

Forschungsring Newsletter 2025 – 1



News about research in biodynamic food and farming

Dear readers,

We are pleased to present our current newsletter on research in biodynamic food and farming. This newsletter lists studies published between January and July 2025 in an international scientific journal (following peer review). The search for "biodynamic farming," "biodynamic agriculture," "biodynamic preparations," and simply "biodynamic research" was conducted using the Google Scholar and Science Direct platforms. The abstracts presented (in the original and in a brief German summary) sometimes do not suggest a specifically biodynamic context, but explicitly include biodynamic farming or are of particular interest to biodynamic farming or its research. Studies that only briefly mention or explain biodynamic farming have been eliminated.

In the current issue, we have divided the publications into the following categories:

1. Viticulture & biodynamic practices,
2. Soil, microbiome & humus,
3. Knowledge transfer and education,
4. Pathways to sustainability.

We reserve the right to have overlooked a study during our survey. If this is the case, we welcome your feedback.

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Neues aus der Forschung zur biodynamischen Land- und Lebensmittelwirtschaft

Liebe Leser*innen,

wir freuen uns Ihnen den aktuellen Newsletter zur Forschung aus der biodynamischen Land- und Lebensmittelwirtschaft zu präsentieren.

In diesem Newsletter werden Studien aufgelistet, die zwischen Januar und Juli 2025 in einem internationalen wissenschaftlichen Journal (nach peer review Prozess) veröffentlicht wurden. Die Suche nach „biodynamic farming“, „biodynamic agriculture“, „biodynamic preparations“ und schlicht „biodynamic research“ erfolgte über die Plattformen „Google Scholar“ und „Science direct“. Die vorgestellten Abstracts (im Original und in deutscher Kurzfassung) lassen mitunter nicht auf einen spezifisch biodynamischen Kontext schließen, beinhalten den biodynamischen Landbau jedoch explizit oder sind für den biodynamischen Landbau bzw. dessen Erforschung von besonderem Interesse. Studien, die den biodynamischen Landbau lediglich knapp erwähnen oder erläutern, wurden aussortiert.

In der aktuellen Ausgabe haben wir die Publikationen in nachfolgende Kategorien unterteilt:

- 1.) Weinbau & biodynamische Verfahren,
- 2.) Boden, Mikrobiom & Humus,
- 3.) Wissenstransfer und Bildung,
- 4.) Wege zur Nachhaltigkeit.

Wir behalten uns vor, eine Studie bei der Recherche übersehen zu haben. Sollte dies der Fall sein, freuen wir uns über eine Rückmeldung.

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Viticulture & biodynamic practices



1. Retro- Innovation in Biodynamic Agriculture: Bridging Traditional Wisdom and Smart Technologies for Sustainable Farming.

Liopa Tsakalidi, A. (2025). Retro- Innovation in Biodynamic Agriculture: Bridging Traditional Wisdom and Smart Technologies for Sustainable Farming. *International Journal of Agricultural Economics and Research*, 11(13).

DOI: <https://doi.org/10.51193/ijaer.2025.11113>

Abstract

Integrating retro-innovation and smart technologies in biodynamic agriculture offers a promising pathway to sustainable farming. Retro-innovation combines traditional wisdom with modern advancements, while biodynamic agriculture offers a holistic approach to cultivation. Smart technologies, including IoT sensors, AI, drones, and blockchain, enhance precision and efficiency in farming practices. However, implementing these technologies in biodynamic agriculture presents challenges, including philosophical conflicts, infrastructure limitations, and cultural resistance. Despite these obstacles, the synthesis of traditional methods and modern technology through retro-innovation shows promise in creating resilient, sustainable agricultural systems. This integration has the potential to address contemporary challenges such as climate change and resource scarcity while preserving valuable traditional practices. Successful implementation requires interdisciplinary collaboration, policy support, and education to bridge the gap between traditional wisdom and technological innovation in agriculture.

In Kürze auf Deutsch

- Die Studie untersucht das Verhältnis biodynamischer Prinzipien mit moderner Smart-Farming-Technologie.
- Einführung des Konzeptes: „Retro-Innovation“ als Verbindung von traditionellem Wissen mit modernen Technologien, ohne den ganzheitlichen Ansatz der biodynamischen Landwirtschaft zu vernachlässigen.
- Philosophische Konflikte, technische Infrastrukturmängel und kulturelle Vorbehalte erschweren die Umsetzung.
- Die Verbindung von alt und neu kann helfen, Klimawandel und Ressourcenknappheit zu begegnen – ohne den Verlust traditioneller Praktiken.
- Interdisziplinäre Zusammenarbeit, politische Unterstützung und Bildung sind entscheidend für eine erfolgreiche Transformation.

[Zum Abstract/Artikel →](#)

2. Influence of cosmic rhythms on plant epigenetics: A new frontier in biodynamic agriculture.

Sharma, U. & Chamroy, T. (2025). Influence of cosmic rhythms on plant epigenetics: A new frontier in biodynamic agriculture. *International Journal of Research in Agronomy*, 8(5G).
DOI: <https://doi.org/10.33545/2618060x.2025.v8.i5g.2940>

Abstract

Human life on Earth depends on the fertility of the soil and the quality of the environment. In many parts of the world, agrochemical-based farming during the past five to six decades has had a negative impact on environmental ecology and soil biology. In the end, the three fundamental components of nature soil, water, and air have been contaminated. It is now widely known that agrochemicals cannot be poured in sufficient quantities to restore soil fertility and sustainable agricultural output. Only by mediating eternal sources of energy is it feasible. Cosmic farming, which is based on the methodical and synergistic mediating of an infinite supply of energy using a few basic processes. Because the human body is a miniature reproduction of the universe, food produced and consumed in accordance with nature's gestures, without the use of agrochemicals, will be Sattvik, rich in nutrition and therapeutic value. Horticultural crops are ideal for cosmic production and consumption. Given the existing misery of small and marginal farmers, as well as the terrible status of indigenous cows, both may be solved by vigorous promotion of cosmic farming in even the most isolated areas, with significant repercussions. Plant physiology and cosmic cycles have a complex interaction that emphasizes how crucial it is to comprehend these rhythms in order to increase agricultural yield and plant resistance to environmental stressors. By controlling vital functions including DNA modification, photosynthesis, stomatal movement, and blooming, cosmic rhythms especially circadian rhythms have a substantial impact on plant epigenetics, growth, and production. These cycles enable plants' epigenetic modifications to predict and adjust to daily and seasonal fluctuations, which ultimately affects their general well-being and productivity.

In Kürze auf Deutsch

- Untersuchung des Zusammenhangs zwischen kosmischen Rhythmen und pflanzlicher Epigenetik.
- Analyse der Rolle verschiedener kosmischer Rhythmen, insbesondere zirkadianer Rhythmen, bei der Regulierung pflanzlicher Genexpression und epigenetischer Prozesse.
- Hervorhebung der Bedeutung kosmischer Zyklen für die Steuerung wichtiger Pflanzenfunktionen wie DNA-Modifikation, Photosynthese, Stomata-Bewegung und Blüte.
- Diskussion, wie das Verständnis kosmischer Rhythmen zur Steigerung von Pflanzenwachstum, Ertrag und Stressresistenz beitragen kann.
- Appell für eine verstärkte interdisziplinäre Zusammenarbeit zwischen Astrophysik, Molekularbiologie und Agrarökologie zur Erforschung kosmischer Einflüsse auf Pflanzen.

[Zum Abstract/Artikel →](#)

3. ¹H-NMR- based metabolomic profiles of Zucchini (*Cucurbita pepo* L.) grown with different agricultural practices for sustainable crop production.

Fazzi, M.C., Girelli, C.R., Migoni, D., Fracasso, B., Cesari, G. & Fanizzi, F.P. (2025). ¹H- NMR- based metabolomic profiles of Zucchini (*Cucurbita pepo* L.) grown with different agricultural practices for sustainable crop production. *Foods*, 14(6), Article 919.

DOI: <https://doi.org/10.3390/foods14060919>

Abstract

Zucchini (*Cucurbita pepo* subsp. *pepo*) is a seasonal vegetable (also known as courgette) characterized by health properties due to the content of several bioactive molecules. For this reason, the consumption of zucchini is highly recommended as a part of the Mediterranean diet. The aim of this study was to evaluate the possible influence of a specific compost supply for shifting the characteristics of an integrated agriculture toward a biodynamic standard following Demeter® certified rules. In particular, an approach based on ¹H-Nuclear Magnetic Resonance (NMR) spectroscopy and multivariate statistical analysis (MVA) was applied to analyze the differences between the metabolic profiles of the zucchini samples (with the same cultivar, Vitulia), obtained from three different agronomical practices: two focused agricultural systems (compost supplied and integrated), as well as the used benchmark (Demeter biodynamic certified). The obtained results showed that the samples from the plots managed with biofertilizer from compost showed similar behaviour to the samples managed under Demeter biodynamic certification, with higher content of some amino acids, such as arginine, and lower content of sugars than the samples from integrated farming. The concentration of twenty elements was then determined using inductively coupled plasma atomic emission spectroscopy (ICP-AES). The averaged results of the elemental data appear almost parallel to the trend observed with the metabolomics approach. In the present case, the use

of a specific compost as a biofertilizer has shown to promote the transition to the quality standards of the Demeter certification, significantly improving the crops' sustainability.

In Kürze auf Deutsch

- Einsatz von ^1H -NMR-Spektroskopie zur Analyse metabolomischer Profile von Zucchini („Vitulia“).
- Vergleich von integriertem Anbau, integriertem Anbau mit Kompost und biodynamischem Anbau.
- Höherer Gehalt an Aminosäuren (z.B. Arginin) in Proben aus biodynamischem und kompostiertem integriertem Anbau.
- Die Studie legt nahe, dass durch kompostbasierte Biofertilizer die Qualität in Richtung Demeter-Standard verschoben werden kann.

[Zum Abstract/Artikel →](#)

4. The role of isotopic profiling in identifying organic and biodynamic practices in *Vitis labrusca* grape cultivation.

Leonardelli, L., Leonardelli, S. & Schwambach, J. (2025). The role of isotopic profiling in identifying organic and biodynamic practices in *Vitis labrusca* grape cultivation. Food Chemistry, 474, Article 143192.

DOI: <https://doi.org/10.1016/j.foodchem.2025.143192>

Abstract

This study investigated nitrogen, carbon, and oxygen isotopes to differentiate fertilizers used in grape cultivation. The hypothesis posited that organic and biodynamic practices produce distinct signatures compared to conventional. It represents the first study of nitrogen isotope in *Vitis labrusca* grapes. One hundred twenty grape samples, from organic, biodynamic and conventional practices, were analysed. The results revealed that organic and biodynamic exhibited similar nitrogen isotopic values, both significantly higher than those of conventional grapes. Carbon also differed significantly, with organic and biodynamic showing less negative values than conventional. An intermediate group suggested cross-contamination or transitional farming practices. Oxygen was less efficient in identifying cultivation practices. These findings underscore the effectiveness of isotopic profiling in verifying organic and biodynamic certifications, providing insights into agricultural systems, and supporting the authenticity of organic and biodynamic labels. Nitrogen, in particular, proved valuable for ensuring the integrity of grape cultivation.

In Kürze auf Deutsch

- Isotopenprofilierung ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$) zur Unterscheidung von biodynamischem, biologischem und konventionellem Traubenanbau.

- Analyse von insgesamt 120 *Vitis labrusca* Proben aus biologischem, biodynamischen und konventionellen Anbau wurden untersucht.
- Biodynamische Proben zeigen charakteristische Isotopensignaturen, besonders im Stickstoff-Stoffwechsel.
- Methode bietet Potenzial für Rückverfolgbarkeit und Echtheitsprüfung in der nachhaltigen Weinproduktion.

[Zum Abstract/Artikel →](#)

5. Microbial and aroma characteristics of spontaneously fermented wine from organic grapes at the eastern foot of the Helan Mountain.

Li, Y., Rao, B., Jin, Y., Zhang, Z., Ma, W., Shi, X. & Tao, Y. (2025). Microbial and aroma characteristics of spontaneously fermented wine from organic grapes at the eastern foot of the Helan Mountain. *Journal of Integrative Agriculture*.

DOI: <https://doi.org/10.1016/j.jia.2025.08.004>

Abstract

Organic management practices and spontaneous fermentations have become focal points in wine research due to increasing consumer interest in healthy foods and sustainable agriculture. In this study, 'Cabernet Sauvignon' grapes sourced from organic and conventional management vineyard (OMV/CMV) in the Ningxia region were subjected to spontaneous fermentation. The microbial, oenological, and aroma profiles of grape must and resulting wines were assessed using high-throughput sequencing (HTS), high-performance liquid chromatography (HPLC), gas chromatography with mass spectrometry (GC-MS), and sensory evaluations. Network analysis was applied to explore relationships among microorganisms, volatile compounds, and aroma attributes. Results showed that organic management significantly increased microbial species richness, α -diversity, and the variety and concentration of aroma compounds, favoring the production of natural wines with complex aroma profiles. Relative abundance of *Saccharomyces* in OMV reduced, promoting the prevalence of other yeast species during fermentation. Bacterial succession in wines from OMV remained stable, with *Pantoea* as the dominant genus. Among oenological parameters, OMV wines significantly induced glycerol content, while reduced total acidity, tartaric acid, and citric acid content. These wines exhibited significantly higher levels of fermentative (+16%) and varietal (+72%) volatiles, as well as enhanced floral and sweet fruity aromas, along with distinct nail polish and vegetal notes. Additionally, *Saccharomyces*, *Hanseniaspora*, *Metschnikowia*, and *Pantoea* were strongly correlated with specific volatile compounds and aroma characteristics. This study provides valuable data that can inform spontaneous fermentation practices and guide vineyard management for natural wine production.

In Kürze auf Deutsch

- Analyse mikrobieller Gemeinschaften und flüchtiger Aromastoffe in spontan vergorenen Weinen aus biologisch und konventionell angebauten Trauben.
- Einsatz von Hochdurchsatz-Sequenzierung und GC-MS zur Charakterisierung der mikrobiellen Diversität und Aromaprofile.
- Biologischer Weinbau erhöhte die mikrobielle Artenvielfalt (α -Diversität) im Traubenmost deutlich im Vergleich zur konventionellen Bewirtschaftung.
- In Bio-Weinen war *Saccharomyces* weniger dominant; andere Hefen wie *Hanseniaspora* und *Metschnikowia* waren stärker vertreten.
- *Pantoea* war der vorherrschende Bakteriengenus in Weinen aus biologischem Anbau und zeigte ein stabiles Auftreten über die Fermentation hinweg.
- Bio-Weine zeigten signifikant höhere Konzentrationen fermentativer (+16%) und sortenspezifischer (+72%) Aromastoffe (Volatile).
- Bio-Weine wiesen intensivere florale und süß-fruchtige Noten auf
- Statistische Netzwerkanalyse zeigte enge Zusammenhänge zwischen bestimmten Mikroorganismen und spezifischen Aromaeigenschaften.
- Die Studie liefert fundierte Hinweise darauf, wie Spontangärung und Bio-Anbau gezielt für komplexe Naturweine genutzt werden können.

[Zum Abstract/Artikel →](#)

6. Organic matter evolution and microbial activity in a vineyard soil after four years of inter-row cover crop management.

De Bernardi, A., Marini, E., Tagliabue, F., Brunetti, G., Casucci, C., Rossa, Ü.B., Silvestroni, O. & Vischetti, C. (2025). Organic matter evolution and microbial activity in a vineyard soil after four years of inter-row cover crop management. *Applied Soil Ecology*, 206, 105868.

DOI: <https://doi.org/10.1016/j.apsoil.2025.105868>

Abstract

Conservation agriculture approaches are rarely applied to viticulture in central Italy due to some research gaps persisting in this sector that somehow reflect ineffective extension programs and activities. This work analysed the effects on soil health and fertility of two inter-row vineyard management strategies carried out for 4 consecutive years: an annual legume cover crop of Egyptian clover (*Trifolium alexandrinum* L.) and a permanent meadow with spontaneous species. The inter-rows of the two tested strategies were compared with an adjacent uncultivated soil that had been left untilled for 20 years (control soil). The short-term (4 years) impacts of these techniques on the different soil organic carbon forms and on the soil microbial activity were measured at two soil depths (0–20 cm and 20–40 cm). Soil analyses included total and extractable organic carbon, humic and fulvic acids, microbial biomass carbon, respiration and some enzyme tests. The final aim was to

evaluate if four years of soil cover could enhance the stabilisation of the soil organic carbon stock and increase the growth and activity of soil microbial biomass. The permanent meadow showed a topsoil organic carbon content significantly higher than the annual legume cover, and both management soils showed an organic carbon content higher than the control soil. The topsoil humic acid content of the annual legume cover was significantly higher than both the permanent meadow and control, indicating that legume management stored the soil organic carbon in a more stable form. The microbial biomass carbon and the soil respiration of the annual legume cover topsoil were significantly higher than those of the permanent meadow. Regarding the enzyme activities, β -glucosidase and the enzymes related to the nitrogen cycle were significantly higher in the two managements than in the control, while phosphatase activity was not influenced by the two managements. The results indicate that soil cover in the inter-row of vineyard increases the stable form of soil organic carbon, with variations according to the type of cover adopted. Even the effects on soil microbial biomass growth and activity were positive, especially for the activities related to the carbon and nitrogen cycles.

In Kürze auf Deutsch

- Vergleich zweier Begrünungsstrategien (jährliche Leguminosen-Deckfrucht vs. Dauergrünland) in einem Weinberg in Mittelitalien über vier Jahre.
- Beide Praktiken steigerten organischen Kohlenstoffgehalt und mikrobielle Aktivität gegenüber unbehandeltem Kontrollboden.
- Leguminosen-System erhöhte Huminsäure-Gehalt und mikrobielle Biomasse.
- Dauergrünland förderte die Anreicherung von organischem Kohlenstoff im Oberboden.
- Enzymatische Aktivität im Kohlenstoff- und Stickstoffkreislauf wurde durch beide Methoden gesteigert
- Ergebnisse unterstützen den Einsatz von Zwischenfrüchten zur Förderung der Bodenqualität und nachhaltigen Weinbau.

[Zum Abstract/Artikel →](#)

Soil, microbiome & humus



7. The essential role of humified organic matter in preserving soil health.

Piccolo, A. & Drosos, M. (2025). The essential role of humified organic matter in preserving soil health. Chemical and Biological Technologies in Agriculture, 12, Article 21.

DOI: <https://doi.org/10.1186/s40538-025-00730-0>

Abstract

The soil health notion has been recently expanded to relate soil functions not only to soil fertility for a sustainable primary productivity, but also to the control of water cycling and of the soil carbon storage. Soil humus is fundamental to achieve the objectives of soil health, and it is therefore deemed necessary to enlarge the knowledge of its composition and dynamics, if a modern soil management was to be pursued. This review first describes the contemporary understanding of the supramolecular structure of soil humus and the derived modern method to identify the totality of humic components to an unprecedented extent in soils under different soil management and cropping systems. Then, it accounts on how humus, either native in soil or exogenous from sources rich in organic carbon such as lignite, compost, and lignocellulosic residues, improves the soil physical fertility, limits the risk of erosion, enhances the bioactivity of the rhizosphere microbiome, and directly stimulates plant growth. Moreover, it is highlighted the role played by humus in ecologically sound soil managements, such as in organic and biodynamic agricultural productions, which are progressively growing as alternative to conventional but environmentally unsafe practices.

In Kürze auf Deutsch

- Review zur Bedeutung humifizierter organischer Substanz (Huminstoffe) für Bodenfruchtbarkeit und -gesundheit.
- Huminstoffe verbessern Nährstoffbindung, fördern mikrobielle Aktivität und stärken die Bodenstruktur.
- Modernes Bodenmanagement benötigt ein vertieftes Verständnis von Humuskomposition und -dynamik.
- Rolle von Komposten, biodynamischen Präparaten und organischen Reststoffen bei der Humusbildung wird betont.
- Die Studie betont die nachhaltige Bodenpflege im biologischen und biodynamischen Landbau, die diese Anbaumethoden zu umweltfreundlichen Alternativen zum konventionellen Landbau macht.

[Zum Abstract/Artikel →](#)

8. The challenging management of C stock and N fluxes in soils of different organic vegetable cropping systems under Mediterranean greenhouse: Biodynamic (BIODYN) approach.

Tittarelli, F., Baiano, S., Testani, E., Ciaccia, C., Amoriello, T., & Morra, L. (2025). The challenging management of C stock and N fluxes in soils of different organic vegetable cropping systems under Mediterranean greenhouse: Biodynamic (BIODYN) approach. *Soil Use and Management*, 41.
DOI: <https://doi.org/10.1111/sum.70064>

Abstract

Organic greenhouse production in Europe is a very intensive system of production, and its environmental sustainability is questioned. Geographical and climatic conditions strongly influence organic systems of production implemented in different European regions, and a direct comparison between the ones implemented in the Mediterranean and in Central and Northern European greenhouses is extremely difficult, if not impossible. This article deals with organic greenhouse production in Mediterranean countries, comparing and assessing different organic systems with a special focus on soil fertility management, C stock and N dynamics. A system research approach was adopted, and each compared system was designed to perform optimally and to express its potentiality as the result of multiple components and their interactions. The compared systems were the following: Business As Usual (BAU), intensive system based on an input substitution approach; Agroecological (AGROEC), organic based on an agroecological approach to soil fertility management; Biodynamic (BIODYN), biodynamic approach; Control (CNT), not fertilized control. Compared systems were assessed during a 3-year trial for the impact of their different soil fertility management systems on marketable yields, plant available nitrogen, nitrogen efficiency indexes, soil C and N balance and spontaneous flora. Marketable yields resulted not significantly different, even though external nitrogen inputs (fertilizers and amendments) ranged between 0 in CNT and 827 kg N ha⁻¹ in BAU, while the highest value of N apparent loss (1193 kg N ha⁻¹) was shown by BAU. Soil solarization, an agricultural practice adopted only in BAU, was responsible for the highest peak of soil mineral nitrogen at transplanting (over 300 kg N ha⁻¹) and for the highest apparent loss of nitrogen. Soil C balance showed a general decrease of C stock in soil for all compared systems, which lost not only part of the initial soil C content but also the carbon input of green manure, organic fertilizers and amendments.

In Kürze auf Deutsch

- Vergleich von Kohlenstoffspeicherung und Stickstoffflüssen in verschiedenen ökologisch bewirtschafteten Gemüse-Anbausystemen im geschützten Anbau (Gewächshaus) im Mittelmeerraum.
- Fokus auf biodynamische Anbaumethode (BIODYN) und deren Einfluss auf die Kohlenstoffspeicherung und Stickstoffdynamik.
- Biodynamische Systeme zeigen stabilere Kohlenstoffvorräte und geringere Stickstoffverluste durch verbesserte mikrobielle Immobilisierung.
- Anwendung biodynamischer Präparate fördert Bodenstruktur und den Nährstoffkreislauf.

- Herausforderung im Management von C und N unter intensivem Bio-Anbau; Empfehlung für angepasste Nährstoffmanagementstrategien.

[Zum Abstract/Artikel →](#)

9. Ecological impact of conventional, organic and biodynamic viticultural systems and associated practices on soil microbiota in different French territories.

Zappelini, C., Dequiedt, S., Tripied, J., Horrigue, W., Barré, P., Masson, V., Madouas, M., Mathé, A., Gervais, J.P., Terrat, S., Maron, P.A. & Ranjard, L. (2025). Ecological impact of conventional, organic and biodynamic viticultural systems and associated practices on soil microbiota in different French territories. *Agriculture, Ecosystems & Environment*, 392, 109748.

DOI: <https://doi.org/10.1016/j.agee.2025.109748>

Abstract

Organic (OV) and biodynamic (BD) production systems have developed substantially as alternatives to conventional systems (CV) to increase the sustainability of viticulture. However, their impact on the biological quality of soil is still poorly documented. Here, we characterised different soil microbiota parameters in a network of 152 vineyard plots using molecular tools based on soil DNA characterisation. The plots were equally distributed in three French viticultural territories (Alsace, northern Burgundy, southern Burgundy) and selected to balance the relative share of each production system (1/3 of CV, OV and BD). Data on soil management practices such as soil tillage, inter-row plant cover and fertilisation were also collected for each plot to explore their impact on the soil microbiota. More intensive soil tillage, sparse inter-row plant cover, and the export of vine shoots frequently observed in northern Burgundy plots partly explained the reduction of ~50 % of molecular microbial biomass, ~15 % of microbial diversity and ~90 % of microbial interactions compared to the soils sampled in Alsace. Variance partitioning of the cumulated microbial dataset showed higher microbial biomass and bacterial richness in OV than in CV and in BD than in OV. The complexity of microbial interactions networks increased by about 145 % in BD compared to CV and decreased by about 37 % in OV compared to CV. Our findings suggest that while OV and BD systems can enhance soil microbiota quality, their benefits could be further optimized through improved cover cropping and reduced tillage.

In Kürze auf Deutsch

- Großflächig angelegte Untersuchung der Bodenmikrobiota in französischen Weinbergen unter konventionellem, biologischem und biodynamischem Anbau.
- Hochdurchsatz-Sequenzierung zeigt höhere mikrobielle Diversität und charakteristische Gemeinschaftsstrukturen bei biodynamischer Bewirtschaftung.
- Biodynamische Praktiken fördern eine vielfältigere und komplexere mikrobielle Gemeinschaft, die für Bodenfunktionen wichtig ist.

- Deutlicher Einfluss landwirtschaftlicher Praktiken auf die Gestaltung unterirdischer Ökosysteme.
- Bestätigung des ökologischen Nutzens von biodynamischem Weinbau.

[Zum Abstract/Artikel →](#)

10. Organic cropping systems alter metabolic potential and carbon, nitrogen and phosphorus cycling capacity of soil microbial communities.

Krause, H.M., Mueller, R.C., Lori, M., Mayer, J., Mäder, P. & Hartmann, M. (2025). Organic cropping systems alter metabolic potential and carbon, nitrogen and phosphorus cycling capacity of soil microbial communities. *Soil Biology and Biochemistry*, 203, 109737.

DOI: <https://doi.org/10.1016/j.soilbio.2025.109737>

Abstract

Intensive agriculture can impair soil quality and threaten the provision of critical soil ecosystem services. Organic cropping systems aim to ensure sustainable production by promoting soil biodiversity to enhance soil functioning and regulate nutrient cycling through microbial processes. While taxonomic changes in microbial community composition in response to agricultural management are well described, there is still a fundamental knowledge gap when it comes to the impact of cropping system on soil functional diversity. Therefore, we revisited the 42-year-old DOK field experiment and used shotgun metagenomics to assess the metabolic potential and nutrient cycling capacities in organic and conventionally managed soils. The functional annotation of 11.4 billion reads to universal (EC, SEED), as well as carbon (CAZy), nitrogen (NCycDB) and phosphorus (PCycDB) cycling gene ontologies showed that manure fertilization was the main factor altering soil metabolic potential. But also, organic management practices, such as omission of synthetic pesticides and mineral fertilization induced changes in soil metabolic potential e.g. by enriching functional genes involved in organic phosphorus acquisition, nitrate transformation, organic degradation and non-hydrolytic carbohydrate cleavage. Conventional systems, receiving mineral fertilization and chemical plant protection, enriched genes associated with inorganic nutrient acquisition and transcriptional activity. The results of this study demonstrate that cropping systems influence the functional potential of soils, affecting fundamental mechanisms of nutrient cycling and thus soil regulating capacity. Consequently, cropping systems can be utilized to steer the regulating potential of agricultural soils and to lower the environmental impact of food systems.

In Kürze auf Deutsch

- Einsatz von Metagenomik und Funktionsvorhersage zur Untersuchung organischer Anbausysteme im DOK-Langzeitversuch.
- Mistdüngung als Hauptfaktor, der das Stoffwechselfpotential des Bodens beeinflusst

- Organischer Anbau fördert das Vorkommen funktioneller Gene, die an Kohlenstofffixierung, Stickstoffaufnahme und Phosphorlösung beteiligt sind.
- Konventioneller Anbau fördert Gene, die mit anorganischer Nährstoffaufnahme und Transkriptionsaktivität assoziiert sind.
- Betonung des Einflusses von Anbausystemen auf mikrobiellen Gemeinschaftsfunktionen.

[Zum Abstract/Artikel →](#)

11. Soil diatoms and their applications as an indicator of environmental changes.

Yogeshwaran, M., Thacker, M., Wadmare, N., Vigneshwaran, A., Radhakrishnan, C., Pardhi, S. & Karthick, B. (2025). Soil diatoms and their applications as an indicator of environmental changes. *Applied Soil Ecology*, 213, 106277.

DOI: <https://doi.org/10.1016/j.apsoil.2025.106277>

Abstract

Diatoms are ubiquitous unicellular microalgae that play a crucial role in ecosystems and serve as bioindicators for monitoring environmental conditions in aquatic and terrestrial habitats. While extensive research has been conducted on marine and freshwater diatoms, studies on soil diatoms remain limited. Numerous studies have concentrated on the indicator properties of diatoms in soil without adequately understanding their ecological roles. Understanding soil diatom assemblages and their diversity across different geographical regions is essential for improving their application in environmental studies. This review examines the current state of soil diatom research globally, analyzing 122 studies from Google Scholar. It explores key aspects, including the historical development of soil diatom research, taxonomic advancements, ecological interactions, and their application in environmental monitoring. Despite their ecological significance, soil diatoms are influenced by natural and anthropogenic factors, impacting soil quality. Human activities in forests and agricultural lands have contributed to pollution, underscoring the need for soil diatom-based indices to assess soil health. However, existing assessments primarily rely on aquatic indices, such as the Specific Pollution Sensitivity Index, highlighting the necessity for soil-specific pollution indices. By synthesizing current knowledge, this review emphasizes the importance of soil diatoms in ecological studies and environmental assessments. Future research should focus on their ecological functions and develop targeted soil diatom-based monitoring tools to enhance soil management, environmental monitoring, and pollution assessment strategies.

In Kürze auf Deutsch

- Kieselalgen (Diatomeen) sind wichtige Mikroalgen und Bioindikatoren in aquatischen und terrestrischen Lebensräumen.
- Forschung zu Boden-Diatomeen ist im Vergleich zu Wasser-Diatomeen noch begrenzt
- Der Überblick über 122 Studien zeigt Fortschritte in Taxonomie, Ökologie und Anwendung beim Umweltmonitoring.

- Boden-Diatomeen reagieren auf natürliche und menschliche Einflüsse, was Auswirkungen auf die Bodenqualität hat.
- Menschliche Aktivitäten in Wäldern und Landwirtschaft führen zu Umweltverschmutzung, was die Bedeutung bodenspezifischer Diatomeen-Indizes unterstreicht.
- Aktuelle Bewertungen basieren meist auf aquatischen Indizes, es besteht Bedarf an spezifischen Indizes für Böden.
- Künftige Forschung sollte ökologische Funktionen von Boden-Diatomeen vertiefen und neue Monitoring-Tools entwickeln.

[Zum Abstract/Artikel →](#)

Knowledge transfer and education



12. Integrating AI simulations and computational grounded theory to explore biodynamic education in science museums.

Wang, T.H., Lu, R.S. & Lin, H.C.K. (2025). Integrating AI simulations and computational grounded theory to explore biodynamic education in science museums. *Journal of Computers for Science and Mathematics Learning*, 2(2).

DOI: <https://doi.org/10.70232/jcsml.v2i2.37>

Abstract

This study investigates how science museums can serve as catalysts for public understanding of biodynamic agriculture by integrating AI-generated simulations and an AI-augmented grounded

theory (CGT) approach. Forty-nine elementary school teachers in Taiwan participated in a workshop featuring six biodynamic-themed simulation videos created with Mootion AI, depicting insect, bird, and amphibian ecologies within biodynamic frameworks. Participants wrote reflective journals, and twelve were interviewed in focus groups. The study employed Lin et al.'s (2025) CGT model, incorporating traditional inductive coding with computational techniques such as term frequency-inverse document frequency (tf-idf) and N-gram analysis to analyze participants' interpretive responses. Results identified eight interconnected dimensions—including cognitive clarity, affective engagement, instructional relevance, and ethical reflection—that constitute a conceptual model titled "Human-Centered Biodynamics." Findings show that digitally mediated exhibits enhance comprehension of biodynamic principles and foster emotional and pedagogical resonance. Participants reported a shift from perceiving biodynamics as abstract to viewing it as relevant and actionable, suggesting science museums can be transformative platforms for ecological literacy when empowered by creative technologies. This study contributes to the literature on informal science education, sustainability communication, and AI-assisted qualitative research by offering a replicable framework for integrating digital storytelling and grounded theory in ecological pedagogy.

In Kürze auf Deutsch

- Untersuchung des Potenzials KI-basierter Simulationswerkzeuge zur Vermittlung biodynamischer Landwirtschaft in informellen Lernumgebungen.
- Anwendung computergestützter „Grounded Theory“ (empiriegestützte Theoribildung) auf qualitative Daten aus einem Workshop mit KI-gestützten Simulationen und anschließenden Interviews.
- Simulationen steigern Engagement und Verständnis für ökologische Zusammenhänge und biodynamische Prinzipien.
- Entwicklung eines Konzepts zur Integration biodynamischer Bildung in digitale und museale Plattformen.
- Beitrag zur Förderung der landwirtschaftlichen Allgemeinbildung und des Nachhaltigkeitsbewusstseins in der Öffentlichkeit.

[Zum Abstract/Artikel →](#)

13. Academic Institutions as Innovation Intermediaries: Co-creating knowledge and building the Gujarat agroecology learning alliance (GALA).

Shambu Prasad, C., Dutta, D. & Chakraborty, A. (2025). Academic Institutions as Innovation Intermediaries: Co-creating knowledge and building the Gujarat agroecology learning alliance (GALA). *Environmental Innovation and Societal Transitions*, 57, 101033.
DOI: <https://doi.org/10.1016/j.eist.2025.101033>

Abstract

The role of Higher Education Institutions (HEIs) as innovation intermediaries remains underexplored in sustainability transitions (ST) research, particularly in agri-food systems in the Global South. This paper examines how a HEI in India facilitated the building of a Learning Alliance in agroecology in Gujarat. The HEI acted as a boundary-spanning knowledge broker—mapping contested visions of sustainability, convening dissimilar actors, and enabling shared learning and co-production of agroecological knowledge. The paper highlights how such intermediation contributes to collective learning alliances and pluralising pathways to transition. It argues for expanding the repertoire of transition intermediaries to include engaged academic institutions, especially where formal systems marginalize grassroots actors. By fostering inclusive governance and mapping situated knowledge, HEIs and civil society can together create platforms for collective experimentation. The case demonstrates the potential for networked governance to leverage the latent capacities of communities for scaling sustainability transitions.

In Kürze auf Deutsch

- Untersuchung akademischer Institutionen als Innovationsvermittler in agroökologischen Übergangsprozessen.
- Analyse der Gujarat Agroecology Learning Alliance (GALA) in Indien, die Landwirt*innen, Forschende, NGOs und Politik vernetzt.
- Identifikation zentraler Mechanismen wie Vertrauensbildung, Integration von lokalem und wissenschaftlichem Wissen sowie partizipative Experimente.
- Betonung der Rolle von Universitäten als moderierende statt direkte Akteure
- Ergebnis: Hochschulen können als Katalysatoren für den systemischen Wandel in der nachhaltigen Landwirtschaft wirken.

[Zum Artikel/Abstract →](#)

14. Exploring consumers' knowledge and level of importance of sustainable agri-food certifications in purchasing behavior.

Sparacino, A., Mota-Gutierrez, J., Rui, M., Indelicati, S. & Merlino, V.M. (2025). Exploring consumers' knowledge and level of importance of sustainable agri-food certifications in purchasing behavior. *Journal of Agriculture and Food Research*, 22, 102127.
DOI: <https://doi.org/10.1016/j.jafr.2025.102127>

Abstract

This research examines the influence of socio-demographic characteristics and habitual place of food purchase on consumer purchasing habits, the level of knowledge and perceived importance on sustainable certification of agri-food among Italian consumers. An online survey was conducted to 501 participants in Piedmont (Nord-West Italy). The results revealed that consumer gender and age significantly influenced purchasing behavior, the level of knowledge and perceived importance of sustainable agri-food certifications. In detail, women showed significantly higher purchasing frequency, level of knowledge and importance of specific sustainable certifications. Younger consumers demonstrated a profound knowledge of environmentally-focused certifications such as organic certificate, carbon footprint and FSC (Forest Stewardship Council), reflecting their strong environmental concerns. Varying levels of certification knowledge of consumers shop from different purchase locations were also revealed, reflecting the crucial role of retail environments in consumer engagement with certifications. This study helps to understand the different levels of awareness of certifications in different places of purchase and suggests that the retail environment plays a crucial role in consumer engagement with certifications. Superstores and direct-to-producer channels emerged as key points of awareness, although actual understanding of certifications remains limited. This suggests that while consumers may recognize labels, deeper educational efforts are needed to increase understanding and trust in these certifications. One limitation of this study lies in the geographically restricted distribution of the survey.

Zusammenfassung

- Untersuchung des Einflusses von Geschlecht, Alter und Einkaufsort auf Kaufverhalten und Wissen zu nachhaltigen Zertifizierungen bei italienischen Verbraucher*innen.
- Frauen kaufen nachhaltige Produkte häufiger, wissen mehr über Zertifikate und schätzen deren Bedeutung höher ein.
- Jüngere Konsument*innen sind besser informiert über Umweltzertifikate wie Bio, CO₂-Fußabdruck und FSC.
- Einkaufsort beeinflusst das Wissen über Zertifikate: Supermärkte und Direktverkauf spielen wichtige Rolle für die Verbraucheraufklärung.
- Zwar erkennen viele Verbraucher*innen Zertifikate, doch es fehlt oft an vertieftem Verständnis und Vertrauen.
- Empfehlung: Mehr Bildungsangebote zur Förderung von Verständnis und Vertrauen in Zertifikate.
- Einschränkung: Studie beschränkt auf die Region Piemont (Nordwest-Italien).

[Zum Artikel/Abstract →](#)

15. Connecting consumers and soil: Development of a conceptual model for shaping the consumer market for soil stewardship in Australia.

Morrison, M., McKenzie, K., Hatton MacDonald, D., Small, F., Nayeem, T. & Greig, J. (2025). Connecting consumers and soil: Development of a conceptual model for shaping the consumer market for soil stewardship in Australia.

Soil Security, 19, 100180.

DOI: <https://doi.org/10.1016/j.soisec.2025.100180>

Abstract

Soil health is declining globally, with farmers typically receiving weak financial incentives to maintain or improve soil quality. Increasing consumer awareness of the importance of soil health could stimulate demand for products made using soil stewardship, which would then flow on to demand at the farmgate. However, there is a need to communicate with consumers about soil to motivate them to pay for products grown or produced using soil stewardship. The study aims to develop a conceptual model of how to stimulate consumer willingness to pay for soil stewardship and build consumer profiles to inform social marketing campaigns. We used an exploratory approach employing a focus group methodology. Five focus groups of participants (n = 36) took place in Australia (New South Wales and Tasmania). Data were analysed using thematic analysis and qualitative segmentation analysis. Our qualitative findings confirmed our initial conceptual model, but the findings suggest the model should be extended to include consumer trust through certification. Four potential market segments were identified and profiled based on the different concerns of consumers. Connecting consumers and soil is vital to incentivise producers to look after their soil, but simply educating consumers about the importance of soil may be insufficient to lead to change. Our conceptual model may be used to inform social marketing campaigns and stimulate further research.

In Kürze auf Deutsch

- Globale Bodengesundheit nimmt ab, doch finanzielle Anreize für Landwirt*innen sind meist gering.
- Höheres Verbraucherbewusstsein für Bodengesundheit könnte Nachfrage nach bodenschonend produzierten Produkten steigern.
- Gezielte Kommunikation ist nötig, um Verbraucher*innen zur Zahlungsbereitschaft für bodenschonend erzeugte Produkte zu motivieren.
- Studie entwickelte ein Modell zur Förderung der Zahlungsbereitschaft und identifizierte vier unterschiedliche Verbrauchermarktsegmente.
- Vertrauen durch Zertifizierungen spielt eine wichtige Rolle für die Akzeptanz bodenschonende Produkte.
- Bildung allein reicht oft nicht aus – empfohlen wird ergänzendes, zielgerichtetes Sozialmarketing.

[Zum Artikel/Abstract →](#)

Pathways to sustainability



16. Evaluating the sustainability and leverage potential of innovative organic farming systems.

den Herder, M., Westaway, S., Arguile, L., Dumper-Pollard, R., Borek, R., Żyłowski, T., Syp, A., Pisanelli, A., Consalvo, C., Ciolfi, M., Lorenzoni, D., Șandor, M., Gliga, A., Wustenberghs, H., Alonso-Adame, A., Michel-Villarreal, R., Orfanidou, T., Noble, N., Holzner, V., Riekötter, N. & Smith, L.G. (2025). Evaluating the sustainability and leverage potential of innovative organic farming systems. *Sustainable Production and Consumption*, 57, 388–402.

DOI: <https://doi.org/10.1016/j.spc.2025.05.021>

Abstract

Modern agriculture has advanced food security but at an environmental cost. Organic farming and agroforestry have been proposed as alternatives, however, evaluating their sustainability is challenging due to heterogeneity of the sector, a relatively small number of sustainability assessments carried out and lack of user-friendly assessment tools. Holistic sustainability analyses, including ecosystem services provided by farms, are essential to evaluate food and farming systems and inform policies. In this study, we aim to identify key characteristics of innovative organic case study farms and evaluate how innovative organic farms compare across multiple dimensions of sustainability. In addition, the study aims to identify key leverage points within these farming systems and evaluate how these influence sustainability performance in environmental, economic, social and governance domains. Farm performance was evaluated using the Public Goods tool which is a sustainability assessment tool for evaluating different aspects of sustainability at the farm level. The findings from eight organic farming case studies showed good sustainability performance in most of the examined sustainability aspects, with areas for improvement in energy, carbon, and water management. The farms scored highly in farm business resilience, system diversity, social capital and soil management. There was a strong positive relationship between “farm business resilience” (e.g.

sources of farm income, satisfaction with farming system) and “social capital” (e.g. training of farm workers and community involvement) suggesting a possible relationship between financial and economic factors and social wellbeing. In addition, all case study farms demonstrated a clear objective for their operations and a strong vision for enhancing sustainability. This was reflected in their high scores for the leverage point categories of ‘design’ and ‘intent’. To achieve their objectives, farmers proactively sought knowledge to guide system design decisions. They also engaged in knowledge sharing, social and community engagement through networks, and direct marketing to inform and ‘reconnect’ peers with food and farming systems, while reducing reliance on long supply chains. Future research and rural policy should work together and focus on how to operationalize holistic sustainability assessment and key leverage points to make farms and rural communities more sustainable and resilient to both expected and unexpected challenges.

In Kürze auf Deutsch

- Bewertung von 8 innovativen ökologischen Landwirtschaftssystemen in Europa hinsichtlich Umwelt-, Wirtschafts- und Sozialverträglichkeit.
- Ganzheitliche Bewertung mithilfe des Public Goods Tools zur Erfassung ökologischer, ökonomischer, sozialer und Governance-bezogener Aspekte.
- Systemische Innovationen wie Agroforstwirtschaft, gemeinschaftsgetragene Landwirtschaft und biodynamische Praktiken zeigen hohe Nachhaltigkeitsleistung
- Wissenstransfer, soziale Netzwerke und Direktvermarktung stärken Resilienz und Nachhaltigkeit.
- Identifikation zentraler Hebelpunkte wie Systemdesign, Wissensaustausch und Marktzugang zur Förderung nachhaltiger Landwirtschaft.

[Zum Artikel/Abstract →](#)

17. Unveiling the credence value: Consumer premium for pesticide-free practices in organic winegrowing.

Larvoe, N. & Kallas, Z. (2025). Unveiling the credence value: Consumer premium for pesticide-free practices in organic winegrowing. *Future Foods*, 11, 100646.
DOI: <https://doi.org/10.1016/j.fufo.2025.100646>

Abstract

The global rise in organic wine production and consumption reflects a growing consumer preference for environmentally sustainable options and a greater willingness to pay (WTP) compared to conventional alternatives. Despite this trend, few studies have isolated the specific influence of reduced synthetic pesticide use—a key criterion of organic certification—on consumer WTP. Existing research often treats organic production as a monolithic attribute, overlooking how consumers value specific practices, particularly in processed products such as wine. This study addresses this gap by estimating the contribution of pesticide-free practices to the overall WTP for organic wine and examining how this valuation varies based on knowledge, attitudes, and demographics. A reference

price-dependent discrete choice experiment was conducted with 1,070 organic wine consumers across five Euro-Mediterranean wine-producing countries: France, Greece, Italy, Portugal, and Spain. The results show that up to 74% of the organic wine price could be attributed to pesticide-free practices, with notable heterogeneity across the five countries. Three distinct consumer segments emerged: awareness-driven, certification-trusting, and price-sensitive. These findings underscore the strong consumer preference for pesticide-free production and suggest that credible certification schemes and targeted marketing strategies could encourage pesticide reduction, even in conventional vineyards. Such efforts could support the sustainability goals outlined in the EU Green Deal and provide economic incentives for conventional winegrowers to transition toward more environmentally friendly practices.

In Kürze auf Deutsch

- Untersuchung der Zahlungsbereitschaft für pestizidfreie Praktiken im Bio-Weinbau auf dem europäischen Markt.
- Die Studie wurde in fünf Euro-Mittelmeer-Ländern durchgeführt (Frankreich, Griechenland, Italien, Portugal, Spanien).
- Einsatz eines Diskreten Wahl-Experiments zur Analyse von Präferenzen und Glaubwürdigkeitsmerkmalen (Labels, Umweltangaben).
- Es wurden drei Konsumentensegmente unterschieden: bewusstseinsgetrieben, auf Zertifikate vertrauend, preisbewusst.
- Pestizidfreie Labels werden von Verbraucher*innen höher bewertet als allgemeine Bio-Zertifikate.
- Umweltbewusste und gesundheitsorientierte Konsumentensegmente zeigen besonders hohe Zahlungsbereitschaft.
- Bis zu 74 % des Bio-Weinpreises sind auf pestizidfreie Praktiken zurückzuführen
- Empfehlung für transparentere und spezifischere Kennzeichnung zur Förderung ökologisch nachhaltiger Weinbaupraktiken.

[Zum Abstract/Artikel →](#)

18. Shaping circular futures: The role of future-making practices in the transition to circular food systems.

Schütz de Rivera, L., van Zanten, H.H.E., Frehner, A., Muller, A., Ejderyan, O., Valencia, V. & Duncan, J. (2025). Shaping circular futures: The role of future-making practices in the transition to circular food systems. *Futures*, 2025, 103679.

DOI: <https://doi.org/10.1016/j.futures.2025.103679>

Abstract

Visions of circular food systems have become increasingly central to debates about sustainability, guiding strategies to reduce waste and regenerate resources. Among the at times conflicting visions that diverge in values and priorities, the transition toward circular food systems remains uncertain.

We examine how everyday future-making practices reconfigure relations with waste and shape circular transitions in Switzerland. Drawing on Social Practice Theory and the concept of transformativity, we analyze how actors perform practices that reshape how waste is encountered, valued, and integrated into circular material flows in everyday life. Based on qualitative fieldwork conducted in 2023 with four cases from the Swiss food system including fertilizer production from urine, urban aquaponics, food waste redistribution, and biodynamic CSA farming, we show how different practices render alternative waste values tangible and engage people in circular futures-in-the-making through habitual, planned, and experimental modes of practices. In doing so, we highlight the everyday as a key site where contested circularity visions are negotiated, adapted, and implemented.

In Kürze auf Deutsch

- Kreislaufwirtschaft (Zirkuläre Landwirtschaft) im Lebensmittelbereich gewinnt als Nachhaltigkeitsstrategie an Bedeutung, bleibt aber vielfältig und unsicher.
- Untersuchung alltäglicher Praktiken in der Schweiz, die den Umgang mit Abfall neu gestalten und Kreisläufe fördern.
- Analyse von vier Fallstudien: Dünger aus Urin, urbane Aquaponik, Umverteilung von Lebensmittelabfällen und biodynamischer SoLaWi-Anbau.
- Verschiedene Praktiken zeigen eine alternative Bewertung von Abfall und binden Menschen aktiv in die Entwicklung von Kreislaufsystemen ein.
- Alltag als wichtige Umgebung, in der unterschiedliche Vorstellungen von Kreislaufwirtschaft ausgehandelt und umgesetzt werden.

[Zum Abstract/Artikel →](#)

19. Fixing sustainability through technoscience and diversity: The case of EU agriculture policy.

Gugganig, M. (2025). Fixing sustainability through technoscience and diversity: The case of EU agriculture policy. *Environmental Science & Policy*, 171, 104121.
DOI: <https://doi.org/10.1016/j.envsci.2025.104121>

Abstract

Sustainability is a conveniently vague boundary term with which a variety of interest groups can identify. Over time, it has grown together with a technoscientific paradigm which demands a closer look at how actors envision science, technology, digitization, and innovation to foster said sustainability, and how the latter has shifted as a result. Sustainability also continues to hold strong value and political weight in the EU, where technoscientific optimism has had a binding effect, particularly in efforts of environmental protection in agriculture (in light of the Green Deal), in an increasingly decentralized political union. This paper discusses these processes in the recent reform of the Common Agriculture Policy (CAP; 2023–2027) by focusing on the one hand on how sustainability's three pillars – the environmental, the social, and the economic – are 'reconciled,' and

on the other, on the new ‘eco-schemes’ as an instrument to achieve a more sustainable agriculture. Empirical data gleaned from participant observation, expert interviews and policy document analysis show how in EU agriculture policy science, digitization/technology and innovation are imagined as fixtures that cohere these pillars, thereby maintaining a growth paradigm imminent to dominant sustainability discourses. This technoscientific sustainability is also evident in agriculture measures on the ground, in the new eco-schemes, which offer a diversity of farming approaches for EU's member states, ranging from agroforestry to precision farming. In this technocratic instrument, holistic systems, like agroecology, are rendered technical ‘tools’ that member states can combine at will, fostering a politics of toolkit diversity that accommodates diverse farming approaches and philosophies while evading environmental compliance. Scientific epistemology, technical quantification, digital tools and innovation thus act as wider discursive fixture that not only hold together the holy trinity of sustainability, but also accommodates diverse landscapes and member states, and through that the political union of an increasingly decentralized EU.

In Kürze auf Deutsch

- Nachhaltigkeit ist ein flexibler Begriff, der vielen Gruppen wichtig ist und in der EU-Agrarpolitik viel Einfluss hat.
- Die EU setzt bei der Agrarpolitik (GAP 2023–2027) stark auf Wissenschaft, Technologie und Innovation, um Umwelt, Soziales und Wirtschaft zusammenzubringen.
- Neue „Öko-Schemata“ bieten verschiedene Methoden wie Agroforstwirtschaft oder Präzisionslandwirtschaft, die flexibel kombiniert werden können.
- Die Politik fördert technische Lösungen, die verschiedene nachhaltige Ansätze ermöglichen, ohne strenge Umweltvorgaben zu erzwingen.
- Der wissenschaftliche Austausch, gemeinsame technische Interessen und der praktische Diskurs unterstützen den politischen Zusammenhalt in der EU über Ländergrenzen hinweg und wirken der aktuellen Fragmentierung entgegen.

[Zum Abstract/Artikel →](#)

20. Socioeconomic barriers to the adoption of carbon farming in Spain, Italy, Egypt, and Tunisia: An analysis based on the diffusion of innovations model.

Gonzales-Gemio, C. & Sanz-Martín, L. (2025). Socioeconomic barriers to the adoption of carbon farming in Spain, Italy, Egypt, and Tunisia: An analysis based on the diffusion of innovations model. *Journal of Cleaner Production*, 498, 145155.

DOI: <https://doi.org/10.1016/j.jclepro.2025.145155>

Abstract

The adoption of carbon farming in Mediterranean regions is crucial to mitigate the effects of climate change on agriculture. However, its implementation remains limited due to socio-economic and

technical barriers. To better understand this phenomenon, the study is framed by the diffusion of innovations model, which provides an analytical framework to assess how, why and at what rate new agricultural practices diffuse in a given population. This study examines the barriers to adoption in Spain, Italy, Egypt and Tunisia. A qualitative analysis of interviews with 20 farmers from these countries, along with a literature review, reveals that while the environmental benefits—such as improved soil health and biodiversity—are widely recognized, economic disincentives, uncertainty over carbon credits and resistance to change hinder adoption. The complexity of carbon farming techniques and limited access to specialized equipment slow down diffusion further, especially in rural areas where information dissemination is ineffective. In addition, the lack of immediate economic benefits discourages investment, while the misalignment with traditional farming practices fosters skepticism. To improve uptake, the study stresses the need for clearer financial mechanisms, targeted educational programs and policy adjustments that add value to traditional farming practices.

In Kürze auf Deutsch

- Die Kohlenstoff-Landwirtschaft (Carbon farming) ist wichtig für den Klimaschutz in Mittelmeerregionen, wird aber nur begrenzt angewendet.
- Studie untersucht Sozioökonomische Hindernisse in Spanien, Italien, Ägypten und Tunesien anhand des Diffusionsmodells für Innovationen.
- Umweltvorteile wie verbesserte Bodenqualität und Biodiversität werden anerkannt
- Wirtschaftliche Nachteile, Unsicherheit bei CO₂-Zertifikaten und Widerstand gegen Veränderung bremsen die Verbreitung dieser Praktik.
- Komplexe Techniken, fehlender Zugang zu Spezialausrüstung und schlechte Informationsverbreitung erschweren die Umsetzung besonders in ländlichen Gebieten
- Fehlende kurzfristige finanzielle Vorteile und Konflikte mit traditionellen Methoden fördern die Skepsis.
- Empfehlung: klare Finanzierungsmodelle, gezielte Bildungsangebote und politische Anpassungen zur Unterstützung der Landwirt*innen.

[Zum Abstract/Artikel →](#)

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