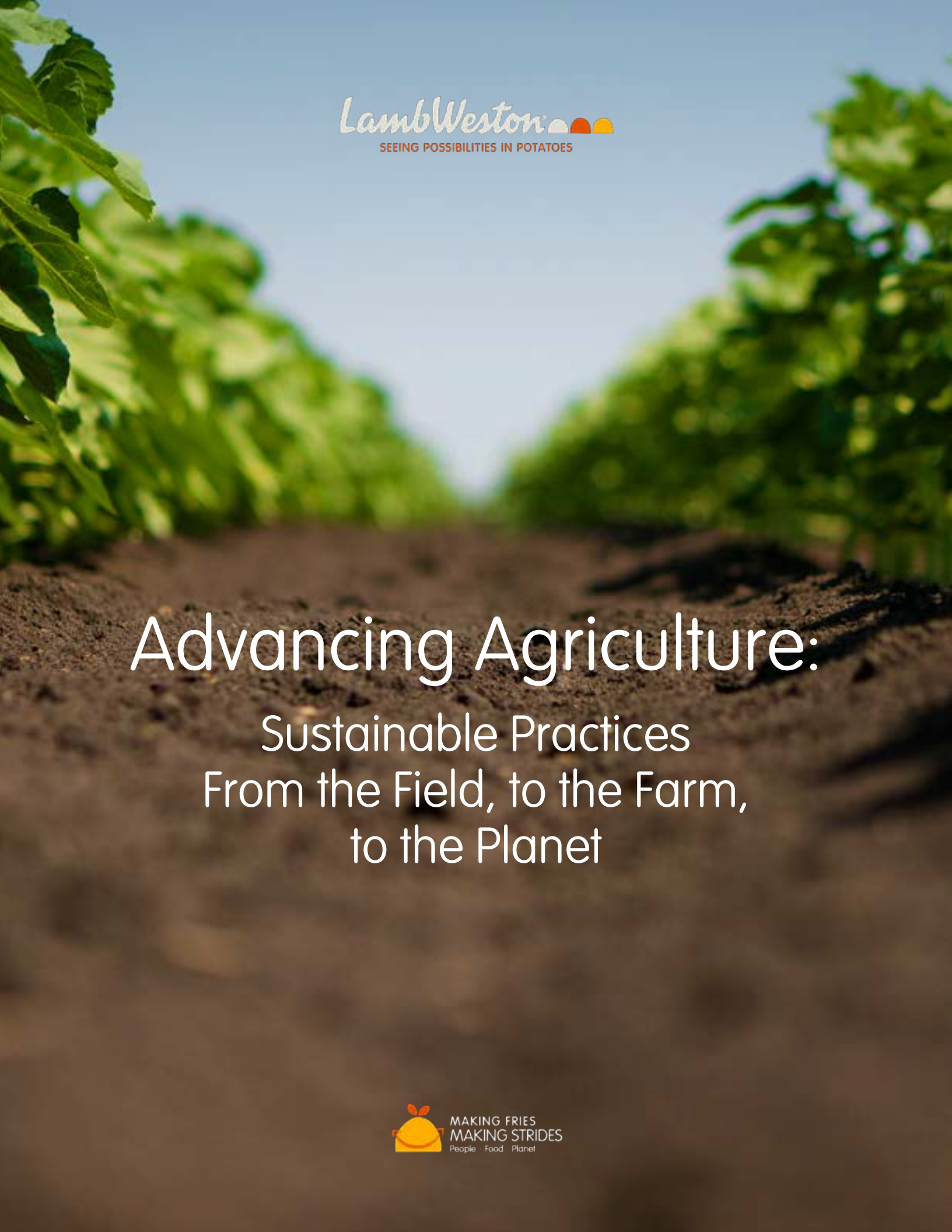

LambWeston
SEEING POSSIBILITIES IN POTATOES
Advancing Agriculture:
Sustainable Practices
From the Field, to the Farm,
to the Planet
MAKING FRIES
MAKING STRIDES
People · Food · Planet

Our Foundational Commitment: Partnering with Growers to Scale Proven Practices for Sustainability

Sustainable agriculture is a priority for consumers, our industry, and society. Nearly 70 percent of consumers now say environmental impact is important for their purchasing decisions.[1] Restaurants are increasingly focused on providing sustainable options. Investments in agtech have surged to nearly $20 billion a year,[2] while keynotes and think pieces speculate on the future of farming.

While it's easy to agree we need sustainable agriculture, it's incredibly complex to deliver.

Growers must understand and balance a huge range of interconnected factors—from water usage and soil health to inputs and carbon emissions—in both the near- and long-term. This means planning for thousands of acres over multiple years, but also closely monitoring small changes in real-time. And they must adjust for every planting, every day, every season.

For all the talk, these challenges can only be solved in one place: the field.

That's where, for more than 20 years, Lamb Weston and our grower partners have been advancing sustainable farming practices. We believe sustainable agriculture must be a win-win: a virtuous cycle that supports both growers' livelihoods and the health of the soil and planet.

Our grower partnerships are central to everything we do. Lamb Weston's goal is to equip growers with practices and tools that work—environmentally and economically—so they can sustain their operations, families, and land for the long-term. We know sustainability won't happen without practicality, and we work closely with growers to solve common barriers to adoption like cost, tech limitations, or unclear results.

These proven practices are the basis of our Grower Guide, which influences more than 100 grower partnerships across 170,000+ acres. This foundational framework is designed to help growers keep the soil healthy, conserve water, and manage chemical inputs, while supporting yield, lowering costs, and delivering return on investment (ROI). Every year, our grower partners produce more than 5 million tons of potatoes for Lamb Weston, and we're helping them do it more sustainably.

But like any science, agriculture is constantly advancing. We help growers stay at the leading edge. Lamb Weston's Ag team runs a sustainable agriculture program to develop, identify, test, and perfect the best new practices, technologies, and concepts.

Based on this work, we see three powerful forces for the future of sustainable agriculture:

- Advances in soil science are opening the next frontier of sustainable crop production.
- More practical agtech is equipping growers to monitor, analyze, and adjust everything happening on their farm in real-time, for greater efficiency and deeper insights.
- Farms are responding to climate change by decreasing greenhouse gas emissions, sequestering carbon, and increasing resilience to climate impacts.

This is the future of our industry—and it's already taking shape. Our team is working with growers and other partners to implement these developments on-the-ground, and we look forward to the new possibilities coming in the near future.

Our Sustainable Agriculture Program: **Lamb Weston's Role as a Leader & Facilitator**

Collaboration and partnership are the foundation of our work on sustainable agriculture.

We believe the best ideas and tools come from a wide variety of sources, and they will only work if they are tested in daily operations by those who will actually use them.

To find those ideas, Lamb Weston strives to be a leader and facilitator in the overall agriculture ecosystem. We use a three-step approach to develop and identify the most promising new sustainability practices, then make sure they will work for growers at scale:

Engage Across the Ecosystem

Our team engages across sectors and disciplines to cultivate new ideas wherever we find them. We provide validation and a market for agtech startups and established manufacturers with new innovations. We partner with universities to fund cutting-edge scientific research. We support USDA initiatives to drive forward progress. And we collaborate with customers and industry peers to lay out common metrics, standards, and goals.

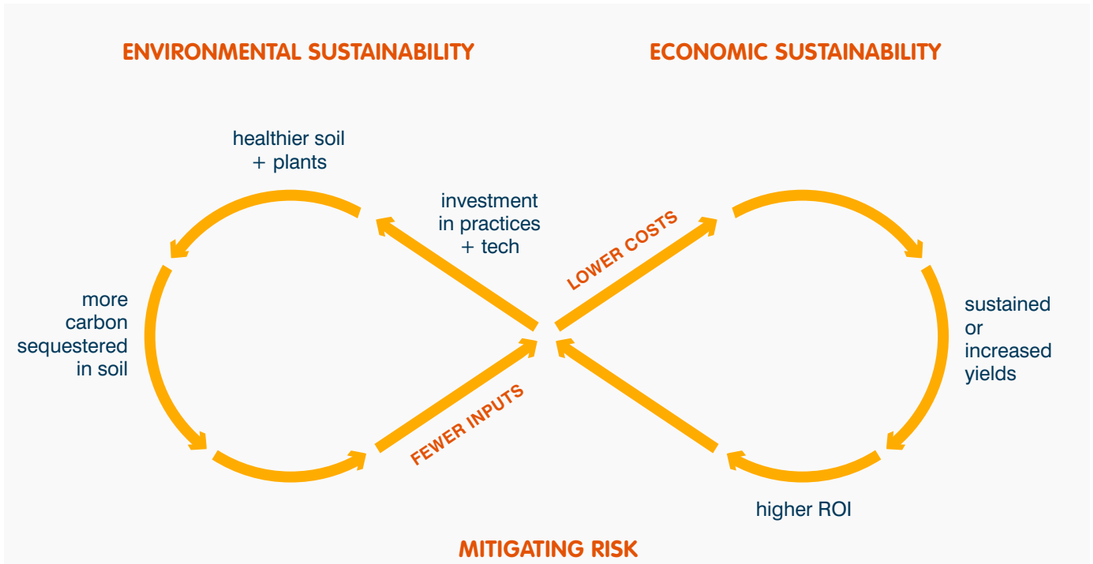
Test Emerging Practices & Innovations at Scale

Drawing on this collaboration, we run more than 20 trials each year on our 100 Circles Farm and with grower partners to determine which ideas work at scale. Lamb Weston's 100 Circles Farm—at 20,000+ acres, much larger than a typical test farm—enables us to reflect real-world conditions and make data-driven decisions. We refine each practice and look for results over multiple years before we recommend it to growers.

Recommend What Works to Our Grower Partners

Once we've determined what works, we partner with growers to implement these best practices. Lamb Weston provides detailed guidance that is tailored to their needs, such as playbooks for growing certain varietals and regular in-person meetings. Growers can have confidence that this guidance is tested and ready for real-world implementation.

Economic and environmental sustainability can feed each other. Healthier soil requires fewer inputs and produces higher yields, which lowers costs and increases ROI—supporting growers' ability to invest in the next set of advances.



The Leading Edge: Three Powerful Forces for the Future of Sustainable Agriculture

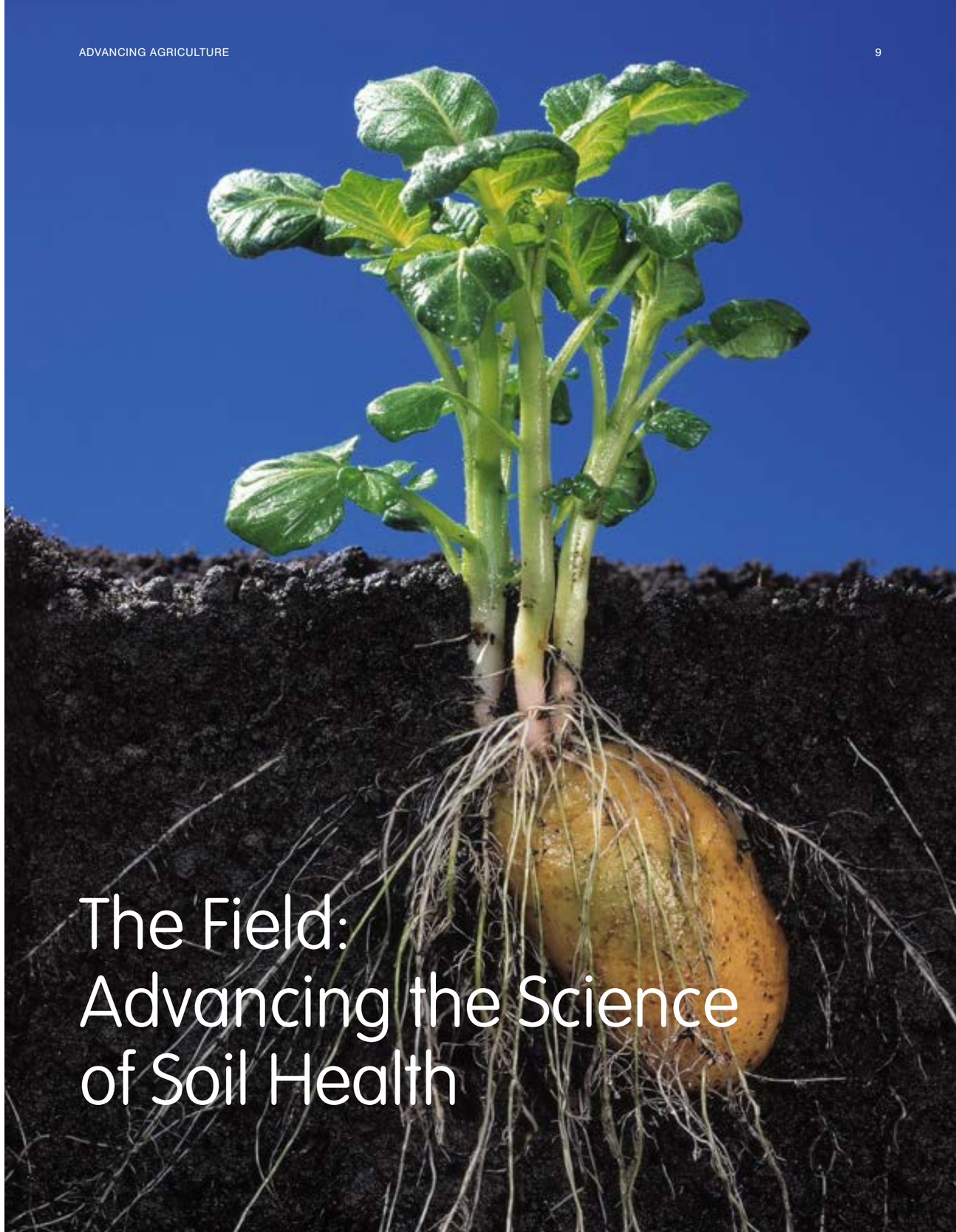
Based on our research, engagement, and trials, we see three forces that are now emerging as the future of sustainable agriculture, scaling up from the soil's microbiome to the level of the farm to the entire planet:

The Field: Advancing the Science of Soil Health

The Farm: Making Modern Agriculture Practical

The Planet: Building Climate Resilience & Mitigation Strategies

Each of these three forces advances numerous sustainability efforts. Healthier soil stores more carbon and requires fewer inputs. More precise agriculture minimizes soil disturbance and reduces usage of fuel and related carbon emissions. Climate-smart agricultural practices cultivate soil health. While the initiatives and practices listed below are structured into these three categories, many support more than one aspect of sustainability at once.



The Field: Advancing the Science of Soil Health

THE FIELD:
Advancing the Science of Soil Health

Soil health brings a new lens to an ancient question: what makes one field more productive than another?

To find more precise answers, a new generation of research is looking at soil as a living system. Its health depends on a complex range of biological, chemical, and physical factors, such as microbial activity, nutrients, soil genomics, organic matter, disease load, acidity, and more. Scientists can now use technologies like soil sensors and polymerase chain reaction (PCR) machines, which copy DNA segments for closer analysis, to to study these factors in greater detail than ever before, unlocking the next frontier of sustainable agriculture.

By understanding which factors are most important and how they interact, soil science equips growers to better manage their land. They can use lower-impact techniques to prevent disease, support plant health, reduce inputs, and sequester carbon—all while improving yields.

WHAT WE'RE DOING

Lamb Weston is advancing soil science as the future of sustainable potato agriculture. Many of the long-standing requirements in our Grower Guide already support soil health, such as cover cropping to prevent erosion and crop rotation to break pathogen cycles. Building from this foundation, we are partnering with universities, researchers, and manufacturers to identify innovative practices, products, and technologies to keep soil and plants healthy, year after year.

RESEARCH PARTNERSHIPS: Collaborating to Study the Soil of the Pacific Northwest

The soil of Eastern Washington is some of the best in the world for growing potatoes—even though it has relatively low levels of organic matter, which is the focus of many existing soil health projects. This gap shows the need to better understand all the factors in soil health, specific to particular regions, crops, and soil types.

That's why Lamb Weston is partnering with universities and researchers to study the attributes of soil where our grower partners operate. We made a $1 million donation to Washington State University to endow a chair focused on soil health research, and our work with the USDA's Climate-Smart initiative will support researchers from three universities and the Soil Health Institute to develop soil healthy techniques for potato agriculture.

As new findings emerge, we plan to provide growers with more detailed information and guidance about soil health specific to their land and soil type. Our goal is to help them identify and focus on the soil health factors that matter most at the level of the field.

BIOSTIMULANTS: Improving Yields with Natural Inputs and Processes

A growing class of biostimulants, like beneficial bacteria, algae, or humic acids (organic molecules that developed from ancient deposits of decaying plants and animals), can reduce the need for artificial fertilizers and support soil and plant health. More of these biological products are entering the market each year, but how well they work can vary widely for different fields, farms, and crops.

Lamb Weston's Ag team is testing biostimulants to find those that work best for growers. We recently trialed a biological solution made of kelp that provides rich micronutrients and minerals to the soil. We're also experimenting with a technique that extracts and cultivates native algae from the soil, then sprays it through irrigation pivots to promote the growth of good bacteria.

As an example of what's possible, Lamb Weston previously pioneered the use of Serenade Prime—a beneficial bacteria that lives in potato roots and improves the uptake of nutrients for larger, better potatoes. Lamb Weston first began trials of Serenade more than 10 years ago, and it is now a mainstay for many growers' programs.

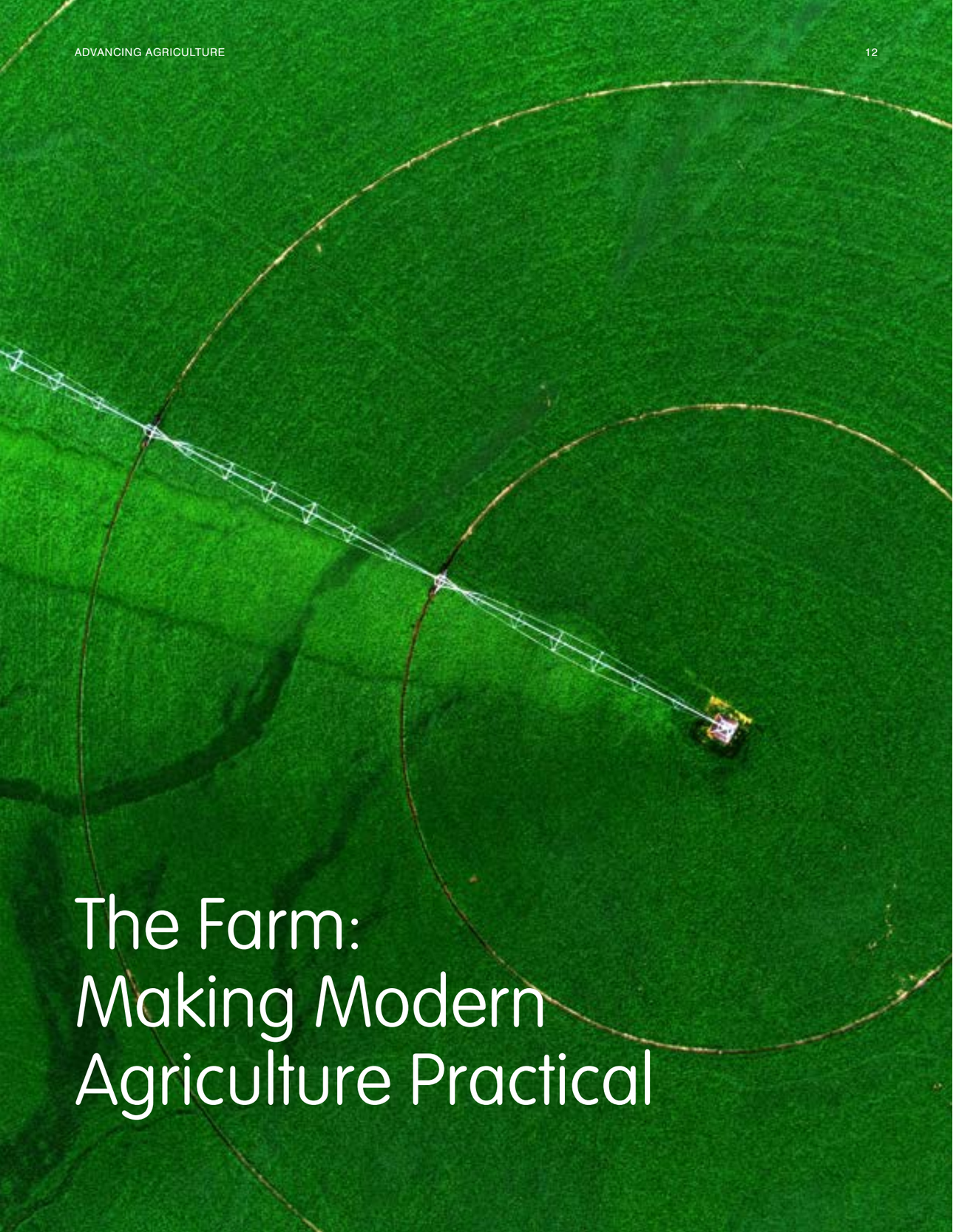
All of Lamb Weston's grower partners complete an annual assessment to monitor progress implementing sustainable agricultural practices. In 2022, our partners excelled in soil health, demonstrating the importance of understanding, safeguarding, and analyzing their soil.[3]

96%	99%	96%
Leverage soil monitoring and sampling to drive pest- and disease-management decisions	Adjust nutrient applications based on foliage and soil samples	Use non-chemical practices to manage pests, including beneficial organisms

WHAT'S NEXT:

Tailoring Soil Science with Soil Sensors and Genomics

Experts expect that technological advances will soon put soil science in the hands of individual growers. With less expensive, more reliable soil sensors, they will be able to closely monitor key aspects of soil health across their fields. High-throughput PCR machines will enable them to sequence genetics in the soil, and machine learning can extract insights from all this data. The result will be much more granular soil science to support higher yields, all while serving as better stewards of the land.



The Farm: Making Modern Agriculture Practical

THE FARM: **Making Modern Agriculture Practical**

In recent years, investment and interest have surged in the field of agtech. These technologies for modern agriculture have shown strong potential for sustainability, promising to help conserve water, optimize inputs, monitor carbon emissions, and more.

Yet practical barriers too often stand in the way of adoption. Globally, less than 40 percent of farmers are currently or planning to use even one agtech tool.[4] In North America, farmers say high costs and unclear ROI are the most common challenges to implementation.

Modern agriculture can drive sustainability—but these tools must be practical, too. Growers need to know that technologies will work reliably each day, integrate with their existing tools and practices, and deliver a return on their investment. This the only path to wide-spread adoption.

WHAT WE'RE DOING

Lamb Weston is piloting technologies to find those that support deeper insights and better decisions for more efficient use of resources. Equipped with these technologies, growers can closely monitor and fine-tune their operations to enhance sustainability, while reducing costs.

SENSING & MONITORING: Real-Time Data for Greater Efficiency & Conservation

As sensors, cameras, and computer chips become cheaper and more powerful, new possibilities open for monitoring everything that happens on a farm. While farmers once had to physically check their fields around the clock, now they can simply see the collected data and make adjust-ments in real-time to save water and optimize inputs.

We're collaborating with growers and agtech firms to explore practical applications of these advances. Re-mote sensing technology has revo-lutionized crop monitoring, providing valuable insights into crop health and growth throughout the season. Aerial and satellite imagery allows grow-ers to promptly detect and correct irrigation issues, while real-time crop monitoring helps them apply the right products at the right times, for better health and higher yields.

Our approach means growers can adopt tech with confidence. Just consider sensors. We recently piloted bruise sensors that can identify where potatoes are most likely to be damaged during harvesting, loading, or storage. Our team determined the sensors could potentially save thousands of dollars in costs. On the other hand, another trial found that a new moisture and impact sensor was not yet reliable or fast enough to provide real value for growers' decisions.

SUSTAINABILITY ANALYTICS & MODELING: Exploring Platforms for a Precise Approach

In tandem with hardware advances, we're exploring technology platforms and software for more sustainable agriculture. These platforms can capture data, uncover insights, and guide decisions for multiple aspects of sustainability, from carbon emissions to water usage.

In fall 2022, we completed a successful pilot program with Regrow, a cutting-edge modeling and analytics platform for carbon and greenhouse gas emissions. These sophisticated tools enable us to measure emissions down to the field level, as well as the sequestration potential of every crop. We now plan to expand carbon baseline and monitoring in partnership with growers and communicate opportunities to improve carbon profile at the farm level.

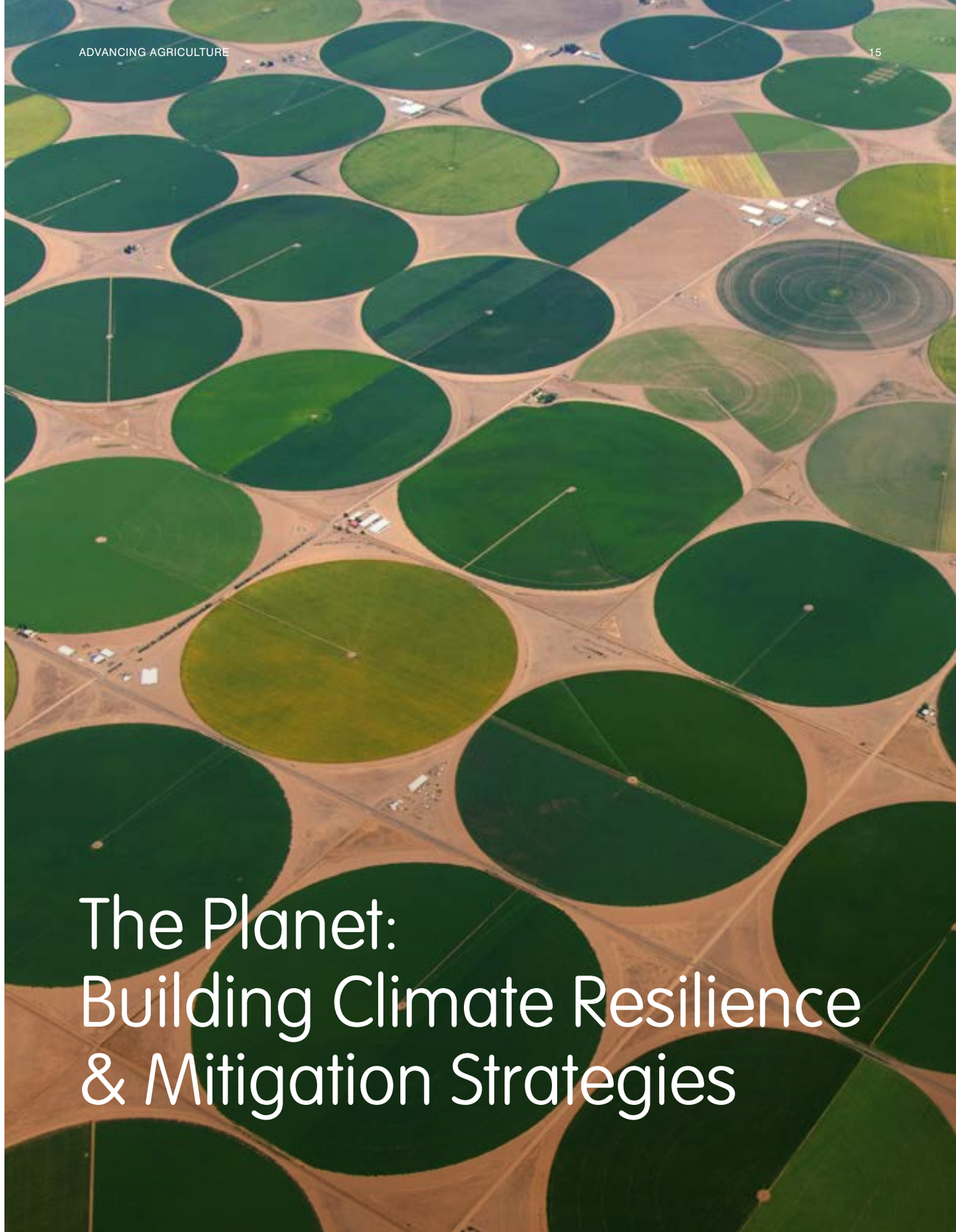
We have also piloted the Arable platform, which captures localized data on weather and crop performance. The platform enables us to better compare and understand growth year over year. Based on the trial's success, we expect to expand deployment going forward.

The Regrow dashboard provides a comprehensive monitoring system for key sustainability metrics, such as GHG emissions, carbon sequestration, field emission factor, and crop yield. With the ability to break down and examine data by region, crop type, and time, the dashboard enables in-depth analysis that helps us make better decisions on the farm.

WHAT'S NEXT:

Nanotechnology Enters the Field

Leading-edge technologies like "nanoliquids" are beginning to unlock sustainability advances across agriculture. Nanoliquids contain thousands of manufactured particles that form protective barriers around nutrient molecules, allowing crop inputs to be deposited into crops more effectively. By covering a greater number of plants with reduced quantities, nanotechnology increases the efficiency of fungicide, pesticide, fertilizer, and other inputs, while minimizing the necessity for repeated applications.



The Planet: Building Climate Resilience & Mitigation Strategies

THE PLANET:
Building Climate Resilience & Mitigation Strategies

As the impacts of climate change intensify, growers face new challenges to the health of their crops and land. The future of agriculture will require new strategies to mitigate these impacts, while also leveraging the land to increasingly sequester carbon.

Our industry can be a part of the solution. While growing potatoes represents a small share of agricultural emissions,[5] smart growing practices can help to further reduce emissions, while also storing carbon in the soil for the long-term. At the same time, growers must build resilience for impacts like droughts, flooding, extreme heat, and pests. These can lead to increased usage of water, pesticides, and chemical fertilizers, threatening to slow progress on sustainability.

Climate-resilient agriculture works towards solutions for both sides of the challenge. Growers do their part to mitigate greenhouse gas emissions, while navigating the challenges that come with climate instability.

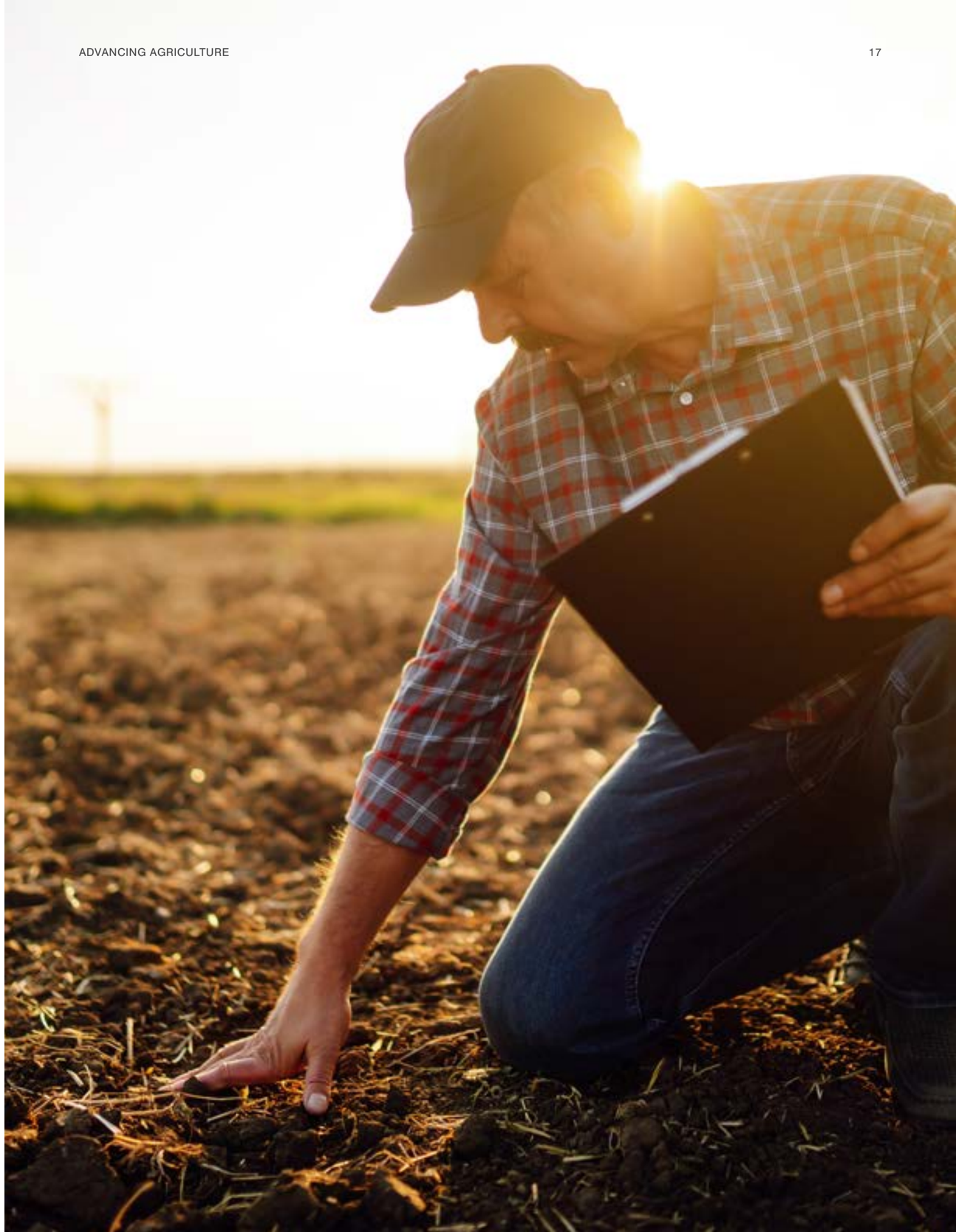
WHAT WE'RE DOING

Lamb Weston is stepping up our work on emissions and climate resilience. We are working towards a carbon neutral future in our field operations, with standard practices built into our grower contracts, like cover cropping and integrated pest management, help to reduce emissions and keep biomass in the soil, while reducing costs. We're now expanding this impact with research into best practices, new tools, and more resilient varietals.

CLIMATE SOLUTIONS: Measuring, Reducing, & Sequestering Greenhouse Gases

Measuring a farm's greenhouse gas (GHG) emissions is critical to reducing our footprint. We are partnering with Regrow, one of the most sophisticated measurement tools available, to help growers identify emissions sources and monitor sequestration processes. Regrow leverages remote sensing technology and DeNitrification DeComposition (DNDC) modeling to provide reliable and actionable information to growers, making it easier to improve their day-to-day sustainability practices.

We're actively seeking out innovative ways to reduce emissions. While farmers have used agricultural lime as a soil additive for centuries, our Ag team has been exploring alternatives to reduce nitrous oxide emissions. Simultaneously, we're applying enhanced rock weathering (ERW) techniques to accelerate natural rock weathering, which permanently captures and stores carbon in soil. We've also trialed a product that applies potassium silicate to reduce emissions from decomposing leaves, while delivering an impressive ROI of 18:1 for growers.[6] In addition, we're



making our equipment and irrigation methods more efficient to reduce fuel and energy usage.

Beyond our own research, we've partnered with the USDA's Climate-Smart Commodities program to help reduce the carbon footprint of potato agriculture.[7] The effort brings together universities, government agencies, private-sector companies, and Native American tribes to identify more climate-resilient practices, such as reduced tillage, cover cropping, and residue management. Lamb Weston supports the program by facilitating collaboration with growers and providing in-kind support via agronomic resources.

NEW VARIETALS: Breeding Potatoes for Greater Resilience and Efficiency

Potato varietals offer an important part of the sustainability solution. By developing new varietals, and matching varietals with soil type, we can grow crops that require less water and fewer inputs, offer greater nutritional efficiency, and are more resilient to disease and extreme weather. This resilience is especially important given that climate impacts are already here, such as the extreme heat seen in the 2021 growing season.

Varietal development is an important part of Lamb Weston's agriculture program. We are currently developing a robust pipeline of varietals and related growing best practices. We look for varietals that offer both economic and environmental advantages, like using nitrogen more efficiently, resisting common diseases, and producing higher yields.

Once we've developed varietals, we provide growers with a Variety Playbook—a comprehensive document that includes all the information they'll need to successfully cultivate the crop. This includes guidelines to optimally manage chemical inputs, supporting high yield while avoiding over-usage.

A crucial step of varietal development is ensuring each variety can make a stellar fry that fits our length, crunch, and color standards. We work with our customers to roll out the new varieties across their restaurants, promoting the use of sustainable, profitable, delicious potato products.

The Variety Playbook provides detailed suggestions for growers, including fertilizer management guideline charts, like the one illustrated here. The chart outlines the appropriate quantities of specific inputs to apply to the crop's petiole during each of the five potato growth stages, helping growers to maximize crop health and yield potential.

WHAT'S NEXT:

Machine Learning Unlocks Genetic Insights

In the near future, machine learning will expedite the development of more efficient, resilient potato varieties. Harnessing the power of artificial intelligence, we will be able to process and analyze huge stores of data about complex plant genetics. This allows us to quickly and easily identify promising new varieties, as well as valuable recommendations and guidelines for growers.

Conclusion: Cultivating the Agriculture Ecosystem for Continuous Progress

Sustainability is about our shared future. It takes collaboration, engagement, and partnership across sectors and specialties. We can only find enduring solutions if we work together.

Lamb Weston strives to lead this collaboration, today and in the future. Beyond the partnerships spotlighted above, we have helped found industry-leading sustainable standards to develop shared metrics and reflect the priorities of our customers and consumers. And we are continually engaging with academic researchers, innovative manufacturers, government agencies, and the overall sustainable agriculture ecosystem.

Most of all, we remain committed to our grower partners—engaging to identify and implement the practices that will support their land and their livelihoods for the long-term.

For more about our work, see our Sustainability page and Progress Together, our Environmental, Social, and Governance (ESG) Report.

Endnotes

1. "Majority of U.S. Consumers Say They Will Pay More for Sustainable Products." Sustainable Brands. August 2022. https://sustainablebrands.com/read/marketing-and-comms/majority-of-us-consumers-say-they-will-pay-more-for-sustainable-products

2. David Fiocco, Vasanth Ganesan, Maria Garcia de la Serrana Lozano, and Hussain Sharifi. "Agtech: Breaking down the farmer adoption dilemma." McKinsey & Company. February 2023. https://www.mckinsey.com/industries/agriculture/our-insights/agtech-breaking-down-the-farmer-adoption-dilemma

3. Lamb Weston, "Fiscal Year 2022 Environmental, Social and Governance Report." chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://esg.lambweston.com/lambweston-2022-esg.pdf

4. Ficco et al. "Agtech: Breaking down…"

5. Michael Clark et al. "Estimating the environmental impacts of 57,000 food products." The Proceedings of the National Academy of Sciences. August 2022. https://www.pnas.org/doi/10.1073/pnas.2120584119

6. Based on Lamb Weston and grower partner trial data

7. Jeff Steiner. "Oregon State and partners will receive $50 million grant to develop climate-smart potatoes." Oregon State University. September 2022. https://extension.oregonstate.edu/news/oregon-state-partners-will-receive-50-million-grant-develop-climate-smart-potatoes

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