

www.terranutra.org



TerraNutra

SUSTAINABILITY REPORT
2025



CONTENT

1.	Executive Summary	03
	Purpose & Scope • Key Findings • Strategic Implications • High-Level Trends	
2.	Section 1: Global Context & 2024 Snapshot	05
	Macro Environment • Energy & Fertilizer Markets • Food Security & Affordability • Climate Pressures • Regional Perspectives • Technology & Innovation • Policy & Finance • Conclusion	
3.	Section 2: Production, Trade & Price Dynamics	09
	Global Crop Production • Livestock & Aquaculture • Trade Flows & Logistics • Price Indices & Volatility • Compost & Soil Health in Trade • Regional Case Studies • Conclusion	
4.	Section 3: Inputs — Fertilizer, Energy, Water & Soil	13
	Fertilizer Markets • Energy & Fuel Trends • Water Stress & Irrigation Efficiency • Soil Degradation & Organic Amendments • Regional Variations • Projections	
5.	Section 4: Sustainability & Climate	15
	Agriculture’s Role in Emissions • Compost & Regenerative Farming • Corporate Supply Chains & Scope 3 • Carbon Markets & Finance • Adaptation & Resilience • Regional Perspectives • Outlook & Trends	
6.	Section 5: Regional Outlooks	17
	Purpose & Scope • Key Findings • Strategic Implications • High-Level Trends	
7.	Section 6: California Agriculture	19
	Water Scarcity • Groundwater Regulation • Composting Mandates • Healthy Soils Program • Almond & Vineyard Systems • Specialty Crops & Regenerative Practices	
8.	Section 7: Market Opportunities & Risks	22
	Input Markets • Value-Added Exports • Sustainability Compliance as Market Access • Climate, Political & Financial Risks	
9.	Section 8: Policy, Finance & Investment	24
	Public Incentives & Subsidies • International Development Finance • Private Capital & Carbon Finance • True Cost Accounting	
10.	Section 9: Future Pathways & Strategic Recommendations	27
	Scenarios for 2030 • Role of Regenerative Agriculture • Compost in Food Security • Recommendations for Stakeholders	



– EXECUTIVE SUMMARY –

PURPOSE & SCOPE

The purpose of this report is to provide a comprehensive 2024 snapshot of global agricultural sustainability and market dynamics. It examines the economic, environmental, and social forces shaping the world's food systems, with a particular focus on regenerative farming, compost, cover crops, and the practices that underpin soil and water resilience. The report is intended for a wide range of stakeholders—farmers, agribusiness leaders, policymakers, NGOs, and investors—who must navigate both immediate challenges and long-term transformations in global agriculture. The scope spans both global and regional perspectives. Drawing on data and analysis from OECD-FAO, FAO SOFA, USDA ERS, IFPRI, and the World Bank, it integrates production, trade, and price trends with insights into soil health, climate pressures, finance, and technology adoption. Coverage includes short-term developments in 2024 as well as forward-looking scenarios through 2030. A key theme is the increasing alignment of sustainability and market incentives: practices like compost application, cover cropping, and regenerative farming are now central to the economics of food production, not optional add-ons.

2024 KEY TAKEAWAYS

Agricultural markets in 2024 reveal a landscape of cautious recovery. Staple crop production—wheat, maize, rice, and soy—has stabilized following disruptions of 2022–2023. Livestock output has likewise steadied, though margins remain thin due to lingering feed and energy costs. Input costs remain 20–30% above pre-pandemic averages. Sustainability has become central, with regenerative farming practices like compost and cover crops scaling rapidly. Policy incentives, NGO programs, and corporate supply chain commitments now embed soil health into procurement. Governments and multilateral lenders are channeling billions into regenerative agriculture, while carbon markets increasingly recognize soil carbon and composting methane reduction. Technology adoption, from precision agriculture to biological soil inputs, is accelerating. The defining theme of 2024 is transition: agriculture is moving from reactive responses toward proactive systems change.

RISKS & OPPORTUNITIES (12–24 MONTHS)

Risks include climate variability, water scarcity, input volatility, and shifting trade policies. Opportunities are equally significant: expansion of funding for regenerative farming, corporate supply chains requiring compost and cover crops, new revenue streams through carbon markets, and affordable technology adoption. The balance lies in aligning short-term profitability with long-term resilience. Farmers and corporations that adopt regenerative systems today will be positioned for stronger outcomes tomorrow.

GLOBAL FOOD SECURITY & AFFORDABILITY

Global production in 2024 is sufficient to meet demand, yet access and affordability remain uneven. Vulnerable regions such as Sub-Saharan Africa and South Asia face acute crises, while North America and Europe demonstrate resilience through subsidies and safety nets. Middle-income growth in Asia-Pacific and Latin America continues to shape demand patterns. Regenerative practices, especially compost and cover crops, are key to closing resilience gaps and ensuring sustainable food security across regions.

REPORT STRUCTURE OVERVIEW

The report is organized into the following sections: Global Context & 2024 Snapshot; Production, Trade & Prices; Inputs (fertilizer, water, soil, energy); Sustainability & Climate; Technology & Innovation; Finance & Carbon Markets; Policy & Regulation; Regional Deep Dives; Outlook 2025–2030; Appendices. Together, these sections provide a roadmap for navigating the evolving agricultural landscape and highlight the role of regenerative farming, compost, and cover crops as anchors of resilience.

GLOBAL CONTEXT & 2024 SNAPSHOT

MACRO ENVIRONMENT: GROWTH, INFLATION, AND TRADE

The global agricultural system in 2024 operates within a macroeconomic environment defined by moderate but uneven growth, ongoing inflationary pressures, and persistent trade disruptions. Global GDP growth has stabilized around 2.8%, but the gains are not equally distributed. Advanced economies such as the United States, the European Union, and Japan are seeing slower expansion, while emerging markets in Asia and Africa continue to post stronger growth rates, often exceeding 4%. This divergence matters for agriculture: higher growth in developing regions translates into rising demand for staple crops, animal protein, and horticultural products. At the same time, inflation remains stubbornly high, averaging 4.5% worldwide. Food inflation in particular has remained elevated, driven by energy costs, supply chain bottlenecks, and climate shocks. For consumers in low-income nations, this means diets are under continued pressure, with households spending a larger proportion of their income on food. For producers, higher input costs—particularly fertilizers, fuel, and labor—continue to erode margins, even as commodity prices show signs of stabilizing.

ENERGY AND FERTILIZER MARKETS

Agriculture remains tightly linked to the energy and fertilizer markets, and in 2024 both remain sources of volatility. While oil prices have moderated compared to the spikes of 2022, they continue to fluctuate between \$75 and \$95 per barrel. Natural gas, a critical input for nitrogen fertilizer, has seen similar stabilization, though prices are still elevated relative to pre-pandemic levels. As a result, nitrogen fertilizer remains costly, and phosphate and potash markets are also marked by uncertainty due to supply constraints from key exporting nations. Producers worldwide are seeking to adapt, either by improving fertilizer efficiency, turning to organic sources such as compost, or adopting precision agriculture tools that reduce waste. The fertilizer market's volatility underscores the importance of regenerative approaches: by investing in soil organic matter through compost and cover crops, farmers can reduce dependence on external inputs and improve long-term resilience.



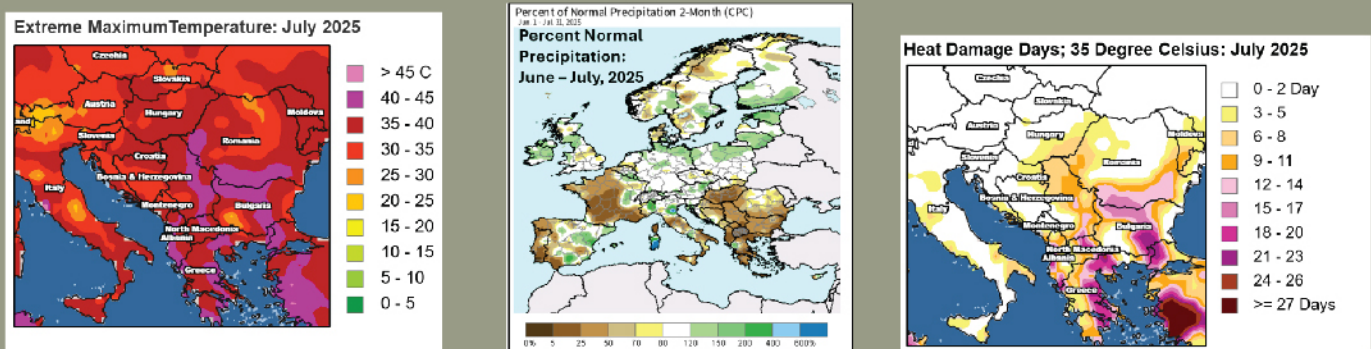
FOOD SECURITY AND AFFORDABILITY

Despite sufficient global production, food security remains fragile in 2024. The FAO estimates that nearly 735 million people continue to experience chronic hunger, with the majority concentrated in Sub-Saharan Africa and South Asia. Conflict, climate shocks, and economic slowdowns exacerbate these vulnerabilities. Affordability is the key driver of food insecurity: while grain stocks are adequate, the high cost of transportation, storage, and retail distribution keeps prices elevated in vulnerable regions. In middle-income economies, dietary transitions are reshaping demand. Rising urbanization is fueling consumption of meat, dairy, and fresh produce, even as affordability constraints slow the pace of change. This dual dynamic—scarcity in some regions and rising demand in others—creates both risks and opportunities for global agriculture. Regenerative farming practices, particularly compost application and cover cropping, are increasingly seen as tools to close yield gaps, build resilience, and lower input costs.

CLIMATE PRESSURES AND ENVIRONMENTAL STRESS

Climate change continues to manifest in more frequent and severe weather events, with profound implications for agriculture in 2024. Droughts in the American Midwest, floods in South Asia, and heatwaves across Southern Europe have all disrupted production cycles. The Intergovernmental Panel on Climate Change (IPCC) warns that without adaptation, crop yields could decline by up to 10% globally by 2030 due to climate stress. Water scarcity is emerging as perhaps the most immediate threat: groundwater reserves in India, China, and parts of the United States are under severe stress, while irrigation demand is rising. Farmers adopting regenerative practices—such as adding compost to soils—are demonstrating measurable gains in water retention. Studies show that compost-amended soils retain up to 20% more water, helping crops withstand prolonged dry periods. Cover crops similarly reduce erosion and improve soil organic matter, enhancing resilience against both drought and flooding.

Dryness and High Temperatures Dominated Southeastern Europe During Summer – 2025



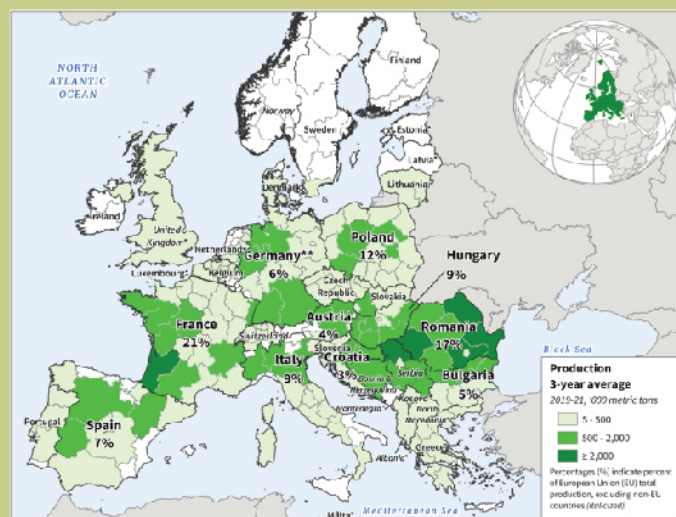
Source: NOAA CPC



REGIONAL PERSPECTIVES

Regional disparities define the global agricultural landscape in 2024. In North America, farm incomes are declining slightly due to falling commodity prices and high input costs, though government subsidies and crop insurance programs provide some relief. In Europe, the Green Deal and Farm-to-Fork strategies continue to reshape agriculture, with stricter sustainability requirements placing pressure on producers but also opening new opportunities for regenerative practices. Asia-Pacific remains the engine of demand growth, particularly for rice, wheat, aquaculture, and fresh produce. China's gradual shift toward higher-value crops and animal protein is influencing regional markets, while Southeast Asia faces challenges from climate shocks and soil degradation. Latin America continues to expand its export footprint, particularly in soybeans, beef, and horticultural products, though sustainability compliance with importing regions such as the EU is becoming a critical factor. In Sub-Saharan Africa, productivity gains remain slow, constrained by limited access to inputs and finance. However, there is growing investment in climate-smart agriculture and compost-based soil amendments to enhance resilience.

Europe: Corn Production



Source: Eurostat by Nomenclature of Territorial Units for Statistics (NUTS) 2 region, with exceptions indicated by (NUTS 0/country-level data), or** (NUTS 1 region); Average production years differ for United Kingdom (2018-20), Norway (2015-18), Bosnia and Herzegovina, Montenegro, Albania, Kosovo, Serbia (2020-22), and North Macedonia (2021-23)

TECHNOLOGY AND INNOVATION IN 2024

The role of technology in shaping agriculture has never been more pronounced. In 2024, precision agriculture tools are widely adopted across high- and middle-income regions. Satellite imagery, drones, and AI-driven analytics are helping farmers monitor crop health, optimize irrigation, and fine-tune fertilizer application. At the same time, biological innovations such as microbial soil amendments and bio-stimulants are becoming mainstream. Composting technology is also evolving, with new facilities designed to process both municipal waste and agricultural residues into high-quality soil amendments. These facilities, often built in partnership with municipalities or NGOs, are helping close the loop between waste management and agricultural productivity. Digital marketplaces are emerging as critical platforms, connecting smallholder farmers to buyers, extension services, and even carbon markets. By linking regenerative practices like compost use and cover cropping to financial incentives, these platforms are accelerating the adoption of sustainable practices worldwide.

POLICY AND FINANCE

Public and private finance are increasingly aligned with sustainability in 2024. Governments are scaling up cost-share and grant programs for regenerative agriculture, while multilateral agencies such as the World Bank are directing billions toward food security and climate resilience. Private investors are entering the sector, particularly in the carbon credit space, where soil carbon sequestration and composting methane reduction are becoming recognized categories. This influx of finance is creating opportunities but also demands new levels of transparency and accountability. Producers must now demonstrate measurable outcomes in soil health, emissions reductions, and biodiversity impacts to access funding. True cost accounting, which incorporates environmental and social externalities into financial analysis, is gaining traction as a framework for evaluating agricultural systems. This signals a shift: profitability in agriculture is no longer assessed solely on yield and market price, but increasingly on environmental and social performance.

CONCLUSION: A SYSTEM IN TRANSITION

The global context and 2024 snapshot reveal an agricultural system at a crossroads. Markets are stabilizing but remain fragile. Climate pressures are intensifying, and food security remains uneven. Yet there is also momentum: regenerative farming, compost, and cover crops are moving into the mainstream, supported by technology, policy, and finance. The central theme is transition—from reactive responses to crises toward proactive investment in resilience. Farmers, agribusinesses, and governments that align with this shift will be better positioned not only to withstand volatility but also to thrive in the coming decade.

PRODUCTION, TRADE & PRICE DYNAMICS (2024)

GLOBAL CROP PRODUCTION

In 2024, global crop production has demonstrated resilience despite ongoing climate challenges and volatile input markets. Wheat, maize, rice, and soybeans—the four key staples—account for the majority of caloric intake worldwide and remain central to global trade. Wheat production rebounded after climate-related shortfalls in 2022–2023, with particularly strong harvests in Russia, Canada, and Australia. Maize output grew modestly, driven by gains in Latin America and Sub-Saharan Africa, offsetting weaker yields in the U.S. Midwest due to drought. Rice output remained stable, though South Asia faced localized flooding events. Soybeans continue their role as both a feed and oilseed crop, with Brazil solidifying its position as the top exporter, surpassing the United States. Global horticultural output, including fruits and vegetables, is expanding in response to dietary diversification, though post-harvest losses remain significant, particularly in developing regions.

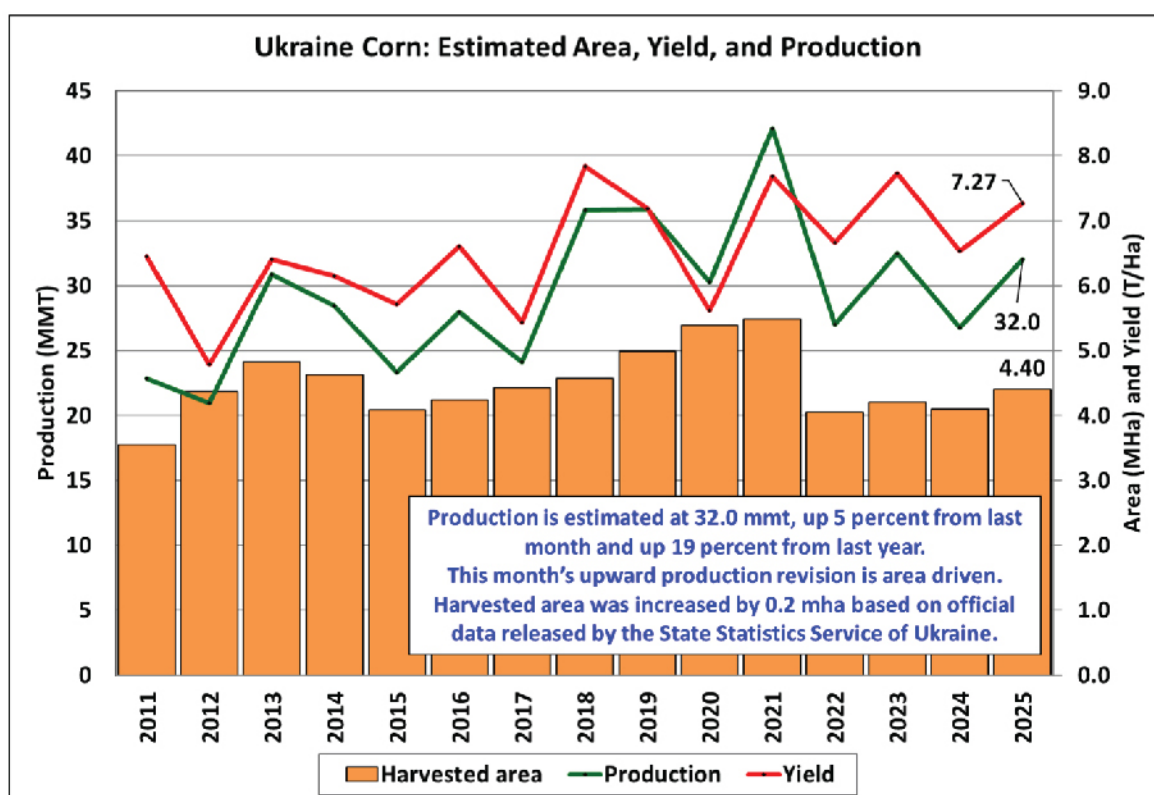
LIVESTOCK AND AQUACULTURE

Livestock and aquaculture production in 2024 is characterized by stabilization following several years of volatility. Poultry remains the fastest-growing protein segment globally due to its efficiency and affordability. Beef and pork production are stable, though demand patterns are shifting with consumer preferences and climate policy pressures. Methane reduction initiatives are reshaping cattle operations, incentivizing composting of manure and adoption of feed additives. Aquaculture, particularly in Asia, continues to expand rapidly, with advances in disease management and feed efficiency improving sustainability. However, both livestock and aquaculture face mounting pressure to demonstrate environmental performance, with markets increasingly rewarding lower-carbon and regenerative production systems.



TRADE FLOWS AND LOGISTICS

Trade flows in 2024 reflect a rebalancing of global supply chains. Grain exports from the Black Sea region have normalized after years of disruption, while North and South America continue to dominate soybean and maize trade. Asia remains the largest import market, with China accounting for nearly 60% of global soybean imports. Maritime freight costs, while lower than their 2021–2022 peaks, remain elevated due to container shortages and congestion at key ports. Regional trade agreements are shaping flows: the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) has facilitated trade across Asia-Pacific, while EU sustainability standards are influencing imports of soy, beef, and palm oil. For many exporters, demonstrating compliance with sustainability regulations is now a prerequisite for market access, fundamentally altering trade dynamics.



PRICE INDICES AND VOLATILITY

Agricultural price indices in 2024 show relative stabilization, though volatility persists. The FAO Food Price Index averaged 128 points, down from crisis highs but still above the pre-pandemic average of 100. Cereals prices fell by 5% compared to 2023, reflecting strong harvests, while vegetable oils rose due to constrained supplies and biofuel demand. Dairy prices stabilized, while meat prices declined modestly. Fertilizer and energy price dynamics continue to feed into production costs, influencing price transmission across supply chains. Currency fluctuations add another layer of volatility, particularly for import-dependent nations. For producers, managing this volatility increasingly requires a portfolio of tools—hedging strategies, diversified crop rotations, and regenerative practices that stabilize yields.



TECHNOLOGY AND INNOVATION IN 2024

Compost and soil health are emerging as trade factors in 2024. As importing regions such as the EU strengthen sustainability compliance rules, exporters are investing in regenerative systems that demonstrate soil health improvements. Compost use is central to these systems, enhancing both productivity and environmental performance. In regions like Sub-Saharan Africa, NGOs and governments are exploring compost trade not just as an agricultural input but as part of circular economy strategies that link waste management with food security. Compost is also beginning to play a role in carbon markets, with credits tied to soil organic carbon and methane reductions from waste diversion. These dynamics create both opportunities and challenges for exporters: those able to integrate compost and regenerative practices into their supply chains are better positioned to access premium markets.

REGIONAL CASE STUDIES

North America: The U.S. faces declining farm incomes due to lower commodity prices, though regenerative practices are expanding. Canada benefits from strong wheat exports. Europe: Sustainability compliance remains a challenge, but producers integrating compost and cover crops see competitive advantages. Latin America: Brazil continues to dominate soybean exports, with growing attention to deforestation-free supply chains. Asia-Pacific: China’s demand for soy and maize remains dominant; Southeast Asia struggles with climate shocks. Africa: Productivity gains are slow, but compost-based interventions are scaling through NGO and government support.

CONCLUSION

Production, trade, and price dynamics in 2024 reveal an agricultural system adapting to new realities. Markets are stabilizing but shaped by sustainability demands and climate pressures. Compost and regenerative practices are no longer peripheral but central to both market access and long-term resilience. The challenge for producers is to integrate these practices while managing volatility, ensuring that agriculture continues to feed a growing global population while reducing environmental impact.



**STA Certified™
COMPOST**

A program of the US Composting Council



INPUTS – FERTILIZER, ENERGY, WATER & SOIL (2024)

FERTILIZER MARKETS: TRENDS, CHALLENGES & IMPLICATIONS

Fertilizer prices in 2024 have stabilized relative to the sharp spikes of 2022, but remain significantly higher than longterm pre-pandemic levels. The World Bank reported that the global Fertilizer Price Index dropped by about 17% year-over-year in late 2024, thanks to easing energy costs and improved supply conditions. Still, nutrient affordability continues to be a concern, especially for smallholder farmers and regions far from major ports. Phosphate fertilizers such as MAP and DAP have been particularly costly due to export policy shifts, while potash supplies have recovered as exports from Canada and Russia improved. Overall fertilizer demand is expected to see little growth, with nitrogen stabilizing, potash recovering, but phosphate under pressure. This has underscored the importance of regenerative strategies such as compost and cover crops to reduce reliance on synthetics.

ENERGY & FUEL TRENDS

Energy remains a major factor in input costs. Oil prices in 2024 are fluctuating between \$75–95 per barrel, while natural gas has stabilized compared to 2022 but remains elevated. Because nitrogen fertilizer production depends heavily on natural gas, prices remain volatile. Transport and freight costs are another persistent challenge: port congestion, container shortages, and geopolitical disruptions continue to push up costs for both synthetic and organic inputs.

WATER STRESS, IRRIGATION EFFICIENCY & SOIL HEALTH

Agriculture continues to account for around 70% of freshwater withdrawals globally. Regions such as Central and Southern Asia, Northern Africa, and Western Asia are already critically water stressed. Farmers are increasingly turning to regenerative practices—especially compost application and cover crops—to improve soil organic matter and water retention. Studies indicate compost-amended soils retain up to 20% more water, improving drought resilience and reducing irrigation needs. Access to efficient irrigation (e.g., drip systems) is expanding but remains limited in many low-income regions.



SOIL DEGRADATION & ORGANIC AMENDMENTS

Soil degradation is one of the most urgent challenges in 2024, with estimates suggesting that up to 75% of agricultural land suffers from some form of degradation. Erosion, compaction, nutrient depletion, and salinization continue to undermine productivity. Compost and organic amendments are increasingly recognized as effective solutions, providing slow-release nutrients, buffering pH, and improving microbial health. Cover crops further contribute by reducing erosion and fixing or cycling nutrients. Challenges remain in scaling up compost production, ensuring quality standards, and reducing transport costs.

REGIONAL VARIATIONS & CASE IMPACTS

North America: Adoption of compost and cover crops is expanding, supported by government soil health programs. Europe: Farm to Fork and sustainability regulations are accelerating regenerative practices but pose compliance costs. AsianPacific: Fertilizer subsidies remain critical, but water stress is pushing interest in compost and soil health solutions. Latin America: Brazil continues to expand exports, while deforestation-free supply chain requirements are reshaping practices. Africa: Compost projects are scaling through NGO and government programs, though transport and cost barriers remain.

PROJECTIONS & EMERGING TRENDS

Looking ahead to 2025, fertilizer affordability is expected to improve modestly if energy markets remain stable. Water scarcity will intensify under climate change, making soil health practices indispensable. Farmers who integrate compost and regenerative practices will be better positioned to buffer against input price volatility and environmental shocks.



SUSTAINABILITY & CLIMATE (2024)

AGRICULTURE'S ROLE IN EMISSIONS

Agriculture is responsible for approximately 23–25% of global greenhouse gas emissions, largely from methane (livestock), nitrous oxide (fertilizers), and carbon dioxide (land-use change). In 2024, governments and corporations have heightened focus on reducing agriculture's climate footprint through carbon markets, stricter supply chain standards, and expanded adoption of regenerative practices. Methane reduction targets are particularly important, with incentives for livestock feed additives, manure management, and composting of organic waste.

COMPOST AND REGENERATIVE FARMING IN CLIMATE MITIGATION

Compost plays a dual role in climate mitigation: reducing methane emissions by diverting organic waste from landfills, and sequestering carbon by building soil organic matter. Cover crops, crop rotations, and reduced tillage further contribute to carbon storage, biodiversity gains, and resilience. The combination of compost and cover crops enhances water retention and nutrient cycling, making farming systems more climate-resilient while reducing reliance on synthetic fertilizers. Evidence shows compost-amended soils sequester more carbon and release fewer nitrous oxide emissions than conventionally managed soils.

CARBON MARKETS AND FINANCE

Carbon markets are expanding, with soil carbon, compost methane reduction, and agroforestry credits gaining traction. However, concerns about permanence, verification, and market integrity persist. Rigorous monitoring, reporting, and verification (MRV) systems are critical to ensuring credibility. Public climate finance—channeled through entities like the Green Climate Fund and World Bank—is increasingly directed toward climate-smart agriculture. Private investment is also growing, as corporations seek offsets and insetting opportunities tied to regenerative practices.





ADAPTATION: BUILDING CLIMATE RESILIENCE

Beyond mitigation, adaptation is a core priority. Farmers are confronting more frequent droughts, floods, and extreme weather. Soil health practices, including compost and cover crops, are frontline strategies for adaptation, buffering systems against climate shocks. Diversification of cropping systems, water-efficient irrigation, and agroforestry are additional adaptation levers gaining momentum in 2024. Governments and NGOs are offering technical assistance and cost-share programs to accelerate adoption.

REGIONAL PERSPECTIVES

North America: USDA climate-smart initiatives are funding compost and cover crop adoption.

Europe: The EU Green Deal mandates emission reductions and regenerative standards, while carbon farming pilots expand.

Asia-Pacific: Vulnerable to flooding and heat stress, adaptation measures are scaling, particularly in rice systems.

Latin America: Carbon finance linked to avoided deforestation and regenerative practices is growing.

Africa: Donor-funded compost and agroecology projects are central to both climate resilience and food security.

OUTLOOK AND EMERGING TRENDS

Looking forward, sustainability in agriculture is expected to be defined by integration: linking compost, regenerative farming, and carbon markets into a cohesive system of climate action. Advances in MRV technology, from satellite imagery to blockchain tracking, will improve accountability and unlock finance. Policies will increasingly tie subsidies and trade access to demonstrated climate performance. The shift underway in 2024 suggests that farmers and agribusinesses who embrace regenerative practices early will be best positioned to thrive under tightening climate and sustainability standards.

REGIONAL OUTLOOKS (2024) – REGENERATIVE AGRICULTURE LENS

NORTH AMERICA

North America remains at the forefront of regenerative agriculture adoption in 2024. The U.S. Department of Agriculture continues to expand its Climate-Smart Commodities initiative, funneling billions into regenerative practices such as compost application, cover cropping, and reduced tillage. California, the Midwest, and parts of Canada are hotspots for compost integration, with farmers adopting practices that improve soil organic matter and water retention. Demand from corporate buyers—particularly food companies under pressure to reduce Scope 3 emissions—has accelerated adoption. Challenges include scaling compost infrastructure, ensuring consistent quality, and overcoming entrenched reliance on synthetic fertilizers. Nonetheless, regenerative farming is moving from niche to mainstream, with measurable benefits for yield stability, water use efficiency, and long-term soil health.

LATIN AMERICA

Latin America's agricultural powerhouses—Brazil, Argentina, and Mexico—are navigating the balance between export growth and sustainability requirements. Soybeans, beef, and coffee dominate exports, but market access increasingly depends on compliance with deforestation-free and regenerative standards. Compost adoption is growing in horticultural and specialty crop sectors, while large-scale commodity systems remain slower to transition. NGO partnerships and regional governments are piloting compost integration projects to reduce dependence on imported fertilizers and improve degraded soils. The regenerative transition is uneven but gaining traction, particularly where export premiums and carbon market participation create incentives.

EUROPE

Europe continues to lead in policy-driven regenerative agriculture adoption. The EU Green Deal and Farm-to-Fork strategies require farmers to reduce synthetic fertilizer use and adopt soil health measures. This has boosted demand for compost and cover crops as viable tools for meeting compliance while maintaining yields. Northern and Western Europe are leading adopters, while Eastern Europe faces financial and infrastructural barriers. The Common Agricultural Policy (CAP) provides significant subsidies for regenerative practices, creating strong momentum. However, rising input costs and strict compliance requirements are squeezing small producers, highlighting the need for technical assistance and equitable financing. Overall, Europe represents both a challenge and an opportunity: its policies drive regenerative farming forward, but they also raise the cost of doing business.

AFRICA

Africa faces the most pressing challenges in achieving food security and soil restoration. Many regions contend with depleted soils, erratic rainfall, and limited access to inputs. Compost and regenerative farming offer critical solutions, and NGOs alongside international donors are scaling up pilot programs. Countries such as Kenya, Ethiopia, and Ghana are seeing compost hubs emerge, linking municipal organic waste with agricultural use. Adoption is most advanced among horticultural producers linked to export markets that demand sustainability certification. However, smallholder farmers face barriers in affordability, logistics, and technical training. The regenerative lens is crucial in Africa: compost, cover crops, and agroforestry can restore productivity while reducing dependence on costly imports, but success hinges on scaling education, infrastructure, and finance.

ASIA-PACIFIC

Asia-Pacific is highly diverse, with regenerative agriculture adoption shaped by both opportunity and vulnerability. China is experimenting with compost and soil health practices in response to groundwater depletion and soil pollution. India remains heavily dependent on fertilizer subsidies, yet regenerative practices such as compost and cover crops are gaining recognition through NGO and government-backed programs. Southeast Asia, facing extreme climate shocks, is beginning to prioritize soil health, particularly in rice and horticultural systems. Australia is seeing strong regenerative adoption in both rangelands and crop systems, supported by drought adaptation policies. Across the region, corporate buyers and export markets are demanding more transparent regenerative metrics, creating strong incentives for adoption.

MIDDLE EAST & NORTH AFRICA (MENA)

The MENA region remains one of the most water-stressed areas globally, making regenerative practices particularly valuable. Compost and cover crops improve water retention and reduce salinity in degraded soils, offering pathways to greater resilience. Wealthier nations such as Saudi Arabia and the UAE are investing in regenerative pilot projects, often linked to food security strategies and partnerships with multinational agribusinesses. North African nations like Morocco and Egypt are scaling compost adoption through both government and private programs. However, climate vulnerability, limited arable land, and political instability in parts of the region constrain progress. Despite challenges, regenerative agriculture offers one of the few viable paths to sustaining food production in this highly vulnerable region.

CONCLUSION

The regional outlooks for 2024 confirm that regenerative agriculture is not a one-size-fits-all approach but a global transition shaped by local contexts. Compost, cover crops, and soil health strategies are advancing in every region, albeit unevenly. Where policy support, corporate demand, and financial incentives align, adoption accelerates rapidly. Where barriers of cost, infrastructure, or political instability persist, progress slows. Across all regions, regenerative farming represents both a resilience strategy and a competitive advantage, positioning producers to thrive in a marketplace increasingly defined by sustainability demands.

CALIFORNIA AGRICULTURE (2024)

– REGENERATIVE LENS

OVERVIEW

California remains one of the most important agricultural regions globally, producing over \$50 billion in annual farm output. Specialty crops—almonds, grapes, citrus, vegetables, and dairy—dominate its production portfolio. In 2024, the state is a testbed for regenerative practices, driven by water scarcity, climate pressures, and progressive policies such as the Healthy Soils Program. Compost use, cover crops, and integrated nutrient management are becoming central to both compliance and competitiveness.

WATER SCARCITY & GROUND WATER REGULATION

California's agriculture faces chronic water stress. The Sustainable Groundwater Management Act (SGMA) requires local agencies to bring aquifer use into balance by the 2040s, placing new limits on pumping. For farmers, this means adapting with soil health practices that maximize water efficiency. Compost increases soil organic matter, which enhances water infiltration and storage, while cover crops reduce evaporation and erosion. Almond and vineyard systems, in particular, are adopting compost to maintain yields under reduced irrigation.



COMPOSTING MANDATES & WASTE DIVERSION

California has some of the most aggressive organic waste diversion laws in the world. Senate Bill 1383 mandates a 75% reduction in organic waste sent to landfills by 2025. This has created an unprecedented supply of compost, linking municipal waste systems with agricultural soil health. Farmers are gaining access to more compost, but challenges remain around transportation, quality assurance, and application logistics. Still, this policy framework is accelerating compost adoption and making regenerative practices more accessible to a broad base of growers.

HEALTHY SOILS PROGRAM & INCENTIVES

The California Department of Food and Agriculture’s (CDFA) Healthy Soils Program provides grants to farmers who adopt regenerative practices, including compost application, cover cropping, hedgerows, and reduced tillage. Since its inception, the program has funded thousands of projects across the state. In 2024, funding levels remain strong, with emphasis on scaling adoption and ensuring measurable climate benefits such as carbon sequestration and reduced emissions. For many growers, these incentives make the difference between experimenting with regenerative practices and integrating them into standard operations.

ALMONDS, VINEYARDS & SPECIALTY CROPS

California’s specialty crops are at the center of the regenerative transition. Almond growers face increasing scrutiny for water use but are adopting compost to improve soil structure and retention. Vineyards in Napa and Sonoma are pioneers in cover cropping and compost integration, marketing their regenerative practices as part of premium branding strategies. Vegetable producers in the Central Valley are turning to compost and reduced tillage to maintain productivity while cutting input costs. Citrus and avocado groves are also experimenting with regenerative models, though adoption varies by region and market access. Overall, specialty crops are proving that regenerative practices can enhance both sustainability and market value.





DAIRY & MANURE MANAGEMENT

California’s dairy industry is a major source of methane emissions but also an opportunity for regenerative solutions. Manure management programs incentivize composting and anaerobic digestion, reducing emissions while creating valuable soil amendments. Composted dairy manure is being integrated into cropping systems, closing nutrient loops and reducing reliance on synthetic fertilizers. In 2024, partnerships between dairies, municipalities, and crop producers are expanding, demonstrating the scalability of regenerative nutrient cycles.

BARRIERS & CHALLENGES

Despite strong momentum, barriers remain for widespread regenerative adoption in California. Transporting compost from urban centers to rural farms is costly. Quality variability, contamination risks, and lack of spreading infrastructure can discourage farmers. Water regulations, while necessary, impose costs that not all growers can absorb. Additionally, small and mid-sized farms often lack the capital or technical expertise to integrate regenerative systems effectively. Addressing these barriers requires targeted investments in infrastructure, education, and cooperative models.

CONCLUSION

California agriculture in 2024 illustrates the potential of regenerative farming at scale. Policy, markets, and climate pressures are aligning to make compost, cover crops, and soil health central to the state’s agricultural future. While challenges remain, California offers a roadmap: align waste diversion with soil health, incentivize regenerative practices, and integrate them into high-value crops and livestock systems. The lessons from California’s transition will inform not only U.S. agriculture but also global pathways toward regenerative food systems.

MARKET OPPORTUNITIES & RISKS (2024)

– REGENERATIVE AGRICULTURE FOCUS

COMPOST & INPUT MARKETS

Global demand for compost and organic amendments is growing rapidly in 2024. Policies such as California’s SB 1383 and the EU’s Farm-to-Fork strategy are expanding markets for high-quality compost. Producers who can guarantee consistent quality, maturity, and nutrient specifications are positioned to access premium markets. Input substitution opportunities are also strong: farmers facing high synthetic fertilizer costs are turning to compost and cover crops for nutrient cycling and soil health benefits. Risks include variability in compost supply, contamination concerns, and lack of uniform standards across regions, which may create trade barriers.

VALUE-ADDED EXPORTS

Regenerative-certified commodities are emerging as value-added exports. Coffee, cocoa, wine, and specialty crops marketed as grown under regenerative systems are capturing premiums in U.S. and European markets. Producers who integrate compost, cover crops, and carbon-friendly practices can differentiate themselves. Risks include verification challenges and consumer skepticism if claims are not backed by rigorous standards. For exporters, aligning with recognized certification schemes and providing transparent reporting are essential to capture these premiums.

SUSTAINABILITY COMPLIANCE AND MARKET ACCESS

Compliance with sustainability standards is no longer optional for many exporters. The EU’s deforestation regulation, U.S. Scope 3 emissions reporting, and other corporate supply chain mandates require verifiable regenerative practices. This trend creates opportunities for producers who can document compost use, soil health metrics, and regenerative transitions. However, the costs of compliance—monitoring, reporting, third-party audits—pose risks, particularly for small and mid-sized producers. Failure to comply risks market exclusion, while successful compliance can unlock premium access and long-term partnerships.

CARBON & ECOSYSTEM SERVICES MARKETS

Carbon markets are providing new revenue streams for regenerative farmers. Compost use generates credits for methane reduction, while cover crops and improved soil management contribute to soil carbon sequestration. Beyond carbon, ecosystem service markets are emerging for biodiversity, water quality, and pollinator habitat. Opportunities lie in stacking these services, but risks include price volatility, unclear regulatory frameworks, and verification challenges. Farmers who establish strong measurement and reporting practices are better positioned to benefit.



CORPORATE PROCUREMENT & VERTICAL INTEGRATION

Large corporations with vertically integrated supply chains are increasingly investing in regenerative transitions. Food service giants, beverage companies, and retailers are offering premiums or long-term contracts for regenerative products. This creates stable demand for compost-based systems. Risks arise when producers cannot meet scale requirements or when corporate sustainability budgets tighten. Transparency and scalability will be key to maintaining these partnerships.

FINANCIAL RISKS & INVESTMENT GAPS

While regenerative agriculture presents strong opportunities, financing gaps remain. Small and mid-sized farms often lack access to capital to invest in compost infrastructure, cover crop seed, or new equipment. Investment risks include uncertain returns, shifting policy incentives, and market volatility for carbon credits. Addressing these requires blended finance models—combining grants, low-interest loans, and private capital—to de-risk adoption for producers.

CONCLUSION

The market opportunities for regenerative agriculture in 2024 are significant, ranging from compost markets to carbon finance and value-added exports. However, risks around verification, financing, and scalability remain. Producers, investors, and policymakers must align to ensure that regenerative practices not only scale but also deliver measurable environmental and financial benefits. Those who adapt early to these market dynamics are positioned to thrive in a rapidly evolving food system.

POLICY, FINANCE & INVESTMENT (2024)

– REGENERATIVE AGRICULTURE

PUBLIC INCENTIVES & SUBSIDIES

Governments around the world are deploying incentives to accelerate regenerative agriculture adoption. In the United States, the Inflation Reduction Act and USDA Climate-Smart Commodities program are channeling billions into soil health, compost, and cover crop initiatives. California's Healthy Soils Program remains a leader, offering grants for compost application, hedgerows, and reduced tillage. The EU's Common Agricultural Policy provides direct payments to farmers adopting regenerative practices under Farm-to-Fork mandates. These subsidies reduce the financial risk of transitioning away from conventional systems and help scale adoption.

INTERNATIONAL DEVELOPMENT FINANCE

Multilateral institutions such as the World Bank, FAO, and IFAD are integrating regenerative agriculture into food security and climate resilience programs. The World Bank's climate-smart agriculture portfolio now exceeds \$4 billion, with compost and organic waste-to-value systems recognized as priority investments. USAID is embedding regenerative practices into Resilience and Food Security programs in Africa and Asia, funding compost hubs, cover crop seed access, and farmer training. These flows of finance align regenerative agriculture with broader development agendas, ensuring that soil health improvements are embedded in strategies for hunger reduction and resilience.

PRIVATE CAPITAL & CARBON FINANCE

Private investors are increasingly targeting regenerative agriculture through impact funds, venture capital, and corporate procurement contracts. Carbon markets are central: soil carbon sequestration, compost methane avoidance, and agroforestry credits are creating investable pathways. Companies like Microsoft and Nestlé are investing directly in regenerative supply chains to meet Scope 3 reduction goals. However, verification challenges and volatile credit prices pose risks. Emerging blended finance models seek to de-risk these investments by combining public grants, development finance, and private capital.



TerraNutra



TRUE COST ACCOUNTING & MARKET SIGNALS

True cost accounting (TCA) frameworks are gaining traction as tools to integrate environmental and social costs into market pricing. By accounting for soil degradation, greenhouse gas emissions, and water depletion, TCA highlights the hidden costs of conventional systems and the long-term value of regenerative practices. Governments, corporations, and investors are beginning to experiment with TCA-based reporting, sending signals to markets that regenerative farming is not just environmentally sound but also financially strategic.

RISKS & BARRIERS

Despite growing financial flows, barriers persist. Smallholders in Africa, Asia, and Latin America often lack access to these funds due to bureaucratic hurdles and limited collateral. Verification of soil carbon and compost benefits remains technically challenging and costly. There is also a risk of greenwashing if corporate actors overstate regenerative claims without rigorous MRV (monitoring, reporting, verification). Policy uncertainty, such as shifting subsidy priorities, can discourage long-term investment.

CONCLUSION

Policy, finance, and investment are aligning more strongly than ever behind regenerative agriculture in 2024. Public incentives reduce risk, international finance expands access, and private capital creates new revenue streams through carbon and ecosystem markets. True cost accounting is reshaping how value is measured, positioning regenerative practices as both environmentally and economically essential. While risks remain in verification, equity, and policy stability, the overall trajectory is clear: regenerative agriculture is becoming a central pillar of agricultural investment strategies worldwide.



FUTURE PATHWAYS & STRATEGIC RECOMMENDATIONS (2024)

SCENARIOS FOR 2030

By 2030, agriculture may evolve under three plausible scenarios. The first is a 'Regenerative Mainstream' scenario, where compost, cover crops, and regenerative practices become the global standard, supported by policy mandates and corporate supply chain integration. The second is a 'Fragmented Transition,' where adoption is uneven, with wealthy regions and large corporations moving ahead while smallholders lag. The third is a 'Business-as-Usual Decline,' where insufficient investment in soil health leads to further land degradation, volatile markets, and deepening food insecurity. The regenerative mainstream offers the most resilient and sustainable pathway, but achieving it requires coordinated global action.

ROLE OF REGENERATIVE AGRICULTURE IN FOOD SECURITY

Regenerative agriculture is increasingly recognized as central to food security strategies. Compost and cover crops directly address soil degradation, which threatens more than 25% of agricultural land worldwide. By improving water retention, nutrient cycling, and resilience to climate shocks, regenerative practices can close yield gaps and stabilize food systems. For regions facing high input costs, regenerative strategies also reduce dependence on imports, keeping production more localized and resilient. Governments and NGOs are embedding regenerative agriculture in food security programming, with strong evidence of positive impacts on both productivity and livelihoods.

COMPOST IN GLOBAL FOOD SYSTEMS

Compost sits at the heart of regenerative transitions. Diverting organic waste from landfills reduces methane emissions while creating valuable soil amendments. In 2024, more countries are building composting infrastructure at municipal and regional levels. By 2030, scaling compost use globally could restore millions of hectares of degraded land, cut fertilizer demand significantly, and sequester vast amounts of carbon. The challenge is logistics: ensuring that compost reaches farms at scale, affordably, and with assured quality.



STRATEGIC RECOMMENDATIONS FOR POLICYMAKERS

- 01 Expand subsidies and grants for regenerative practices, particularly compost application and cover cropping.
- 02 Invest in compost infrastructure to link urban waste diversion with rural soil health.
- 03 Incorporate regenerative agriculture targets into climate and food security policies.
- 04 Support research and extension services that help farmers adapt regenerative practices to local contexts.
- 05 Build international cooperation to harmonize standards for regenerative certification and compost quality.

STRATEGIC RECOMMENDATIONS FOR CORPORATIONS

- 01 Integrate regenerative criteria into procurement policies, rewarding suppliers who use compost and cover crops.
- 02 Invest in farmer training and infrastructure, sharing risk and cost across the supply chain.
- 03 Use Scope 3 reporting requirements as an opportunity to incentivize regenerative adoption.
- 04 Collaborate with governments and NGOs to co-fund compost and regenerative initiatives.
- 05 Communicate transparently with consumers about regenerative commitments and outcomes.

STRATEGIC RECOMMENDATIONS FOR PRODUCERS

- 01 Begin transitioning to regenerative practices incrementally, starting with compost or cover crops.
- 02 Engage with carbon and ecosystem markets, but ensure verification and transparency.
- 03 Diversify crops and integrate livestock where possible to improve system resilience.
- 04 Form cooperatives to share compost transport and spreading equipment, reducing individual costs.
- 05 Document soil health improvements to strengthen access to finance, grants, and premium markets.

CONCLUSION

The future of agriculture hinges on regenerative transitions. Compost and cover crops are not optional extras but foundational tools for resilience, productivity, and climate action. The pathways ahead are clear: governments must provide enabling policy, corporations must align supply chains, and farmers must integrate regenerative practices into their operations. If these actors align, agriculture can move decisively toward a regenerative mainstream by 2030, securing food systems and safeguarding the planet for future generations.



www.terrannutra.org



TerraNutra