of the vineyards in New Zealand operat[ing] under these sustainability standards." *Id*. at 124. A similar trend has been noticed in Uruguay: "Sustainability is a key focus for many Uruguayan wineries. Bodega Garzón, for example, is renowned for its commitment to sustainable practices, including water conservation and organic farming." Chris Rigge, *Uruguay: South America's most underrated wine region*, SMOOTHRED (Aug. 1, 2024), https://www.smoothred.com/inspiration/uruguay-south-americas-most-underrated-wine-region/ [https://perma.cc/B7TW-L7KC]. Similar trends toward natural-systems viticulture appear in France, which accounted (in terms of revenue) for 18.3% of the global organic wine market in 2023. *See France Organic Wine Market Size & Outlook, 2024-2030*, GRAND VIEW RSCH., https://www.grandviewresearch.com/horizon/outlook/organic-wine-market/france [https://perma.cc/D9RB-KBA6].

[246] *The Wine Business in Italy, Consumption, Trends and Growth Prospects*, ROME BUS SCH. (Oct. 23, 2023), https://romebusinessschool.com/blog/the-wine-business-in-italy-consumption-trends-and-growth-prospects [https://perma.cc/YJ23-ZTRS].

- In 2023 and 2024, the EU invested around 323.8 million euros into the Italian wine industry.[247] The EU's Common Market Organization (CMO) is providing the funding.[248] However, the CMO has strict parameters for how the industry may use the subsidies.[249] A decree from the Italian Ministry of Agriculture and Food sets out a rough breakdown of the subsidies noting that "the largest amount of 144 million euros will be given to farms for the restructuring and conversion of vineyards, while about 98 million euros have been granted for sales promotion on export markets."[250] Although not strictly about viticulture — but still in the realm of agriculture — clean harvesting or "green harvesting" is also being promoted.[251]

- Due to a study conducted by researchers at the University of Bologna, "Italy plans to invest 3 billion euros (3.06 billion U.S. dollars) to transition 25% of the country's agricultural land to organic by 2027."[252]

- In 2011, the Italian Ministry of Environment and Energy Security created VIVA,[253] a national program that focuses on promoting sustainability throughout the Italian wine industry. According to the Ministry, "VIVA is the only Italian public standard for measuring and improving the sustainability performance of the wine sector."[254] The program utilizes research conducted by the Centro di Ricerca OPERA,[255] which is a sustainable agriculture research center and think tank.[256]

- A few years ago, Italy passed a law approving an "Organic Made in Italy" label and funding for organic farming research in hopes to support and encourage organic production throughout Italy.[257]

---

[247] *EU Subsidises Italy's Wine Industry with 323.8 Million Euros*, WEIN.PLUS (Jan. 31, 2023), https://magazine.wein.plus/news/eu-subsidises-italy-s-wine-industry-with-323-8-million-euros-conversion-of-vineyards-promotion-green-harvesting [https://perma.cc/34E6-2NEA].
[248] *Id.*
[249] *Id.*
[250] *Id.*
[251] *Id.*
[252] *Italy to Invest 3 Billion Euros to Transition 25% of Farmland to Organic by 2027*, ORGANIC & NON-GMO REP. (Oct. 3, 2022), https://non-gmoreport.com/italy-to-invest-3-billion-euros-to-transition-25-of-farmland-to-organic-by-2027/ [https://perma.cc/P6SR-YM46] ("The decision to transition the land to organic was spurred by a new study on sustainable strategies to limit the spread of pests and disease in Italy").
[253] *The Program VIVA Sustainable Wine*, MINISTRY OF ENV'T & ENERGY SEC. (Dec. 6, 2022), https://www.mase.gov.it/pagina/program-viva-sustainable-wine [https://perma.cc/T393-8SPR].
[254] *Id.*
[255] *Id.*
[256] *See generally* Eur. Observatory on Sustainable Agric., *About OPERA*, OPERA RSCH., https://operaresearch.eu/#_blank [https://perma.cc/JP89-CU4F].
[257] Paolo DeAndreis, *Italy Introduces New Legislation to Promote Organic Production*, OLIVE OIL TIMES (Mar. 25, 2022), https://www.oliveoiltimes.com/production/italy-introduces-new-legislation-to-promote-organic-farming/106185 [https://perma.cc/262E-JGZZ].

- Also a few years ago, a bill dealing with biodynamics, which had previously won the approval of the Italian senate, was blocked by only one vote.[258]

IVC. California

A review of California's approach to organic practices in viticulture shows an important shift in that state — a shift toward sustainable practices, organic certification, and the like. As in the case of Italy, California's support for the wine industry takes many forms, some of which are viticulture-specific and most of which are applicable to agriculture in general. Still, as the following developments illustrate, organic operations are getting priority attention:

- California has created a plan to eliminate pesticides by the year 2050 in an attempt to embrace a more environmentally sustainable culture. However, many of the state's wineries have been farming organically or biodynamically long before California "unveiled its 'sustainable pest management roadmap'."[259]

- In California, the California Certified Organic Farmers (CCOF), a non-profit entity, has created an organic certification program for agriculture (including viticulture). To receive an organic certification from CCOF, "a vineyard must be farmed without the use of any prohibited substances for a minimum of three years."[260]

- In addition to representing over 4,000 organic practices in California, CCOF is an advocate for California's agriculture industry, pushing for legislative changes and funding in organic agriculture. Recently, CCOF celebrated the California Governor signing a state budget into

---

[258] Jessica Mason, *Biodynamic Farming Favoured by Sting Sees Bill Blocked in Italy*, THE DRINKS BUS. (Feb. 11, 2022), https://www.thedrinksbusiness.com/2022/02/stings-biodynamic-farming-ends-as-bill-gets-blocked-by-italian-government/ [https://perma.cc/XT8J-UHPA]. Those opposed to the bill complained that biodynamics has no basis in science, whereas its supporters advocated that biodynamics requires a higher set of standards than organic wine production. *Id.*

[259] Marisa Finetti, *California's Ban on Pesticides by 2050 Sees the State's Wineries Embracing 'Slow Wine'*, DECANTER (Mar. 28, 2023) https://www.decanter.com/wine-news/californias-ban-on-pesticides-by-2050-sees-the-states-wineries-embracing-slow-wine-500270/ [https://perma.cc/22W6-SGWB].

[260] Baldacci Fam. Vineyards, *Farming for the Future: Your Guide to Understanding Conventional, Sustainable, Organic, & Biodynamic Viticulture*, BALDUCCI, https://www.baldaccivineyards.com/2023/03/farming-for-the-future/ [https://perma.cc/7SFR-NTZF].

law which allocated US$5 million to transitioning farms and ranches into organic operations.[261]

- A study conducted by John Dunham & Associates "shows that the California wine industry generated over [US]$88 billion for the American economy in 2022" as well as created 513,738 jobs and paid billions in tax revenue to the local, state, and national government.[262]

- A bill, SB 1135, that would establish a tax credit for sustainable agricultural practices was submitted in 2024 to the California legislature. SB 1135 sought "to incentivize sustainable agricultural practices, undertaken by winegrape growers and other ag producers, by offering a tax credit for the utilization of compost to enhance carbon sequestration efforts."[263] The bill was held in committee for several months before becoming inactive and dying.[264]

IVD. Chile

A review of Chile's governmental and private support to its wine industry shows a relatively recent escalation in funding and a push for sustainability. Typically, the Chilean government's support for its agricultural industry is fairly weak. Some private actors in Chile, however, are taking steps similar to those of Italy and California by investing in research, creating organic certification, and pushing the government's financial incentive structures for the industry. The following developments illustrate these points:

- More than 80% of Chilean wines comply with the Wines of Chile's Chilean industry sustainability code and identify as a "Certified Sustainable Wine of Chile" in addition to other organic or biodynamic certifications.[265] However, the Chilean industry

---

[261] CAL. CERTIFIED ORGANIC FARMERS, *New Organic Transition Program in California Following CCOF Advocacy Efforts*, (July 27, 2022), https://www.ccof.org/news/new-organic-transition-program-in-california-following-ccof-advocacy-efforts/ [https://perma.cc/LB4V-VMXN].

[262] Nat'l Ass'n of Am. Wineries, *California Economic Impact Study 2022*, WINE AM. (2022), https://wineamerica.org/economic-impact-study/california-wine-industry/ [https://perma.cc/FAW3-3XG7].

[263] *California Association of Winegrape Growers Announces California Compost Tax Credit Legislation*, AM. VINEYARD (Mar. 6, 2024), https://americanvineyardmagazine.com/california-association-of-winegrape-growers-announces-california-compost-tax-credit-legislation/ [https://perma.cc/48TM-XQL8].

[264] For a report on the action taken on this proposal, *see* the California "legislative information" website at https://leginfo.legislature.ca.gov/faces/billStatusClient.xhtml?bill_id=202320240SB1135 [https://perma.cc/JPV8-GNTR].

[265] David Falchek, *Chilean Wine Producers Embrace Sustainability*, REPUBLICAN HERALD (July 10, 2021, 4:00 PM), https://www.republicanherald.com/2021/07/10/chilean-wine-producers-embrace-sustainability-2/ [https://perma.cc/Y4ZQ-YBC9].

sustainability code is a voluntary standard that simply guides wine companies on how to work sustainably.[266]

- In addition to creating a Chilean industry sustainability code, the Wines of Chile, together with the Chilean Economic Development Agency (CORFO), offer support by co-financing sustainable projects.[267] Examples of sustainable projects that receive CORFO funding are: (i) a research project that looks "into native yeasts and wild fermentation surrounding the vineyards that will further understanding of the way biodiversity impacts on the wines and [(ii)] a circular economy research project that is looking to improve the quality of compost by incorporating organic agro-industrial wastes."[268]

- The Chilean government spends only about 5% of its total government spending on agriculture — 0.5% of that funding being used for research and development in the wine industry — with no national agricultural investment policy.[269] However, the Chilean government did invest in several programs instituted by different government agencies.[270] One program by the National Agricultural Development Institute (INDAP) focuses on helping agricultural producers who are INDAP members gain access to "better commercial alternatives and new markets in order to contribute to the improvement of sustainable and transparent commercial relations."[271]

- In the wine industry specifically, Chile's government — in hopes of boosting its wine production — has implemented several policies supporting the industry. These policies "include investment

---

[266] *Sustainability*, WINESOFCHILE, https://www.winesofchile.org/sustainability/ [https://perma.cc/4JSC-5647].
[267] Arabella Mileham, *Chile 'Needs to Push its Green Credentials' to Stand Out, Winemakers Agree*, THE DRINKS BUS. (Oct. 14, 2020), https://www.thedrinksbusiness.com/2020/10/chile-needs-to-push-its-green-credentials-to-stand-out-its-winemakers-agree/ [https://perma.cc/W8MB-DK65].
[268] *Id.*
[269] Mayarí Castillo, Rodrigo Pérez-Silva, Catalina Chamorro & Macarena Sepúlveda, *Public Policies, Sustainaibility, and Smallholder Producers' Access to the Market. The Productive Alliance Programme in Chile: A Case Study*, 6 FRONTIERS IN SUSTAINABLE FOOD SYS. 1, 2 (Oct. 2022), https://www.frontiersin.org/journals/sustainable-food-systems/articles/10.3389/fsufs.2022.1020049/full [https://perma.cc/4632-G4JR].
[270] *Id.*
[271] *Id.*

incentives, tax breaks, and the establishment of wine routes and tourism initiatives."[272]

IVE. Washington

A review of the Washington wine industry shows that organic certification processes are conducted through governmental and private actors. Similarly, funding for research and sustainability follows this pattern with grants and reimbursements coming from both. With the wine industry being a big contributor to the Washington economy — and with sustainable and organic operations being an important part of that revenue — Washington appears to be prioritizing organic operations, as illustrated by these points:

- According to data provided by Washington Wine, wine production is a large part of Washington's economy with Washington wineries and grape growers "contributing more than [US]$10.56 billion in annual in-state economic impact."[273] This marks Washington as the second largest (falling behind California)[274] wine producing state in the United States.[275]

- On the state level, Washington was the first state to implement a statewide certified sustainability program for its wine industry.[276] The program, Sustainable WA, requires a third party to audit vineyards before certification to ensure the vineyard meets established standards, which Sustainable WA asserts are rigorous and science-based.[277]

- At the national level, the Washington State Department of Agriculture (WSDA) Organic Program serves as a certification agent for the USDA National Organic Program (discussed above in subsection IID).[278] In order to get certified by the WSDA, vineyards must pay a number of fees.[279] However, the WSDA can "reimburse

---

[272] *Wine – Chile*, STATISTA (June 2024), https://www.statista.com/outlook/cmo/alcoholic-drinks/wine/chile#analyst-opinion **[**https://perma.cc/P8SP-WWR6].

[273] WASH. STATE WINE COMM'N, *Fast Facts*, WAWINE, https://www.washingtonwine.org/fast-facts/ [https://perma.cc/2WPL-YNR9].

[274] Eloise Feilden, *Top 10 Wine Producing States in the US*, THE DRINKS BUS. (Sep. 14, 2022), https://www.thedrinksbusiness.com/2022/09/top-10-wine-producing-states-in-the-us/#:~:text=Top%2010%20wine%20producing%20states%20in%20the,(0.3%)%20*%20Vermont%20(0.3%)%20*%20Virginia%20(0.3%) [https://perma.cc/RW4L-AVXM].

[275] *See Fast Facts*, *supra* note 273.

[276] WASH. STATE WINE COMM'N, *Sustainable WA*, WAWINE (May 29, 2024), https://www.washingtonwine.org/sustainable-wa/ [**https://perma.cc/55H9-A39D**] [hereinafter *Sustainable WA*].

[277] *Id.*

[278] Wash. State Dep't of Agric., VOLUNTARY CERTIFICATIONS: ORGANIC CERTIFICATION 1, 1 (2019), https://cms.agr.wa.gov/WSDAKentico/Documents/DO/RM/RM/20_OrganicCertification.pdf [https://perma.cc/6CLS-4BHN].

[279] *Id.* at 3.

certified operations for up to 75% of their annual certification fees."[280]

- In addition to reimbursing certification fees, the Washington state government helps fund wine and grape research.[281] The state's grant program gave over US$1 million for research during the 2024-2025 fiscal year with funding from Washington State University, Washington Wine, and state liter taxes (1/4 cent per liter of all wine sold), among others.[282] Examples of the projects being funded include studies on irrigation approaches to prepare vines for winter, cultural and chemical approaches for sustainable vineyard pest management, and support for vineyard maintenance for wine grapes.[283]

IVF. Oregon

A review of Oregon's approach to its wine industry shows a similar dichotomy to that of Washington, with both governmental and private actors playing a part in the organic certification processes and viticulture research funding. However, while Oregon seems to be on par with other states and countries in pushing "sustainable" practices and "organic" certification, there appears to be even more of a drive in Oregon to take these practices a step further and focus on biodynamic practices and certification. The following points help illustrate these developments:

- Wine-focused industries and grape growing in Oregon contributed about US$8 billion in economic impact to the state in 2022 with a statewide increase from previous years according to a study released by the Oregon Wine Board (OWB).[284]

---

[280] *Id.*

[281] Wash. State Wine Comm'n , *FY 25 Viticulture and Enology Research Grants Awarded*, WAWINE, https://www.washingtonwine.org/research/fy-25-grants-awarded-from-the-washington-state-grape-and-wine-research-program-and-washington-state-wine-commission-research-grant-program/ [https://perma.cc/SY2C-KQFU].

[282] *Id.*

[283] Wash. State Wine Comm'n, WASHINGTON STATE GRAPE AND WINE RESEARCH PROGRAM FY 25 PROJECTS 1 (2024), https://www.washingtonwine.org/wp-content/uploads/2024/05/FY25ResearchProjectList.pdf [https://perma.cc/6CLS-4BHN].

[284] Or. Wine Bd., *The Oregon Vineyard and Wine Industry's New Economic Impact Report Shows Continued Growth and Increased Contribution to the State's Economy*, WINE INDUS. NETWORK ADVISOR (Mar. 27, 2024), https://wineindustryadvisor.com/2024/03/27/oregon-wine-industrys-economic-impact-report-continued-growth/ [https://perma.cc/7YD6-R3L2].

- Similar to the WSDA Organic Program mentioned above, Oregon also has a state USDA-accredited certifying agent, which is the Oregon Department of Agriculture (ODA).[285]

- The OWB, "a semi-independent state agency[,] . . . manages marketing, research, and education initiatives that support and advance Oregon's statewide wine and wine grape industry."[286] One initiative OWB funds is research in viticulture and enology.[287] The OWB granted US$279,060 worth of funding in the 2023-2024 fiscal year to support projects such as (i) grapevine trunk disease management for conventional and organic production and (ii) generating baseline data for smoke exposure and taint of nine grape varieties and corresponding wines.[288]

- A fully independent, non-for-profit organization, LIVE, offers a third-party certification for "environmentally and socially responsible winegrowing" in Oregon.[289] LIVE is accredited by the International Organisation for Biological Integrated Control, which is an organization that promotes environmentally safe plant practices.[290] LIVE has also expanded past Oregon and certifies vineyards in other states in the United States.[291]

- In terms of biodynamic certification, Oregon is leading states in the United States by being home to "52% of all Demeter Certified Biodyamic acreage in the country."[292]

IVG. British Columbia

The various forms of support that British Columbia vineyards can benefit from — including some support focusing specifically on natural-systems operations — include the following:

- In 2024, the Investment Agricultural Foundation partnered with British Columbia's Ministry of Agriculture and Food to create the

---

[285] *National Organic Program*, OR. DEP'T OF AGRIC., https://www.oregon.gov/oda/agriculture-services/ma-certification/pages/national-organic-program.aspx [https://perma.cc/62RL-GHW6].
[286] Or. Wine Bd., *About the Oregon Wine Board*, OR. WINE, https://industry.oregonwine.org/about-the-oregon-wine-board [https://perma.cc/N5XR-P668].
[287] Or. Wine Bd., *2023-24 OWB Funded Research | Viticulture & Enology Projects Summaries*, OR. WINE, https://industry.oregonwine.org/resources/reports-studies/2023-2024-owb-funded-research-projects/ [https://perma.cc/Y8A5-44MQ].
[288] *Id.*
[289] *About*, LIVE, https://livecertified.org/about [https://perma.cc/HC3A-BV6Z].
[290] *See also About IOBC-WPRS*, IOBC-WPRS, https://iobc-wprs.org/about-us/ [https://perma.cc/AA47-QAFF].
[291] *See* LIVE, *supra* note 289.
[292] Maya Seaman, *Biodynamic Wine Explained*, OR. WINE, https://www.oregonwine.org/discover/biodynamic-wine-explained/ [https://perma.cc/ADG5-8LCJ].

Enhanced Replant Program (ERP). The goal of the CA$70 million, five-year project is to provide funds to the fruit and wine industries in British Columbia to replace struggling crops with climate resilient varieties.[293] All eligible ERP applications are scored on criteria set by the Ministry of Agriculture and Food. Additional scoring criteria for wine grape replanting include participation in Sustainable Winegrowing British Columbia (discussed above in subsection IIF) or completion of the SWBC online self-assessment.[294]

- More generally, British Columbia's agriculture sector finds environmental sustainability support through a variety of public (government) programs and initiatives. These include the Agri-Ecosystem Stewardship Initiative (AESI) (for helping farmers in adopting beneficial management practices that enhance Ecological Goods and Services)[295] and the Environmental Farm Plan Program (to help farmers "enjoy increased efficiency, profitability and new customers as a result of increased environmental sustainability)."[296]

- Funding programs for Canadian wineries generally (not confined just to British Columbia) also take several forms, including investments in research and development to help improve grape cultivation techniques.[297]

- The Canadian government also provides sector-specific funding for viticulture through its Wine Sector Support Program, which "provides non-repayable grants to eligible Canadian wineries to help them adapt to ongoing and emerging challenges."[298] The program received another extension and further government funding in 2024

---

[293] *Enhanced Replant Program*, GOV'T OF B.C. (Jan. 21, 2025), https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/programs/enhanced-replant-program [https://perma.cc/6QY6-8YV9].

[294] *Enhanced Replant Program*, INV. AGRIC. FOUND. OF B.C., https://iafbc.ca/enhanced-replant-program/ [https://perma.cc/DMD7-PTXE]. For further details about how the ERP benefits vineyards in British Columbia, *see* Dave Townsend, *B.C. vineyards, orchards receive help to replant for changing climate*, B.C. GOV'T NEWS (Mar. 13, 2024), https://news.gov.bc.ca/releases/2024AF0006-000340 [https://perma.cc/8K28-P64Y].

[295] *See Agriculture and seafood programs*, GOV'T OF B.C. (Nov. 3, 2025), https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/programs [https://perma.cc/2J7P-CBUT] (look under "Environmental sustainability").

[296] *Id.*

[297] *See Top Funding Programs for Canadian Wineries*, RYAN ULC (Aug. 24, 2023), https://funding.ryan.com/blog/government-funding/top-funding-programs-for-canadian-wineries/ [https://perma.cc/DAZ8-TFKX].

[298] *See Funding Opportunities*, B.C. WINE GRAPE COUNCIL, https://bcwgc.org/funding-opportunity/wine-sector-support-program/ [https://perma.cc/YA98-YYP2].

> to "continue to help the Canadian wine sector improve its competitiveness and adapt to the challenges it faces."[299]

IVH. A comparative wrap-up

The illustrative survey I have offered above reveals three key points. First, all jurisdictions included in the survey provide some types of public — that is, government-funded — support for viticulture, with particular emphasis on natural-systems operations. The forms of support vary widely. Some governments provide funds for restoration and conversion of vineyards. Some pay for promoting wine-export sales. Some have created public programs for measuring and improving sustainability efforts in the viticulture sector and for permitting special labeling ("organic," "sustainable"). In some jurisdictions, governments have prohibited or further restricted pesticide use in vineyards. In others, tax credits are offered to viticulture operations using compost to boost carbon sequestration. Some states direct public funds to support research projects focusing on sustainable viticulture (irrigation, pest management, etc.). Others provide investment incentives for establishing wine routes and tourism initiatives. Several have implemented or facilitated jurisdiction-wide certification programs for viticulture sustainability standards.

Second, the degree of support offered by various jurisdictions falls far short of the support available to conventional "industrial" agricultural operations (of the sort summarized in subsection IVA, above). For instance, the scale of subsidies and other sorts of financial assistance for wheat, maize, and soybeans dwarfs the scale of financial support directed to the viticulture sector.

Third, private-sector entities play a large role in facilitating the shift toward SBBRV — presumably because the support of the viticulture sector pales in comparison to that provided to farmers producing the staple crops I refer to above. The CCOF in California, the Wines of Chile organization, the LIVE program in Oregon — these all illustrate the broad reliance that governments place on private and not-for-profit entities in supporting viticulture's move toward environmental sustainability.

V. Concluding observations

This has turned into a long article on viticulture, not because of the enjoyment my wife and I get out of working in a biodynamic, organic, and regenerative vineyard (although we do enjoy that), but mainly because I have tackled a rather broad range of topics here. I have surveyed (i) the history and current status of the shift away from conventional "industrial" viticulture and toward what I have called SBBRV (science-based biodynamic-regenerative viticulture), (ii) the notion of "soil health" and how a transition to SBBRV can

---

[299] *See Minister MacAulay announces $177-million extension to Wine Sector Support Program*, GOV'T OF CAN. (Mar. 2024), https://www.canada.ca/en/agriculture-agri-food/news/2024/03/minister-macaulay-announces-177-million-extension-to-wine-sector-support-program.html [https://perma.cc/BY8W-8CRT].

reverse the global scourge of soil degradation and thereby help to restore soil health, and (iii) the forms of public support that currently are — or are not — provided to facilitate SBBRV and soil health. Now I offer some closing thoughts.

Worldwide, viticulture today (like agriculture more generally) faces big challenges. It finds itself in a transition prompted by both consumers and viticulturalists. The trend is toward techniques, and I would say toward mindsets and philosophies, that Rudolf Steiner and many others suggested long ago. Unfortunately, Steiner's blend of some science with lots of speculation, anthroposophy, and straight-out woo-woo fluff has left a dark stain on the term "biodynamic."[300] Perhaps some or much of what Steiner said in his 1924 lectures will ultimately prove correct. After all, as Jancis Robinson has noted, there is "a missing link in our knowledge"[301] — indeed (I would say) whole chains of missing links. For now, though, most true scientists (including my friend Tim Crews) spurn many of Steiner's speculations.

This surely accounts in part for the separate rise of other terms and designations in lieu of "biodynamic." I have discussed the most prominent of these in my summaries of organic viticulture and regenerative viticulture. In actual operation, organic and regenerative viticulture closely resemble biodynamic viticulture as it is defined in the Demeter Standards. Indeed, the requirements for ROC regenerative viticulture certification, like the Demeter certification requirements, mainly expand (albeit significantly) on the requirements for organic-agriculture certifications offered in both the United States and the EU.

The presence of several similar but separate certification-and-labeling regimes causes trouble; it adds considerable complexity and confusion (certainly among wine-consumers[302]) to the already-demanding efforts that any of the certification systems require. Much of this trouble could be eliminated in a series of initiatives, beginning with a well-funded research program to expand our too-

---

[300] Some other aspects of Steiner's career and personality also disturb many observers. For one thing, "Steiner's racial theories are a source of ongoing controversy." Peter Staudenmaier, *Race and Redemption: Racial and Ethnic Evolution in Rudolf Steiner's Anthroposophy*, 11 NOVA RELIGIO 4, 5 (2008). In addition, his academic credentials and scholarship were disparaged even during his lifetime, as "his theosophy and anthroposophy and the Waldorf humanism in particular were considered pseudoscience or at best pedagogy, not a philosophical system. Steiner's credentials were not university-level professional work. ... German mainstream scholarship called him an 'autodidact, with a poor teacher' and 'gypsy-intellectual.'." THORSTEN J. PATTBERG, SHENGEN: ABOVE PHILOSOPHY AND BEYOND RELIGION 125 (2012); *Rudolf Steiner*, WIKIPEDIA https://en.wikipedia.org/wiki/Rudolf_Steiner#cite_note-t111-50 [https://perma.cc/YSX9-4M4L].

[301] *See supra* note 221 and accompanying text.

[302] For a reference to this consumer confusion, *see supra* note 71 and accompanying text. *See also Sustainably Produced Wine*, *supra* note 73, at 31 (noting that "[c]ertification 'over-load' leads to confusion … Due to the number of certifications and claims made, consumers find difficulty in knowing which ones are 'reliable' and the specifics of what they stand for").

shallow understanding of which viticulture techniques best hit the target of "soil health." Improving our understanding should lead to a science-based consensus on (i) just what are the crucial elements and techniques of biodynamic and regenerative viticulture and (ii) how we can best clarify and simplify the certification standards to dramatically boost our chances of addressing the global soils crisis effectively. This research program should also deepen our understanding of "soil health" itself, giving primacy not to the soil's contribution to *human* well-being but rather to the soil's overall role in the complicated natural systems that make our Earth a living planet.

Another set of initiatives, to be taken simultaneously with an intense research program, would involve public action by government agencies at multiple levels to support the "SBBRV transition" that is currently underway but is proceeding too slowly. I have provided in section IV of this article an illustrative summary of the types of support being provided in six jurisdictions. I urge the expansion of these programs. Government agencies should take a proactive approach and shoulder a much bigger role. This role would involve coordinating with effective private-sector and not-for-profit entities but not relying on them to assume the role that governments alone can play in issuing binding regulations and mobilizing public money.

I will close with a call for stronger *international* efforts. In addition to all of the suggestions I have made here — to do more research into SBBRV and soil health, to bring much-needed clarity to the relevant designations and certification requirements, to inject much more public (state) formality into the SBBRV transition through legal structures and binding rules, and to expand dramatically state-based financial and policy support for that transition — I would urge that these initiatives should all have a strong international component.

In my four books on global environmental governance, I have offered many details for international legal and institutional reforms relating to agriculture.[303] These and other reforms need to be implemented with special attention to viticulture at the global level. Otherwise, awkward inconsistencies between political jurisdictions will continue to fragment the SBBRV transition.

---

[303] For instance, I have enumerated 10 key principles that countries would commit to, in the form of a treaty called the Global Convention on Agroecology, for enhancing environmental protection in their own jurisdictions. *See* AGROECOLOGICAL HUSBANDRY, *supra* note 8, at 299–305. I have also formulated specific requirements that governments would hew to in enacting agriculture-related legislation, in removing fossil-carbon subsidies, and in funding ecology-focused research. *See id.* at 306–07, 318–19. I have also proposed the creation of "eco-states" with the powers and responsibilities adequate to coordinate with traditional nation-states ("anthro-states") in governing human interaction with the rest of the natural world. *See id.* at 379; *see also* DEEP AGROECOLOGY, *supra* note 30, at 84–97. I have also identified the mechanisms by which a new global institution — the Global Corporate Trust for Agroecological Integrity (GCTAI) — would be created in order to give primacy to the soils crisis while ensuring adequate supplies of human food; in this connection, I have offered specific details about voting powers, participatory certifications, and sovereignty-like privileges and immunities to be accorded to such a GCTAI to avoid many of the structural criticisms that have been appropriately leveled at existing international organizations, such as the IMF and the World Bank. *See* GLOBAL TRUST, *supra* note 8, at Chapter 6.

Such a fragmentation will reduce the likelihood of meeting the overall goal I have in mind, in focusing here specifically on viticulture. That goal is to facilitate a transition of agriculture at large (not merely viticulture) from (i) the conventional "industrial" model that now dominates agriculture to (ii) a natural-systems agroecology based on biodynamic, organic, and regenerative principles and techniques.

Appendix — selected excerpts from Rudolf Steiner's 1924 lectures[304]

Some key elements of Steiner's so-called "spiritual science" views appear in these excerpts:

- In the immediate vicinity of the earth, we have the Moon and the other planets. The old instinctive science which reckoned the Sun, as one of the planets had one of the following sequence: Moon, Mercury, Venus, Sun, Mars, Jupiter, Saturn. Now, without going any further into the astronomical aspect of the subject, I wish to point to the relation which exists between planetary life and life on the earth. If we consider life on the earth in general the first thing we have to take into account is the very important part played by what I might call the life of the siliceous substance in the world …. Now everything siliceous contains forces that come, not from the earth, but from the so-called distant planets Mars, Jupiter and Saturn — the planets beyond the Sun. These planets work indirectly upon plant-life through silicon and allied substances. But the planets near the Earth namely, Moon, Mercury and Venus, send out forces into the plant-life and animal life on earth through the medium of the limestone and kindred substances. Thus, of any cultivated field it may be said that the forces of both silicon and limestone are at work in it. The silicon mediates the influences of Mars, Jupiter and Saturn, the limestone those of Moon, Venus and Mercury.[305]

- If we consider plants which are not used for food, which do nothing but reproduce themselves, we focus our interest in the cosmic forces of Venus, Mercury and Moon, related to reproduction. But in the case of plants which are eminently suitable for food because their substances have become perfected to the point of forming food-stuffs, for human and animal consumption, it is the planets Mars, Jupiter and Saturn that are working through the medium of silicon. Silicon opens up the being of the plant to the expanses of the Universe, it awakens the plant's senses, so that it absorbs the formative forces bestowed by the distant planets, Mars, Jupiter and Saturn. From the sphere of

---

[304] As noted in the main text of this article, a full English version of the lectures' transcripts (first prepared in 1929) is available at *The Agriculture Course*, RUDOLF STEINER ARCHIVE, https://rsarchive.org/Lectures/GA327/English/RSPC1938/Ag1938_index.html [https://perma.cc/RRA4-Y7N5]. Excerpts appearing below are drawn from Steiner Lecture I, RUDOLF STEINER ARCHIVE, https://rsarchive.org/Lectures/GA327/English/RSPC1938/19240607p02.html [https://perma.cc/U2WU-8KY3], Steiner Lecture II, RUDOLF STEINER ARCHIVE, https://rsarchive.org/Lectures/GA327/English/RSPC1938/19240610p02.html [https://perma.cc/XH94-2EB8], and Steiner Lecture IV, RUDOLF STEINER ARCHIVE, https://rsarchive.org/Lectures/GA327/English/RSPC1938/19240612p02.html [https://perma.cc/36LL-BWFE].

[305] Steiner Lecture I, *supra* note 304.

Moon, Venus and Mercury on the other hand, the plant absorbs only that which makes it capable of reproducing itself.[306]

- There is much more hidden in water than appears in the chemical properties of hydrogen and oxygen. Water by its very nature is eminently fitted to bear along with it the forces coming from the Moon on to the Earth. So, it comes about that it is water which distributes the lunar forces throughout the earthly realm. There is a certain kind of relation between the Moon and the water on the Earth. Let us suppose that after a rainy spell there is a full Moon. Now the forces coming from the Moon when it is full causes something tremendous to happen on Earth. They shoot right into the whole growing forces of the vegetable kingdom. They cannot do so if there has not been a rainy spell beforehand. We must always realise the importance of sowing seed after rainy days followed by the full Moon, and we should never work at random ….[307]

- If we burn wood taken from a tree which has been planted without an understanding of the cosmic rhythms we do not get such a healthy heat as from wood taken from a tree which has been planted with right understanding.[308]

- [T]he basis of all Agriculture is the soil of the earth. This soil … is generally looked upon as being something purely mineral into which at the best organic substance has entered either because humus has been formed or manure has been introduced. … If you start by considering the soil, then you must bear in mind the fact that it is a kind of organ within that organism which manifests itself wherever the growth of Nature appears. The earth surface is really an organ, an organ which, if you care to. you may compare with the human diaphragm. We may put the matter broadly in this way (it is not quite exact but will give the right idea): Above the diaphragm there are in man certain organs, the head in particular, and the processes of breathing and circulation which work up into the head. Under the diaphragm are other organs. Now if we compare the earth surface with the human diaphragm we must say: The individuality represented by our farm, having the earth surface for its diaphragm has its head under the earth, while we and all the animals live in its belly. Above the surface of the earth, is really what may be regarded as the bowels of what I will now call the "agricultural-individuality."

---

[306] *Id.*
[307] *Id.*
[308] *Id.*

> On a farm, we are walking about inside the belly of the farm, and the plants grow upwards within this belly. Thus, we are dealing with an individuality which is standing on its head, and which is only rightly looked at if so understood, especially as regards its relation to Man. In relation to animals, the situation, as we shall see later on, is slightly different.[309]

- [T]here must be a constant interaction between the cosmic forces that have entered into the plant through silicon and those that are active … in the "belly" and that supply the "head" below with what it requires. True the "head" must be provided for out of the Cosmos, but this process must interact with that which takes place above ground in the "belly." The forces coming in from the Cosmos and being caught up underground must be able to flow upwards again, and the substance which brings this about is clay. Clay is the mediator through which the cosmic activity in the soil is enabled to work from below upwards.[310]

- If … we plant the seed of a given plant in the earth, the seed contains the impress of the whole Cosmos from a particular cosmic direction, which means that it came under the influence of a particular constellation and received its particular form. At the moment when the seed is placed in the soil it is strongly worked upon by the terrestrial … forces, and it is filled with the longing to deny the cosmic forces, in order that it may spread and grow in all directions. For the forces above the surface of the Earth do not want the plant to retain this cosmic form. The seed had to be driven to the point of chaos; but now that the plant is sprouting it is necessary to oppose the terrestrial to the cosmic forces which live as the form of the plant inside the seed. For the cosmic forces must be opposed and balanced, as it were, by the terrestrial forces. We must help the plant to become more akin to the Earth in its growth. This can only be done by introducing into the plant some form of living earthly matter which has not yet reached the state of chaos and seed formation, life which has been held up in a plant before the seeds have been formed. For this purpose, a rich humus formation comes to man's assistance in those districts that are fortunate enough to possess it.[311]

The basis for Steiner's instructions to farmers on "preparations" appears in his Lecture IV:

> Let us put manure just as it comes to hand into a cow-horn, pressing it full, and bury it at a certain depth — say 1½ to 2½ feet deep according to the soil, which should not be too sandy or clayey. We can choose any spot where the soil is in good heart. Now by thus burying it with its filling of manure, we

---

309 Steiner Lecture II, *supra* note 304.
310 *Id.*
311 *Id.*

preserve in the horn that function which it would normally exercise in the cow's body, that is the reflecting of the life-giving and astral elements. Through the fact of its being surrounded with earth, all the currents of etheric and astral forces stream into its interior. These forces attract all the astral and etheric elements from the surrounding soil, and the manure contained in the horn becomes inwardly quickened with these forces in the course of the winter season when the earth itself is most alive. For the earth is most inwardly alive during the winter. All these living forces are preserved in the manure and thus there is a highly concentrated, life-giving manuring force in the contents of the horn. Then (in spring) the horn can be dug up and its contents removed. … [W]hen the manure [is] removed it [will be] completely odourless … , though naturally it [will have some odour] when it [gets] mixed with water. This shows that all its odour [will have] been concentrated and worked up within it. You have here a tremendous astral and etheric power which you can utilise by taking the content of the cow horn after its period of hibernation and diluting it with water which perhaps should be slightly warmed. As regards quantities and dilution, I have ascertained by repeated observation that an area of about 1500 square yards (near one-third of an acre) can be served with the contents of such a cow horn, diluted in about half a bucket full of water. The whole of the contents of the horn must be thoroughly united with the water. You must begin to stir it briskly round the edge of the bucket, until a crater is formed, in the middle reaching almost down to the bottom. At this point, suddenly reverse the movement thus causing the liquid to swirl round in the opposite direction. If you do this for an hour, the ingredients will become thoroughly mixed. You must remember what a really small amount of work is entailed in this. ….

The next thing to do is to spray the mixture over tilled land so that it can get thoroughly into the soil. Small areas can be treated with an ordinary syringe, larger areas will naturally call for the employment of specially constructed machines. But once we have learned to combine this kind of "spiritual dung" with ordinary manure it will be found that very great fertility will be produced. In particular, it will be found that these things are capable of still further development, for in addition to the measures I have [just] indicated, we can proceed as follows:

Again, we take a cow-horn and fill it in the same way, not with manure this time, but with quartz or flint or even orthoclase or feldspar that has been ground to powder and mixed with water so as to form a thin paste. Then instead of leaving the horn in the ground throughout the winter, we leave it there over the summer, take it out in late autumn and keep it till the following spring. Its contents, which have been exposed to the. summer-life of the earth, are then emptied out and treated in the same way as has been described in connection with the dry manure, except that much smaller

> quantities are required. Thus, a pinch of the contents of the horn about the size of a pea or even of a pin's head can be diluted in a bucket of water; the main thing is that it must be stirred for an hour, as before. And if you use this mixture for spraying the plants (not pouring it on to them but finely sprinkling it) you will see, particularly in the case of vegetables and the like, that this has the effect of supplementing and reinforcing that which works out of the soil through the cow horn manure. And if, as would not be amiss, the practice was extended to whole fields — it would be easy enough to devise machines which would sprinkle the liquid over whole fields — then you would see how the cow-horn manure was pressing up from below, the other drawing from above, neither too weakly nor too strongly. And this could have a wonderful effect, particularly on cereals.[312]

[312] Steiner Lecture IV, *supra* note STEINLECNOTE.