

OCTOBER 2023



BAYER CROP SCIENCE SUSTAINABILITY PROGRESS REPORT

With our business, we aim to make
meaningful contributions to the United Nations

**SUSTAINABLE
DEVELOPMENT GOALS**



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Foreword

Throughout the summer of 2023, record-breaking temperatures were measured across the Northern hemisphere. A spate of heatwaves, floods, wildfires and weather extremes brought suffering to many of the communities affected. These events marked the latest warning sign that the impact of climate change is escalating. As the Intergovernmental Panel on Climate Change (IPCC) noted in its most recent report, even modest rises in global temperatures are making natural hazards more disruptive and intense.

Global food production is one area that is beginning to come under strain. Innovations in agriculture over the last decades have helped farmers produce more food with ever greater efficiency. But in recent years, climate change has slowed the rate of growth as farmers face crop losses from more frequent and severe weather events. If this trend continues, securing enough food for a growing population could be at serious risk.

The world therefore faces a monumental challenge: We now have the urgent task to create agricultural systems that help farmers adapt to climate change and boost food production, while at the same time reducing agriculture's negative impact on Earth's climate and its natural ecosystems. The only way forward is to radically transform today's farming methods and switch to more sustainable agriculture practices that put productivity gains and climate resilience on an equal footing.

That's why Bayer has embraced regenerative agriculture as its vision for the future of farming. Simply put, that vision is about "producing more with less, while restoring more" and aims to deliver positive outcomes for farmers, their communities and nature alike. This ambition informs our long-term strategy as much as our everyday work. And it's therefore at the heart of our 2030 sustainability commitments: enabling our farming

customers to reduce their on-field greenhouse gas emissions per mass unit of crop produced in our major markets by 30%, reducing the environmental impact of our global crop protection portfolio per hectare by 30%, supporting 100 million smallholder farmers in low- and middle-income countries by improving their access to agricultural products, services and partnerships, and improving water use per kilogram of crop by 25%, by transforming rice-cropping systems for our smallholder customers in the relevant regions where we operate, all by the end of this decade.

With our push toward regenerative agriculture, we're further raising our ambition by focusing not just on limiting agriculture's negative impact, but also on delivering net benefits to nature. We are using the latest data insights to develop new standards and frameworks to measure key outcomes in soil health, water conservation, biodiversity and carbon sequestration – as well as improvements in the economic and social well-being of farmers and their communities.

In this progress report, we want to demonstrate not only how we are working towards this vision, but also how sustainability is already a driving force behind our entire business. While our commitments may be ambitious, we recognize that they are only one step in our long-term sustainability journey. That's why we want to be transparent about how we're tracking progress and what metrics we're using to hold ourselves accountable against our targets.

It's clear: To shape a future that is truly regenerative, we need deep and lasting changes to our global agriculture system. This can only be achieved with more innovation and close collaboration across the entire food value chain. Together, we can drive the transformation that is needed to build climate resilience, secure food for more people and create the best possible outcomes for farmers and our communities – as well as the natural world on which we all depend.



FRANK TERHORST,

Head of Strategy & Sustainability
at Crop Science, a division of Bayer AG



JESSICA CHRISTIANSEN,

Head of Sustainability and Business
Stewardship at Crop Science,
a division of Bayer AG

About this report

Each year, alongside a broader Integrated Annual Report, Bayer AG publishes a [Sustainability Report](#). Its purpose is to provide an account — across all three of our divisions, Pharmaceuticals, Consumer Health and Crop Science — of our advanced sustainability strategy and transparently document the company's sustainability-related achievements in detail.

This **Crop Science Sustainability Progress Report** is meant to supplement the Bayer AG Sustainability Report by providing a closer look at the many ways the Crop Science division is promoting sustainable agriculture and creating the best possible outcomes for farmers. As part of a broader reporting landscape at Bayer, we publish different reports that vary in their focus and depth. Our main corporate reports and publications are supplemented by special ad-hoc reports. You can find an overview of our reporting landscape [here](#).

The information in this Crop Science Sustainability Progress Report is tailored to ESG-focused audiences that rate, benchmark, and want to learn more about how we embed sustainability into our business and seek to make a positive contribution to the global food and agricultural systems. Our purpose for creating this report is to go beyond stating our commitments to sustainability and transparently demonstrate the actions we're taking, the measure of their impacts, and how we're constantly evolving our business to improve our impact on the environment and add value for farmers and society.

In addition to serving as a vehicle to share information with our ESG stakeholders, this report is about transparency and accountability more broadly. Our intention is to highlight the areas where we are focused on improving our operations and creating sustainable solutions in agriculture. But we openly acknowledge there are gaps: ones that we know we need to fill and ones that we still need to identify. It is our hope that readers will explore the links to other resources where they can learn more about many of the topics covered, engage with us directly, and ultimately help hold us accountable as we progress toward our 2030 commitments and, more importantly, our **“Health for all, Hunger for none”** vision.



TOMAS ZABOROWSKI,
Head of Sustainability Excellence at
Crop Science, a division of Bayer AG

For comments, feedback, or general inquiry
please contact sustainabilityexcellence@bayer.com

End to End Value Chain Coverage

Chapter	Upstream	Own Operations	Downstream
Introduction	✓	✓	✓
Governance	✓	✓	✓
Innovation		✓	
Food System	✓	✓	✓
Product Supply	✓	✓	
Smallholder Farmers		✓	✓
GHG			✓
CP EIR			✓
Biodiversity			✓
Water			✓
Sustainable Use		✓	✓
Annex			✓

This year's report features the following changes compared to last year's edition:

- The overall content structure has been further developed for easier access to information on our sustainability efforts and progress supported by traceable internal and external data.
- Three new chapters (Innovation, Enabling Sustainable Food Systems and Product Supply) have been added to further increase our transparency in reporting on all aspects of our value chain (upstream, downstream and own operations).

Progress Highlights

**We joined
the Taskforce**
on Nature-related
Financial Disclosures



We have **committed to improve water use per kilogram of crop by 25% by 2030**, by transforming rice-cropping systems for our smallholder customers in the relevant regions where Bayer operates

In 2022, together
with our partners,
we have supported

52M

smallholder farmers
in LMICs¹ with
our products
and services

¹Low-and middle-income countries



In 2022, we have reached more than
**3.4M external contacts, including
2.7M smallholder farmers**, in the
safe use of our products



2017-2021:
We have reduced the
environmental impact
of our global crop
protection portfolio
per hectare by

14%

against a 2014 -
2018 baseline



We have **calculated a
global baseline** of our
customers' GHG intensity
in our major markets and
most important crop-
country combinations



Elevating Sustainability in Agriculture through Good Governance & Strategy

Can companies truly be trusted to hold themselves accountable for the steps they promise to take toward a rapid transition to a more equitable and sustainable economy? We think so. We can't skip to the finish line when it comes to reaching our targets for 2030. Accountability means reporting on the progress we make day in and day out: how we are getting there is just as important as where we are going. Good governance, a sustainable strategy, clear leadership and transparency are the keys to holding ourselves accountable every step along the way.

SDGs on which we have the greatest impact through our businesses:



Sustainability — embedded in our Corporate Strategy

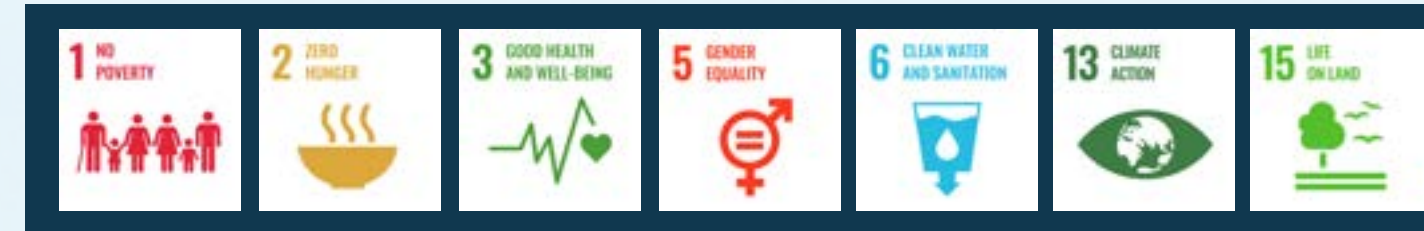
The Bayer vision of “**Health for all, Hunger for none**” is the focal point for strategy across all divisions at Bayer. We hold ourselves to a high standard of accountability when it comes to our Sustainability Strategy. Bayer has sustainable development objectives and targets embedded into its strategy and business model.

Through our Sustainability Report and additional ad hoc reporting, we disclose how we have identified and prioritized relevant sustainability topics on which Bayer has a clear impact.

These fundamentals for the whole Bayer organization carry through within the Crop Science division. In this report, we will highlight the most impactful stories regarding sustainable agriculture that complement and link to other reporting across the organization.

[Learn more about our corporate sustainability strategy in the Bayer Sustainability Report](#)

SDGs on which we have the greatest impact through our businesses



Our vision: “Health for all, Hunger for none”



¹These targets are accounted for in the long-term variable compensation (LTI) of our Board of Management of Bayer AG and our LTI-entitled managerial employees.

²This infographic provides only a high-level overview of our targets. Some targets are to be achieved by the end of 2029. Please refer to our [Bayer Sustainability Report](#) for details on each of the 2030 targets as well as our overall sustainability strategy.

LMICs: low- and middle-income countries
ESG: environmental, social, governance
GHG: greenhouse gas



Becoming an impact generator in agriculture

No one can see into the future, but we can all work together to shape it. At Bayer, we're committed to building a world where hunger and climate change are taken care of for years to come. We are working to make that a reality – and innovations on the farm can help get us there. That's why we're pursuing new possibilities in agriculture that are helping address some of humanity's greatest challenges for a more sustainable future.

Farming has always thrived on innovation. From the very beginning, farmers have sought better ways to nourish themselves, their families and their communities. This commitment continues today as we continually strive to find more sustainable solutions that can help farmers grow enough for a growing world.

Our Crop Science division's sustainability strategy focuses on the following sustainability areas and transformational commitments.

Producing more with less, while conserving nature

Areas of Impact



Our sustainability areas and transformational commitments

Biodiversity & Soil Health

Balance the need for crop production and nature conservation to ensure a healthy environment

Promoting Sustainable Use

Promotion of effective, safe and responsible use of our products; protection against product counterfeiting

On-field GHG Emissions

Reduce on-field greenhouse gas emissions of our farming customers per mass unit of crop produced in our major markets by 30% by 2030

Smallholder Farmers

Empower 100M smallholder farmers to benefit from access to education, tailored solutions & partners by 2030

Crop Protection Environmental Impact

Reduce the environmental impact of our global crop protection portfolio per hectare by 30% by 2030

Water

Improve water use per kg of rice crop by 25% by 2030 by transforming rice-cropping systems for smallholder customers in the relevant regions where Bayer operates

Governance — our path to become an impact generator

Clear leadership

Our governance system at Bayer starts with the Board of Management and its highest-level members acting with responsibility and accountability for our Sustainability Strategy. Our sustainability targets are not only being integrated into the company's decision-making processes – **Bayer also has incorporated measurable sustainability targets that carry weight into the long-term compensation of its management staff, including the Board of Management.** Operational implementation takes place in the divisions and along the value chain.

Additionally, Bayer has a dedicated **Environmental, Social & Governance (ESG)** Committee in its Supervisory Board to deal with ecological and social responsibility matters and sustainable corporate governance.

In 2020, we convened a Sustainability Council composed of independent international experts. This body brings together expertise in the areas of biodiversity, digitalization, health systems, the food and agriculture industries, sustainable finance and technology, fair trade and transformation strategies and women's rights. The Sustainability Council is helping us further develop the sustainability elements of our business strategy and provide guidance on the contribution that we can make with our research and development. It independently examines progress in the implementation of our sustainability targets and oversees the advancement of social innovations by the Bayer foundations. The Council reports annually on the progress of its work, and also promotes cooperation with networks in the areas of society, education, industry and politics.

Building Trust through Transparency

Our compliance principles apply throughout the Bayer Group and are established in our Corporate Compliance Policy. Here we commit to uphold ten principles, particularly in antitrust and anticorruption matters.

The Bayer Societal Engagement (BASE) Principles guide our interactions with everyone – our employees, patients, customers, consumers, business partners, public policy stakeholders, scientists, critics and our shareholders worldwide.

Our lobbying activities are guided by fairness, integrity and transparency, as well as fact-based information, and our Code of Conduct for Responsible Lobbying sets out binding rules for our involvement in political matters.



Learn more about our Code of Conduct for Responsible Lobbying and our Sustainability Stakeholder Engagement on our website



BILL ANDERSON,

Chairman of the Board of Management and Chief Executive Officer of Bayer. Responsible for sustainability implementation across the company.



RODRIGO SANTOS,

Member of the Board of Management of Bayer AG and Head of Bayer Crop Science Division, also responsible for the Latin America and Africa regions on the Group Board of Management; deeply committed to shaping a more sustainable and digital future of agriculture using science, innovation and technology to help farmers, the society and the planet.

Bayer Transparency Platform

Bayer has made safety-relevant data on crop protection products and genetically modified crops accessible. [Learn more](#)

Bayer Science Collaboration Explorer:

We publish information related to our scientific collaborations with [external partners.](#)

“OpenLabs”:

On our OpenLabs 360° platform you can observe our scientists as they carry out a safety registration study. [Learn more.](#)

Building strong relationships to foster agricultural transformation

At Bayer, we believe purposeful and strategic stakeholder engagement is fundamental to drive agricultural transformation. At Crop Science, our dedicated team within the Strategy and Sustainability group manages long-term relationships and partnerships, streamlining the inclusion of external input into our strategy.

Identifying key stakeholders

Following our vision, “Health for all, Hunger for none,” we are working to meet challenges like climate change, food security, environmental impact reduction as well as biodiversity and nature conservation. This is the lens through which we prioritize and identify stakeholders across our value chain. We identify stakeholders with whom to engage based on alignment with our sustainability and strategic priorities. For instance, we engage to promote regenerative agriculture as our vision for the future of farming.

In identifying key stakeholders, we first look within our value chain: growers (customers and non-customers), grower organizations and associations, retail partners, off-takers and traders, food manufacturers and processors to retailers. Additionally, we identify key stakeholders across international organizations, financial institutions, entrepreneurs, think tanks, non-governmental organizations, researchers and academia, and multistakeholder platforms such as the World Economic Forum (WEF) and the World Business Council for Sustainable Development (WBCSD). We seek engagement with underrepresented groups as well, particularly with youth and women. We identify organizations and individuals with shared goals and values, as well as those with different points of view.



We engage with a variety of stakeholders – from local farming initiatives to international organizations.



Who we engage with and how

At the Crop Science division of Bayer, our stakeholder activities range from local dialogues to international initiatives, addressing topics such as regenerative agriculture, healthcare, nutrition, climate change, biodiversity and water, taxes as well as poverty alleviation and farmers’ wellbeing.

To ensure diverse perspectives, we actively engage with International Organizations such as FAO, UN, UNEP, OECD, GSI and more, to find solutions to common challenges, develop global standards, share experiences and identify best practices to promote better policies for better lives. We also support and engage with farmer groups such as the World Farmers Organization and the Global Farmer Network, fostering dialogue and sharing insights to shape a more sustainable future.

But our commitment doesn’t stop there. We extend our engagement to local communities, embracing open dialogues and implementing programs that create a tangible impact. By collaborating and including many different voices, we forge robust relationships and work towards sustainable outcomes in agriculture.

Crop Science’s customer-centric approach shines through our Food Chain Partnership. With hundreds of initiatives across the value chain, we establish strategic alliances and cooperative models. Our shared goal? Driving positive change in food security, sustainability, and economic opportunities by offering innovative crop solutions and dedicated services for farmers.

Respecting human rights along our value chain

At Bayer, we are constantly working toward creating a world where everyone has access to essential services – be it health or nutrition.

In this report, we present some projects that either already have or will have a major impact toward achieving this aim. While much of the downstream impact we have generated is through our global work with [Smallholder Farmers](#) and [Sustainable Use](#), social inclusion is also a critical component of our governance that ripples across the value chain.

Our Human Rights Policy defines the human rights requirements within the company and obligates us to respect and foster human rights within our own business activities and in business relations. This applies to all Bayer employees worldwide and the entire value chain i.e. vis-à-vis suppliers, business partners, customers, consumers and local communities alike.

To reinforce our Human Rights Policy, we support and adhere to the United Nations' Universal Declaration of Human Rights and a number of globally recognized declarations for multinational enterprises, which you can read more about in our Human Rights Policy. In 2022, we introduced the position of Human Rights Officer at Bayer, who oversees human rights risk management and reports to the Board of Management. In collaboration with external business and human rights experts, a group-

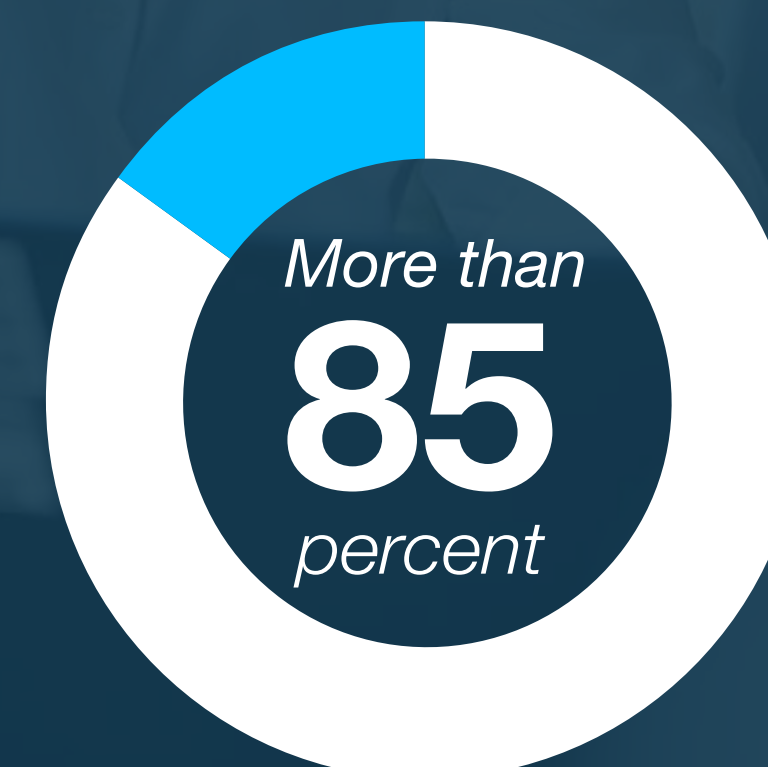
wide human rights risk assessment was completed, also involving internal experts and civil society organizations. We reported our results in the [2022 Bayer Sustainability Report](#).

A critical component of our Human Rights Policy is setting sustainable standards that the Bayer group requires its suppliers and subcontractors to share.

We established these principles through our Supplier Code of Conduct, which details key standards around pillars of Ethics; Labor & Human Rights; Health & Safety; Environment; Quality; Governance & Management Systems.

One factor of our Human Rights Policy that we hold to a particularly high standard is our stance against modern slavery and child labor — contemporary realities, especially in the agricultural business, that require unilateral cooperation from businesses, governments and stakeholders up and down the value chain in order to be stopped.

We also offer training on human rights, which includes the topics of modern slavery and child labor, in the form of an e-learning program. **In 2022, more than 85% of our employees received training on aspects of our Human Rights Policy in sessions totaling more than 165,000 hours. With this training, employees learn how to identify, analyze and address cases of human rights violations.** The topic of human rights is also an integral element of training measures for the management of our country organizations.



of our employees received a training on aspects of human rights

Diversity, equity and inclusion

Cultivating an inclusive workplace

The Bayer group goals of furthering diversity, equity and inclusion carry through within the Crop Science division. One established target that we are striving towards is establishing gender parity at all management levels by 2030. By the end of 2022, the proportion of women in management rose to 42.9%, compared to 41.9% as reported in 2021. The proportion of women in the Group Leadership Circle, the highest management level in the Bayer Group below the Board of Management, rose slightly. In 2022, it consisted of 27.8% women, compared to 26.8% as reported in 2021.

Various business resource groups (BRGs) are also in place to give a voice to diverse constituencies within our company and to our customers. These business resource groups assist Bayer with cultivating an inclusive workplace and help shape how we engage with customers, community, and our culture. Participants of these company-sponsored BRGs work together to promote inclusion within Bayer and provide a multicultural lens to our company's engagement for our customers and the communities we serve.

3 of the 9
company-recognized BRGs
with a global footprint.

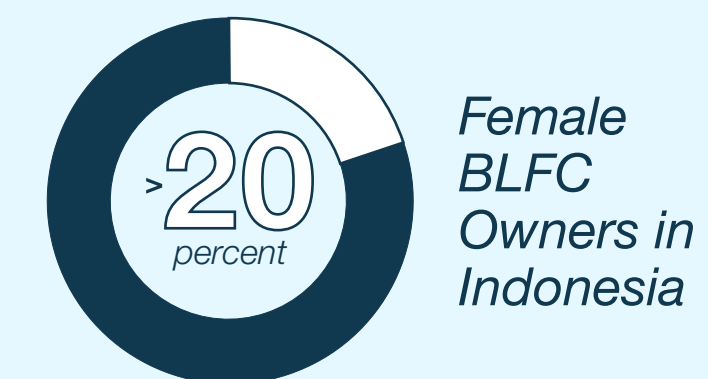
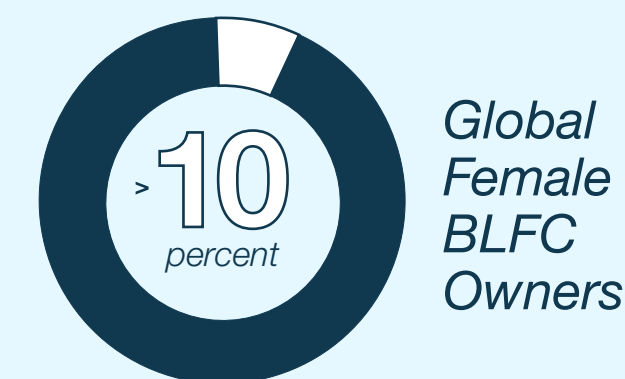


Supporting women and youth in agriculture

Inclusion is an important factor for all our operations, as demonstrated in the Smallholder Farmers chapter of this report. Here are some concrete examples on how we are working to support women and youth in agriculture:

- **Better Life Farming Centers (BLFC):**

Through Better Life Farming, a long-term partnership between Bayer and several external partners, a growing number of women have opened Better Life Farming Centers in their communities. This means increased women's empowerment and female farmer community-building in rural areas. Read more about how we support women farmers holistically in our chapter on Smallholder Farmers.



- **Farm to Market Alliance (FtMA):**

Together with the UN World Food Programme (WFP) and other organizations, Bayer is a founding member of the Farm to Market Alliance which supports smallholder farmers in Kenya, Rwanda, Tanzania and Zambia. Since 2016, FtMA has reached around 490,000 farmers through the engagement, 47% of them being women. In Kenya, for example, FtMA has built a network of 944 Farmer Service Centers (FSCs) benefitting 207,000 smallholder farmers, of them 41% women and 21% youth. FtMA ensures inclusion of women, youth, and marginalized persons by increasing representation from these groups by 9% from 2021-2022.

FtMA globally reached

490,000 & 1,900
farmers at the end of 2022 Farming Service Centers

47% Female

In Kenya

944 FSCs & 207,000
have been onboarded to the FtMA network they currently serve smallholder farmers

41% Female

- **Recognizing female entrepreneurs through the Bayer Foundation's Women Empowerment Award:**

This reward recognizes outstanding female entrepreneurs from the Global South (Latin America, Africa, and the Middle East, and Asia Pacific) who are driving social change through their innovations in health, nutrition and agriculture. Read more about these female founders revolutionizing health, nutrition and agriculture [here](#).

- **Empowering the next generation of agricultural leaders:**

With the average age of a farmer being 60, and less than five percent of the population in developed countries being engaged in farming, empowering the next generation of agricultural leaders is imperative to the future of agriculture. Therefore, Bayer engages with a diverse set of stakeholders interested in the future of agriculture through partnerships, including a multistakeholder platform called [the Next Generation Ag Impact Network](#) (NGIN – pronounced engine). NGIN involves student associations, youth movements, academic institutions, the private sector, and international organizations to provide a place for open discussions, capacity building, and a 'marketplace' to exchange ideas and networks. The objective is to ensure the economic, ecological and social viability of the agricultural sector for generations to come.



Learn more about our efforts demonstrating good governance



[Sustainability Management](#)



[The Sustainability Council of Bayer](#)



[Supervisory Board Committees](#)



[Stakeholder Dialogue](#)



[Code of Conduct for Responsible Lobbying](#)



[Our Collaborations with External Partners](#)



[Food Chain Partnership](#)

Have questions or would like to discuss governance and transparency directly with us? Please reach out!



[Engage on LinkedIn](#)

JESSICA CHRISTIANSEN,
Head of Sustainability and Business Stewardship at Crop Science, a division of Bayer AG



Powering Regenerative Agriculture through Our Innovation Engines

How can we grow enough to feed and fuel the world around us? Can we create a more sustainable, healthy and resilient food system while helping farmers produce more with less? We believe we can, even as climate change, declining natural resources and supply chain issues make the job even more complex. At this pivotal moment, we need breakthrough technologies for a smarter approach. We need science and smart systems to optimize our inputs and outcomes, and we need to do it all in a way that sustainably benefits the environment and growers. Put simply, we need to do things differently – and this is where regenerative agriculture comes into play.

Our efforts in R&D and innovation contribute to the following U.N. Sustainable Development Goals:



Our Vision for Sustainable & Regenerative Agriculture

Innovation Engines to Power our Vision

The Farming of the Future

R&D Investments

Access to Innovation and IP Rights

Broadening our sustainability approach with a regenerative focus

Two of the most globally recognized challenges the planet must face by 2050 are food security and climate change. From a farmer's perspective, climate change is projected to reduce harvest yields by 17 percent by 2050 while arable land is expected to decrease by 20 percent in the same time period. Moreover, our global population is expected to increase by 2.2 billion people by 2050¹; combined with climate change impact, this means the planet will need to increase food and feed output by 50 percent to meet future food demand.

Growing Population — — — — — Pressure on Ecosystems — — — — —

+2.2bn
people on the planet by 2050¹

+50%
more food and feed required to meet growing demand²

-17%
harvest losses from climate change³

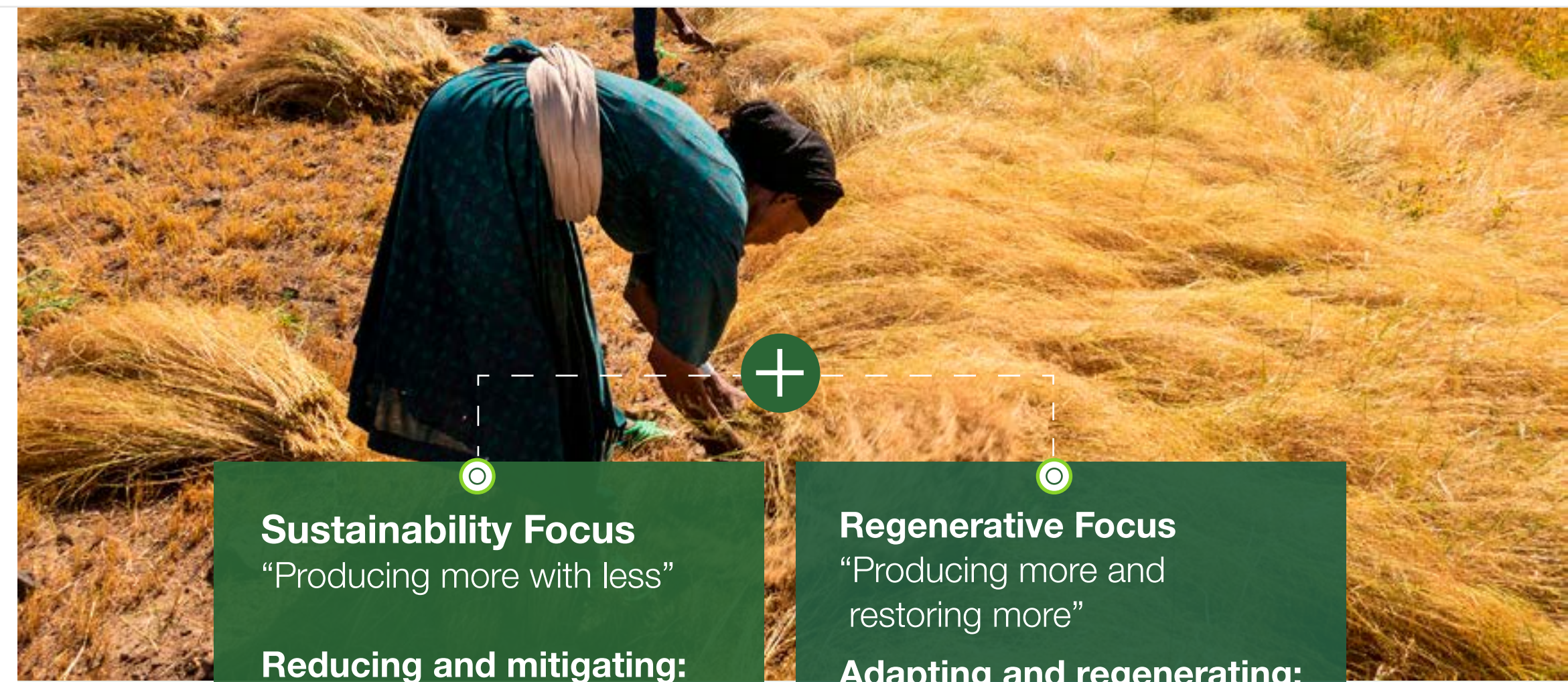
-20%
loss in arable land per capita by 2050⁴

¹UNDESA 2017 (United Nations Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision)

²FAO 2017, (FAO Global Perspective Studies)

³Nelson et. al, (2014); FAO 2016 "Climate change and food security"

⁴FAOSTAT for 1961-2016 data on land, FAO 2012 for 2030 and 2050 data on land, and UNDEDA 2017: World Population Prospects for world population data



Sustainability Focus
"Producing more with less"

Reducing and mitigating:
Increasing productivity while reducing the impact on nature

Regenerative Focus
"Producing more and restoring more"

Adapting and regenerating:
Increasing productivity and incomes while renewing nature

In order to address these global challenges, we believe that we must do things differently. At Bayer, we're only at the beginning of the journey towards a sustainable future in farming, but we see potential to scale up regenerative practices on farms around the world – whether big or small. As a key point of departure, we're taking a system approach to regenerative agriculture. This means we're increasingly treating each farm as an ecosystem in itself, with its unique soil and environmental conditions. With this information, we can provide farmers with a tailored but comprehensive farm solution combining innovations in seeds and traits, crop protection and digital technology.

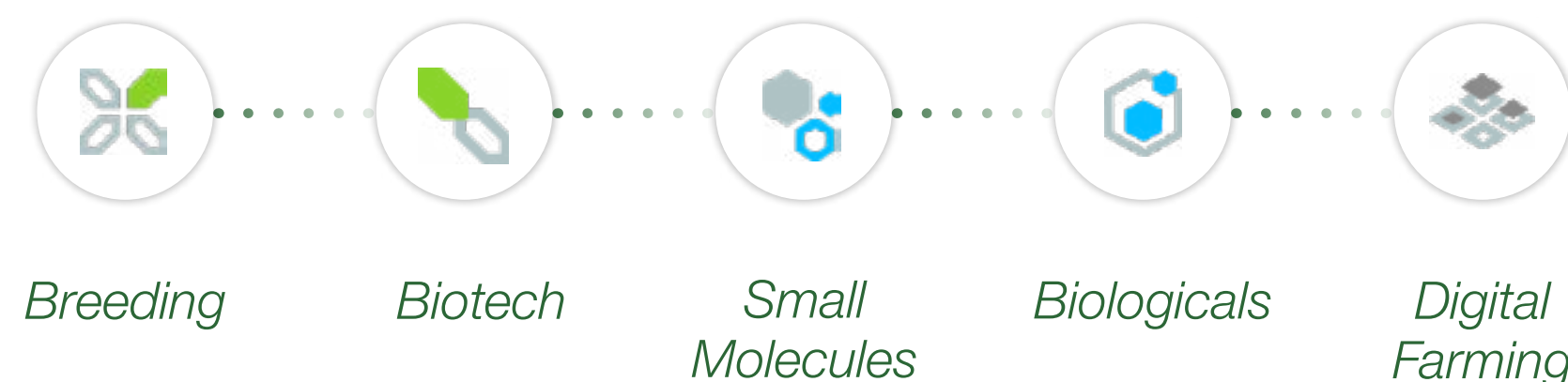
Our concept of regenerative agriculture is based on two key building blocks: **productivity**, which focuses on helping farms to produce more with less, and **restoring more through delivering positive impact on nature**, which can be done, for instance, by improving soil health, restoring biodiversity and conserving water.



Advancing sustainable agriculture solutions towards regenerative agriculture

With our global presence, leading market position and comprehensive farming solutions, we aim to drive the shift towards regenerative agriculture by decreasing the climate footprint of farming, reducing the environmental impact of crop protection, enabling smallholder farmers, and improving water use. At the same time, we're aiming to deliver net benefits to nature that could be measured in terms of, for example, better soil health, restored biodiversity, reduced water and sequestered carbon. We're doing so while supporting farmers in their efforts to increase agricultural yields, farm productivity and incomes with effective climate adaptation solutions and new sources of revenue. Our vision is powered by five innovation engines:

Innovation Engines



Breeding: Through our global breeding efforts in vegetable seeds and row crops, our Precision Breeding initiatives aim to create a design-driven methodology for crop improvement, developing more resilient crops and sustainable product concepts. Agriculture is undergoing one of its biggest transformational shifts: Advancements in mechanization, sensors, imaging capabilities and digital solutions are driving substantial increases in on-farm productivity and more precise management of environmental variability. This will help farmers adjust to changing pests, weeds and diseases, and variable climatic conditions while **decreasing the environmental impact in both the breeding R&D process and on the farm.**

Plant Biotechnology: Over the last 27 years, we have launched more than 65 biotech traits – more than any other company – enabling farmers to grow crops like maize, soybeans, cotton and canola with game-changing capabilities. Our biotechnology traits contribute to sustainable agriculture by **protecting plants from insects and plant-specific diseases helping farmers increase their yields and productivity while using natural resources more efficiently.**

Small Molecules: To address climate change and sustainability, we focus on **optimal and precise application and better environmental profiles in our crop protection products.** Our scientists are unlocking the future of sustainable protection using an approach we call CropKey. Using data-driven technologies, we narrow down those molecules with promise of efficacy and eliminate those that do not reach our high safety and sustainability standards far faster than in the past. Over 30 potential new targets under investigation currently, including a unique broad-spectrum fungicide for use in fruit and vegetables and a new herbicide molecule for broad acre post-emergent weed control, are expected to reach the market in the next decade.



The key to delivering CP EIR is innovation and the high product development standards we apply. With CropKey, we bring the future of sustainable crop protection to the market. Our seeds & traits and digital offerings complement our crop protection portfolio. All these technologies help to deliver on our CP EIR commitment.

CP EIR = Crop Protection Environmental Impact Reduction

Biologicals: The biologicals industry is rapidly expanding in various directions, including nature-derived biocontrol and biostimulant solutions like pheromones, botanicals, plant extracts and synthetic biology applications. Bayer is already shaping and growing the biologics segment as the preferred R&D development and commercial partner, leveraging our trusted brand, regulatory expertise and global capabilities to efficiently bring new products to the market. Nitrogen-fixing microbes for food security crops like maize, wheat and rice are among the innovative solutions we are exploring. Through open innovation and partnerships with Ginkgo Bioworks and Kimitec, we are developing next-generation biologicals, including nitrogen-fixing technology and nature-derived crop protection products and

Our Vision for Sustainable & Regenerative Agriculture

Innovation Engines to Power our Vision

The Farming of the Future

R&D Investments

Access to Innovation and IP Rights

biostimulants. Synthetic biology plays a vital role in nitrogen fixation, offering a sustainable alternative to synthetic fertilizers. By bioengineering nitrogen-fixing bacteria, Bayer aims to **reduce reliance on harmful fertilizers while maintaining food production capacities.**

Digital Farming Solutions: Digital tools and data have been transforming agriculture for years. We have developed new ways to help growers make decisions about their farm – equipping them with data far beyond what the eye can see. Our FieldView™ platform and partnerships with companies like Microsoft deliver downstream value, while digital tools enable growers to make data-driven decisions to improve farm sustainability and productivity. By expanding the digital transformation into the value chain, we aim to **create new value pools in regenerative agriculture practices.** Consumers increasingly demand sustainably-grown products, and digital farming plays a crucial role in achieving that.

The combination of these innovation engines differentiates us from the competition and allows us to think differently about how agriculture can work as a system, bringing sustainability targets into our core business. While we are only at the beginning of unlocking the full potential of a system approach, we believe some key offerings in our current solution portfolio have the potential to shape the regenerative future in agriculture in the coming years.

Today, our accessible market has an estimated value of more than 110 billion dollars globally. By 2030, we expect our systems to unlock new opportunities – from carbon farming to digital platforms – with an estimated value of over 220 billion dollars. This would double our accessible market today, and we don't see ourselves as mere participants: we want to co-lead innovation within the agricultural sector. **In the future, we expect that both data and carbon stored in the field will be as important as yield.** We're actively building the future we envision, where our technologies will contribute to sustainable farming worldwide.



Top Talent:

>7,700

R&D employees⁵
distributed
across ~130 sites
worldwide

>100

Key Collaborations

Providing Next Generation Solutions:

>500

Hybrids & Varieties
Deployed in '22

12

New Biotech Traits
in Development

>250

New Crop Protection
Registrations in '22

30-60

New Molecules in
Field Trials Annually

⁵Per Bayer Annual Report

Enabling regenerative agriculture systems around the globe

More than half a billion farmers worldwide could benefit from our comprehensive portfolio of sustainable solutions to take their operations to a whole new level. Our systems will help ensure they are at the forefront of regenerative agriculture.

We will now look into our vision of what the farms of the future – powered by Bayer – can look like across North America, Europe, Latin America and Asia/Pacific.

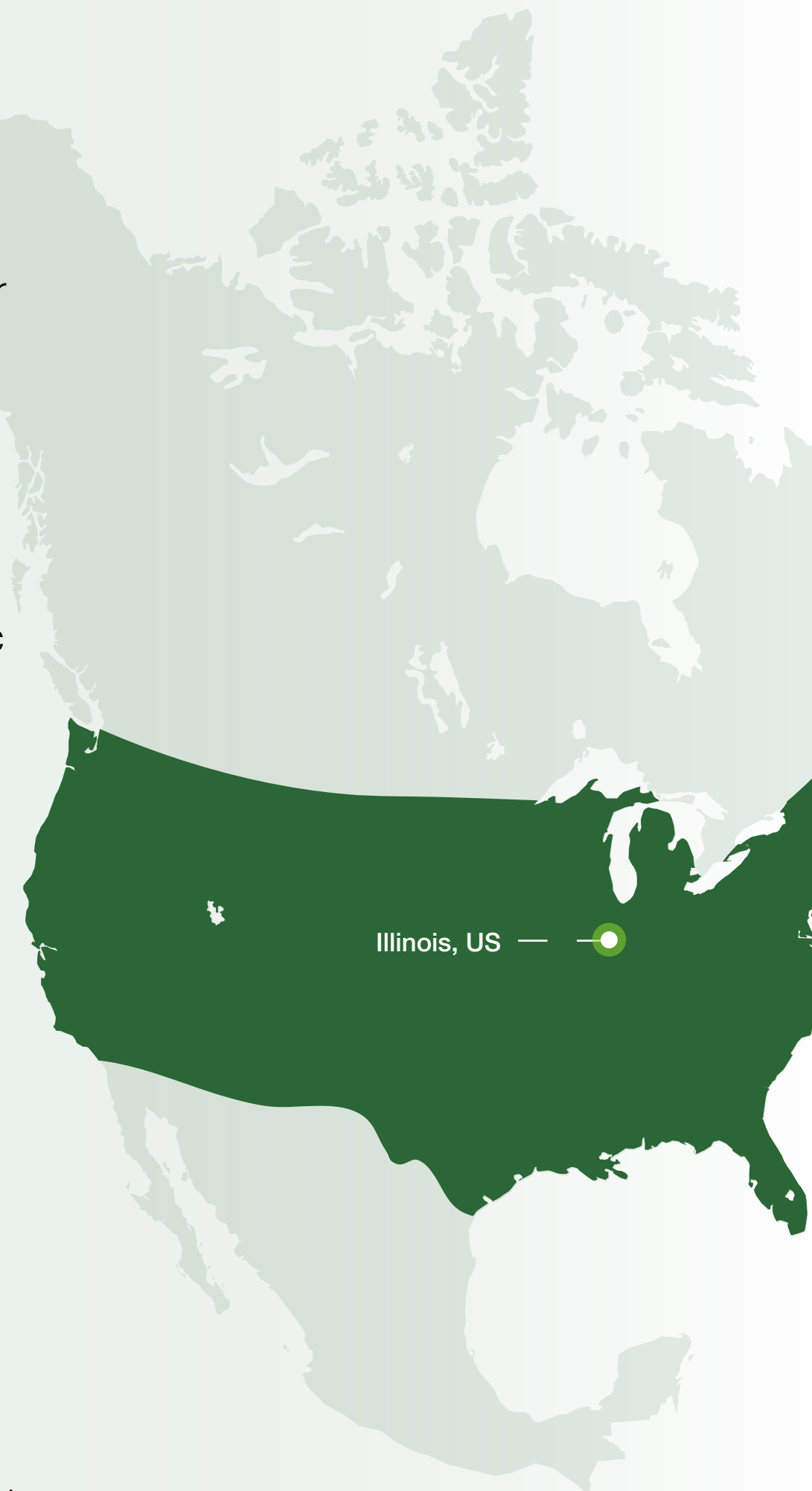


Farm of the future: Visionary example for North America

John, a farmer in Illinois, has transformed his 2,000 hectare farm using Bayer innovations. He follows a three-crop system of Preceon™ Smart Corn, CoverCress cover crops and next generation herbicide-tolerant soybeans, embracing regenerative agriculture. By adopting these technologies, John's farm has become more productive, sequestered carbon and has improved soil health.

Through digital tools such as FieldView™ and tailored recommendations from Microsoft Azure based on historic field data, he optimizes planting, monitors his fields and makes precise product applications. He also harvests cover crops as low carbon biofuel and sells the carbon credits he is qualified for via ForGround, generating additional revenue. With this regenerative model, John and other farmers in North America could plant three crops over two seasons with outcome-based pricing, where their system of products would come with a predicted yield and a plan for how to make it happen.

This system-based approach from Bayer showcases the future of farming in North America, with increased productivity, additional revenue streams and environmental benefits through regenerative practices.



[Learn more about the Preceon™ Smart Corn System](#)

[Our Vision for Sustainable & Regenerative Agriculture](#)
[Innovation Engines to Power our Vision](#)
[The Farming of the Future](#)
[R&D Investments](#)
[Access to Innovation and IP Rights](#)

Farm of the future: Visionary example for Europe

In Almería, Spain, farmers have been innovating in intensive, protected agriculture for decades. Despite the climate, they harvest multiple times per year thanks to groundwater collection and innovative structures.

Pablo, a local farmer, is using precision-bred De Ruiters tomato plants that are resistant to disease. He uses biological fungicides and plant activators, such as Serenade™, Nematool® and Ambition®, to enhance root development and manage pests. Through digital tools like PlantBalance, he is able to make efficient cropping decisions based on weather and disease forecasts. By employing Vynyty Citrus® – a pheromone-based product that meets residue standards – Pablo ensures high-quality, marketable harvests.

With these advancements and sustainable practices, Pablo achieves higher yields, decreased emissions and reduces his water usage, all while satisfying tomato consumers in Spain.



[Learn more about our innovative vegetable seed solutions helping farmers produce more with less](#)



Farm of the future: Visionary example for Latin America

Anna, a future farmer in the state of Paraná, Brazil, operates a unique cropping system where soybean and maize can be grown and harvested in the same year. With innovative solutions from Bayer, she optimizes her farming practices and achieves sustainable outcomes.

Using the Orbia platform powered by FieldView™ data, Anna receives tailored advice on seeds and traits, along with access to value-added services like financial support and insurance. She chooses Monsoy, a high-yielding soybean variety bred specifically for her farm, and purchases crop protection products following Orbia's marketplace recommendations.

Anna ensures seed success by pretreating them with a biostimulant that provides insect and nematode control. Through digital monitoring with FieldView™ alerts, she promptly detects and manages pest and disease pressure. Precision application practices allow her to save input and fuel costs, and enhanced Verango® helps control nematodes effectively. She also uses Plenexos™ when she receives alerts about increasing pest pressure.

Anna adopts science-based assessments and agronomic recommendations to produce with a low carbon footprint and sequester carbon, leading to higher yields and new revenue streams. With verified data points, she sells her soybeans with a valuable low carbon certification to Bayer via PRO Carbono commodities.

As Anna prepares for her maize rotation, she has confidence in solutions to maximize her yield while improving the soil's health. The future of farming through Bayer innovations brings excitement for Anna and all of us.



[Learn more
about modern
breeding](#)





Farm of the future: Visionary example for Asia/Pacific

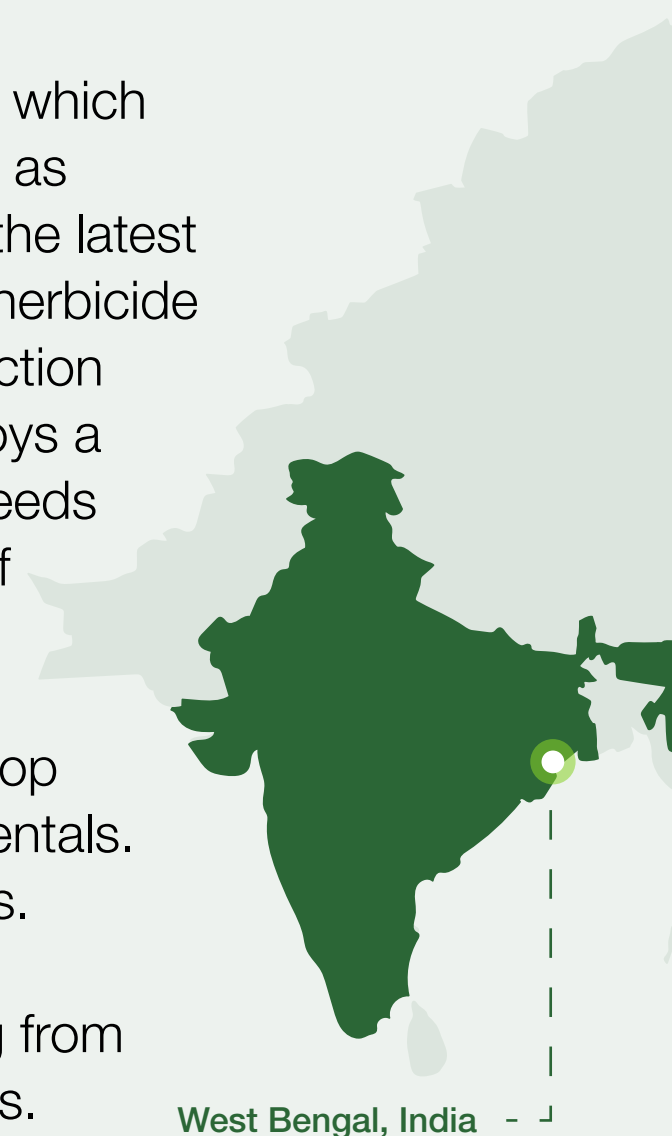
Ramesh, a rice farmer in West Bengal, India, faces challenges of labor shortages and impact from climate change. To overcome these, he adopts innovative farming practices supported by Bayer solutions.

Ramesh transitions from traditional rice transplanting to direct seeding, which requires less water and labor. He uses a rice seed drill machine as well as drone technology for planting, saving time and effort. Ramesh selects the latest hybrid rice seed specifically designed for direct seeding, with traits for herbicide tolerance, resistance to diseases like bacteria and leaf blight and protection against pests like rice stem borer and EverGol® for leaf blast. He employs a combination of herbicides with different modes of action to manage weeds effectively. For disease control, Ramesh relies on the next generation of Bayer fungicides.

The Farmrise™ digital app provides Ramesh with agronomic advice, crop management practices and access to services like tractor and drone rentals. He also participates in a carbon credit program for additional incentives.

Ramesh is part of a larger community of smallholder farmers benefiting from mechanization, digital empowerment and access to inputs and markets. The adoption of Direct Seeded Rice can significantly increase rice yields while reducing production costs, greenhouse gas emissions and water usage. This transformative shift has the potential to benefit millions of smallholder farmers globally, creating a sustainable future for agriculture.

These fictional example are used to portray what an output systems farm can look like in the future. They show the interaction of our innovative products that will be key for each region and how they can interact in a system-based approach.



[Learn more about hybrid rice seeds](#)



[Learn about direct seeded rice](#)

Technology to power the future of farming

From **John**, our multi crop farmer in Illinois, **Pablo**, our tomato grower in Spain, **Anna**, our soybean and maize farmer in Brazil and **Ramesh**, our rice farmer in India, we have a strong sense of what the future of farming will look like around the globe. All of them show how our innovative systems can produce more food, have less environmental impact and help to restore the planet.

The future of our business will be determined by new technologies such as biological breakthroughs, precision application and technology and carbon reduction solutions. Given that we expect our accessible markets to double in the next decade, we have set ourselves **four strategic priorities**.

- 1 **Maintain leadership in core markets** like maize, soybean and crop protection.
- 2 **Define and shape regenerative agriculture**, and scale it up, fulfilling our downstream sustainability commitments.
- 3 **Enable farmers with full crop systems and digital tools** to make data-driven decisions that increase their efficiency and productivity.
- 4 **Walk the talk by investing in our accessible markets**, building the farms of the future.



Investing in the future of agriculture

Our innovations add value to farmers worldwide. With over 2.6 billion euros invested annually in R&D and a strong global presence, we are the leader in innovation in the agriculture sector.

Scale and size matter – and as a leader in our industry, we’re investing more than twice the level of our peers. We also serve as a technology provider for the industry through our broad licensing approach and our Open Innovation Framework.

These investments translate into a pipeline with a peak sales potential of more than 30 billion euros, half of which is incremental to our current sales. Despite numerous new launches each year, we continue to replenish our potential value with more than we deplete. We’re proud of our progress and **aim to reach 80% of our peak sales potential by 2037.**

Transformative solutions such as the Preceon® Smart Corn System, herbicide-tolerant soybeans and insect protection in soybeans will be key drivers for our growth and sales opportunities. Additionally, we have set ambitious targets and actively pursue open innovation sourcing strategies for biologicals. New molecules in herbicides, fungicides and hybrids also hold significant revenue potential, addressing weed control, disease management and crop protection challenges.

We are also the partner of choice for up-and-coming innovators, as evidenced by more than 100 key collaborations, and we further expand our innovation reach through our Leaps by Bayer venture capital arm, which has 18 distinct investments in sustainable productivity and improved nutrition.

Leaps by Bayer technology investments expand R&D reach

18 Distinct Investments in Sustainable Productivity and Improved Nutrition

Leap 03 | Reduce environmental impact of agriculture

Leap 07 | Provide next-generation healthy crops



Leap 08 | Develop sustainable protein supply

Leap 09 | Prevent crop and food loss





Access to innovation and path to market

As communities fight poverty, hunger and malnutrition, it's our responsibility to expand the reach and impact of our global breeding resources. Supporting the advancement of agricultural science for the benefit of farmers, consumers and the planet through partnerships and contributions is at the core of who we are as an innovation company. These global partnerships are aimed at knowledge sharing as well as germplasm and data contributions, working to improve the availability of high-performing seeds for farmers.

The partnerships we pursue are often cross-sector and focus on supplementing the skill sets of local researchers and farmers by sharing our team's knowledge and experiences. They prioritize the inclusion and diversity of local culture and gender representation, driving a positive impact by connecting unique local know-how with our global insights. We believe that the solutions with the greatest impact for agriculture's biggest challenges will be reached through collaboration that brings together diverse insights.

We also use our scale for good – through germplasm and data contributions to breeding and seed bank programs – across a variety of crops and world regions. Our large global testing footprint, vast germplasm library and extensive genetic characterization data are unmatched in the industry. **As a company that's passionate about the advancement of agricultural science and – most importantly – seeing that advancement make a positive impact for farmers as quickly as possible, the opportunity to enable this kind of benefit sharing is exciting for our team.** We are involved in many projects and programs dedicated to advancing agriculture around the world.

For example, Bayer collaborates with [The World Vegetable Center](#) in Asia and Africa, an international non-profit research and development institute. The institute's mission is to reduce hunger by increased production and consumption of vegetables. One way to reach the goal is by providing germplasm to partners like Bayer that can develop improved varieties for smallholder farmers. Another example is our collaboration with the Asia and Pacific Seed Association (APSA) which strives to promote, develop, research and market quality seeds. These collaborations can boost smallholder business, while improving the quality of inputs and access to resources that support food security.

We apply market segmentation and/or differentiated pricing schemes and ensure affordability by adapting package size, pricing, distribution, advice and training. We also have differential pricing schemes per country and focused breeding programs for certain crops.

We price our technologies taking into consideration the value that they generate. We develop local trials to understand the value that our products bring to smallholder farmers, and prices are set according to market realities, smallholder farmers' affordability and local regulations.

We also uphold an internal [Stewardship Guiding Principle](#) to identify and implement adequate processes to grant access to technology for humanitarian purposes. The guideline ensures that seeds and traits technology transfer requests from third parties in the Developing World, or representing Developing World interests, are assessed in a consistent and diligent way so that Bayer can select and then support appropriate initiatives on a case-by-case basis according to the Bayer policy on technologies for the Developing World. This guideline considers requests for the transfer of seeds and traits technologies and associated IP from Bayer to third parties for research and development activities that have the potential to capacity-build or enhance agricultural practices in the Developing World.

Critical to tackling the many and diverse challenges of smallholder farmers is the establishment of successful public-private partnerships. **Like other companies in the agricultural industry, we are committed to driving innovation into new seed markets and partnering with other organizations to improve product quality.** An example is our [TELA Maize Project in Africa](#): by providing research, technical expertise and both drought-tolerant and insect-resistant traits on a royalty-free basis, we can enhance food security for farmers and their families.



Providing research, technical expertise and both drought-tolerant and insect-resistant traits on a royalty-free basis, we can enhance food security for farmers and their families.

Intellectual property rights

We are an innovation-driven company with significant investment in R&D. It is important to find measures that secure the investment in R&D because the result of our innovation may be easily copied by competing companies. Therefore, we advocate for high standards of intellectual property protection that should be internationally aligned.

As a major contributor to agricultural research and development globally, we invest significantly, among other things, in plant breeding innovations including biotechnology, and we are therefore an active participant in discussions and arrangements concerning plant-based intellectual property rights.

Facilitating access to patented traits in seeds

Beginning in 2023, Bayer is a founding member of the [Agricultural Crop Licensing Platform \(ACLP\)](#), an industry initiative aimed at enabling and expediting access to innovation for European-based seed companies. European breeders becoming members of ACLP will be able to continue using commercial varieties for breeding, including those containing patented traits.

Bayer also offers [small vegetable breeding companies in the European Union](#)⁶ access, free of cost, to our European patents on traits in vegetables, which are in the [Euroseeds PINTO](#)⁷ database and licensable by Bayer. With this initiative, we intend to address concerns that small breeding companies especially may have regarding access to patented innovation. The initiative has now been translated into several EU languages and communicated to many small breeding companies and relevant stakeholders. Bayer openly welcomes other owners of intellectual property rights to provide similar initiatives.

Intellectual property rights play an important role in innovation, including developments in plant breeding to make vegetables and crops more resilient, less demanding of resources and higher yielding. These innovations help to meet sustainability goals, mitigate the impact of climate change and support food security. You can find more information on our position on intellectual property rights on our [Principles and Positions page](#).



⁶Company (i) registered in a Member State of the European Union, (ii) operating in the business of breeding and selling seeds of vegetable varieties in Europe, and (iii) being a small enterprise according to the definition of the European Commission Recommendation 2003/361/EC (available [here](#) in several EU languages).

⁷PINTO (Patent Information and Transparency On-line) was created with the aim of improving transparency regarding plant varieties that might fall under the scope of patents or patent applications.

Enabling Sustainable Food Systems

In a rapidly growing and interconnected world, the sustainability of our food systems has become of paramount concern. As the global population continues to expand and the effects of climate change become increasingly evident, it is essential that we develop and maintain food systems that are not only capable of meeting the nutritional needs of present and future generations, but also reduce their impact on the environment. The importance of sustainable food systems lies in their ability to preserve natural resources, ensure food security, support local economies and mitigate the adverse effects of agriculture on climate change and biodiversity. These global challenges require a scaled-up impact to overcome them, and this can only be achieved through a global community and with collective action. This is why at Bayer, we believe that by participating and enabling multi-stakeholder partnerships, we can join forces with key food system players – through a united agenda and co-creation models – to safeguard our planet's ecosystems and ensure the well-being of both present and future generations.

U.N. Sustainable Development Goals on which we have the greatest impact through our businesses:



Our Approach

As a global leader in the life sciences industry, we are committed to playing a significant role in the transformation of our food system towards sustainability. Our goal is to contribute to food and nutrition security for all while preserving the economic, social and environmental foundations for future generations. Aligned with the Food and Agriculture Organization's (FAO) definition of a sustainable food system, our focus lies in three key priorities outlined in the UN Food Synthesis Report 2021 (status 2022): **Zero Hunger & Nutrition, Resilient Food Supply Chains and Sustainable Productivity Growth.**

Our response to these priorities is centered on improving food and nutrition security, enabling farmers to produce nutritious foods and reducing food loss and waste. To this end, we recognize the vital role of collaboration, and actively engage with Multi-Stakeholder Platforms as these partnerships are instrumental in driving the necessary transformation of our food system.

Through innovation, responsible practices and collaboration, we want to help build a future where everyone has access to safe, nutritious and sustainable food. We are dedicated to developing inclusive solutions that address the challenge of food and nutrition in security. By working with governments, civil society, farmers and other key stakeholders, we aim to create resilient and innovative food supply chains that contribute to sustainable productivity growth.

We have also committed to the Zero Hunger Private Sector Pledge, joining the global movement to end hunger. By fostering collaboration and employing responsible practices, we strive to build a future where the economic, social and environmental aspects of food and nutrition security will not be compromised for future generations.

Our collaboration with Multi-Stakeholder Platforms



GABRIELA BURIAN,
Global Partnerships /
Multi-Stakeholder Platform Lead



[Read the UN Food Systems Summit Synthesis Report 2021 \(status 2022\) here](#)

*WBCSD: World Business Council for Sustainable Development

**WEF: World Economic Forum

***SMI: Sustainable Markets Initiative

Our stake in the food system

Our core mission at Bayer is “Health for all, Hunger for none”. As leaders in our industry, it is our responsibility and our great honor, to develop programs, tools and technologies that help put nutritious vegetables, fruits and wholesome grains on every table.

The Zero Hunger Private Sector Pledge

The Zero Hunger Pledge is a demonstration of our commitment to help end hunger by 2030.

This pledge was created as part of the UN Food Systems Summit Coalition of Action for Achieving Zero Hunger, one of the emerging multistakeholder coalitions from the UN Food Systems Summit process. We committed to contribute \$160 million dollars to achieve Zero Hunger in developing countries between 2022 and 2030, with multiple partners.

The Zero Hunger Pledge aligns governments, agencies, civil society and businesses with the 10 high-impact intervention areas from the Ceres2030 evidence, a unique research project by scientists from Cornell University, the International Institute for Sustainable Development (IISD) and the International Food Policy Research Institute (IFPRI) that provides practical recommendations on how to end hunger by 2030 worldwide – and on a lasting basis.

According to Ceres2030, the investments needed can be categorized as “Empower the Excluded”, “On the Farm” and “Food on the Move”, and there are several ways for private companies to contribute to the Zero Hunger Pledge. We are aligning our investments and business operations more clearly and strongly with this new evidence on effective ways to achieve these goals.

Achievements and advancements in 2022

We invested €13M to develop **Vegetable Seeds** varieties that help smallholders grow quality and nutritious fruits and vegetables in Africa and Asia. We’ve developed 20 different vegetable crops with the intention to reduce both field and post-harvest losses. We helped to support more than 50,000 households and smallholder farmers in Ukraine and Brazil with seed donations.



In Africa and Asia, we’ve invested

€13M

to develop Vegetable Seed varieties that help smallholders grow quality and nutritious fruits and vegetables


Through the **Modern Breeding Project**, we co-developed superior cultivars for critical African crops alongside our partners at the International Institute of Tropical Agriculture (IITA). Together we contributed technical expertise in plant breeding to create a baseline for genetic gains across six crops and 31 product pipelines. Furthermore, we provided industry best practices on operational excellence of the product pipeline progress. The project received a high commendation for the “Best Public Outreach Program” by S&P Global Commodity Insights in 2022.

Through our **Arize Hybrid Rice Seeds** Program, we are upscaling sustainable rice cropping systems to 10,000 acres in India, with farm level interventions and innovations. Through this [program](#), we offer a comprehensive system of technological and agronomic advisory and inputs to make direct seeded rice successful at the farmer’s own rate.

Three of our Arize hybrids – known for their higher nutrient and water use efficiency – were launched in India, Bangladesh and the Philippines.

Through **Better Life Farming** and the “BLF Academy” in India, Indonesia and Bangladesh, we trained smallholder farmers on business topics, including safe-use of agrochemicals, good agricultural practices, gender awareness and health. Additionally, we invested in two government programs in India to help identify potential female agri-entrepreneurs.

Through the **BayG.A.P.** program, we trained small and medium-scale farmers in 16 countries to implement sustainable farming standards and principles of good agricultural practices. We also added two new value chain solutions that are being piloted in Ecuador and India, with the aim of improving market access for farmers with local supermarkets, reaching more than 190 farmers. Additionally, we have expanded our training portfolio with a new training on Regenerative Agriculture. We have also held biosecurity trainings on Tropical Race Disease of bananas (TR4) for more than 200 farmers in Vietnam.

 [Read more about the Zero Hunger Pledge](#)


402,000 farmers
trained on Sustainable Farming Standards

3 *new rice hybrids developed* 

50,000 households 
supplied with seed donations

11 African countries 
supported in breeding technology

>900 *Better Life Farming Centers opened*

Better farming to ensure food and nutrition security

Food and nutrition security are pressing global challenges, and we are deeply committed to addressing them. In 2022, approximately 900 million people were severely food insecure, and by 2050, our food systems must provide quality and nutritious food for an additional two billion people. At Bayer, we recognize the urgency of this challenge, and we're collaborating with multiple stakeholders to help shape food and nutrition security for the benefit of farmers, consumers and the planet.



Our contribution to food and nutrition security

As included in the [FAO's The State of Food Security and Nutrition in the World 2020](#), we similarly see food and nutrition security as a three-tiered challenge: ensuring sufficient energy and calories in a diet, ensuring richness in nutrients and ensuring the inclusion of foods from different food groups. Through our products, investments and initiatives, we are playing a role across each level:

- Level **Energy Sufficient Diet:** our large footprint in supporting corn and wheat exports worldwide, and our investments, **1** show our commitment to supporting the foundational staples for a food- and nutrition-sufficient diet. We focus on maize for African countries such as Kenya and Malawi, and on rice for Asia/Pacific geographies like India. Our actions are aimed at optimizing portfolios, implementing stewardship programs, fostering partnerships and developing and promoting digital solutions.
- Level **Nutrient Adequate Diet:** our commitment to this level is exemplified through our work with the UN-private sector led Zero Hunger Pledge, combined with our innovative vegetable seed varieties and through our solutions to help secure productive pulse yields. For example, two tomato varieties available in India and/or Kenya are disease resistant, have great adaptability to heat stress and are firmer than other varieties, enabling farmers to benefit from its 12-14 days of shelf life. Similarly, also in India, our Huntington sweet pepper variety enables climate-resilient farming and prolongs shelf-life, making it suitable for long-distance transportation and giving smallholder growers more market access opportunities. Lastly, our crop protection solutions for fruits, vegetables and pulses help prevent yield loss from pests and diseases.
- Level **Healthy Diet:** we actively promote a healthy diet with a particular emphasis on fruits and vegetables through the **3** Nutrient Gap Initiative and our global sustainability commitments. We also advocate for equal access to an appropriate balance of all major food groups, while also playing an important role in feed supply, as our innovative solutions for corn and soy support the production of milk, meat and egg protein.



[Read more about the state of food security and nutrition in the world by the FAO.](#)

Driving change through innovation, digital tools, and sustainability

Some examples that showcase our innovation are the **Preceon™ Smart Corn System**, which aims to enhance corn productivity through risk-sharing models, provides the potential to produce more on every acre and provides in-field education; **Direct Seeded Rice** (DSR) revolutionizes rice cultivation by reducing cost of cultivation, potentially increasing yields and significantly decreasing greenhouse gas emissions and water consumption; and **our partnership with the Cereal Grower’s Association (CGA) in Kenya**, which focuses on enhancing food and nutrition security through training, access to hybrid seeds and building a stable ecosystem of partners and services.

How we contribute to each food and nutrition security level

Segments by Level of Diet Quality ¹		Facts & Figures ²	Examples of Bayer Relevance ²
Level 1: Energy Sufficient Diet	Corn	+30% of caloric intake in 94 developing countries and one of Africa’s main staple crops	Bayer is contributing to ~40% of global corn exports and investing \$1.15M in Kenya & Malawi on biotechnology and partnerships Our crop protection pipeline contains three solutions that will strengthen our positioning in the wheat markets Our rice hybrid varieties are within Bayer India’s top 3 products , with Arize Rice seeds representing +40M€ in revenue
	Wheat	Wheat is the most planted crop in the world , surpassing 200M hectares in 2019	
	Rice	1.2% - 1.5% annual global yield increase is needed to meet growing demand , while rice is one of APAC’s main staple crops and provides 20% of calorie intake to 3.5 billion people	
Level 2: Nutrient Adequate Diet	F&V	Consumption of fruits and vegetables (F&V) is largely inadequate in most regions of the world	Our F&V seeds and horticulture crop protection portfolio, combined with our value chain partnership models, increase market access opportunities for Indian & African smallholder farmers We play a key role in preventing yield loss from pests and diseases in pulses , with a significant presence in India where ~1.4M ha of pulses are being treated with Bayer crop protection products Approximately 75% of our core business is used for feed production , supporting feed supply and availability of quality proteins
	Pulses	For many countries, including India, the most populous country in the world, pulses are key to food and nutrition security	
	Meat	18% of global calories and 34% of global proteins are supplied by livestock	
Level 3: Healthy Diet	Nutrient Combination	No end in sight: global trend of focus on health and nutrition for all people everywhere	Globally, our smallholder farmer programs reached 52M smallholder farmers , with the aim of 100M by 2030 We carry out several initiatives that ultimately contribute to healthy diets , such as the Modern Breeding Project, smallholder farmer targeted seed varieties and systems, DirectAcres, Better Life Farming and BayG.A.P. + <u>Nutrient Gap Initiative</u> , <u>Zero Hunger Pledge</u> and youth/ balanced eating advocacy
		WHO global health targets for 2030 require agricultural solutions that support a balanced diet, including access to fruits, vegetables, pulses, cereals and high-quality proteins	

¹FAO’s *The State of Food Security and Nutrition in the World, 2023*.
²Data as of September 2023

Contributing to the nutrition of our consumers, customers and employees

At Bayer, we develop innovations that enable farmers to produce nutritious foods for people and animals while sustaining the planet. We support people's efforts, including our employees, to nourish themselves and their families with foods that are rich in nutrients. Though we are just one part of a complex food chain, our solutions help the world's farmers bring a range of healthy, affordable and safe foods from the field to the plate. In the spirit of the Sustainable Development Goals targeting Health and Nutrition, Bayer Crop Science contributes directly and indirectly towards [SDG 2](#) and [SDG 3](#).

According to the World Health Organization (WHO), every country in the world is affected by one or more forms of malnutrition. Combating malnutrition in all forms is one of the greatest global health challenges. At Bayer, we are working on solutions from the ground up to help everyone – from farmers to our employees – be a part of the solution.

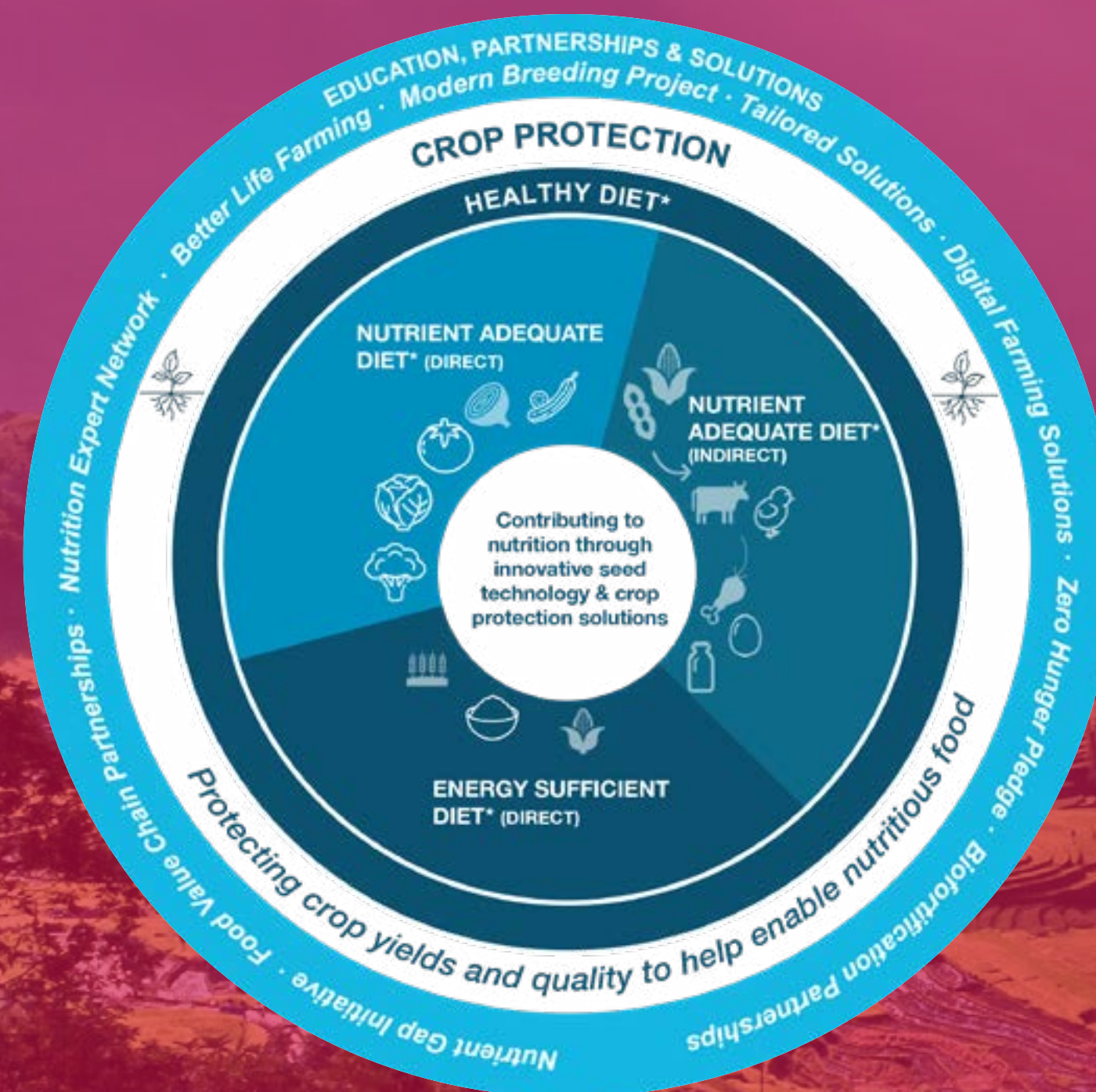


Read more about some of the [partnerships](#) here:
 - [International Maize Improvement Consortium for Africa](#)
 - [International Rice Informatics Consortium](#)



Click through to learn more about [Vegetables by Bayer](#) and our [Seeds & Traits](#) offerings and other [Tailored Solutions](#)

For more information on our [Global Breeding partnerships](#) as well as efforts towards a healthier workforce, you can visit [Bayer Crop Science's Global Nutrition Webpage](#).



Combating Malnutrition: Our Global Initiatives

By offering seeds for more than 25 different crops and tailored solutions that enable farmers worldwide to plant, grow and protect their harvests, we aim to improve farmers' ability to produce higher yields with the same or less inputs, which helps ensure a consistent and stable food supply for the world.

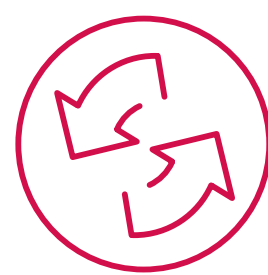
As communities continue to fight poverty, hunger and malnutrition, it's our responsibility to expand the reach and impact of our global breeding resources. We work to improve the availability of high-performing seeds for farmers globally through partnerships aimed at knowledge-sharing as well as through germplasm and data contributions.

*FAO SOFI Report 2020

Nutrient Adequate Diet: adequate calories and relevant nutrient intake
 Energy Sufficient Diet: adequate calories for energy balance
 Healthy Diet: includes foods from several food groups and had greater diversity within food groups



The Nutrient Gap Initiative: reversing the cycle of malnutrition



Guided by our vision of “Health for all, Hunger for none,” we launched The Nutrient Gap Initiative in 2021 with the goal **to impact 50 million people in underserved communities annually by 2030 by expanding access to diverse, nutritious food (such as vegetables, fruits and grains) and nutritional supplements** through direct interventions and in partnerships with non-governmental organizations (NGOs). This is a key step in improving access to nutrition and ensuring food security and health equity.



Hidden hunger

Often called “hidden hunger,” vitamin and mineral deficiencies are highly prevalent in underserved communities, with women and children being most vulnerable. This type of malnutrition develops gradually over time, with the impact not seen until irreversible damage – such as birth defects or a weakened immune system – is inflicted, often exacerbating the cycle of poverty.

As a global leader in both agriculture and nutritional supplements, Bayer is uniquely positioned to help vulnerable groups get access to proper nutrition. With the Nutrient Gap Initiative, we aim to consolidate our commitment to food security by addressing both the quantity of food needed to tackle world hunger as well as the quality needed to ensure healthy lives, with access to nutritious food as well as essential vitamins and minerals as a safety net for malnutrition. Smallholder farmers are the backbone of many food systems – but their rural communities often suffer from malnutrition and lack adequate health services. Building on the existing strong infrastructure of the [Better Life Farming centers](#), smallholder farmers and their families are a key audience for the Nutrient Gap Initiative. Bayer pilots the expansion of services offered at these centers, providing access to nutritional solutions and education given that food security cannot be achieved without health equity. [Projects for this have already been initiated in Indonesia.](#)

1 in 3 people

in our world suffer from diets lacking the essential vitamins and minerals needed to grow properly, live healthy lives and raise a healthy family.

Source: UN, [One in three people suffers malnutrition at global cost of \\$3.5 trillion a year](#)



In 2022, the Nutrient Gap Initiative impacted more than

19 million people

in underserved communities

Initiative Focus Areas

- 1 Intervention:**
We will provide nutritious food, such as produce and grains, and supplementation (i.e. essential vitamins and minerals from the [WHO Essential Medicines List](#)) within physical and financial reach of underserved communities.
- 2 Education:**
Through both direct education and work with healthcare providers and farmers, we will support vulnerable populations with information on self-care, family planning, nutrition, the importance of vitamins and minerals and how to integrate them into diets.
- 3 Advocacy:**
We will join forces with partners who can initiate large-scale impact, such as governments and policy makers, to advocate for access to affordable and nutritious food, health literacy and essential supplementation.



Learn more about the Nutrient Gap Initiative and our partnerships on [our website](#) or in our [Sustainability Report](#)

Addressing food loss and waste to enable Hunger for none

A key metric for holding true to our Zero Hunger Pledge and the **Bayer group vision of “Health for all, Hunger for none,” is by supporting stakeholders to reduce food loss and waste (FLW) by 50% in 2050, a target set by the United Nations Sustainable Development Goals (SDG 12.3).**

With its existing solutions and priorities, Bayer is uniquely positioned to drive value chain collaboration and education in the subject of reducing food loss and waste. As a topic that complements our existing corporate values and enables the world to achieve its shared sustainability goals, reduction of FLW is a key strategic priority for Bayer and our stakeholders.

By strategically building our portfolio of solutions to help farmers on and beyond the farm, we align our business growth with the principles of sustainable agriculture. This means we generate impact along the entire value chain, from disease and pest-resistant genetics through breeding, chemical and biological crop protection and other methods we’ve explored throughout this chapter, all the way to ensuring that our products have consumer preferences in mind and can survive the passage from

- Enabling reduction of FLW by



Co-creating with stakeholders along the value chain

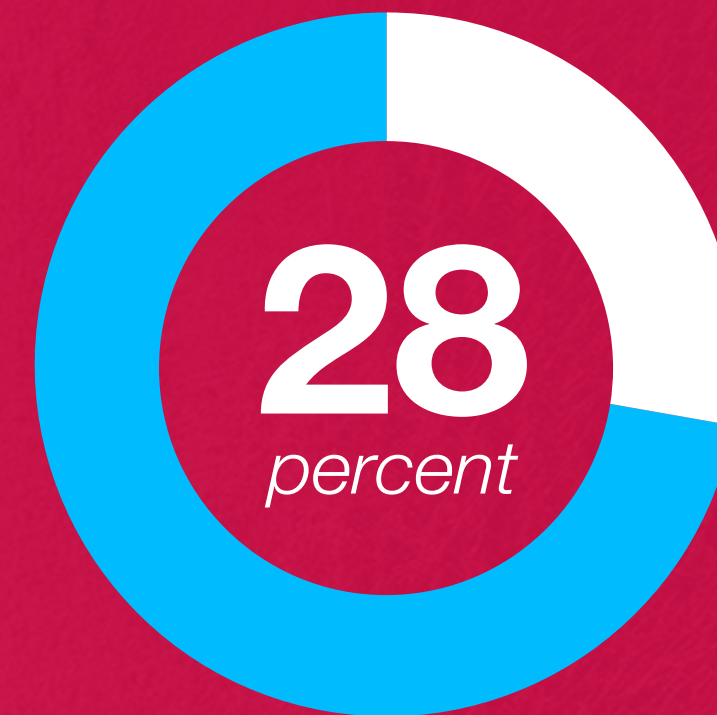


Promoting sustainable agriculture*

**For our definition of sustainable agriculture, please see [the Annex](#).*



Learn more about the sustainability benefits of our vegetable seeds varieties in our [SHF chapter](#) and [the Annex](#) of this report



*of global agricultural land is used to produce **food that is either lost or wasted***

This is equivalent to the land area of



and corresponds to

8-10%

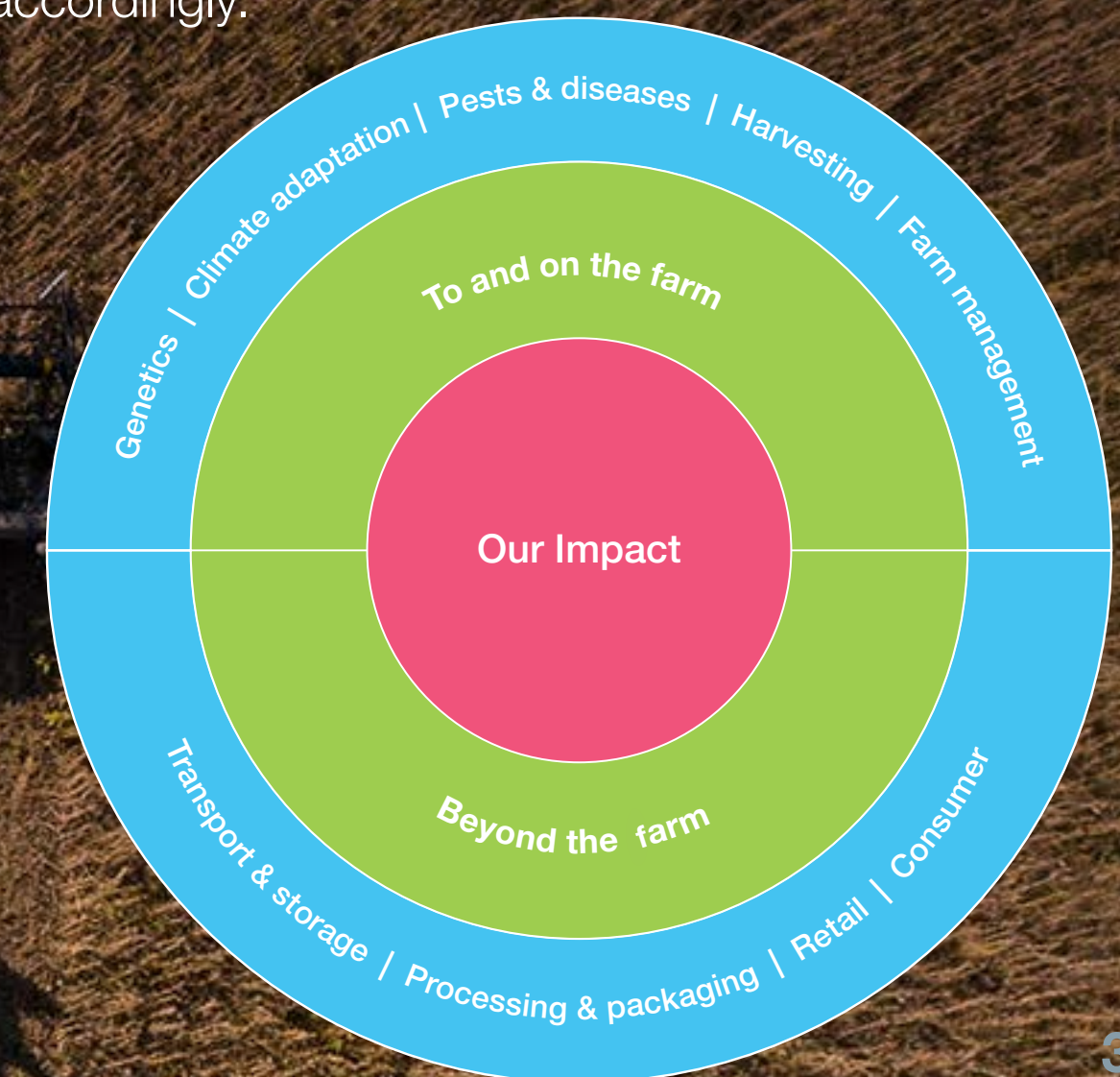
of total anthropogenic greenhouse gas emissions
(which equals more than 90% of global road transport emissions)

Source: United Nations

Integrating FLW within our workforce nutrition

As part of a holistic approach to promoting health and well-being, our internal company platform “House of Health” regularly provides information and explanations about health and nutrition and advises all employees on specific health checks relating to nutritional aspects. Regarding nutrition, the platform educates on responsible food handling, with specific tips and recipes that encourage the use of regional products to be used in ways that limit food waste.

Our Global Facility Management Service Specification for Catering sets out general requirements and specific service standards for food and canteen services operated by external service providers, where employee nutrition and FLW are considered. The knowledge and data available from the external service providers or subject matter experts can be used to measure effectiveness and progress with regard to nutrition and FLW accordingly.



Sustainability Starts with Product Supply

In Product Supply, we have instilled a goal to exceed expectations across every interaction, product and service we deliver – even when facing great challenges such as global supply chain disruptions. Our tailored solutions are essential to sustainably managing resources and improving productivity for our customers, while also driving sustainability within our own operations. We are also constantly working to increase efficiency for suppliers and growers, reducing our GHG emissions and improving water use and quality across the entire value chain.

Our work at Product Supply contributes to the following U.N. Sustainable Development Goals:



Sustainability Challenges

Supply chains in the agricultural inputs segment face significant sustainability challenges, including **escalating energy costs, disruptions in the flow of raw materials and minimizing environmental impact while meeting customer demands**. To tackle these issues, companies are transitioning towards sustainable raw material sourcing, clean energy, waste and pollution reduction and the conservation of natural resources. By adopting a multifaceted approach, companies can overcome these challenges.

Our Approach

In Product Supply, our goal is to build a world-class, end-to-end supply chain that is efficient and sustainable. By investing in efficiency measures and renewable energies contributing to our global climate targets and water commitments, we are reducing our greenhouse gas emissions and conserving water. Additionally, we drive positive impact in the communities surrounding our production and breeding sites worldwide through our Product Supply Community Outreach program.

We also have an impact on society and the environment through our procurement activities and supplier relationships. We have high expectations for our suppliers to practice sustainability principles and we support them in doing so. In order to improve sustainability within our supply chain, we apply not just economic standards, but also **environmental, social and corporate governance (ESG) standards** in selecting new suppliers or continuing relationships with existing ones.

Progress

Between 2019 and 2022, we reduced our Crop Science operations' CO₂ emissions by 0.60 million tons. With our new [water strategy](#), we strengthen our commitments and develop our operations towards reducing our environmental footprint. In addition, we've transitioned to the RSPO¹ Mass Balance model in our sourcing practices for palm oil.

Progress highlights:

- Since 2022, we have transitioned to an **RSPO Mass Balance Certified Sustainable Palm Oil supply chain**
- **+1,100 Bayer suppliers evaluated** on their sustainability performance in 2022
- 5 consecutive years recognized as **leader on climate protection by CDP² (A-rating)**

¹ Roundtable on Sustainable Palm Oil

² The Carbon Disclosure Project

Case Studies

Water-related

Adiabatic Crystallizer

Developing technology to recycle warm water and reduce energy consumption



Managing Water Resources

Using water efficiently across our value chain



GHG-related

Energy Partnerships

Renewable energy purchase agreement enables us to reduce emissions



Waste Heat Recovery Boiler

Recovering waste heat from incinerators for energy savings and CO₂ reductions



Navigating global challenges

The importance of sustainable and resilient supply chains

A growing world population and the increasing burden on natural ecosystems are among the biggest challenges humanity faces. This situation is further complicated by the effects of the COVID-19 pandemic and the war in Ukraine, leading to logistical constraints, inflationary pressure and an increase in commodity prices. Furthermore, both crises have clearly shown the importance of protecting health and ensuring food security worldwide – and how these goals are in jeopardy.

Product Supply teams work across Seeds and Crop Protection functions and leverage Digital Solutions to offer innovative and effective solutions to our customers worldwide, while navigating and performing through global challenges such as supply chain disruptions and high energy prices. We believe in delivering the right product, in the right place, at the right time. At the same time, we reduce the ecological footprint of our own sites through investing in efficiency measures and renewable energies.

A growing world population and the increasing burden on natural ecosystems are among the biggest challenges humanity faces.



Our mission at product supply: Shaping agricultural supply together



The need to produce enough for a growing world

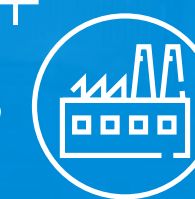


while protecting natural resources

Our Product Supply network consists of

140+

Production Facilities



with more than



15K employees

& +60K growers

~2,000

Crop Protection Formulations



2,000+ vegetable seeds varieties

& ~100 row crops SKUs*

*Stock keeping unit



In 2022 Crop Science achieved a **reduction of 0.60 million metric tons of GHG emissions** (Scope 1 & 2) relative to 2019

Driving sustainable transformation

Advancing towards our climate commitments and responsible practices for a sustainable future

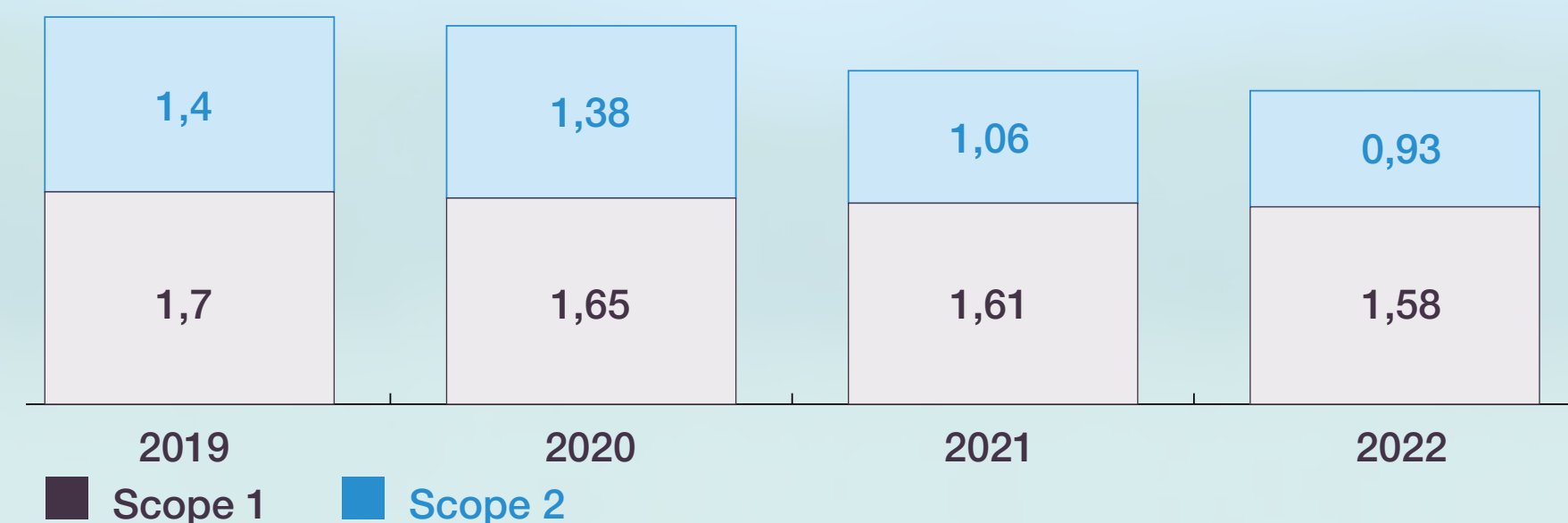
We support the Paris Agreement and the objective of limiting global warming to 1.5 °C relative to the preindustrial level. Therefore, **within the strategic core element of “Reduction of our ecological footprint”, we have set decarbonization targets.** The Science-based Targets initiative (SBTi) is a collaboration between different international organizations targeting translation of global warming limits to emission reduction goals. SBTi has validated our targets and confirms our contribution to fulfilling the Paris Agreement:

- Achieving **climate neutrality at our own sites by 2030:** our target is to reduce our own GHG emissions by 42% relative to the reference year 2019 by the end of 2029 (Scope 1&2). This is supported by our target to achieve **100% renewable electricity by the end of 2029** and achieve climate neutrality by offsetting our remaining GHG emissions.
- Reducing our **value chain-related Scope* 3 emissions by 12.3% by 2029** (relative to 2019).
- Additionally, we aim to reach **net zero GHG emissions by 2050 or earlier (Scope 1, 2 & 3)**

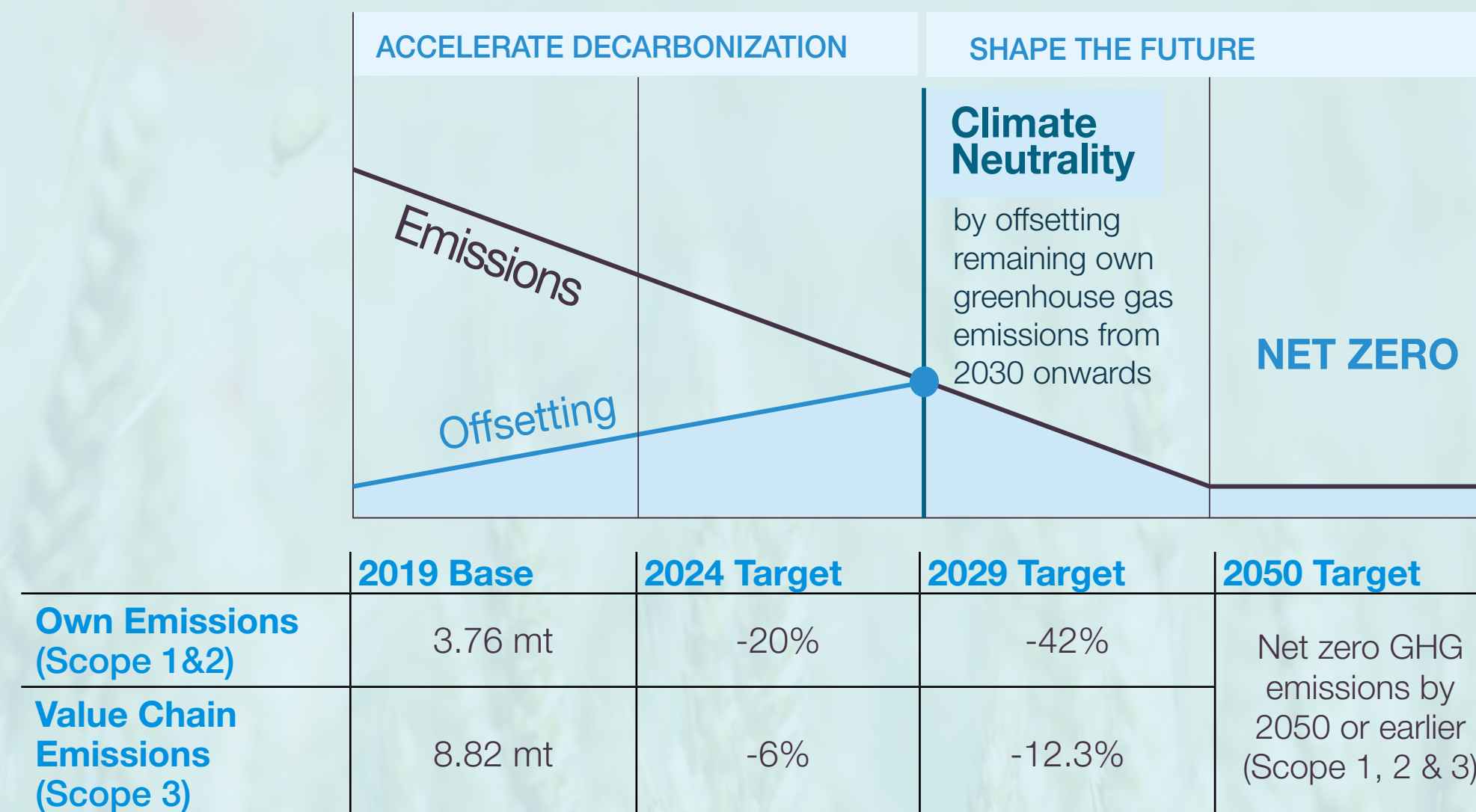
*In accordance with the criteria set out by the Science-Based Targets initiative (SBTi), the following Scope 3 categories of the Greenhouse Gas Protocol Corporate Value Chain (Scope 3) Accounting & Reporting Standard are relevant for Bayer: (3.1) purchased goods and services, (3.2) capital goods, (3.3) fuel- and energy-related activities, (3.4) (upstream) transportation and distribution and (3.6) business travel.



Crop Science GHG Emissions (Million metric tons of CO₂ equivalents)



Bayer's Net Zero Pathway



GHG = greenhouse gas

For our value chain-related emissions, or Scope 3 emissions, Product Supply and Procurement work together to engage with our suppliers and growers. We renewed our Supplier Code of Conduct in 2022, which sets forth key social, environmental and ethical standards that we expect our suppliers and subcontractors to share. We also participate in various initiatives to reduce our Scope 3 emissions including Together for Sustainability (TfS), an initiative of the chemical industry, the Supply Chain Initiatives of CDP and the Pharmaceutical Supply Chain Initiative (PSCI).

Our holistic water strategy across the value chain

Addressing risks and creating opportunities for agriculture

Put simply, **our vision of “Health for all, Hunger for none,” cannot be fulfilled without water** – and as a global leader in health and agriculture, we have an intrinsic motivation to address the water crisis. **Bayer's primary use of fresh water is in production processes, irrigation and seed production, and is also required by our suppliers and customers.**

Some of our sites, suppliers and customers are in water scarce regions, which poses a greater risk to impact our business.

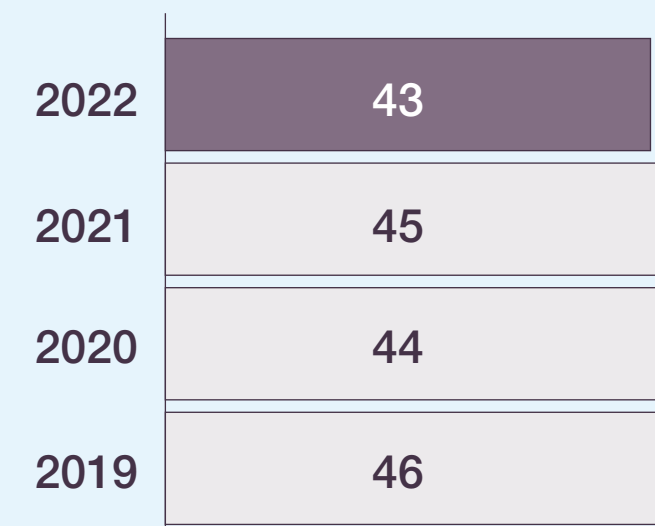
Clean water is essential; therefore, it is crucial that industrial water usage doesn't lead to local problems.

In Product Supply, we take responsibility over our water consumption, collaborating upstream with growers across the seed production footprint. We continue to drive improvements in water use efficiency and look to identify improvement opportunities in our own facilities to reduce water risks, especially at relevant sites located in water-scarce areas.

We have established water management systems at all relevant sites* in water-scarce areas or in areas identified as being threatened by water scarcity by the end of 2030.

*Sites with annual energy consumption of at least 1.5 terajoules that also account for at least 0.1% of our global water consumption.

In our own operations:
Crop Science Water Use
(Million m³)



Engagement and collaboration with our seed growers:

In Mexico, India and Sub-Saharan Africa, we have

increased water application efficiency by 40%

on farms through enhancing irrigation methods from furrow to drip irrigation.

“Bayer’s new water strategy is aligned with the care and concern with which we are already developing our own operations. We know that sustainability starts with us in Product Supply, and that we all need to act to accelerate change and solve the water challenges agriculture is facing today.”

*– Dirk Backhaus,
Head of Product Supply*

Across the globe, **we engage and collaborate with our seed growers to implement new practices such as irrigation methods and irrigation management systems.** This is key not only to ensure the conservation of water resources, but also to improve yield and quality of crops, which translates to higher profits for the grower while sustaining water resources. These activities are especially relevant to smallholder growers in Low- or Middle-Income Countries (LMICs).

In 2023, we launched **our holistic water strategy**, which addresses potential water-related risks and levers our innovation skills to build business opportunities while adding value to the community.



Adiabatic Crystallizer

Technology and innovation to reduce our GHG emissions across the supply chain

Antwerp: Adiabatic Crystallizer, new technology for energy savings

One key step in the production of one of our crop protection processes is a crystallization of the product out of an aqueous solution, which requires significant amounts of energy. Our site and optimization teams researched an alternative process including energy recycling. With an investment in new technology we could recycle part of the reaction stream and use significantly less energy.

The first Adiabatic Crystallizer was introduced in Antwerp (2021) and proved the concept: it demonstrated 18% steam energy reduction which corresponds to approx. 8,000 tons/year CO₂e reduction. Product Supply operations is currently detailing the roll out to other sites in our production network.

**CO₂e Reduction
(metric tons/year):**
~8,000



Farmer City, Constantine, Waco: Direct harvesting – an alternative method to reduce losses

When farmers harvest with traditional practices, they often face an increased yield loss when a field dries up. The practice of direct harvesting uses an enhanced combine to capture this seed loss. **Maize is picked, de-husked, shelled, and pre-cleaned directly in the field while only the seed is transported to the site.**

With this method, we win in three ways:

- **Benefits of direct harvest:** less fossil fuel use, operational costs, less damaged seeds.
- **Increased yield:** reduction between 5-10% in seed loss, and less acreage planted to produce the same amount of seeds.
- **Sustainability benefits:** 80% reduction of CO₂ emissions when compared to traditional ear harvest.

**CO₂e
Reduction
(metric
tons/year):**

509



Waste Heat Recovery Boiler

Vapi: Waste Heat Recovery Boiler, reducing natural gas consumption

Incinerators are a technology used for waste management, and if the heat created in the process is recovered, it could self-sustain its energy requirements.

CO₂e Reduction
(metric tons/year):

~1,917

At our site in Vapi, India, a new technology for the waste heat recovery boiler in their incinerator was installed in 2022. A membrane wall with an economizer in the boiler allowed for the equivalent reduction in Natural Gas consumption of about 970,000 m³ and 1,917 MT of CO₂e emissions.

Energy Partnerships

Renewable Energy Purchase Agreement between Bayer and Cat Creek Energy

Under the agreement, **Cat Creek Energy will construct multiple renewable energy resources and energy storage facilities in Idaho, taking a bold step towards achieving our energy goals** while also supporting Idaho's green ambitions. In terms of CO₂, the deal enables Bayer to reduce annual emissions by 370,000 tons.

CO₂ Reduction
(metric tons/year):

370,000

We have established **strict guidelines for our own green energy purchase, which includes the utilization of innovative, renewable forms of generation, with a particular emphasis on wind and solar power, and the proximity of energy production facilities to Bayer sites.** They are based on the World Wide Fund for Nature's "next generation green power" principles.



In line with WWF's recommendations, the share of green power in the total electricity consumption of a business or institution must increase to: no less than 80% by 2025 and 100% by 2030.



[Read more about how we are protecting the climate](#)

Managing Water Resources

Using water efficiently in our agricultural operations

Managing water resources: INEX Production – India

Since 2016, we have engaged with more than 600 smallholder farmers across INEX³ production in Lonar, D-Raja, and S-Raja, India to build approximately **77 farm ponds with our full support by raising awareness of water scarcity and educating on how to obtain government subsidies for investment purposes if available at that time.**

77 Farm Ponds built

The outcome:



Water availability during the dry season



More productivity during the dry season, which increases their income and improves their livelihood

³ India Export



European farmers: Irrigation management system for increasing efficiency and enhancing yield

How much water should be used for irrigation, and when is the best time to irrigate?

These are key questions that farmers must consider for their crops to succeed. Partnering with the Agriculture Technical Institute in France, our maize seeds growers use the **irrigation management system Irré-LIS[®] as a tool for irrigation management. This tool calculates the water balance while also taking into consideration the weather, the soil condition, and the stage of development of the crop.** With that, the growers are able to manage water supplies without decreasing crop yields and can improve irrigation efficiency by 10%.

Similar irrigation management systems like the Irriga solution are also used in other countries, including Hungary, Romania and Ukraine.

+10% Irrigation Efficiency



Chiapas: Increased efficiency through automation

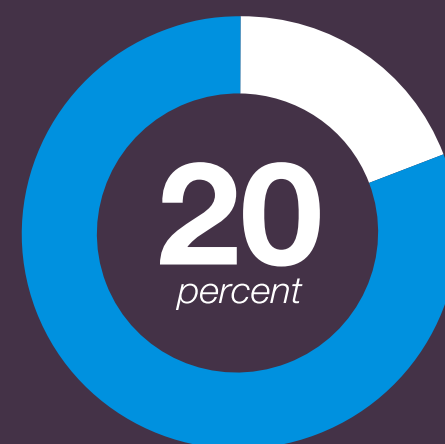
In our Chiapas, Mexico site, we automated irrigation processes with the NetaJET system, which allows pulse fertigation to be applied quickly and accurately, using a uniform fertilizer solution and reducing water and energy consumption.

Three wins:

- 1 **Improving crop** yield and quality
- 2 **Minimizing the consumption** of energy, labor, water and fertilizer
- 3 **Reducing** the levels of fertilizer in the site's wastewater

We also reduced the amount of water and therefore chemicals with the use of thinner drop lances.

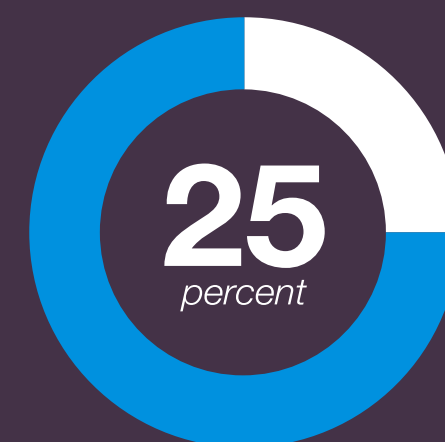
Efficiency in **consumption of water and chemicals**



Old system consumed
120k m³/year

NetaJET
90-100k m³/year

With the new system, the **irrigation uniformity coefficient (IUC)** has also improved around



Old system
65-70% IUC

New system
>95% IUC

Sustainable irrigation in our vegetables seed supply

Our Vegetable Seeds product supply organization facilitates access to infrastructure, such as irrigation systems, to enable successful crops. By promoting and activating sustainable irrigation practices like changing from gravity to drip irrigation, we contribute significantly to the technification of local growers in the Bayer supply chain and enable higher yields and preservation of soil and water resources.

Our Crop Science Product Supply Community Outreach Program

Making a positive impact in the communities where our employees live and work

Our Community Outreach Program is part of our corporate social responsibility in sustainability, aimed at addressing the needs of the communities surrounding our production and breeding sites worldwide. We want to have a positive impact on the communities where we live and work – and we achieve this through volunteering, social investments, disaster relief and long-lasting partnerships that support education, promote health and nutrition and enrich community life. **Through personal interactions of our teams with society and key community members, we raise awareness about our work at Bayer and the value we bring to our local communities, our customers and sustainable agriculture.**

Stakeholders within this program include:

- Local community leaders and organizations
- Education leaders, organizations and schools
- Our customers
- Food security organizations
- Government leaders and organizations

Based on impact analyses, the material needs at our sites are identified and suitable measures are then defined.

Aligned with our vision “Health for all, Hunger for none” and the SDGs on which we have the greatest impact through our business, our community engagement is structured into four pillars of activities that address local community needs:

- **Community Development** such as planting of community gardens, construction of school buildings and libraries, donations or event sponsoring, job trainings for women, disaster response
- **Health, Wellness and Safety:** safety trainings (e.g. for third party workers or on road safety), telemedicine, awareness raising on topics such as breast cancer and mental health
- **Food and Nutrition:** food supply donations and working with local food banks
- **Education:** career fairs, site visits for students, our Baylab education program and teaching units in the STEM⁴ disciplines at schools

To achieve our objectives, we collaborate with both internal and external partners, also utilizing company resources like the Bayer Fund or the Bayer Cares Foundation. Additionally, we leverage our Health, Safety, and Environment (HSE) and sustainability site initiatives – like pollinator gardens or activities as part of our work supporting the Wildlife Habitat Council – and other country-specific communications efforts.

Our community outreach activities follow our BASE principles, which comprise our values regarding innovation, our workplace, our business model and the way we interact with stakeholders.



[Learn how Bayer is strengthening communities across Hawaii](#)

⁴ Science, technology, engineering, and mathematics





*The target achievement of the implemented measures is closely monitored. **In 2022, more than 2,000 actions and initiatives took place at around 140 sites in the world. We are committed to create significant impact and difference in the community where we operate by building mutual understanding and trust.***

The Muscatine site



The Muscatine site, which has maintained a Gold Certification with WHC for many years, **was nominated for three awards in June 2022- Formal Learning, Reptiles and Amphibians and Species of Concern (Yellow Mud Turtle) and won two (Formal Learning and Species of Concern).** The site team of around 100 employees from Bayer Muscatine contributes to the conservation efforts. **The Formal Education Program, which targets local 4th-5th grade students**, has been specifically recognized by WHC **where our employee volunteers participate in the education program, prairie management activities and projects in our 2-acre Butterfly Garden.** The garden contains both native and ornamental plants, produce, a pond and gazebo and is visited by many members of our community. **Bayer Muscatine has approximately 200 acres set aside for conservation.** A portion of that land is part of the 510-acre Big Sand Mound Nature Preserve in the state of Iowa, which has been co-owned and managed by Bayer and MidAmerican Energy since 1981.

Creating positive change: our product supply key role in more sustainable operations and supply chain collaboration

In Product Supply, we can have a positive impact in operations, suppliers, and communities. We continue delivering quality products and services to meet the needs of our customers while reducing our ecological footprint.

As an agricultural input provider, we are at the beginning of the production chain, which means we can contribute to shaping agriculture supply. Therefore, we take responsibility and collaborate with others to continue to drive improvements.

In our own operations, we work to continue reducing our GHG emissions and develop a baseline to set water targets in the coming years, and in our upstream we engage and collaborate with our suppliers and growers in different initiatives including best practice sharing.



In Product Supply, we can have a **positive impact** in operations, suppliers, and communities



Learn more about our work around the product supply value chain



[2022 Sustainability Report](#)



[Supplier Code of Conduct](#)



[How we protect the climate](#)



[Our water strategy and commitments](#)



[Preserving Biodiversity in the Community](#)

Have questions or would like to discuss our work around the product supply value chain? Please reach out!



[Engage on LinkedIn](#)

DR. SIGURD BUCHHOLZ,
Head of Sustainability: Product Supply,
Crop Science at Bayer
sigurd.buchholz@bayer.com

Empowering the Smallholder Farmer

The estimated 550 million smallholder farmers worldwide play a central role in improving the quality of life in Low-and Middle-Income Countries (LMICs) and thus implementing our vision of “Health for all, Hunger for none.” They form the backbone of food security in many rural regions of the world.

Our work supporting smallholder farmers contributes to the following U.N. Sustainable Development Goals:



Sustainability Challenges

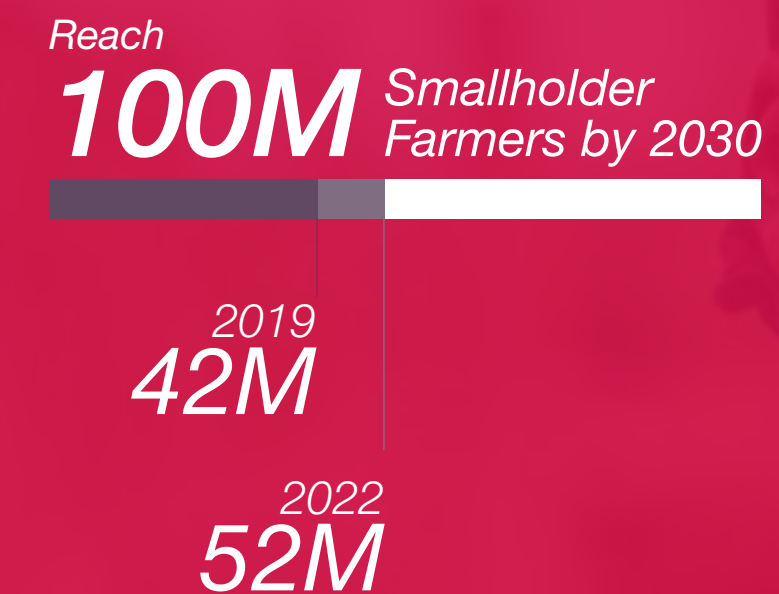


Smallholder farmers' yields are often lower due to a lack of access to high-quality crops and practical knowledge of more productive and sustainable cultivation methods. It's also a challenge for them to gain affordable financing opportunities or access markets to sell their products at appropriate prices. Furthermore, smallholder farmers are highly exposed to the impacts of climate change and increasingly to harvest losses. Therefore, **it's quite difficult for them to achieve a stable income through farming.**

Our Approach

As a global leader in agriculture, **we are dedicated to supporting 100 million smallholder farmers in LMICs by 2030** by improving their access to agricultural products and services, including collaboration with our partners. **To achieve this ambitious goal, we are extending our range of commercial efforts and strategic initiatives tailored to the needs of smallholder farmers.** Our strategy for strengthening smallholder farmers is embedded in our regional commercial strategies and the formation of partnerships along the value chain.

Our Overarching Goal



Main Actions

Better Life Farming

Helping smallholder farmers access inputs, know-how and opportunities through last mile delivery model



TELA Maize Project

TELA Maize's drought tolerance and resistance to pests to improve livelihoods



Partnering with the food chain

For improving food security with potatoes



DKsilos

Aligned efforts across the supply chain to support small dairy farms in Central America



Vegetable Seeds

Helping smallholder farmers become more resilient to climate change while supporting local diets



Modern Breeding Project

For higher yield versions of key smallholder crops



Progress

In 2022, together with our partners, we supported 52 million smallholder farmers in LMICs with our products and services – **three million more than in the previous year.** We achieved this by significantly expanding business activities – particularly in the Asia/Pacific region. We further scaled key partnership models such as Better Life Farming and DKsilos.

Smallholder farmers' big role

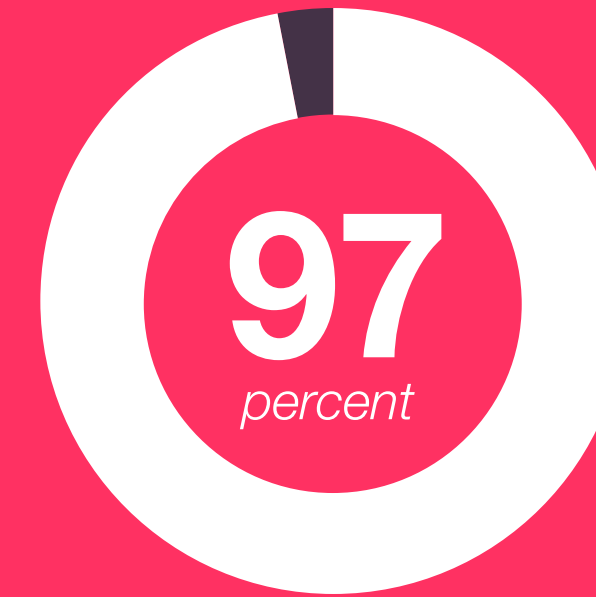
Smallholder farmers have an enormous impact on the world's nutrition

Smallholder farmers are those who farm on less than 10 hectares of land. And **while their plots may be small, their impact on the world's nutrition is huge.** They're responsible for feeding more than half of the populations of LMICs, all while living on incomes averaging \$2/day.

As independent farmers, smallholder farmers must each play the role of manager, laborer and salesman. They are often responsible for the food security of their community. Which means the daily threats of adverse weather, disease and pests endanger not only their livelihoods but also the nutrition and prosperity of their entire communities.

To accomplish our mission of feeding the world's growing population while also reducing our strain on the earth's resources, **our own efforts to enable smallholder farmers must be big.** Because they make up more than 97% of the world's farmers, our path to sustainability starts on their small plots of land.

Our path to sustainability starts on their small plots of land



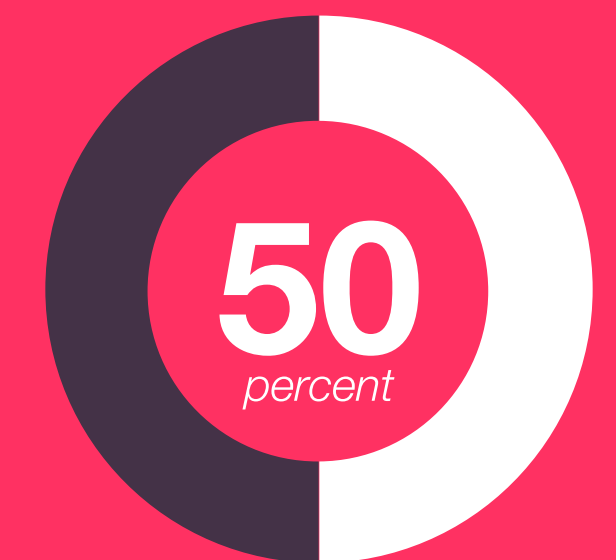
of the world's farmers are smallholder farmers

Earn on average less than

\$2 USD

per day (compared to the international poverty line defined as \$1.90 per day)

Responsible for feeding over



of low- and middle-income populations



They work on

10 *hectares of land or less*

Growing our commitment to smallholder farmers

Investing in their future

We are doubling down on our efforts to provide smallholder farmers with more sustainable practices, improved incomes and better lives. We've pledged unwavering commitment to the United Nations Sustainable Development Goals (SDGs). Recognizing urgent action is required, we are dedicated to reaching 100 million smallholder farmers in LMICs with products, services and partnerships by 2030.



We are providing **agronomic education** including product stewardship



We are **creating unique products and partnerships** along the value chain



We actively **support our smallholder farming business and initiatives across the food chain**, with a focus on sustainably improving their harvests and therefore their incomes and livelihoods



Investing in smallholder farming is good business — not corporate philanthropy

While we know improving the livelihoods of smallholder farmers will improve food security and quality of life in their communities, we also know it will help us grow our business. Today, roughly 9% of our divisional revenue is the result of our work with smallholder farmers, and we expect our business with them to double by 2030.



TELA Maize Project

Providing livelihood-changing products

Our increased focus on smallholder farmers means an increase in products tailored to their needs. Just one example of this is our TELA Maize partnership project.

In Nigeria, maize is a food staple – making up a large portion of its population’s nutrition. However, severe drought paired with infestations by the fall armyworm and stem borer pests have made conditions for growing maize incredibly difficult. This has resulted in significantly lower yields and income for smallholder farmers in Nigeria. And, without its staple to rely on, much of the country has become food insecure.

For years, our world-class scientists have been hard at work with external partners on a solution to end this devastating problem through a game-changing technology: TELA Maize. **TELA Maize is genetically modified (GM) to tolerate drought and resist fall armyworm and stem borer insects.** It was recently approved by the Nigerian government for evaluation and open cultivation, making it closer to becoming commercially available to Nigeria’s smallholder farmers.

Data from official variety registration trials in Nigeria in 2022 showed that:

The **GM insect-resistant hybrid** had an average yield of

7.61 T/Ha

signifying an **extra 1.6 T/Ha** of yield protection provided by the technology.

compared to

6.04 T/Ha

for the **non-GM hybrid**,



[Read more about the TELA Maize Project](#)



[Read more about the big impact smallholder farmers have on food security](#)

Banyabetjeng Phinea Mohlala, or Mma Mohlala, is a smallholder farmer in the Matibidi community South Africa – currently the only country in Africa where farmers have access to plant the GM hybrids. Many of the Matibidi community farmers abandoned their farms due to the plight brought on by the fall armyworm. But after planting TELA Maize, Mma Mohlala was pleasantly surprised to harvest 54 bags of maize (10,000 Kg) – a bountiful harvest she had never experienced before. Given the success, she opted to plant TELA Maize again the following season.

Making it easier for smallholder farmers to escape poverty

While our ultimate vision remains “Health for all, Hunger for none”, smallholder farmers’ efforts to escape poverty and provide nutrition for their families are our efforts as well. Their livelihoods are of key importance for us – and we will work collaboratively to better integrate them into the world of commercial farming.

We do not plan to assert our intellectual property rights against smallholder farmers who save seeds on their farms for private and noncommercial use in order to avoid extreme poverty.



Better Life Farming

Helping smallholder farmers access inputs, know-how and opportunities

Leading an alliance of private sector organizations

To help improve the livelihoods of smallholder farmers, **we must first help them improve how they operate their farms.** In partnership with the World Bank's International Finance Corporation (IFC) and Netafim, along with many local value-chain partners and government initiatives, we established the **Better Life Farming Alliance**. At its core, the alliance aims to provide smallholder farmers with the knowledge, best practices, modern agricultural technologies and resources to connect to the value chain. These resources enable smallholder farmers to grow their farms into commercially viable and sustainable farming businesses. It also ensures profitability and helps them reduce their ecological strain. Overall, the Better Life Farming Alliance leads to value generation for the involved partners, longevity and the development of rural ecosystems – ultimately contributing to food security.



[Read more about the global impact of the Better Life Farming Alliance here](#)

The Better Life Farming Alliance Commitments



Develop rural communities



Make rural farming more inclusive for women & youth



Drive environmental sustainability

Smallholder farmers coming together to support one another — Better Life Farming Centers

Smallholder farmers are often heavily independent and toil in relative isolation – despite the fact that dozens of other farmers may live and work nearby. As a key component of the alliance, **we created the Better Life Farming Center platform**, which consists of physical centers run by agri-entrepreneurs. These centers have become a convergence point for alliance partners to connect with smallholder farmers in surrounding villages. **Part supply store, part educational hub, each of the more than 2,500 Better Life Farming Centers is geographically positioned to connect hundreds of independent growers.** A short visit to the center provides smallholder farmers with the products, knowledge, financing and other crop support they need to help their farming businesses thrive.

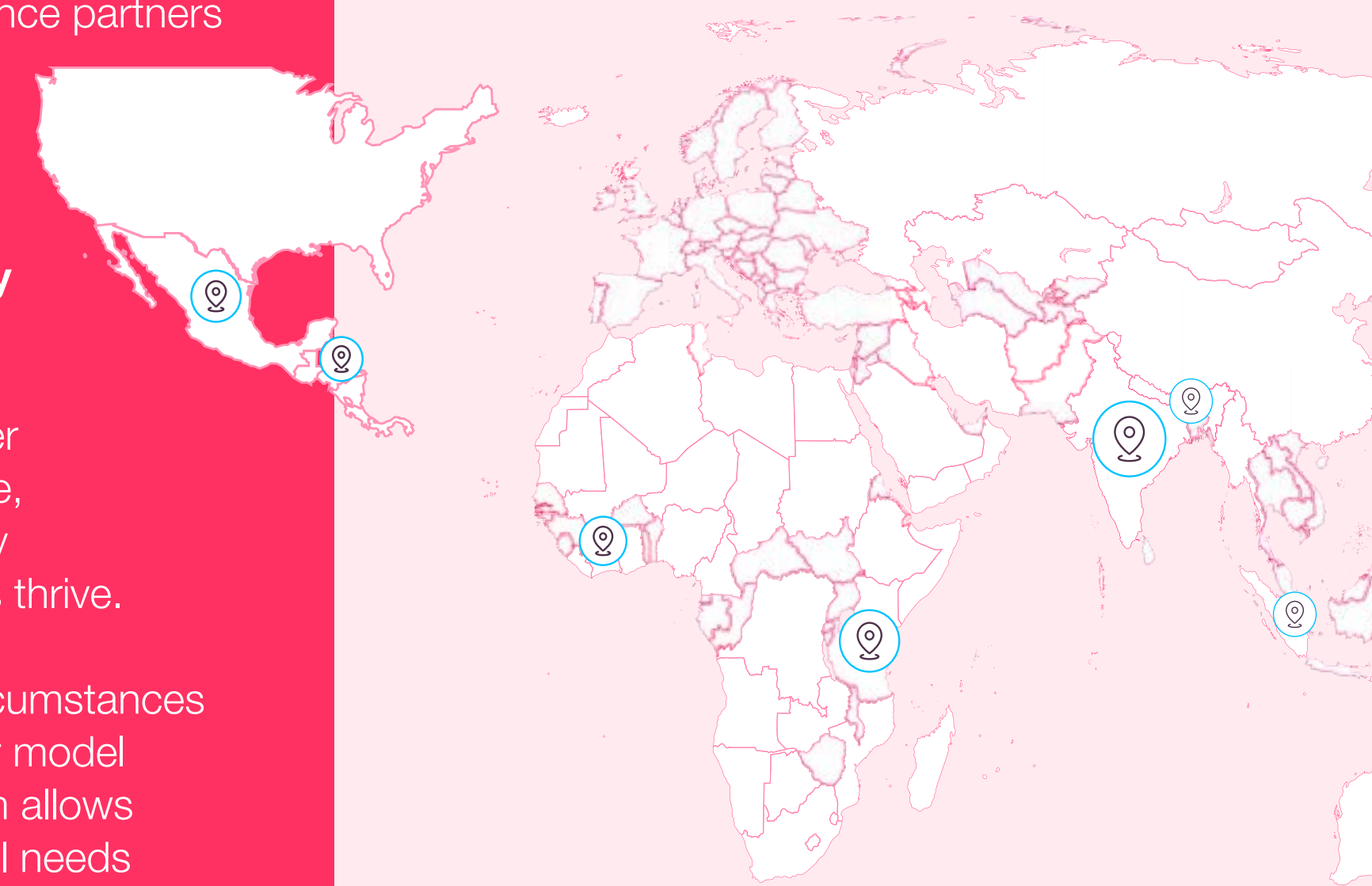
The ingrained adaptability to local circumstances makes the Better Life Farming Center model scalable and adjustable. This platform allows entrepreneurs to cater directly to local needs and link relevant local partners to provide tailored smallholder solutions.



[3D Model of a Better Life Farming Center](#)



more than
2,500
Better Life Farming Centers



Creating stronger livelihoods

Better Life Farming creates ecosystems that enable smallholder farmers to build commercially viable businesses, thereby improving rural livelihoods. The project was set-up with a dedicated focus on last-mile delivery to improve initially limited access to essential agricultural services.

Reaching across India, Indonesia and Bangladesh, the program is estimated to have impacted more than 1,000,000 smallholder farmers. In 2022, we expanded the Better Life Farming Alliance into Mexico and Honduras and we have recently opened the first centers in Tanzania and Ivory Coast.

Each Better Life Farming Center creates new rural employment with the agri-entrepreneur position. Over 2,500 agri-entrepreneurs generate annual revenue, which is, for instance in India, double the country's average income for a rural farmer.

Over time, a growing number of women have opted to open Better Life Farming Centers in their communities. As a result, it has increased women's empowerment and female farmer community-building in rural areas. Globally, more than 10% of the Better Life Farming Centers are owned and run by female agri-entrepreneurs, with the highest share being more than 20% of centers in Indonesia.

Leveraging Better Life Farming to help close the nutrient gap in rural areas

As part of Bayer's Global Nutrient Gap Initiative, Better Life Farming initiated pilot projects with 22 centers in Indonesia in 2022 to bring access to nutritious food and nutritional supplements closer to communities based on its last-mile reach into remote rural areas. Access to healthcare facilities is not always easy and may take up to 1.5 hours of commuting time.

The local Better Life Farming agri-entrepreneurs, together with our local teams and NGO partners, also distributed contraceptive products as well as samples of vitamin supplements and offered general and prenatal nutrition education to enhance knowledge, especially of women, in family planning, self-care and stunting prevention.



Through Better Life Farming, we have reached roughly

800,000

smallholder farmers and their families and trained

44,000 women

Smallholder farmers in India who have worked with Better Life Farming report positive social benefits¹:

72%

say their income increased because of Better Life Farming,

74%

experienced a better way of farming, and

71%

perceived an improved quality of life.

¹Source: 60 Decibels, March 2023, 684 farmer phone interviews in India from October 2022 to February 2023

“I am very happy that we have access to the best agricultural inputs which promote growth and production. Not only do I have more income but also have increased land size for farming.”

– Male smallholder farmer, India

“After working with Better Life Farming, I am more confident about running my farm, and I feel more independent.”

– Female smallholder farmer, India



Read the article in the Harvard Business Review about the impact that Better Life Farming has on smallholder farmers



BLF received recognition (2nd Position) for “Outstanding Sustainable Farmer Income Enhancement program” in FICCI’s Sustainable Agriculture Awards

DKsilos

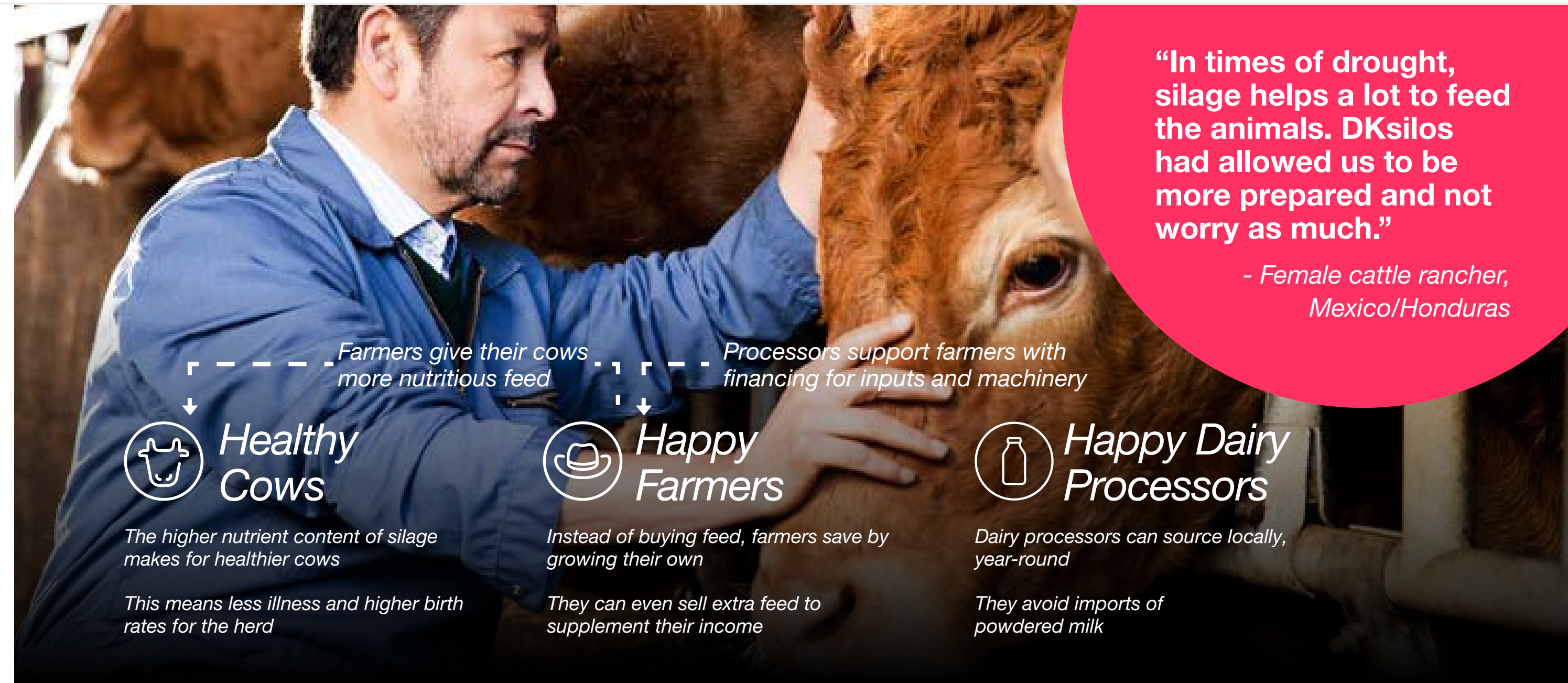
Aligned efforts across the supply chain to support small dairy farmers

For low-income farming families in Central America and Southeast Mexico, raising cattle and selling dairy to local milk processors help keep food on the table. The typical small dairy rancher has about 25-30 head of cattle, grazing on a similar number of hectares.

During the five-month dry season, problems arise when grass growth is insufficient to feed the herd – which is worsening with climate change. With droughts, cows can lose up to 20-25% of their weight, producing 50% less milk and becoming more susceptible to illness and less likely to breed.

At Bayer, we saw an opportunity to help solve this challenge and share economic growth with more than 40,000 dairy ranchers and with dairy processors such as Lacthosa Sula in Honduras: train ranchers to plant maize on part of their grazing land and perform maize silage, a technique that allows feed to be preserved through long periods of time. The DKsilos program complements this support with access to a technological package, machinery, technical advice and milk recollection centers.

Small-scale cattle ranchers quickly received economic benefits from this new business model. The average farmer makes about \$5,000 USD more per year with DKsilos thanks to lower feeding costs and higher milk productivity. The connected dairy processors, in turn, benefit from access to locally sourced milk year-round. In the future, the program will expand to more countries, and digital products will continue to be tested to help improve production and sustainability.



“In times of drought, silage helps a lot to feed the animals. DKsilos had allowed us to be more prepared and not worry as much.”

- Female cattle rancher, Mexico/Honduras

Small-scale cattle ranchers in Mexico and Honduras who have worked with DKsilos report positive social benefits¹:

68%

say their income increased because of DKsilos,

75%

experienced a better way of farming, and

67%

perceived an improved quality of life.

¹Source: 60 Decibels, March 2023, 400 cattle rancher phone interviews in Mexico/Honduras from February to April 2023



[Learn more on how maize silage improves the livelihood of cattle ranchers in Mexico & Central America](#)



[Read the article in the Havard Business Review about why sharing economic growth with the community is good business](#)

Partnering with the food chain



Improving food security with potatoes

Second only to maize, potatoes are one of Kenya's staple foods. However, due to a lack of access to knowledge, high-quality seeds and the food value chain, **the majority of smallholder farmers in Kenya are unable to grow and harvest anywhere close to the yield potential for their fields.** This has led to income instability for the smallholder farmers of Kenya as well as food insecurity for the people of Kenya.

Partnering with a consortium of public and private organizations, **we worked to train more than 2,000 smallholder potato farmers on agricultural best practices to help grow their yields.** And we specifically designed the training program so that we would gain a clear understanding around the amount of impact proper access could have on their livelihoods.



By giving Kenyan smallholder farmers access to the knowledge, products and opportunities needed to successfully farm potatoes, we help them significantly grow their incomes, and we're able to help improve the nutrition for the people in Kenya. This project can serve as a roadmap for feeding a growing population around the world.

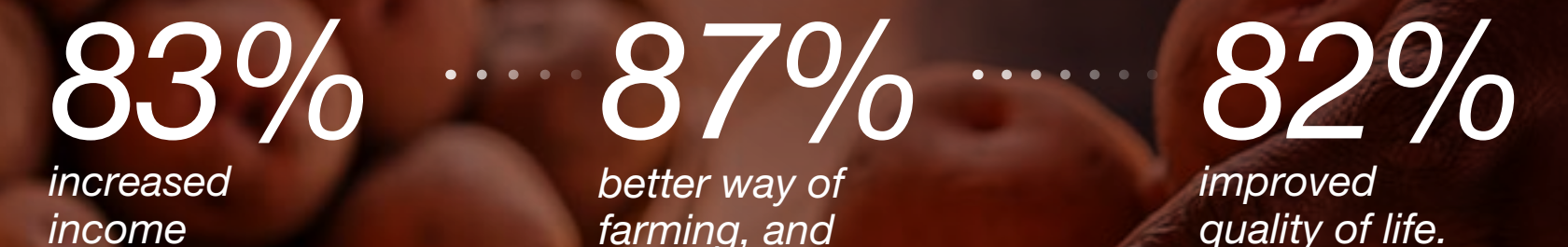
BayG.A.P. certification opens the doors to food chain partners and buyers. [Learn more here.](#)

Early warning system for potato growers

GeoPotato is designed to support small-scale potato farmers by enabling preventive crop protection and easier decision-making. It is a geodata-driven early warning system for late-blight disease in potatoes to optimize fungicide use, devised by Wageningen Plant Research, Terrasphere, mPower, Bayer and governmental institutions.

In the last 7 years, tests across select geographies in Bangladesh found that the GeoPotato brought a 15-20% yield increase for the farmers. As part of our commitment to empower smallholder farmers, we plan to expand the GeoPotato to reach more than 1 million farmers by 2030.

Small-scale potato farmers in Bangladesh who have worked with GeoPotato report positive social benefits:¹



“I have suffered many times because of blight. But I now know in advance about the blight breakout and remedies. In the last season, my crops were free from the attack. I was able to avoid losses.”

- Male potato farmer, Bangladesh

¹Source: [60 Decibels](#), June 2023, 275 farmer phone interviews in Bangladesh in April 2023

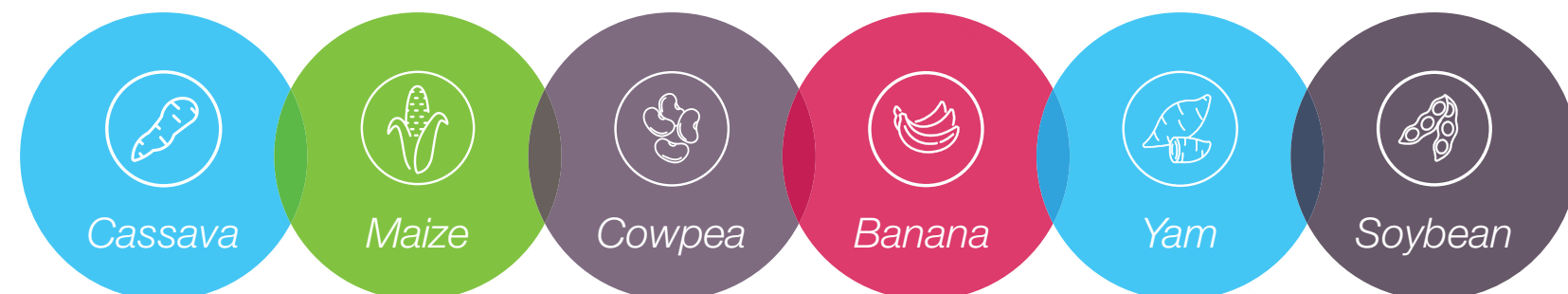
[Learn more about the GeoPotato system on our website](#)

Modern Breeding Project

Breeding higher-yield versions of key smallholder farmer crops

Supplying tools to improve smallholder farmers' operations

To efficiently feed a growing population, we must adapt our food to ensure it can grow. With this in mind, we've partnered with the International Institute of Tropical Agriculture (IITA) to create the Modern Breeding Project. Through this unique partnership between a private company and a public organization, **we're sharing the knowledge, tools and manpower to breed hardier versions of Africa's most critical crops:** cassava, maize, cowpea, banana, yam and soybean.



The project's beneficiaries are millions of smallholder farmers who grow IITA's mandate crops on about 60 million hectares in the humid to semiarid zones of sub-Saharan Africa. Bayer also assists IITA with research workflow management, product development, implementation of shared services, and general organizational insights.

With improved breeding, millions of smallholder farmers throughout sub-Saharan Africa will be able to improve their harvests, their incomes and their communities' access to nutritious food. Our vision: a more food-secure Africa.



[Read more about Bayer's partnership with IITA to create the Modern Breeding Project](#)

Imagine what could happen if smallholder farmers had access to digital tools

Growing the reach of our digital products

For decades, we've been developing advanced technology to aid commercial farmers. Tools like our Climate LLC's FieldView™ make large-scale growing more efficient, profitable and sustainable.

Imagine what could happen if smallholder farmers had access to these same tools. Our FarmRise™ App, for example, provides detailed weather, pest and disease management insights so that smallholder farmers can act quickly to protect their crops, as well as gain market insights to get a fair price for their harvests.



[Read more about how modern breeding methods are being used to improve smallholder farmer harvests](#)



Vegetable Seeds

Helping smallholder farmers become more resilient to climate change while supporting local diets

In our Vegetable Seeds business, we are prioritizing providing solutions that mitigate risks for smallholder farmers, such as extreme weather events, rising temperatures, erratic rainfall and new pests. We aim to increase their productivity and income, all while helping them to become more resilient to climate change.

Seminis® Manik tomato is an example of a variety that can help smallholders in India tackle some of these challenges. Studies have shown its good heat stress tolerance against high temperatures, that can rise up to 45°C during summer months in Rajasthan and Haryana Indian states¹. Together with its increased yield potential, it's opening up new opportunities for growers in the region.

We are also working to increase smallholder farmers' access to innovative vegetable seeds that can support local diets, while being tailored with optimal traits. Our breeding program is working to **improve the resistance of bitter gourd seeds to help farmers grow more resilient and productive crops**. In the last year alone, we launched 6 new gourd varieties in India that help growers achieve better results in a changing environment.

¹Data from 2020-2021, 10 Bayer trials, against the Heemsona variety, in Rajasthan and Haryana states in northeast India

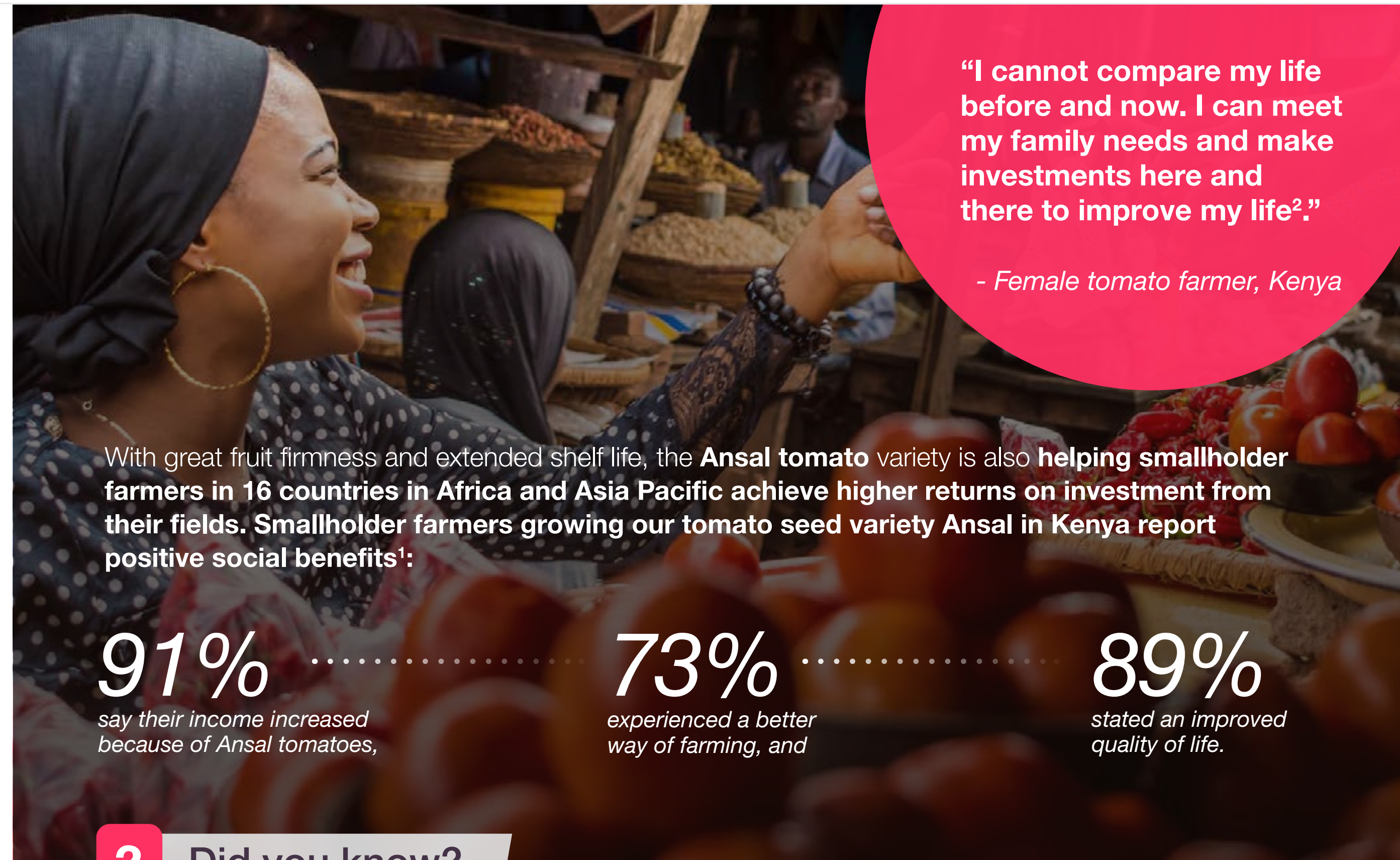
²Source: *60 Decibels*, November 2022, 418 farmer phone interviews in Kenya in October 2022



[Read more about how Vegetables by Bayer is working to improve the lives of millions of smallholder vegetable growers](#)



[Read more about our Vegetable Seeds innovations in the Annex](#)



"I cannot compare my life before and now. I can meet my family needs and make investments here and there to improve my life²."

- Female tomato farmer, Kenya

With great fruit firmness and extended shelf life, the **Ansal tomato** variety is also **helping smallholder farmers in 16 countries in Africa and Asia Pacific achieve higher returns on investment from their fields. Smallholder farmers growing our tomato seed variety Ansal in Kenya report positive social benefits¹:**

91%

say their income increased because of Ansal tomatoes,

73%

experienced a better way of farming, and

89%

stated an improved quality of life.



Did you know?

Knowledge and innovation that empower smallholder farmers

Shaping new solutions that help smallholder farmers access knowledge and innovations beyond seeds is a key goal in our strategy. One solution is the **Knowledge Transfer Initiative**, an accessible virtual platform launched in China and India that helps vegetable growers obtain agronomic information to better manage their crops and optimize their production systems.

Better outcomes lead to better lives for smallholder farmers

By transforming our business to take action in service of smallholder farmers, we're making measurable progress toward a world in which all growers have the resources they need to run a thriving, sustainable business – and toward a world in which all people have access to the nutrition they need.

We will continue to deliver on our 2030 commitment by expanding our activities in numerous regions across the world – through the means of Better Life Farming Centers worldwide, BayG.A.P. certification in Kenya, the GeoPotato in Bangladesh and India, DKsilos in Central America and innovative vegetable seeds in Africa and Asia Pacific. We invite interested partners to embark on this journey.

We start at the farms of those who form the backbone of food security in many rural regions of the world: smallholder farmers. Smallholder farmers' efforts to escape poverty and feed their families are our efforts as well. We want to help them thrive, and empower them to build viable and sustainable businesses, with ripple effects on their rural communities. We want to make a difference – not only in the lives of smallholder farmers but ultimately all our livelihoods.

This world – it's not so far away. Together, we can get there by 2030.



Learn more about our work with smallholder farmers



[2022 Sustainability Report](#)



[Better Life Farming Alliance Homepage / LinkedIn](#)



[Smallholder Farmers | Bayer Global](#)

Have questions or would like to discuss our work with smallholder farmers? Please reach out!



[Engage on LinkedIn](#)

RONALD E. GUENDEL GONZALEZ,
Vice President, Smallholder Farming
smallholder@bayer.com

Reducing Agriculture's Greenhouse Gas Emissions

Greenhouse gas (GHG) emissions pose a significant challenge for agriculture, impacting both the environment and food security. Agricultural activities, such as livestock production, use of synthetic fertilizers and land-use management, contribute to the release of GHGs like carbon dioxide, methane, and nitrous oxide into the atmosphere. These emissions exacerbate climate change and disrupt ecosystems, leading to adverse effects on crop yields and water resources.

Through our innovative product portfolio and the promotion of climate-smart practices, we strive to play a pivotal role in enhancing soil health, increasing resilience to climate change, and reducing GHG emissions.

Our work reducing agriculture's greenhouse gas emissions contributes to the following U.N. Sustainable Development Goals:



Sustainability Challenges

Climate change poses significant challenges for agriculture, primarily through increased frequency of extreme weather events such as floods, droughts, winds and wildfires. Over the past decade, these events have led to substantial crop losses and instability for farmers – which have tripled in the last 50 years – endangering global food security. At the same time, agri-food systems are responsible for nearly a quarter of global greenhouse gas emissions. By implementing sustainable farming practices, farmers can make meaningful contributions by retaining carbon in the soil, reducing the amount of carbon in the atmosphere and bringing us closer to a climate-neutral future.

Our Approach

At Bayer Crop Science, we are committed to tackling climate change and driving towards a climate-neutral future for agriculture. To achieve our target, we foster the adoption of climate-smart practices and technologies by our farming customers, including: high-yielding crop genetics, crop protection products, precision irrigation systems, soil management tactics through no-till and cover crops, crop rotation, root health, fertilization management, microorganisms and inoculants, a switch to direct seeded rice, and digital and precision farming tools. Combining different levers can lead to profitable, tailored solutions for our farming customers. We're also driving the implementation of carbon farming initiatives in various regions to scale the adoption of climate-smart practices and solutions and create new value streams for farmers.

Our GHG commitment in agriculture:

Reduce on-field greenhouse gas emissions of our farming customers per mass unit of crop produced in our major markets

by **30%**
by 2030

Progress

We are making significant strides in reducing greenhouse gas emissions across our most important countries and crops.

North America: Bayer ForGround, launched in 2022, offers growers tools and resources as well as the potential to earn revenue for adopting sustainable practices through the Bayer Carbon Program. Beyond the capture of carbon in the soil, ForGround is exploring other approaches and collaborations that can enable farmers to make a positive impact in their operations and on the environment.

Latin America: As part of the **Bayer PRO Carbono Program**, launched in 2021, farmers in Brazil who fulfill social and environmental compliance and adopt climate-smart practices are eligible for various services and incentives.

Europe: Our **agricultural decarbonization program**, launched in 2021, enables food chain partners to decarbonize their value chains. We are also working with partners to identify the best interventions and technologies to support farmers in reducing their environmental footprint.

Asia/Pacific: The India Sustainable Rice project, started in 2021, trains farmers in sustainable practices related to greenhouse gas emissions reductions, water efficiency and integrated weed management to improve the environmental footprint and productivity of farmers' fields.

Main Actions

North America

We provide farmers incentives to adopt innovative, climate-smart practices in programs such as ForGround



Europe

We support the decarbonization of the food value chain through our Bayer Carbon Program and in collaboration with other organizations as a member of the Carbon + Farming Coalition



Latin America

We implemented the Bayer PRO Carbono program that allows farmers to increase carbon sequestration in the soil



Asia/Pacific

We support GHG emissions reductions in rice cropping systems through our India Sustainable Rice Project, which combines the use of sustainable cultivation techniques with our innovative hybrid seeds



On the front lines of the problem and the solution

Farmers are experiencing the impact of climate change, and we are striving to help them do something about it

More frequent extreme weather conditions, including floods, drought, high winds and wildfires, are the consequences of a rapidly warming atmosphere. The last decade has delivered an unprecedented amount of these type of events. Not only has it been the hottest decade ever recorded, but six category-5¹ hurricanes have torn through the Atlantic, numerous intense wildfires have burned through hundreds of millions of acres of farmland and forests across the Amazon, Australia, North America and Greece, and warmer temperatures have brought on more intense episodes of flooding and droughts.

These extremes in weather mean crop loss for farmers and can threaten the food system. According to recent studies throughout Europe, crop losses due to extreme weather events have tripled over the last 50 years. Amidst the grave consequences faced by farmers, we're focused on helping them adapt to climate change and be part of the greater solution.

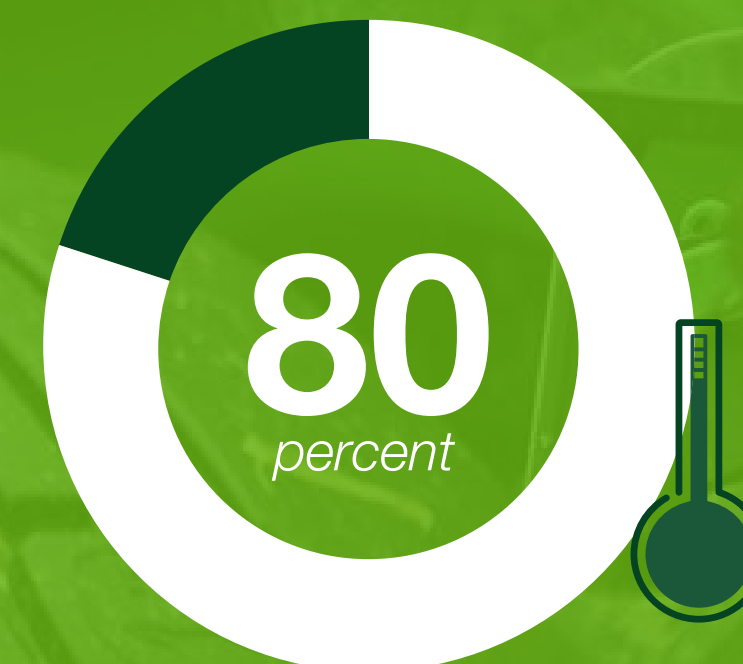


[Read key takeaways from our 2023 Farmer Voice Survey here](#)

¹Data from 2021 Source: Environmental Research Letters, 2021

²What climate-smart agriculture means for smallholder farmers, McKinsey, 2023.

An analysis shows that in three countries – India, Ethiopia and Mexico – nearly



of all smallholder farmers could be affected by at least one climate hazard by 2050²

In Europe, crop losses due to extreme weather events have increased by

3x over last 50 years

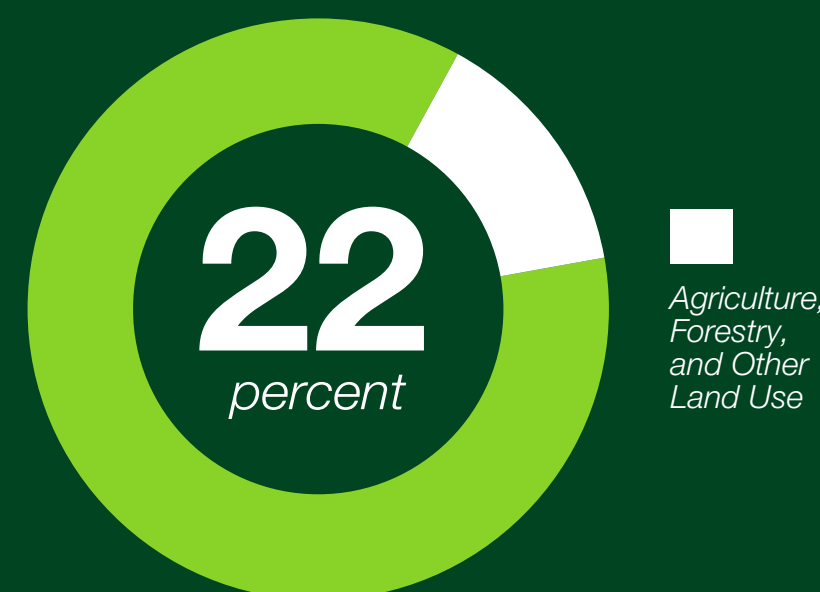




We collaborate with farmers and partners across the value chain to innovate and drive adoption of tools, practices, and business models to reduce agriculture's greenhouse gas emissions by:

- // Keeping carbon in the soil
- // Sequestering carbon from the atmosphere
- // Reducing farmer operational emissions of CO₂, N₂O, and CH₄

Agriculture and related land use changes account for



of global greenhouse gas emissions

Leading an industry-wide response

Greenhouse gas emissions, including carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), are a leading cause of climate change. Land use and land use changes including those occurring within the agriculture industry, coupled with crop and livestock activities, account for a large percentage of these global emissions. The latest [IPCC report](#), released in March 2023 states: **“In 2019, approximately 22% of net global GHG commissions came from Agriculture, Forestry, and Other Land Use (AFOLU).”**

The agriculture sector has an opportunity to lessen the impact of climate change. As a leader in agriculture, we at Bayer strive to discover ways to achieve this. And, as we have found, at least one solution is in our farming customers' backyards. Or rather, their fields.

Crops actively absorb carbon dioxide from the atmosphere during the process of photosynthesis. Subsequently, as the plant biomass decomposes, it releases carbon into the soil. **This makes soil one of the earth's largest natural carbon sinks,³ second only to oceans.** Carbon can then be retained in the soil through sustainable farming practices like no-till farming and planting cover crops in the off season. By helping farmers to implement practices that help keep the carbon in the soil, we can lessen the amount of carbon in the atmosphere – taking us one step closer to a climate-neutral future.

What's more, carbon-rich soil is also healthy soil. It requires less fertilizer and yields more bountiful healthy harvests. What's good for the atmosphere is also very good for growing food. And that means it's good for farmers' businesses.



Source: IPCC Report

³Carbon sinks: natural deposits that absorb and capture CO₂ from the atmosphere, reducing its concentration in the air

Our Commitment to reduce on-field greenhouse emissions

In 2019, we set an ambitious commitment. By 2030, we aim to enable our farming customers to reduce their greenhouse gas emissions per mass unit of crop produced by 30% This applies to the highest greenhouse gas emitting crop systems and in the regions Bayer serves with its products. This target is measured against a baseline, consolidated from customers' specific GHG footprints on selected crop and countries between 2020-2022 harvest years. Accurate definition of our scope and measurement is essential so we know what's working and what isn't, as well as to maintain focus on our goal.

The scope of our commitment is centered on where we can make a significant difference — and that is with the most carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) emitting cropping systems in the regions that we serve. That's soybean and maize in the U.S., Brazil and Argentina, paddy rice in India, as well as wheat, cotton and rapeseed in other geographies. More specifically, we're focused on the sources of these emissions, primarily cultivation and land management practices, decomposition of applied fertilizers and organic matter, as well as irrigation. We define our customers as farmers whose share-of-wallet for our products at least equals our market share in a particular market, farmers using our seed varieties, our digital platform Climate FieldView™ or farmers participating in our Bayer Carbon Program. To measure progress against our target, we'll use representative samples of field-level data from a third-party market research data provider obtained in interviews with randomly selected farmers.

Our methodology is described in more detail in a report reviewed by an external panel of experts to ensure the baselining and performance tracking methodology is adequate.



[Read more about our methodology to track the progress against our commitment](#)

Centering our approach around farmers and society

Farmers are the earth's original conservationists. After all, when the land is your livelihood, any changes to it can be devastating. However, our ambitious goal of significantly reducing atmospheric carbon won't be achieved if it doesn't work for farmers' businesses. Therefore, farmers are at the center of every initiative we have to reduce agricultural emissions and sequester carbon in soil. **In everything we do, we first work to fully understand the impacts it will have on farmers' day-to-day practices and their livelihoods.**

If it impacts their businesses positively and is practical for their day-to-day work, we move forward. With that in mind, we asked ourselves, beyond improving the health of their harvests, is there a way we can make soil carbon something farmers want to farm? Our answer is yes.

Our Commitment
Reduce on-field greenhouse gas emissions of our farming customers per mass unit of crop produced in our major markets

by **30%**
by 2030

“Farmers are not only faithful stewards of the land, but they’re also leading the way to a more sustainable future. They love the land that sustains them and know that it must be responsibly managed for their livelihood and for that of the next generation.”

Rodrigo Santos

Member of the Board of Management,
Bayer AG, and President of the
Crop Science division

Bayer's climate objectives - understanding emissions through three scopes

Like all corporations, our GHG emissions are classified into three different scopes. Scope 1 emissions are our direct emissions from our corporate-owned facilities and vehicles. Scope 2 emissions are our indirect emissions as a result of procuring electricity, steam and cooling energy. Scope 3 emissions represent all indirect emissions along our value chain, both upstream and downstream.

We are committed to transparently communicating our climate targets and progress, as well as the impact that climate change has on Bayer. Through continued participation in the Carbon Disclosure Project (CDP) we disclose a high level of details on our climate related activities and progress. In 2022, CDP once again gave the highest rating (A) to our climate strategy for leading in environmental performance and transparency.

Scope emissions

1

Direct emissions from our corporate-owned facilities and vehicles

2

Indirect emissions as a result of procuring electricity, steam and cooling energy

3

Indirect emissions along our value chain



Find out more information regarding our Scope 1, 2 & 3 progress within the Product Supply chapter

Looking internally to reduce our own footprint

We have set ambitious targets for our own GHG emission reductions



We've joined the world's leading Science Based Targets Initiative (SBTi), founded by the CDP, the United Nations Global Compact, the World Resources Institute (WRI) and the World Wide Fund For Nature (WWF). **The initiative, aimed at assisting organizations in setting transparent targets for reducing emissions, has approved our ambitious targets in the reduction of our Scope 1, Scope 2 and Scope 3 emissions.** With these targets, we have committed ourselves to actively playing our part in limiting global warming to 1.5°C for Scopes 1 and 2, and 2°C for Scope 3.

Enabling farmers to reduce their GHG emissions goes above and beyond what we have set with these organizations. As a leading life sciences company, we realize there's a lot we can do to lessen the footprint for greenhouse gas emissions.

Partnering for more reach & impact across the value chain

When it comes to reaching climate neutrality, we recognize that our new business models will only get farmers so far. So, **we're collaborating with other entities to create new pathways for reducing agriculture's emissions.** When we combine our expertise with the knowledge, technologies and power of NGOs, governments, international organizations, farmers, consumers and food chain members, together we can achieve profound impact.



A summary of our climate strategy can be found here

Enabling a climate-smart agriculture

Based on our farming customers' greenhouse gas intensity in our major markets and for our major crop-country combinations, we calculated a global baseline with data from 2020-2022 harvest years.

To calculate an overall baseline, individual baselines were weighted according to Bayer's footprint in these crops and regions. We then made an estimate using the total production volume of a particular crop in a particular market from the Food and Agriculture Organization (FAO) database for crop production, our market share in the market, and the carbon intensity of the crop-country combination.

To achieve our target, we are fostering the adoption of climate-smart practices and technologies by our farming customers in the different regions where we operate.

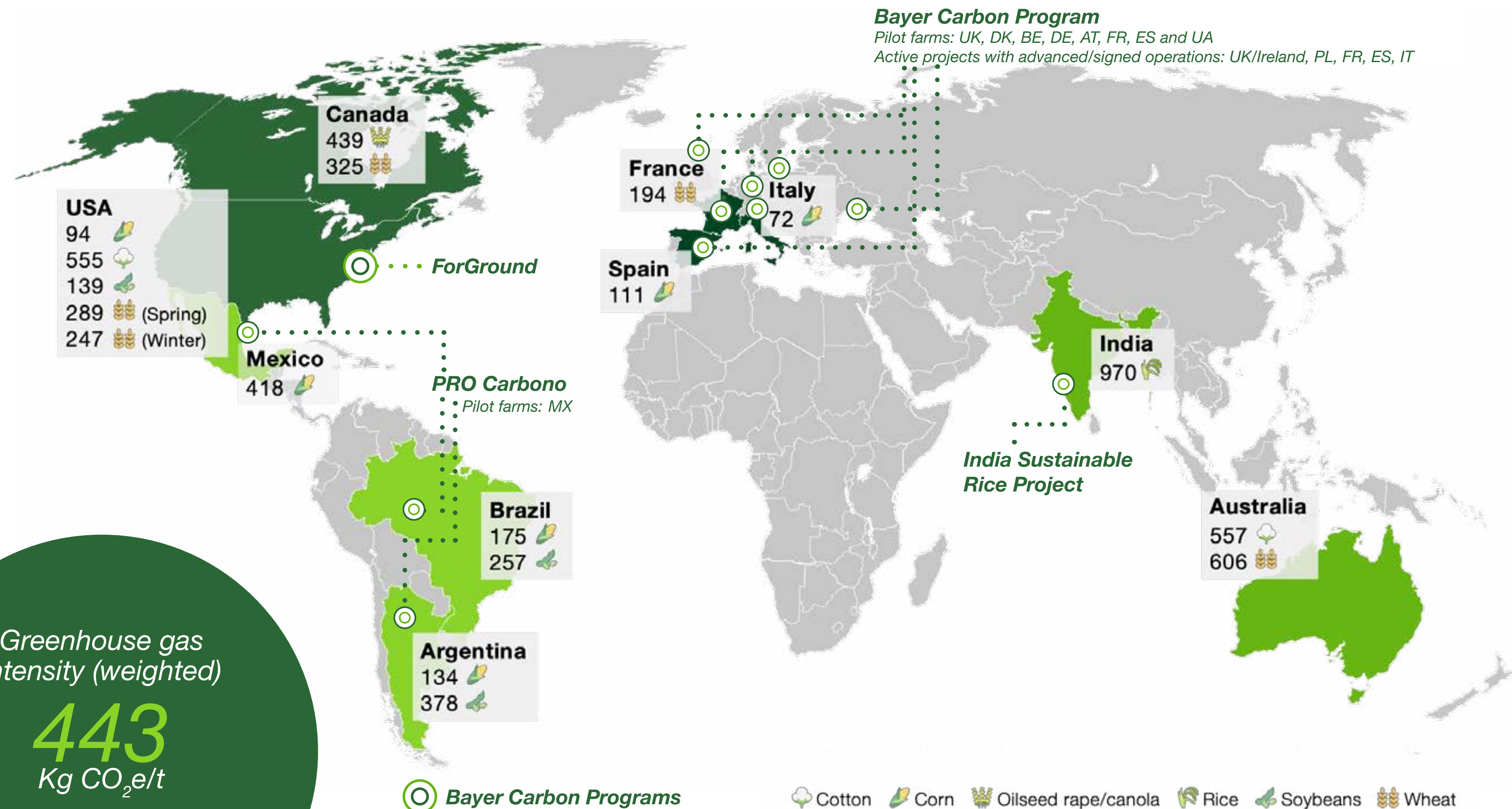


Greenhouse gas intensity (weighted)

443
Kg CO₂e/t

*Kg of CO₂ equivalent per metric ton of crop produced

Greenhouse Gas Intensity for Our Most Important Crop-Country Combinations & Bayer Carbon Programs



Country and crop data in kg CO₂e per metric ton of crop produced (not weighted)



Find more information on our baselining and performance tracking methodology

Carbon: Farmers' newest crop

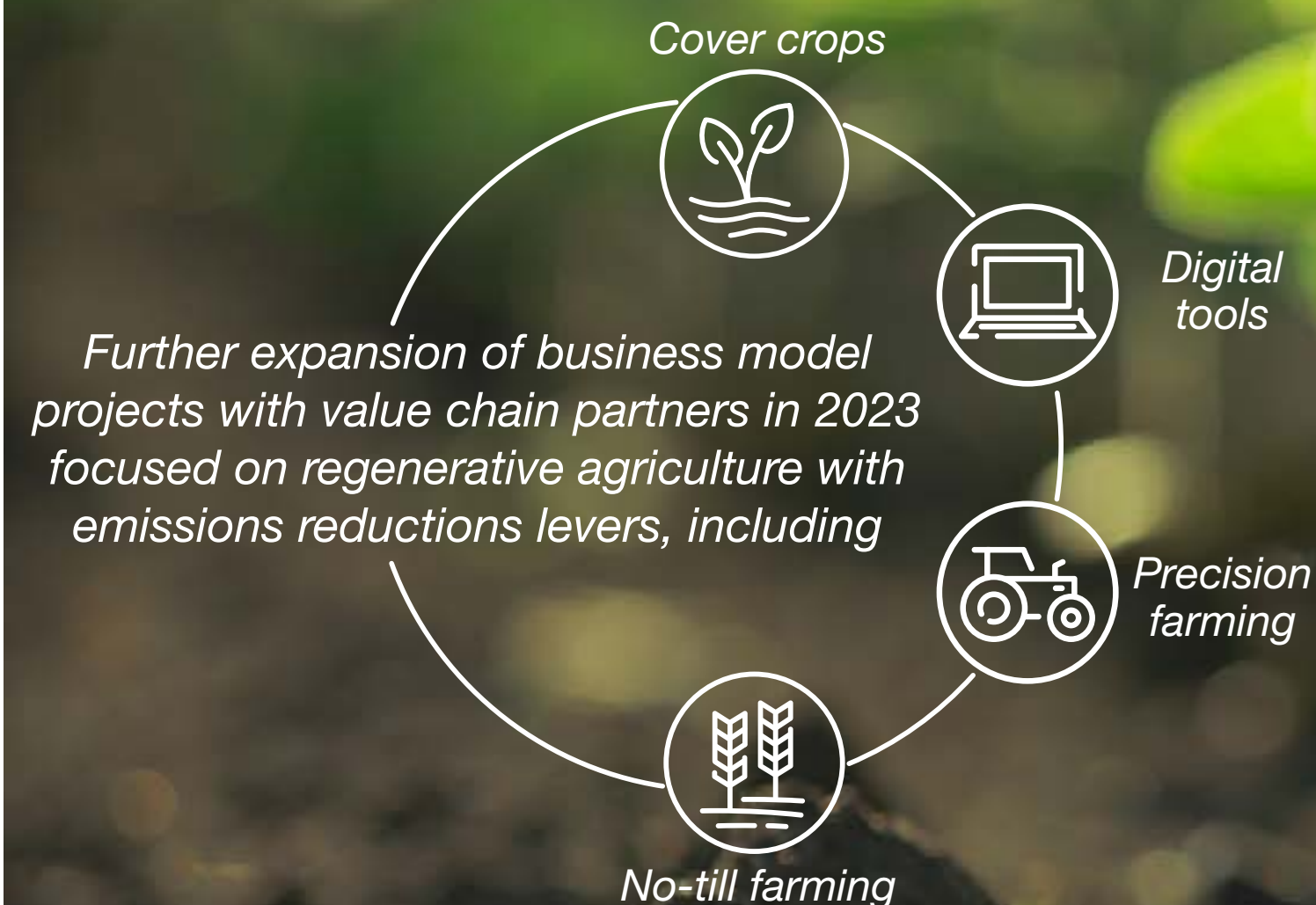
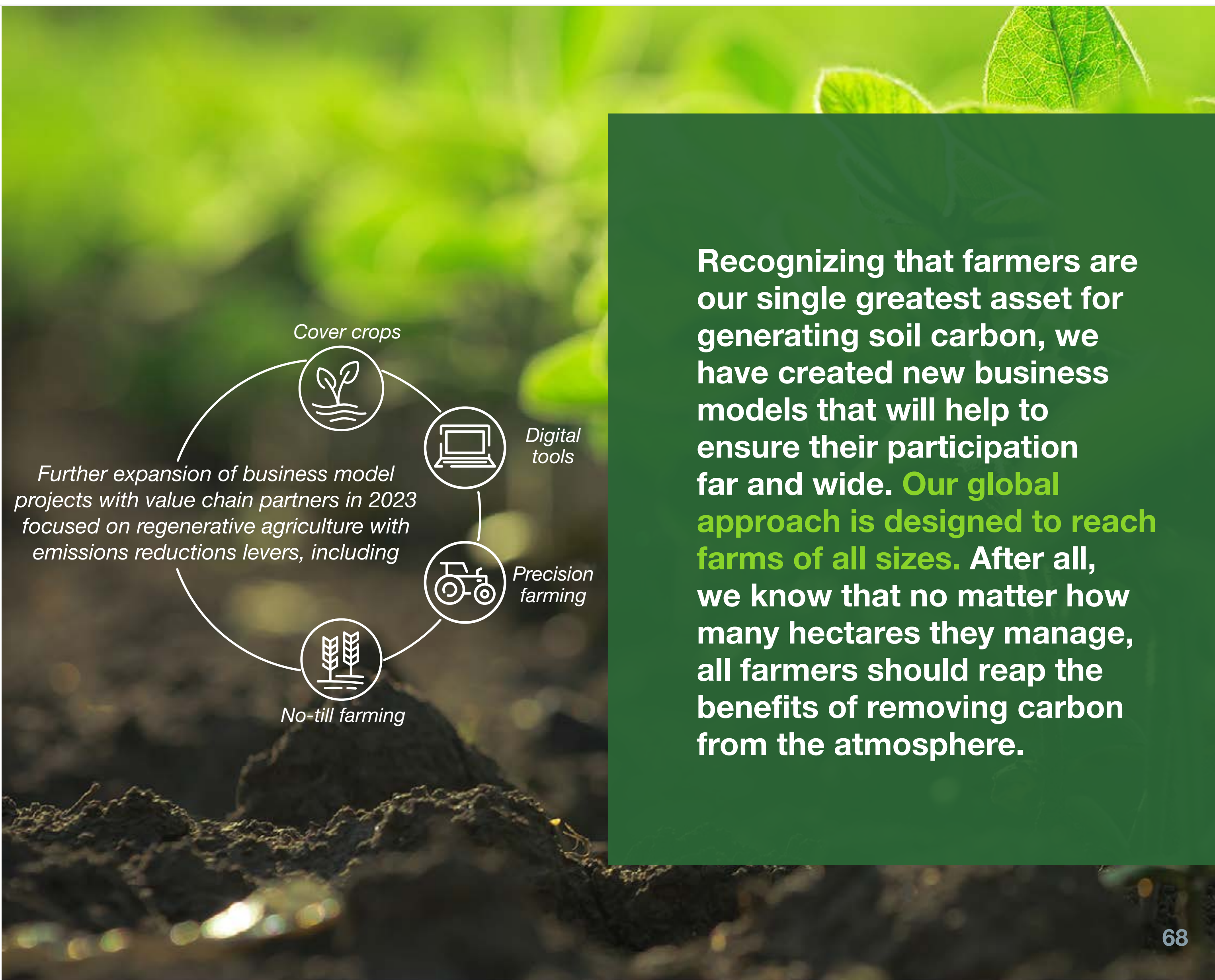
Farmers are in the business of growing, harvesting and selling crops based on the price dictated by commodity markets. **To make sequestering carbon a vital part of their work, we must treat carbon as a potential revenue stream. That means giving farmers a way to generate income at a price equal to their efforts.** By giving farmers the tools and methods to increase the carbon retained in the soil and ensure it remains there, they're able to measure it and earn from it, just as they would with hectares of tomatoes, maize or soybean harvests.

Prices for carbon offsets
could be as high as

\$120/ton
by 2050



At Bayer, we believe that using soil to reduce carbon from the atmosphere is not just our responsibility, but it could unlock our own promising business opportunities. **Our work on the ground with farmers puts us in the right position to help them improve their practices and, in turn, their businesses.** By creating new ways of working, we can create new value opportunities for all of us. **It's good for farmers, good for business and good for the world.**



Recognizing that farmers are our single greatest asset for generating soil carbon, we have created new business models that will help to ensure their participation far and wide. Our global approach is designed to reach farms of all sizes. After all, we know that no matter how many hectares they manage, all farmers should reap the benefits of removing carbon from the atmosphere.

North America

Empowering farmers to create big impact

Launched in the United States in 2020, the premise of the Bayer Carbon Program is simple: supply farmers with the motivation to adopt climate-smart practices.

In the U.S., participating farmers who adopt practices like no-till or strip-till farming and planting cover crops, receive payment from Bayer relative to the number of acres where they're implementing them. This provides us with a way to generate high-quality, certified carbon assets. **Guaranteed payment based on the number of acres enrolled makes participation straightforward for farmers and easy to track by Bayer.** It also offers flexibility around which methods work best for farmers' individual businesses, while also giving them certainty about the income they can expect to generate. Since its inception in 2020, hundreds of farmers have signed on and received payment for their efforts, making as much as \$506,000 individually.

ForGround

Based on the successful foundation of the existing Bayer Carbon Program, we launched the farmer-first digital platform ForGround in 2022, which has expanded and evolved to explore other ways farmers can make a positive impact in their operations through the adoption of regenerative agriculture practices and technologies. This program offers the ability for Bayer to connect farmers with other companies to help them meet their sustainability goals.



[Learn more about ForGround here](#)

ForGround: Bayer carbon program in North America



\$506K

Top individual payout for 2022 season

\$12

per acre in 2023 for participating farms

total payouts since inception amounting to more than

\$13M

The Preceon™ Smart Corn System

Corn farmers face many hurdles, including pressure from weeds, pests, diseases and unpredictable weather conditions that have increased in frequency and severity. The Preceon™ Smart Corn System provides a solution to these heightened challenges with features that reap big benefits:

- 1 The system brings a new variety of hybrids, which are shorter in stature without compromising yield (short-stature corn hybrids). Beside the significantly improved lodging resistance in strong wind conditions, they provide extended in-season access to the fields – with standard equipment – and can generally be planted more densely than tall hybrids. The ability to use ground equipment, rather than having to access the crops aerially, also means an improved greenhouse gas footprint.
- 2 The Preceon™ Smart Corn System is an integrated system combining the short-stature hybrids with management practices, crop protection, digital solutions and agronomic advice, orchestrated to unleash the potential of each field tailored to individual conditions.

Combining the Preceon™ Smart Corn System with climate-smart practices enables corn farmers to produce more profitably and sustainably.



[Learn more about the Preceon™ Smart Corn System](#)

Latin America

Putting emission reductions at the center of our business

PRO Carbono

In LATAM, we launched the PRO Carbono program in Brazil in 2020, where more than 1,900 farmers across 16 different states began participating – totaling over 540,000 acres. **The growers implement regenerative agricultural practices in their fields to increase carbon in the soil while also increasing their crop yield. In addition to reaping the direct benefits of greater soil fertility, participating farmers have access to carbon analysis, technical consultants and professional agronomists.** Our current estimates suggest that the resulting carbon capture improvements to soil health could result in more than 10% yield and 6% profitability increases. Participants have access to exclusive benefits from partner companies, such as access to differentiated credit from banks and discounts or early access on the purchase of inputs. In Argentina, we also launched the PRO Carbono program where more than 160 farmers have started to participate since 2021, now reaching 40,000 acres under sustainable practices.

In addition to this program, in May 2023 Bayer delivered the first load of Brazilian soybeans with a traceable, deforestation-free carbon footprint. Titled PRO Carbono Commodities, this initiative stems from our global program to protect forests and other natural vegetation. The carbon footprint data was measured by a carbon calculator (PRO Carbono Footprint), which we are developing initially for soybean cultivation in the tropical zone in a joint effort between Bayer and Embrapa. We expect to have an accurate carbon footprint calculation based on primary data for the 4 million bags or 240,000 tons of soybeans produced.



[Learn more about the Embrapa Agricultural Research Corporation](#)

PRO Carbono: Bayer Carbon Program in Latin America



Brazil

1,900+

Farmers have signed up

540K

Total acres enrolled across 16 states

Carbon capture improvement in soil health results in more than

10% yield

and

6% profitability increases



Argentina

160+

Farmers have signed up

and

40K

Total acres enrolled

Europe

Decarbonizing the food system

In Europe, we launched the Bayer Carbon Program in 2021. With a goal of supporting the decarbonization of the food value chain, this program consists of 4 main pillars:

- ① **Agronomy:** identifying the best levers and types of interventions to reduce the carbon footprint of European farms is essential. With this objective, and to always support the best interests of our customers, we have developed a network of pilot farms across 8 different countries to test new carbon farming methods and generate learnings. These farms are connected to the value chain players and supported by our own experts for testing.
- ② **Science:** in Europe, agricultural conditions vary considerably, resulting in different crop rotations, soil types and climatic conditions, among other aspects. That's why we leverage all of our scientific expertise and our best soil engineers to assess and validate the most accurate farming models for the region.

- ③ **Digital:** data collection and precision farming are two critical tools to develop successful Carbon Farming projects. With Climate FieldView™, Bayer can provide a powerful, daily connection with growers. The tool also brings a unique benefit to the market: connecting carbon farming interventions with the farm productivity thanks to high-quality yield maps.
- ④ **Carbon Project Management:** while the previous elements are essential to develop a low carbon project in agriculture, the ability to aggregate these components in a project is equally important. This represents the last pillar of development for our value proposition to the Food Value Chain. This complete portfolio of solutions starts with a feasibility study at the early stage of a project and finishes with a fully-certified project compliant with the most recognized registries.

Learn more about Climate Fieldview™ [here](#)

We're developing **Agriculture Value Chain Intervention Carbon Projects & Services** that leverage our unique digital capabilities. We strive to support companies in achieving their climate commitments by fostering growers to increase adoption of smart carbon practices.

Europe Carbon Program

Food chain discussions in several countries to engage pilots, feasibility analysis and Value Chain Intervention (VCI) Projects

13 **4** **26,000**
Countries Projects Hectares

Regional Partnerships & Alliances

Cover crop breeders, University, Public institutes, agronomical consultants

8 **27** **500**
Countries Farms Hectares

A 'lab' based approach on the reality of agriculture, testing different systems & crops with growers

Enrollment Soil Analysis Carbon Footprint Recommendation
..... Field View Deployment Data Collection Baselineing Testing



● Value Chain
● Pilot Farms
● Value Chain + Pilot Farms

Partnering to decarbonize European agriculture

As part of the Carbon+ Farming Coalition, we're partnering with organizations representing every step along the food value chain with a goal of decarbonizing the European food system. Starting with a lighthouse project we're calling the Carbon+ Farming Journey, the coalition is taking a farmer-centric approach to increase the adoption of regenerative and climate-smart practices. **The coalition will ultimately deliver a set of recommendations to the European Commission to help frame EU policies that will accelerate climate-smart solutions on a size and scale suitable to encourage adoption across the entire continent.** By identifying the roadblocks to adoption, designing solutions with practical benefits to farmers and creating public and private financial tools like subsidies, tax incentives and carbon markets we can help farmers transition to more sustainable practices, and support them to do their part in reaching climate neutrality.

In line with the objectives of the new EU Green Deal, we are confident this initiative will set the standard for carbon farming throughout all of Europe.

Asia/Pacific

Reducing the emissions from rice cultivation

Today ~80% of the world's rice crop is produced using transplanted paddy rice (TPR) cultivation practices, which are land, water, energy and labor intensive and contribute heavily to global greenhouse gas emissions.

The crop is among the largest contributors of GHG, producing 1.5% of total emissions globally, and is responsible for 12% of global methane emissions – a greenhouse gas 28 times more potent than carbon dioxide. In Southeast Asia, rice cultivation accounts for as much as 25-33% of the region's methane emissions.

As part of the [India Sustainable Rice project](#) started in 2021, Bayer is evaluating GHG reduction and water-saving potential in the cultivation of rice under Alternate Wetting and Drying (AWD) and Direct Seeded Rice (DSR).

In addition, we are engaged in developing a holistic rice crop system powered by direct seeding. This will reduce labor requirements, optimize water use for growing rice and reduce GHG emissions – especially methane. Since 2022, field pilots are well under way in India, covering Bayer solutions, planting services and agronomy package testing, as well as the generation of carbon credits. We've also worked with the International Rice Research Institute (IRRI) over the past years to further develop the right agronomy advice for farmers for direct seeded rice.

This rice crop system package will consist of different solutions, including but not limited to: **Arize hybrid rice seeds**, weed management solutions such as Council® and Ronstar®, Reatis™ seed growth solution, pest and disease management solutions like Vayego® and Nativo®, and digitally-enabled advisory and application services.

Our AWD and DSR systems have the potential to lower GHG emissions by up to ~45%, with GHG avoidance being compensated through conversion into carbon credits, offering farmers an additional source of income.



[Learn more about how we are collaborating with GenZero and Shell to reduce methane emissions in rice cultivation](#)

Direct seeded rice benefits against traditional rice cultivation*

Conventional

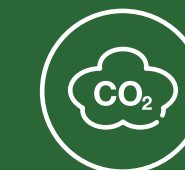
Direct seeded rice ^{4,6}



12.5-15.5 mio. l

up to 40% reduction

7.5 - 9 mio. l



6.8 t CO₂e ⁵

up to 45% reduction

3.8 t CO₂e



300 labor h. ⁵

up to 50% reduction

150 labor h.

⁴The reduction numbers relate to paddy rice and could vary for different rice cultivation practices and geographies

⁵ Considered yield of 5 ton / ha for the carbon footprint and labor calculations

⁶Savings on electricity and diesel to be evaluated

*Absolute numbers are per hectare

References: TPR Water Use: Kynetec Panel Survey Data 2020, IRRI (2009). Bouman et al. (2002) | Water Savings from TPR to DSR: Bayer Sustainable Rice Initiative Pilot, Singh et al. | Carbon emission - IPCC (2008/2019) | Labor: Sidan et al (2020)

Putting more weight behind our efforts

Seeing the benefit as well as the business opportunity in galvanizing farmers to sequester carbon and reduce emissions, we're putting more and more resources toward it. We're increasing our percentage of full-time employees dedicated to carbon farming business models, and we plan to add more resources as we expand into new regions and explore more programs. We're also significantly increasing the amount we're investing in developing our carbon farming business models.

Enabling verification

Central to our new business models is our proprietary platform, **Climate FieldView™**.

FieldView™ provides farmers with real-time updates about their fields. **Through the platform, we can support verifying farmers' carbon farming, acre by acre.** Additionally, farmers can access monitoring tools to manage their operations and use inputs more efficiently – reducing their emissions. **It's just one more way we're empowering farmers to adopt sustainable practices.**



Advancing our digital capabilities

Thanks to Climate FieldView™ and many other digital tools, farmers around the globe can generate more information about how and what they grow. Such data can provide critical insights that can, in turn, help feed a growing population more efficiently and sustainably. **Beyond the farm, businesses that support food production and farming are also generating and relying on data to make the best decisions possible to support a healthy, productive and increasingly interconnected food system.** Satellites, field sensors, drones, field equipment and soil sensors generate hundreds of variables and attributes, but until recently, it's been difficult and expensive to turn that information into insights because these systems aren't linked.

Until now, data from all corners of agriculture – production patterns, weather data, insect and disease tracking – were not connected due to a lack of digital infrastructure. Without a common data format across the industry, interoperability and sharing has proven to be a challenge.

Bayer is proud to announce the evolution of its collaboration with Microsoft through the preview launch of the Azure Data Manager for Agriculture platform and the release of Bayer AgPowered Services. **Azure Data Manager for Agriculture extends the Microsoft Intelligent Data Platform with industry-specific capabilities to connect farm data from disparate sources, enabling organizations to leverage high-quality datasets and accelerate the development of digital agriculture solutions.** AgPowered Services are a set of capabilities and tools built on top of the platform that turn data into timely insights on crop health, weather forecasts, crop growth tracking and more. The platform will help promote sustainable farming practices by laying ground for sustainability applications built on rich and plentiful agronomic data. The two work interchangeably, enabling agri-food value chain companies to accelerate digital innovation and build new business value.



Scaling Sustainability Through Bayer & Microsoft Partnership

Accelerating the world's progress toward reducing emissions

Our efforts to reduce greenhouse gas emissions are helping to shape a future one step closer to climate neutrality.

A large part of our greenhouse gas emissions (GHG) occurs in our upstream and downstream value chain.

To minimize these emissions, innovation and collaboration are key.

While our efforts to reduce the emissions from our own operations are but a tiny contribution to the greater whole, **by providing the tools, programs and partnerships to reduce emissions throughout the entire food system, we can help lead a step change in the reduction of emissions in agriculture.**

Some additional examples of our partnerships and collaborations are:

Perdue AgriBusiness: Advancing regenerative farming



Perdue AgriBusiness is our first major partner onboard to work towards large-scale reduction of carbon emissions under our ForGround platform. This collaboration is aimed

at creating a model for a more sustainable food value chain spanning across Perdue's entire grain network.

The program is anticipated to help improve soil health and reduce Scope 3 GHG emissions at scale in the long term. Through the collaboration, we are creating additional opportunities to help support farmers on their regenerative agriculture journey, benefiting their land and helping them produce more environmentally friendly food and ingredients for businesses and consumers.

Nori: Enabling a marketplace for carbon removal offsets



Nori was founded in 2017 with the mission of massively scaling carbon removal in order to reverse climate change. The company has built a vertically integrated marketplace that takes on not only the sale of carbon removal offsets, but also the incentivization, creation, and management of new supply. Here is how it works: Farmers participating in the ForGround program log their data in FieldView™, and upload it into the Nori app. Data and agricultural practices such as no-till, strip-till and/or cover crops are verified by third-party verifiers using project data, satellite imagery and seed or equipment receipts to support the practices and carbon removal. Nori then quantifies the carbon removal and generates tokens, which can be sold for cash or other equivalents on the marketplace.

Learn more about our efforts to reduce agriculture's greenhouse gases



[2022 Sustainability Report](#)



[Crop Science Greenhouse Gas reduction commitment](#)



[Learn more about how we protect the climate](#)



[Our investment in the sustainable lower carbon oilseed producer CoverCress™ Inc.](#)

Have questions or would like to directly discuss our efforts to reduce agriculture's greenhouse gas emissions? Please reach out!



ALEXEY KUZMENKIN,
GHG & Ecosystem Services Venture Lead

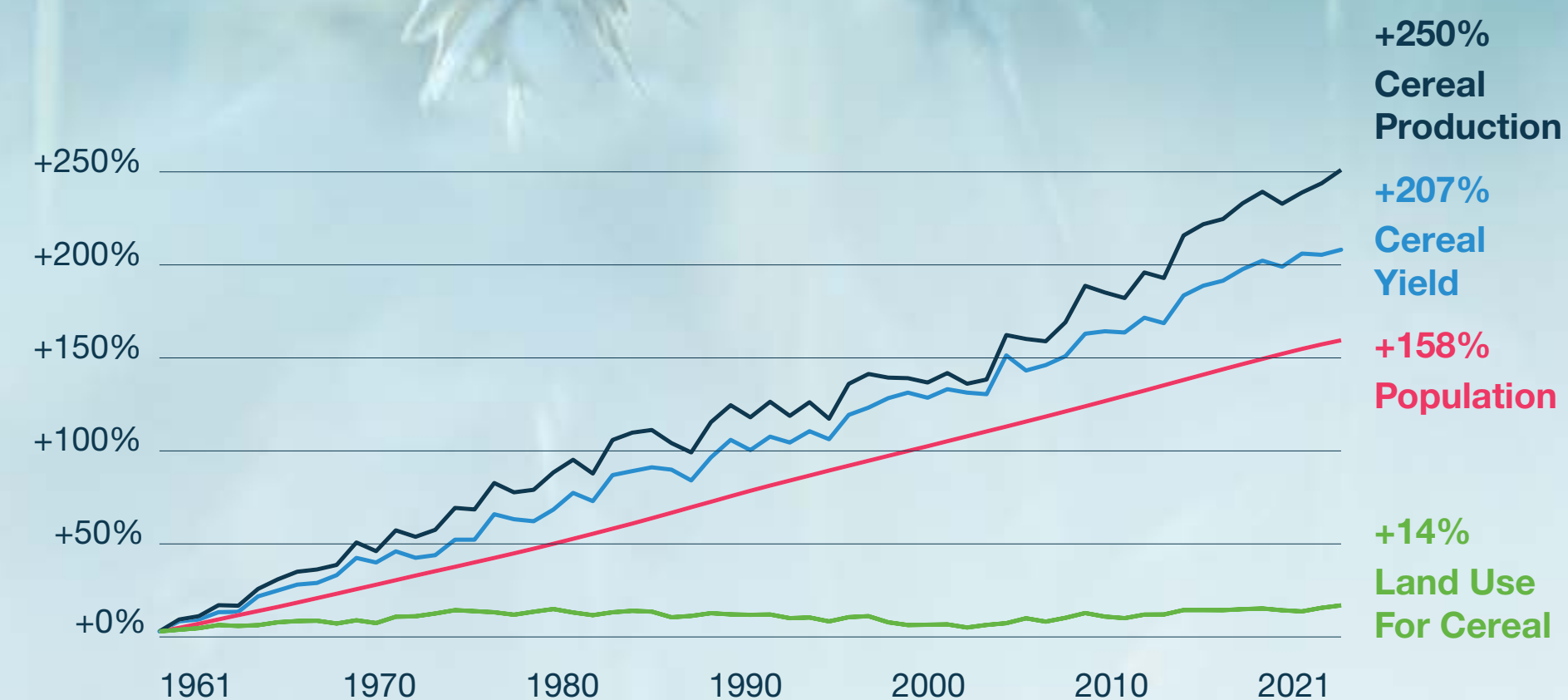


MIYA HOWELL,
Climate and Land Use Change Venture Lead

Crop Protection Environmental Impact Reduction

Crop protection, next to fertilizers and breeding advancements, has helped humanity to feed an ever growing population while limiting the increase of arable land, which is a vital step in helping minimize land use change. Yet crop protection products do not just increase yield – they also have an environmental impact when applied on fields. At Bayer, we strive to develop crop protection products with the same or better benefits for the farmer while decreasing its environmental impact.

Our work reducing the environmental impact of crop protection contributes to the following U.N. Sustainable Development Goals:



Source: *Our World in Data* based on World Bank; Food and Agriculture Organization of the United Nations

Sustainability Challenges

While crop protection has benefits for our food supply, we must also consider its impact on the environment beyond the field. Crop protection products enable farmers to meet the world's growing food and feed demand while using less land and resources, which reduces the need to expand agricultural production into natural habitats.

Agriculture must strike a balance between the need for tools like crop protection and potential trade-offs posed by increasing the use of such tools. With new products and technologies, we aim to ensure that our solutions serve farmers' needs and wellbeing, while also reducing the impact of the products on the environment.

Our Approach

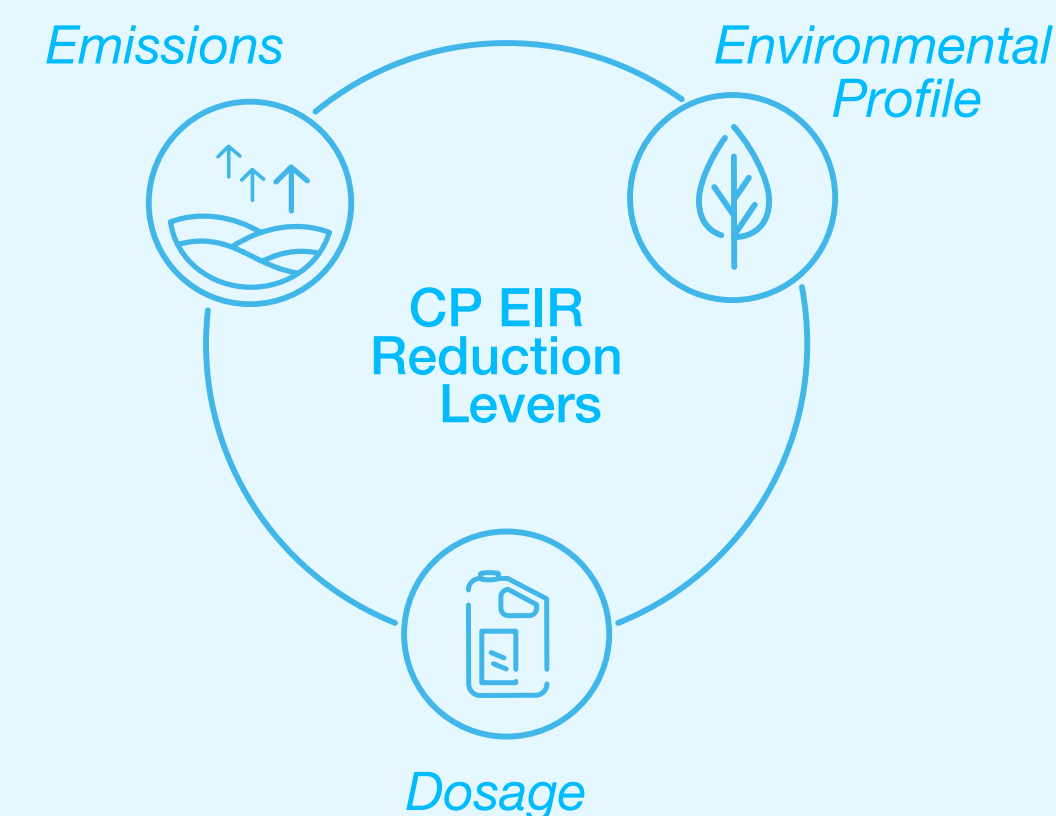
At Bayer Crop Science, we are committed to reducing the environmental impact of our global crop protection portfolio per hectare by 30% by 2030.¹ To achieve this, **we take a holistic approach that starts with the way we develop crop protection solutions and finishes with product application.**

To this end, we are working on reducing the amount of crop protection products needed per hectare, our product emissions to the surrounding environment and improving the environmental profile of the active ingredients while ensuring its efficacy. In addition, we strive for the safe, responsible use of crop protection products with our Stewardship efforts. We collaborate with external experts to apply state-of-the-art methodology for measuring the environmental impact of our crop protection products. We strive to develop and offer products that have the same or better benefits for farmers while having less impact on the environment.

¹Environmental impact is defined as the potential effect on non-target organisms

Main Actions

- **Improve** the environmental profile of crop protection active ingredients while ensuring efficacy
- **Optimize** the amount of crop protection products needed per hectare
- **Reduce** crop protection emissions to the surrounding environment



Progress

As a market leader in crop protection, we have already achieved exceptionally low environmental impact levels of our crop protection portfolio, but we must continue to improve. Based on the data collected between 2017-2021, we have reduced the treated-area-weighted environmental impact per hectare of our global crop protection portfolio by 14% against the 2014-2018 baseline while increasing crop protection sales by 15% from 2018 to 2021.² This reduction was mainly the result of changes in our crop protection product portfolio in recent years. We have also started reporting quantitatively against our commitment in our [2022 Sustainability Report](#).

²Crop protection sales also includes a price effect

2017 - 2021

against the baseline 2014 - 2018

Reduced the environmental impact of our global crop protection portfolio per hectare

14%

From 2018 to 2021

Increased our crop protection sales by²

15%

Our Commitment

Reduce the environmental impact of our global crop protection portfolio per hectare by

30% by 2030

Agriculture's paradox

By definition, farming alters the natural environment in order to supply the food we eat across the globe. Farmers need to tend to their land to protect their crops from harmful insects and diseases as well as guard them from weeds competing for the same land, nutrients and water.

Crop protection is not just critical for farmers' businesses, it is imperative for our food system. Historically, crop decimation from blight and pests resulted in starvation and conflict in the developing world, and it is still a significant threat in many countries. Crop protection gives us the security of knowing our food supply is better protected from this type of destruction.

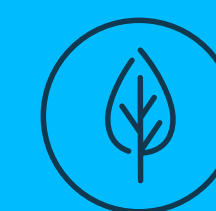
Crop protection also increases yields, allowing farmers to grow more food on less land, which is a necessity now more than ever. Today, farmers use less than one third of the land they would have needed in 1961 to produce the same amount of food. This ability to do more with less reduces the need to expand agricultural production into natural habitats.

By definition, farming alters the natural environment in order to supply the food we eat across the globe

Because of increased demand for food and challenges caused by pests, disease, extreme weather and other factors, the use of crop protection results in a net-benefit yield gain. **Without using crop protection, sustaining production could lead to:***

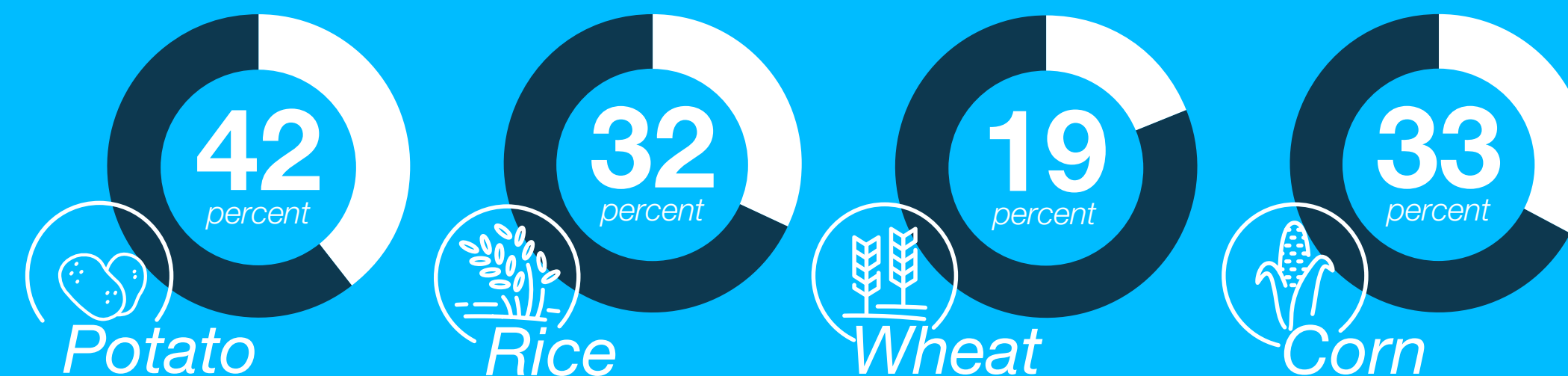


Significant increase in food prices



Non-agricultural land use conversion

Net-Benefit**
yield gain using Crop Protection



*Scientific Foresight Unit, European Parliamentary Service, March 2019

**The Benefit which cannot be mitigated by alternative actions related to agronomy, rotation or cultural measures



Our Commitment

Reduce the environmental impact of our global crop protection portfolio per hectare by

30%
by 2030

How to produce more with less and better preserve our environment

While crop protection has obvious benefits for our food supply, we also know that crop protection products impact the environment beyond the field.

We continuously seek to develop and offer products that have the same or better benefits for farmers, while having less impact on the environment. Our safety standards reflect the guidelines and standards of international organizations such as the Food and Agriculture Organization (FAO), World Health Organization (WHO) and Organization for Economic Cooperation and Development (OECD), as well as those of local regulatory authorities around the world.

Through extensive testing and risk assessments, we ensure products have no effects on human health and only acceptable environmental effects if applied according to label

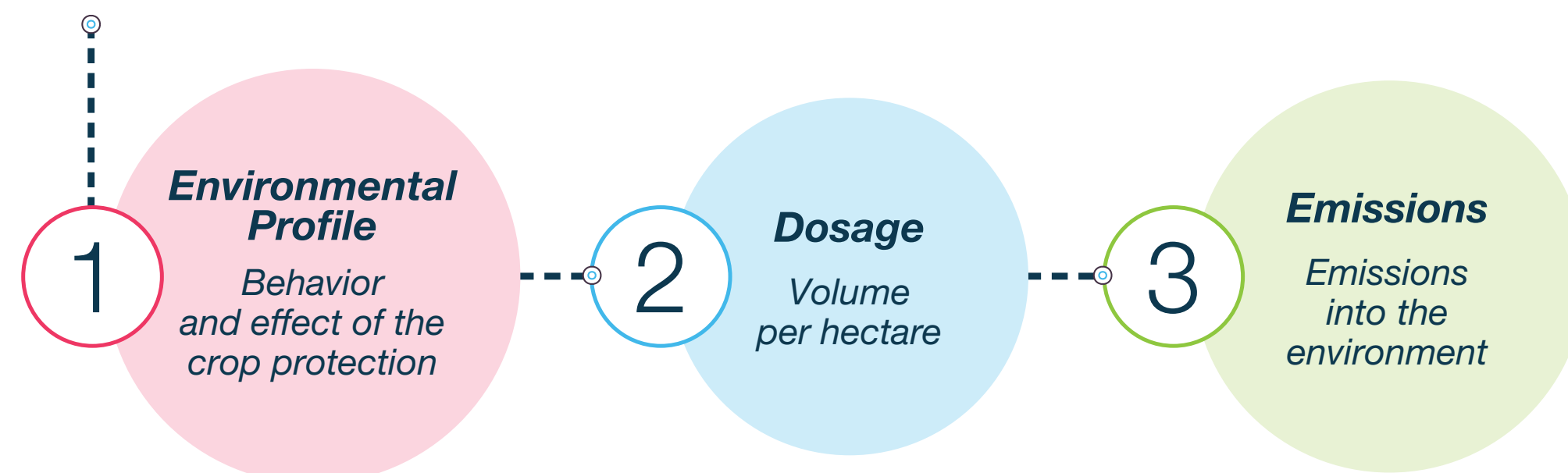
As the global population grows along with society's concerns about the usage of chemical crop protection, so does our need to produce more products – which means we must ensure that the environmental impact of our crop protection does the opposite. That is why, as the world's leading provider of crop protection products, we are committed to reducing the environmental impact of our global crop protection portfolio per hectare by 30% by 2030. We are proud to be currently the only company within our industry to make such a measurable commitment across the entire crop protection portfolio with publicly available scientific models.

Addressing crop protection's environmental impact accurately and holistically

Going beyond volume — a more comprehensive way to evaluate impact

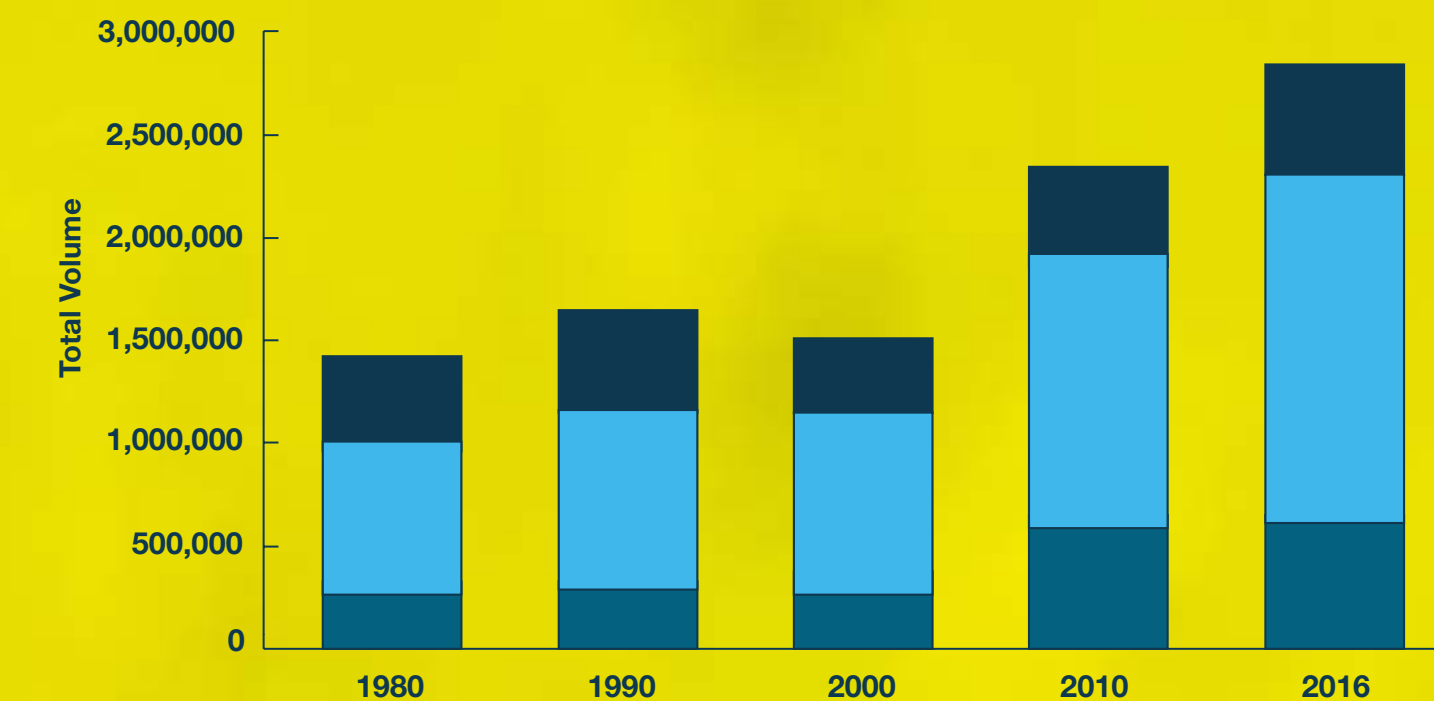
As part of our commitment to significantly reduce the environmental impact of our global crop protection portfolio, we set out to adopt a more accurate way of measuring it. Oftentimes it is assumed that environmental impact is only correlated with the volume of product used. While volume certainly plays a role, there are more important factors in determining a product's efficacy and environmental impact.¹ One indication is that while the total global volume of crop protection sold has steadily increased, the average amount of active ingredients applied per hectare has decreased. This overall volume increase is due to greater food demand, stemming from a growing world population, whereas **the decreased volume applied per hectare is the result of innovations to improve the efficacy and reliability of crop protection products.** These innovations have resulted in less product needed for the same level of control, and in many cases, active ingredients with better environmental profiles.

Bayer strives for the ability to look beyond volumes per hectare. Broadly speaking, **the environmental impact of crop protection is determined by three main variables:**

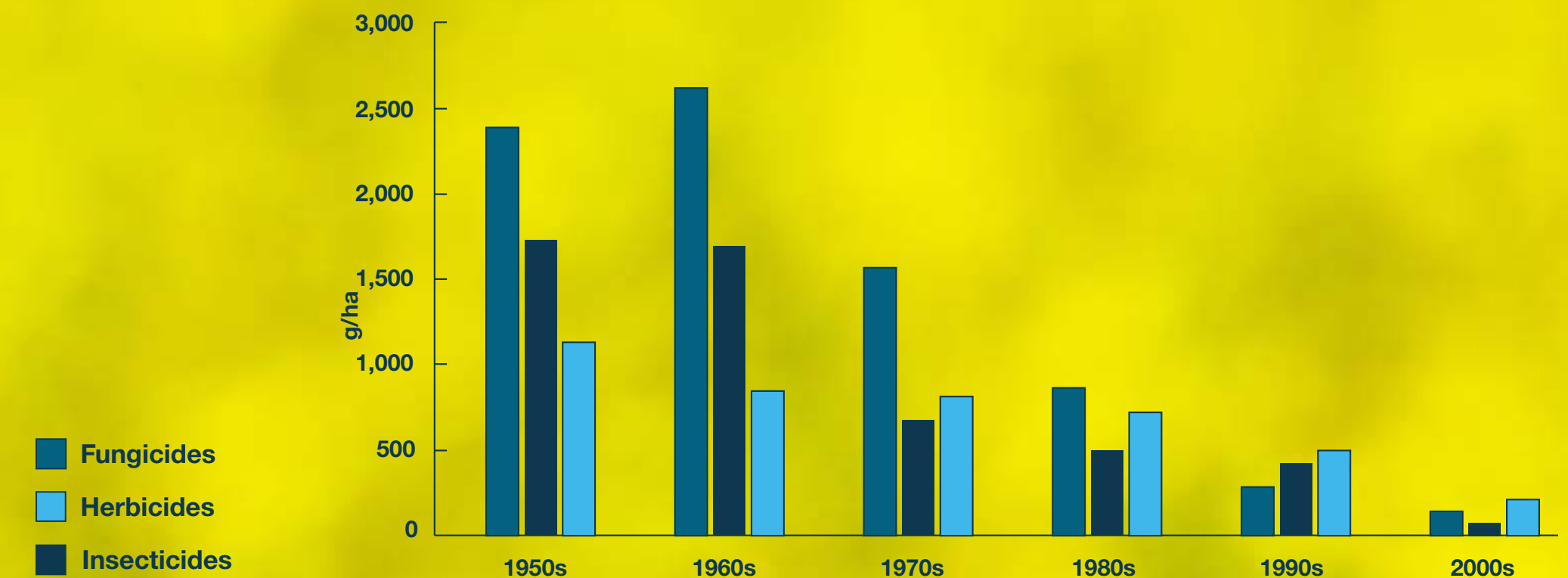


¹Environmental impact is defined as the potential effect on non-target organisms

Total global crop protection volumes increase steadily (despite lower amounts/ha)



Crop protection (CP) efficacy is higher = less CP/ha needed for same level of control



Source: The Global Agrochemical Market Trends by Crop, Phillips McDougall, 2017

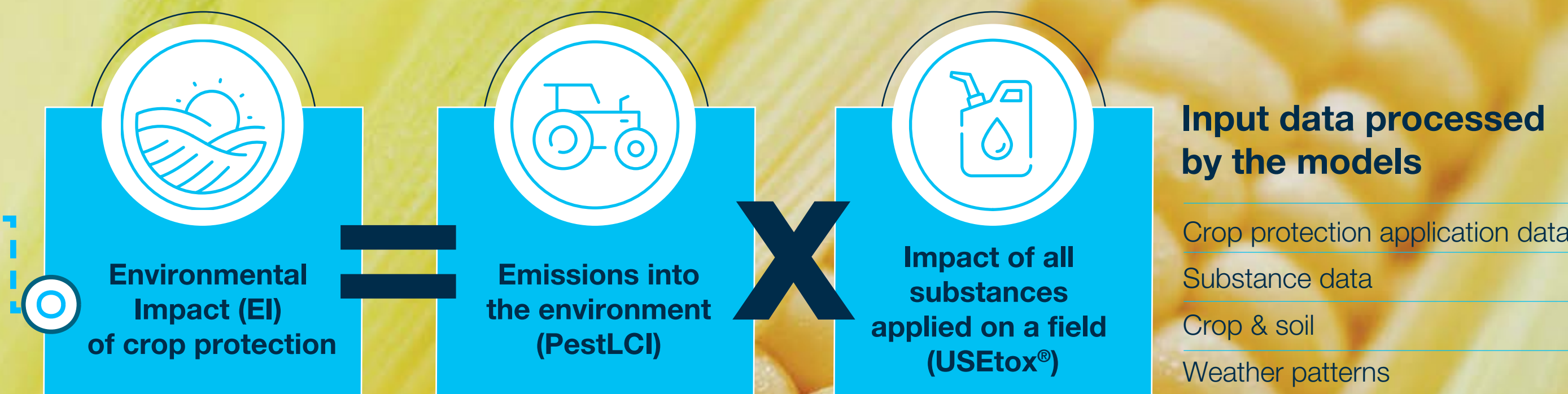
Developing and adopting a science-based model

Since 2019, we have collaborated with the Technical University of Denmark (DTU) to create a state-of-the-art methodology for measuring the environmental impact of crop protection. The new approach combines two renowned models — PestLCI and USEtox® — with a global data set of crop protection applications for a more precise measurement.

These two models, developed externally in academia, have been peer-reviewed and adopted by leading public authorities. USEtox® is being developed under the auspices of the United Nations Environment Programme (UNEP) and the Society of Environmental Toxicology and Chemistry (SETAC).

We are actively collaborating with DTU to apply these models to a global data set of crop protection applications, and to assess progress against our 30% Crop Protection environmental impact reduction commitment. The application of the models and the global impact assessment to this commitment is vetted by an unbiased, external panel of experts to guarantee that we are applying the models adequately across our entire global crop protection portfolio.

While we have financially supported the research project at DTU and provided sector-specific information upon request, the independence of the university's scientific research work and model development have been respected and safeguarded at all times throughout the process. It is important that the models remain unbiased and based solely on sound science – which is why we insist on working to ensure that the models remain an independently-developed tool. The DTU is working to publish the global impact assessment in peer-reviewed journals, which we fully support.



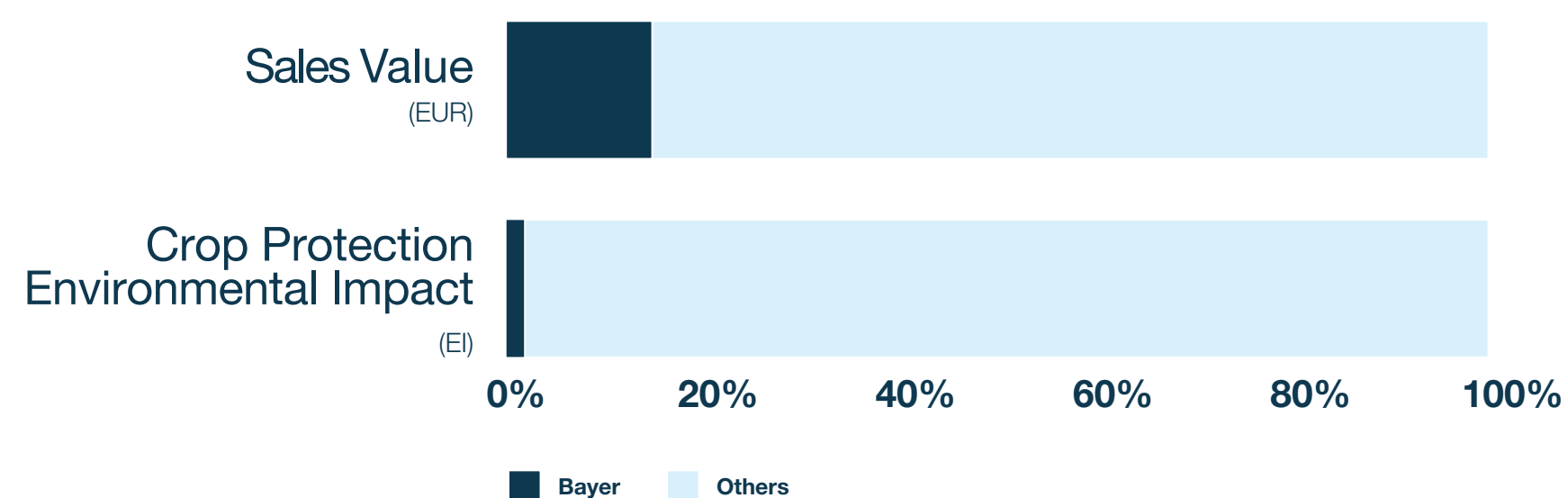
[Read the methodological report here.](#)

Taking responsibility for our share of impact

While we already scrutinize the impact that our new and existing products have on the environment, with this new methodology, we will be able to assess the complete global crop protection portfolio. And we will be even better positioned to help growers increase their output with less impact on surrounding environments.

Using the methodology, assessments show that despite our strong global market position, **Bayer products only account for about 2% of the environmental impact from crop protection in 2021**. While this new measurement is encouraging for our business, it makes us more determined to further reduce our portfolio's impact and lead the charge in transforming the level of impact for the entire industry.

2021 Crop Protection Industry Environmental Impact



Preliminary impact assessment has been conducted by Technical University of Denmark (DTU) based on the PestLCI/USEtox® models. PestLCI secondary distributions currently out of scope. Impact assessment limited to current scientific consensus of USEtox®: aquatic organisms and the substances which can be characterized in USEtox®. Terrestrial and pollinator impact assessment is currently not included in USEtox®. Crop Protection application data mostly from third parties such as Kynetec/Kleffmann in some countries based on Bayer estimates.

Progress

Based on the data from 2017 to 2021, Bayer has reduced its environmental impact of our global crop protection portfolio per hectare by 14% against the 2014 - 2018 baseline. The reduction was mainly the result of changes in our crop protection product portfolio in recent years. Crop protection sales rose by around 15% from 2018 to 2021.³

Bayer products accounted for only

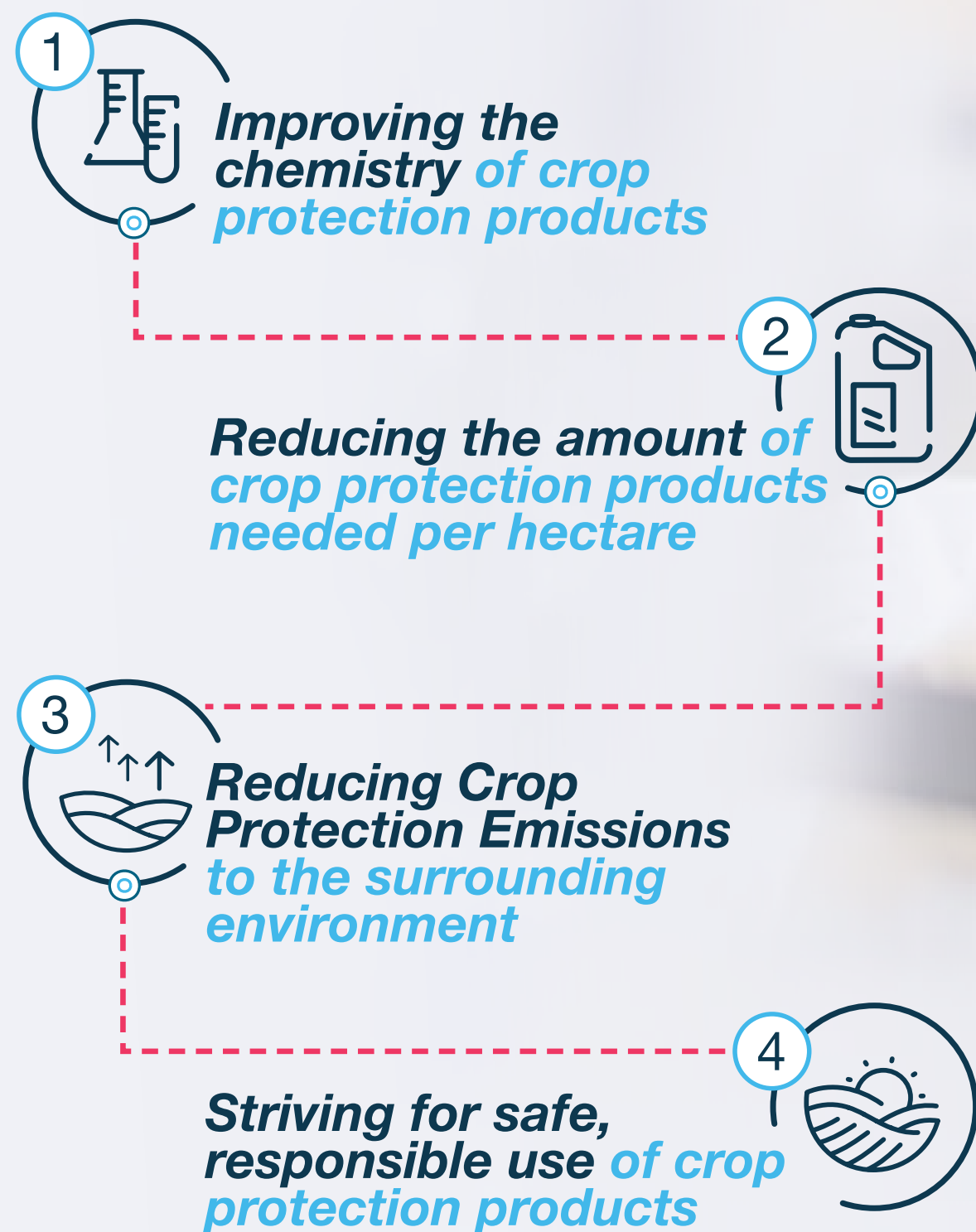


of the environmental impact from crop protection in 2021

³Crop protection sales includes a price effect

Identifying and pulling the levers for impact reduction

We have identified a number of different technologies that can be deployed to help progress towards our **commitment** of a 30% reduction in our global crop protection portfolio's environmental impact per hectare. These technologies fall into four main categories:



[Learn more in our Sustainable Use chapter](#)

1

Improving the chemistry of crop protection products

One straightforward way we can reduce the environmental impact of our crop protection products is by adjusting their chemistry. We are striving for active ingredients with reduced effects on non-targeted plants and species. And we are evolving them to keep the active ingredients where they are supposed to be.

We have integrated our holistic methodology into the governance of our research and development decisions, and all future crop protection research and development projects will incorporate our commitment to impact reduction as an additional decision-making criteria. To ensure delivery of our commitment, we plan to initiate mitigation measures in geographic areas and with specific crops where our crop protection environmental impact is currently higher compared to our baseline.

We have integrated our holistic methodology into the governance of our research and development decisions.

2 Reducing the amount of crop protection products needed per hectare

As a business that supports farmers, we know that the crop protection we offer is just one part of a holistic, tailored approach. So, we also explore ways to reduce the need for chemical products by optimizing their application and complementing them with other tools.

Precision application tools:

We are putting our focus on tools that can help farmers ensure the right amount of crop protection is applied in exactly the right place at the right time.

Through our innovative **Climate FieldView™** Technology, farmers have the ability to work smarter and with greater nuance. Armed with real-time data, they can better plan the position, timing and application of the right amount of crop protection products only when and where they are needed.

Partnering with Netafim™, we developed a new mode of targeted crop protection application that allows farmers to apply with this kind of precision. **DripByDrip** Automated Irrigation leads to less runoff, less drift and less product needed.

New seeds and traits:

By breeding new crops specially designed to withstand and fight against pests and diseases, we are aiming for less chemical crop protection to be required throughout the crop lifecycle.

Our **Intacta RR2 PRO™** soybean seeds contain insect-resistant traits that help plants protect themselves. They also contain herbicide tolerant traits. This eliminates the need for some insecticide use and leads to plants that are more easily protected through integrated weed management strategies.

Their benefits are also verified. A 7-year trial of Intacta soybeans planted in South America revealed a **30.7% reduction in environmental impact*** across herbicides and insecticides.

And the benefits continue: second-generation insect-protected soybeans will provide protection against an expanded spectrum of insects including armyworm and podworm, which in turn will allow for more efficient use of herbicides and insecticides.

*Calculated based on trial data with the PestLCI and USEtox® models.



Biologicals

Our biological crop protection portfolio is one of the industry leaders with more than 20 commercial products, reaching 60 million acres in row crops and high value vegetables. Recent launches, like Flipper™ and Serenade™, provide excellent control options in organic production systems and are complementary to our conventional crop protection.

To address the need for further reducing the environmental impact of agriculture, we introduced BIOLOGICALS by Bayer®, a new signet for all biological crop protection products. Bayer's biological products provide growers with a broad choice for pest and disease management. Biological solutions are key to advancing benefits of Regenerative Agriculture.

Accelerating development of biologicals through collaborations with Ginkgo Bioworks, Kimatec and M2i

Driving the development of biologicals is promising as it addresses both environmental concerns and business potential. Bayer recently entered a strategic partnership with Spanish biologicals company Kimatec, focused on accelerating the development and commercialization of biological crop protection products, as well as biostimulants, to promote plant growth.

Another partnership was established with French company M2i Group to supply fruit and vegetable growers around the world with pheromone-based biological crop protection products. In 2022, Ginkgo Bioworks became a multi-year strategic partner with Bayer to develop biological solutions in areas such as nitrogen optimization, carbon sequestration, and next generation crop protection.

Offering substantial reductions to environmental impact, the biologicals market is expected to more than double to around €30 billion by 2035.⁴



[Crop Science Innovation Summit 2023: Learn more about our journey toward regenerative agriculture](#)

⁴Source: *Global Agricultural Biologicals Market, Forecast to 2030*, Frost & Sullivan, 2022 and internal estimates

Cover Crops – planted in between two cash crops – cover the soil and can help suppress weeds while also creating a habitat for beneficial insects. These “good bugs” can naturally feed on invasive species, reducing the farmer’s need for insecticides.

Crop Rotation is the practice of planting different crops on a field in each growing season. This benefits soil health and disrupts breeding patterns of pests and diseases who only feed and/or live on a specific type of crop.



Helping farmers reduce crop protection emissions to the environment

DriftRadar, our integrated drift management concept, was awarded the “DLG-Agrifuture Concept Winner 2022” for pioneering agricultural technology work and visions for the future by the DLG (German Agricultural Society) at the 2022 Agritechnica (digital), a leading global trade fair for agricultural machinery and equipment. The accolade was awarded for the first time in 2022.

The integrated drift management concept is based on the reading of information on the spray drift tendency and buffer zones as well as distance control shown on the labels of pesticides. When the pesticide is poured into the sprayer, the saved information is translated into an application map. At the same time, wind direction and speed are recorded in the field in real time. If required, drift reducing spray nozzles are activated and buffer zones and distance control are maintained, all automatically. The system records and saves all activities including weather information.



[Winners 2022 - AGRITECHNICA](#)

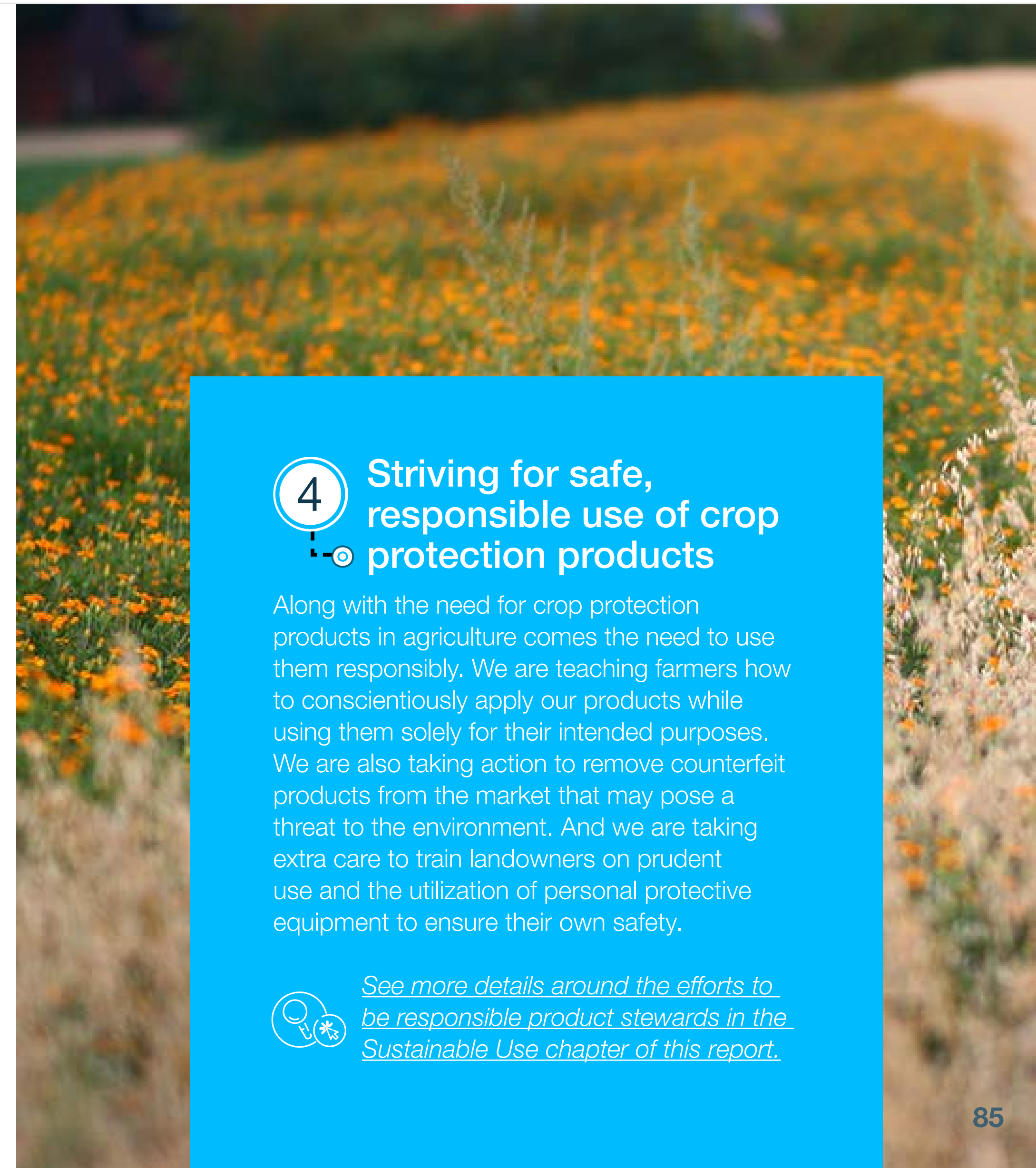


Striving for safe, responsible use of crop protection products

Along with the need for crop protection products in agriculture comes the need to use them responsibly. We are teaching farmers how to conscientiously apply our products while using them solely for their intended purposes. We are also taking action to remove counterfeit products from the market that may pose a threat to the environment. And we are taking extra care to train landowners on prudent use and the utilization of personal protective equipment to ensure their own safety.



[See more details around the efforts to be responsible product stewards in the Sustainable Use chapter of this report.](#)



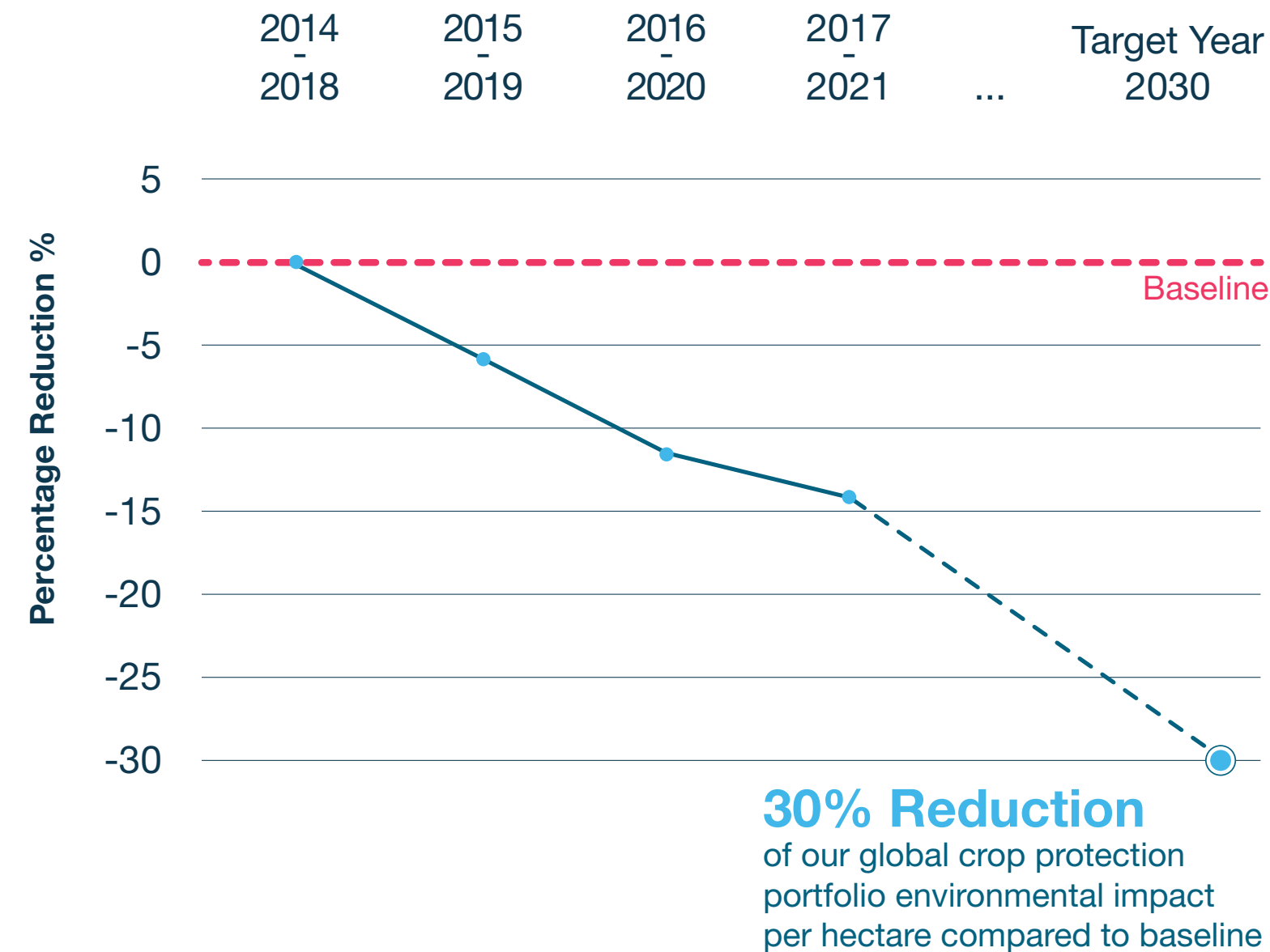
Making greater progress towards lowering our impact

How we achieved a 14% environmental impact reduction, and how we will reduce further in the future

The strategic intent of our crop protection environmental impact reduction commitment is a continuous, relative improvement of our crop protection portfolio (chemical and biological) against the baseline.

The main contributors to the 14% reduction so far are:

- 1) The criteria we use internally governing how we develop new crop protection products
- 2) Which crop protection compounds we in-license or acquire through acquisitions
- 3) Which crop protection compounds we decide to phase-out or divest
- 4) How the products are used by the farmer (amount, application method, etc.) and how they are embedded in a crop system approach (e.g. complemented by crop rotations, cover crops, seed & trait technology, etc. which helps to reduce the amount of crop protection needed).



How will we meet our 30% commitment?

[Our industry leading pipeline](#) across Seeds and Traits, Crop Protection and Digital Solutions will help us deliver against our 30% commitment. Among the key contributors in our future portfolio are Xivana Fungicide, Plenexos Insecticide, Delaro Complete, Iblon Fungicide, Incelo Herbicide, Seeds & Traits ThryvOn™ and next generation insect control traits in maize and soybeans.

Learn more about our efforts to reduce the environmental impact of crop protection



[Protecting Crops: Reducing Crop Protection's Environmental Impact](#)



[Crop Protection Environmental Impact Reduction: methodological report reviewed by independent panel of experts](#)



[2022 Sustainability Report](#)



[Climate FieldView™](#)

Have questions or would like to discuss directly with us our efforts toward environmental impact reduction? Please reach out!



[Engage on LinkedIn](#)

DANIEL GLAS,
Venture Lead Impact Reduction & Beyond the Farm

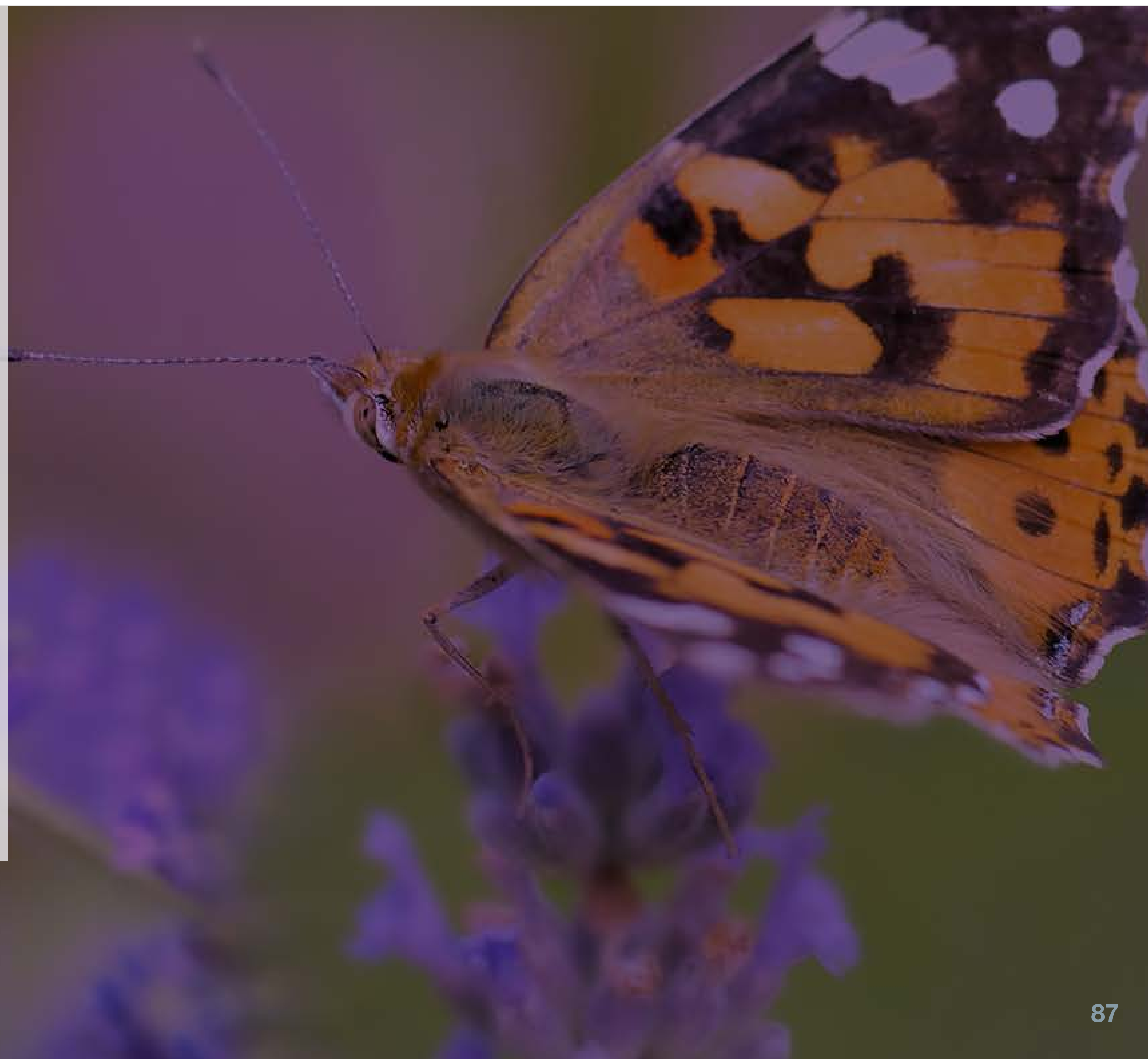


Conserving Biodiversity

We believe farms and biodiversity can thrive together and contribute to each other's success. This is why we seek to develop solutions and cropping systems that not only support the conservation of biodiversity but also provide tangible benefits to farmers.

We address the Global Biodiversity Framework Targets 7, 10, 13, 15 and 17

Our work around biodiversity conservation contributes to the following U.N. Sustainable Development Goals:



Sustainability Challenges

According to the [2019 IPBES Report](#), land use change and [intensification](#), as well as land degradation and habitat fragmentation, are part of the direct drivers of terrestrial biodiversity decline. For agriculture, a balance between production, conservation and restoration of biodiversity is needed, but finding ways to mitigate trade-offs between agriculture and biodiversity that are timely, economical and at scale to achieve critical SDGs and targets remains a major challenge for all involved actors.

Our Approach

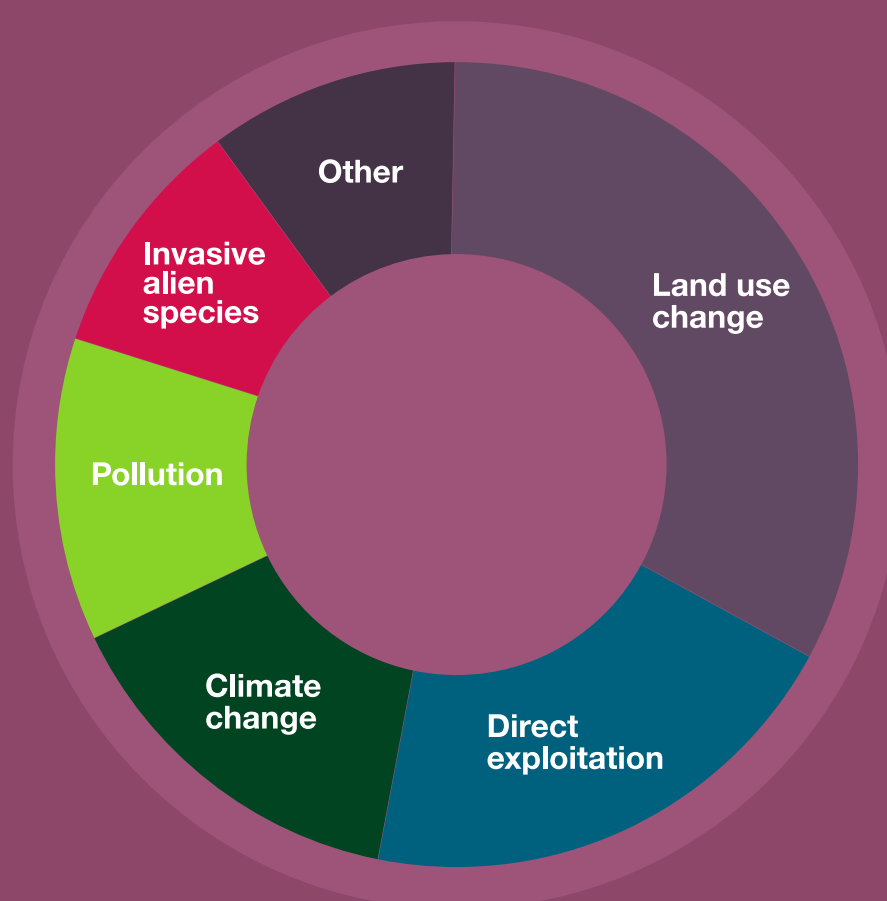
We seek to develop solutions for cropping systems that not only produce more with less, but also become more regenerative in terms of soil health, more viable in terms of habitats and more resilient towards climate change. To explore and develop corresponding elements for those systems, we work along the following three key pillars: Soil Health, Habitats and Genetic Diversity. In this report, we highlight promising approaches, actions, and partnerships that support our journey.

Progress

In the last year, we've made important progress in the advancement of our biodiversity strategy. We developed our forest protection strategy in Brazil, announced our ambitions around regenerative agriculture – where soil health and biodiversity play an important role – and proved that our crop system solutions can increase farmers' profitability while improving soil health at the same time. Through numerous partnerships, we continued to support habitat creation and also published our **results and insights about the root causes of insect decline**. We continuously support the conservation and preservation of valuable genetic resources, and we improved access to high quality seeds for our countless smallholder farmer partners across the globe.

Biodiversity decline is a multi-dimensional problem

According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report (2019), land use change, fragmentation and degradation are the main drivers of terrestrial biodiversity decline.



Main Actions

Enabling Forest Protection in Brazil

In the context of our PRO Carbono program



Sustainably Intensified Management (SIM) System

Producing more while improving soil health



Creating Habitats for Pollinators

Making habitat creation more viable for farmers and landowners



Understanding Drivers for Insect Decline

The basis to create effective countermeasures



Banking on Genetic Diversity

Our collaboration with the World Vegetable Center



Moving Towards More Sustainable Operations

Driving regenerative practices at our R&D site in California



Striving for balance between agriculture and biodiversity

Meeting the future needs of food, feed, fuel and fiber production while considering biodiversity conservation has been discussed and debated for decades in the scientific community – yet no consensus has been reached on the best approach. The two main positions within the debate fall into what is termed “land sparing” and “sharing”. A recent publication modeled that land sparing, which is achieved by sustainable intensification,² can have a more beneficial impact on maintaining biodiversity.³ However, other reports⁴ have indicated that intensification can actually have rebound effects driving more land use change.

One promising approach that both schools of thought agree on is to conserve and restore degraded lands for both native vegetation and crop production. Aside from the debates around how to best halt land use change, land degradation and fragmentation are also major drivers of biodiversity decline. Therefore, it is very important for us to not only consider how best to integrate agriculture into the landscape, but also to think about how to implement agronomic systems that will be most beneficial for on-farm, below ground and broader landscape-level biodiversity.

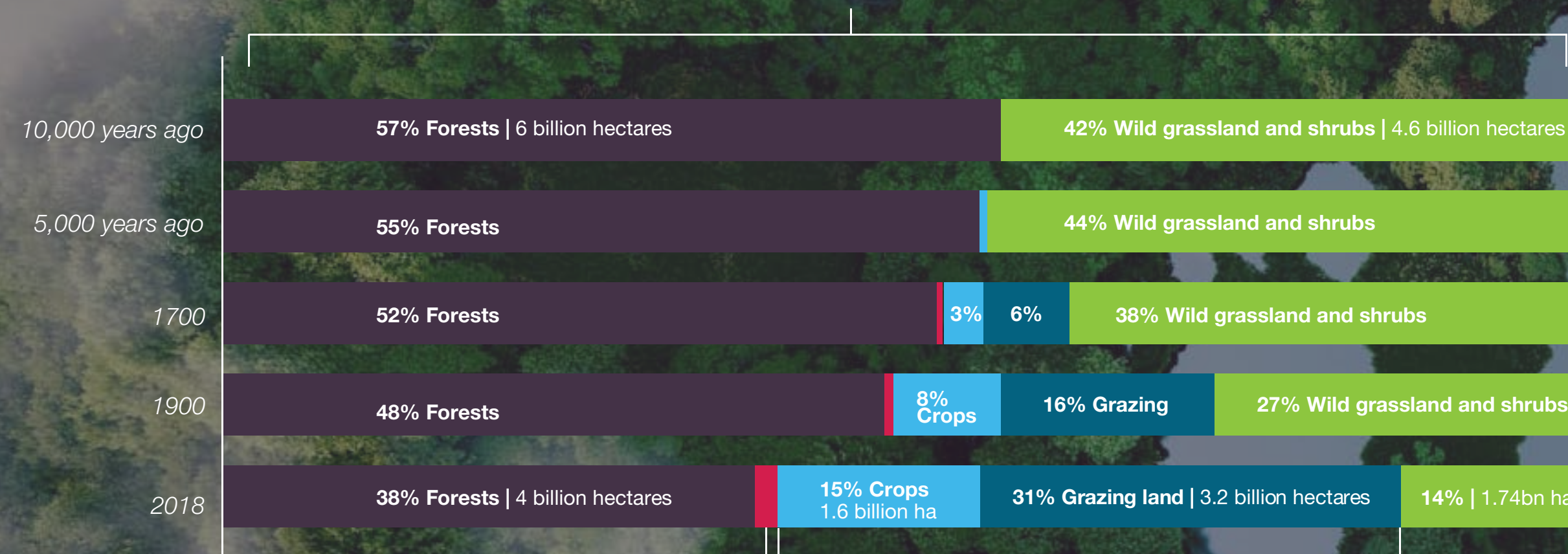
²*Sustainable intensification is an approach using innovations to increase productivity on existing agricultural land with positive environmental and social impacts.*

³*Current conservation policies risk accelerating biodiversity loss*

⁴*Sustainable agricultural intensification or Jevons paradox? The role of public governance in tropical South America*

Agriculture is the largest driver for deforestation

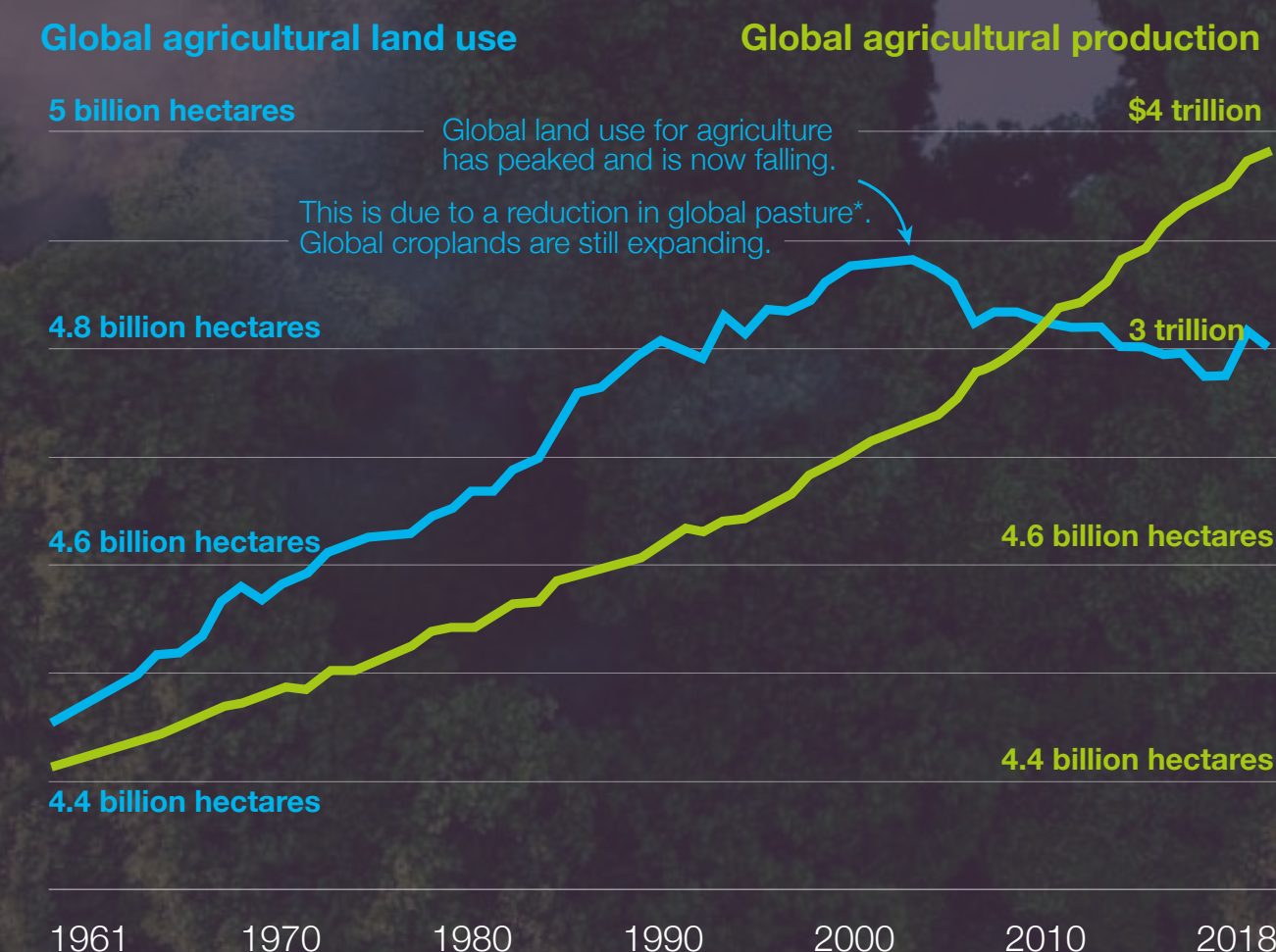
10,000 years ago, 10.6 billion hectares – 71% of the earth’s land surface – were covered by forest, shrubs, and grasslands. The remaining 29% are covered by deserts, glaciers, rocky terrain and other barren land (these categories are excluded from graphic to focus on how habitable land is used). *Source: Our World in Data*



Agricultural land: 46% of the land that was once covered by forest, wild grasslands and shrubs is today used for agriculture.

Global decoupling of agricultural land and food production

Source: Our World in Data



Enabling more regenerative cropping systems

At Bayer, how can we address those challenges and trade-offs, given that it is the farmers' decision on what, where and how to crop? We can play a role as an enabler of sustainable*, regenerative* or even nature-positive* cropping systems which do not compromise farmers' profitability. This means we must consider soil health, biodiversity and genetic diversity as part of our offerings in a way which can be beneficial for farmers (see figure). This is not a one-size-fits-all solution, and requires different approaches for different crops and regions. We are building on the knowledge we have gained thus far, testing and evaluating elements for key crops and regions such as maize in the US, soy in Latin America and rice in Asia/Pacific.

In addition, we continue to engage in scientific partnerships to more rapidly close knowledge gaps and gain insights on topics such as biodiversity monitoring, root causes of biodiversity decline and effectiveness of on-farm biodiversity measures. In the following pages, you will find different examples of how we are addressing biodiversity in agriculture through the lens of our three pillars.

**A glossary of key terms used in this report can be found in the Annex.*



Potential benefits growers can achieve by considering soil health, habitats and genetic diversity in the way they farm

Soil Health

Habitats

Genetic Diversity

Expected Benefits for Growers:

- Yield stability
- Drought resilience
- Nutrient availability
- Water quality, retention & availability
- Carbon sequestration
- Disease suppression

- Land use optimization (e.g., enrolling unproductive land or existing farmland habitats in incentive schemes)
- Benefits from ecosystem services such as protection against run-off and erosion, pollination, and natural pest control

- Access to better crop genetics
- More resilient crops (climate change & resource efficiency)
- More diverse and regenerative crop system

Habitats

Enabling forest protection in Brazil by creating value for standing forests and native vegetation

In most regions across the world, forests play a critical role in balancing ecosystems and mitigating climate change, as they provide habitat for many species, enable water and soil conservation and are important for maintaining ecosystem services and carbon stocks. Scientists also point to an important interdependence of agricultural activity with relation to forests. Based on these considerations, we launched the global initiative “**Bayer Forest Protection,**” which aims to increase our positive impact on the agricultural chain and take a leading role in the conservation of forests and biomes.

Brazil is the first country where we develop this program since it holds important environmental assets, such as the Cerrado and Amazon biomes, which are among the largest biomes in Brazil and have one of the highest rates of conversion of native vegetation to other land uses. Moreover, Brazil is accountable for a large share of the global production of food and raw materials, such as soybeans, maize and cotton, and we believe we can contribute together with farmers and other partners to an agricultural transformation that protects Brazilian forests.

Creating value for standing forests and native vegetation is key to prevent further conversion into agricultural land. With our **PRO Carbono Commodities program**, we recently started a pilot which involves the soybean production of 10 Brazilian growers and agricultural companies within the Cerrado and Amazon biomes. As a prerequisite for taking part in the initiative, farmers may not work on agricultural fields that have been converted from natural vegetation in the last 10 years, even if legally authorized. Additionally, farmers in the program commit to conserving the surplus of natural vegetation on their properties. A total area of 159,000 hectares is enrolled in this program – with 90,000 hectares of corresponding native vegetation. For the first time, we are measuring the carbon footprint of crops in a pilot of deforestation and conversion-free (DCF) soybeans with transparency and traceability of information up to field level.

Pillars of the Forest Protection Program

- 1 Enabling Forest Protection via
 - commercial incentives
 - internal policies and traceability
 - coalitions
- 2 Creating Value for Standing Forests via
 - forest carbon
 - innovation

What we're focused on

- Analyzing the impacts of **opportunities and risks**
- Sizing level of **feasibility and scalability**
- Fitting into our **capabilities**
- Searching for the best **partners to escalate positive impact**
- Building the **business cases**

The program has five focus areas for action, divided into two pillars.

The first pillar is dedicated to creating new tools that enable forest protection, through which we intend to establish new commercial incentives, improve the implementation of our internal policies and traceability systems and expand our participation in multi-sectoral coalitions to build collective action.

In the second pillar, we aim to create value for standing forests together with those who are committed to conserving native vegetation. We have established a research investment effort to broaden the scientific knowledge of the interconnection between agriculture and forest conservation. In addition, we have invested in another front to build commercial business models through which we support growers in producing measured footprint, deforestation-free grains, and create opportunities for industries to achieve their goals to either reduce or offset carbon emissions. PRO Carbono Commodities is included under such initiative.



Source: Bayer delivers first shipment of soy with tracked carbon footprint, deforestation-free – AgNews

Sustainable Intensified Management (SIM) System

As scientists continue to learn about low-impact agronomy, we're discovering ways to increase yield while improving soil health. A great example of this is our Argentinian Sustainable Intensified Management System, which incorporates both lower-carbon farming and integrated agronomic management practices that increase soil organic matter and reduce the impact of crop protection on the surrounding environment.

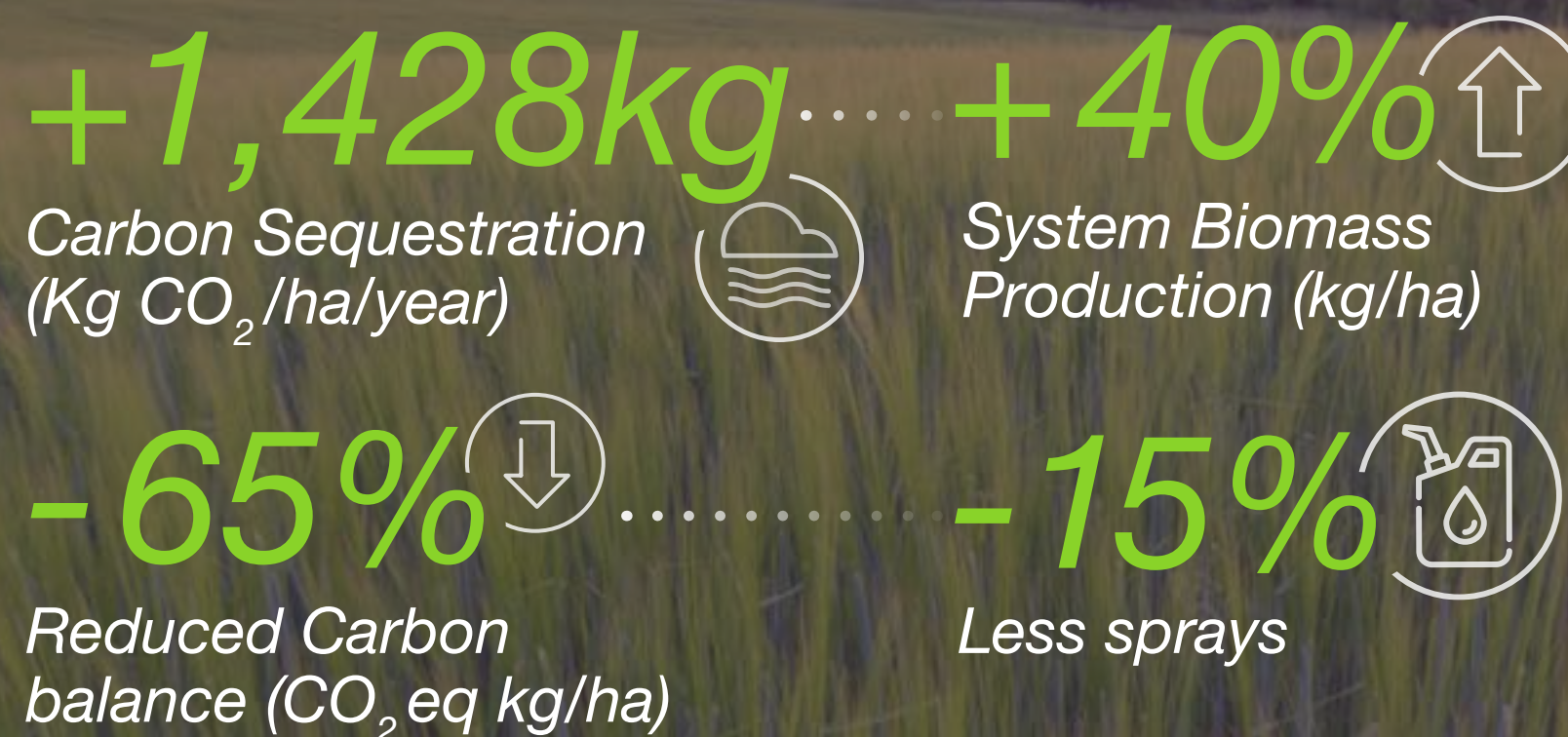
Our tailored solutions serve broad aspects of the system approach and thus contribute to sustainable intensified management. By using specific crop rotations and cover crops, farmers in Argentina were able to increase yields and return on investment. At the same time as those gains were realized, the farms became significantly more sustainable, using less herbicides, reducing their GHG emissions and increasing soil's carbon sequestration. It's a win-win: increased yield stability, which can lead to more reliable income for farmers, more resilience regarding climate change impacts and improved soil health.

Results from our Bayer Forward Farm in Pergamino, Argentina:

Increased farmer return on investment



And more sustainable agriculture



[Learn more about Bayer ForwardFarming](#)

Sustainable Intensified Management System



Habitats

Creating habitats for pollinators in North America

Pollinators are vital to a healthy ecosystem – as well as for successful cultivation of pollinator-dependent crops. Bayer collaborates with conservation groups, academic experts, farmers and government agencies across North America to help enable pollinator populations to thrive. Conserving and enhancing habitats is beneficial for land stewardship in multiple ways: it can support multiple other insects, birds and mammals, improve soil structure, water infiltration and decrease field run-off to local water bodies. Through our partnerships, we can extend our positive impact with on-the-ground habitat projects and move the conservation needle more efficiently.

Since 2015, we have supported the creation of more than 171,000 hectares (423,000 acres) of pollinator habitat through providing wildflower seeds and support for habitat establishment to farmers, ranchers and landowners, which improve density, diversity and duration of pollinator forage. Through initiatives on our corporate grounds, we have established habitat at over 70 Bayer research and manufacturing sites across the U.S.

We're also supporting research to identify the best vegetation management practices to improve pollinator and wildlife habitats. We're part of a network of 124 organizations working towards Monarch Butterfly conservation in North America. Since 2022, we've worked on a program funded by the Natural Resources Conservation Service (NRCS) called Regional Conservation Partnership Program (RCPP) which provides cost-sharing opportunities for farmers to use precision data to establish field borders, streambank buffers or pollinator habitat.



[Read more about our U.S. pollinator initiatives here.](#)

Supported the creation of more than
171,000
hectares (~423,000 acres) of pollinator habitat

Distributed more than
3.5B
pollinator seeds

Propagated and planted

1.7M
native milkweed plants with partners

Member of a network of

124
organizations working towards Monarch conservation in North America



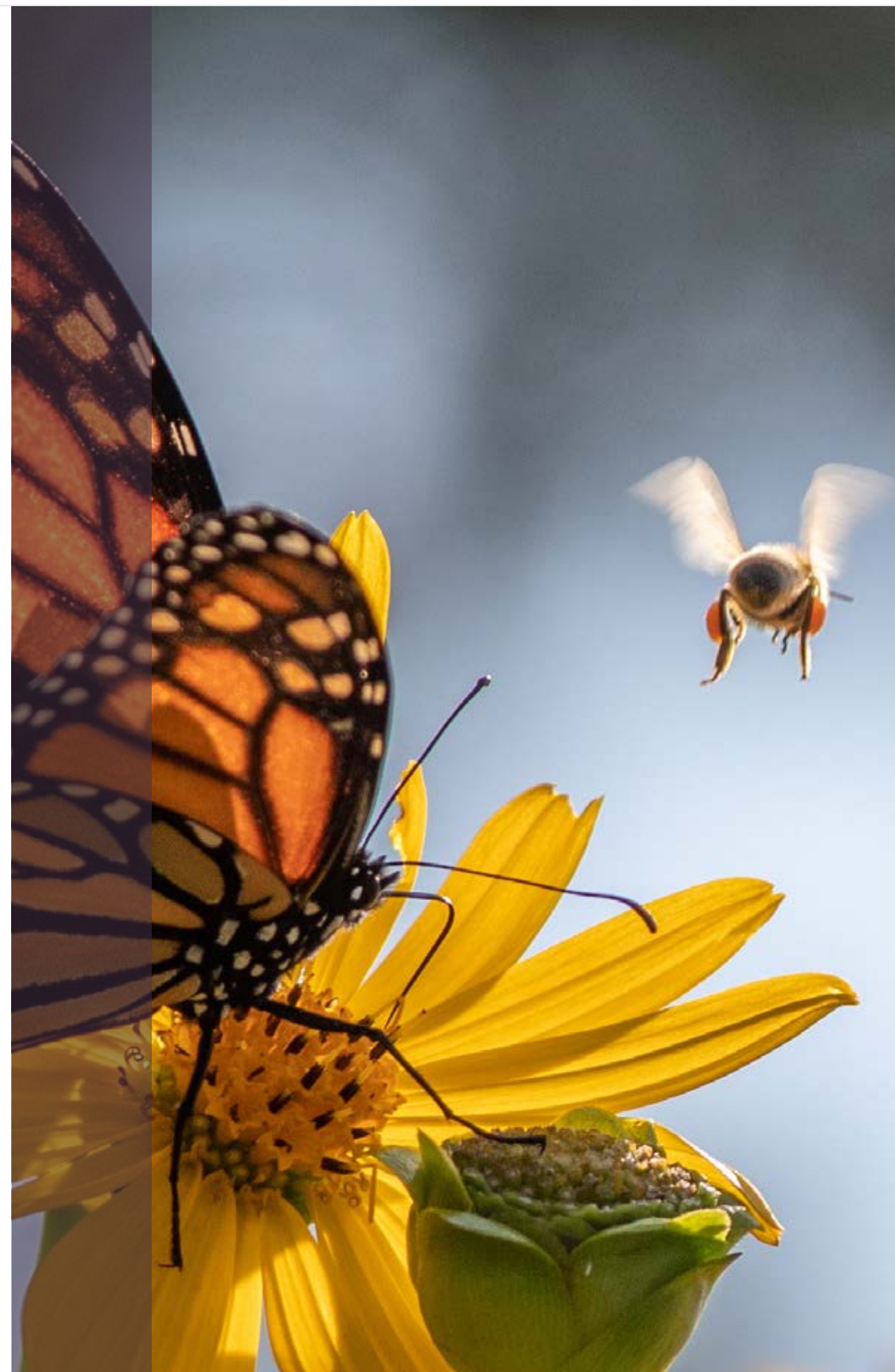
Understanding drivers of insect decline

Current reports suggest a global decline in insect abundance and biodiversity. There is broad consensus that insect decline is a key environmental issue.

Recognizing that land use intensification is one of the likely drivers of insect decline, Bayer established a working group analyzing the root causes of decline and identifying potential countermeasures for farmers and society to apply

This is a part of our endeavor to understand biodiversity in an agricultural context holistically and to work towards a healthy balance between agriculture and nature conservation.

One of our research approaches has been evaluating long-term data sets regarding the development of insect populations and communities to better understand the drivers of changes and pressures on insect biodiversity.



Our study analyzing insect population and biodiversity trends in Europe based on data from the last 250 years found that most pressures are acting on a landscape level – influencing the availability and condition of habitats. This suggests long-term structural changes in the landscape as root causes for insect decline. Land use intensification and changes in landscape structures played a key role among the factors linked to decline processes. This highlights the importance of landscape management as a factor determining habitat quality and availability, which are the main drivers behind the long-term development of insect habitats and populations.

Another ongoing, large-scale analysis looks at potential factors linked to insect decline and how they are correlated to measured decreases of insect abundance, focusing on an exemplary region of Germany where the decline is well documented. Again, most conspicuous correlations are with the development of landscape management features, such as urbanization and land use intensification, e.g. grassland management intensification, or intensification of livestock farming.

The results underline the importance of the structure and the management of cultural landscapes as key factors behind the decline of insects. As a next step, a detailed evaluation of the findings will be instrumental for conceiving measures in agricultural practice that can help counteract insect decline.



Banking on genetic diversity

Biodiversity is crucial for a healthy ecosystem and sustainable agriculture. To address the challenges posed by climate change and population growth, it is important to preserve genetic resources as a component of biological diversity. This enables farmers to cultivate new varieties that are nutritious, resilient to diseases and better equipped to withstand the challenges of climate change like water scarcity.

Through providing in-kind support to public gene banks, we help to ensure the conservation of global collections of agricultural crops for current and future generations. At the same time, we access and incorporate novel genetic variation into our varieties. We support renowned research centers like the national gene banks of the Netherlands (CGN), France (INRAE) or United States (USDA) with collection missions and the conservation of agricultural crops and their wild relatives from different regions of the world before they become extinct from their natural habitats. This is particularly important for vegetable crops, where many species are not yet conserved in any gene bank.

We work with the [World Vegetable Center](#) (WorldVeg) in rescuing their unique collection of Brassica crops such as broccoli, cabbage and cauliflower.

The collection contains over 1,500 accessions that are not found in any other gene bank and almost certainly no longer exist in natural habitats or farmers' fields. We invest in resources and expertise to increase the seed stock and taxonomically characterize 65 accessions annually. Fresh seeds will be returned to the WorldVeg for conservation and distribution to any interested users.

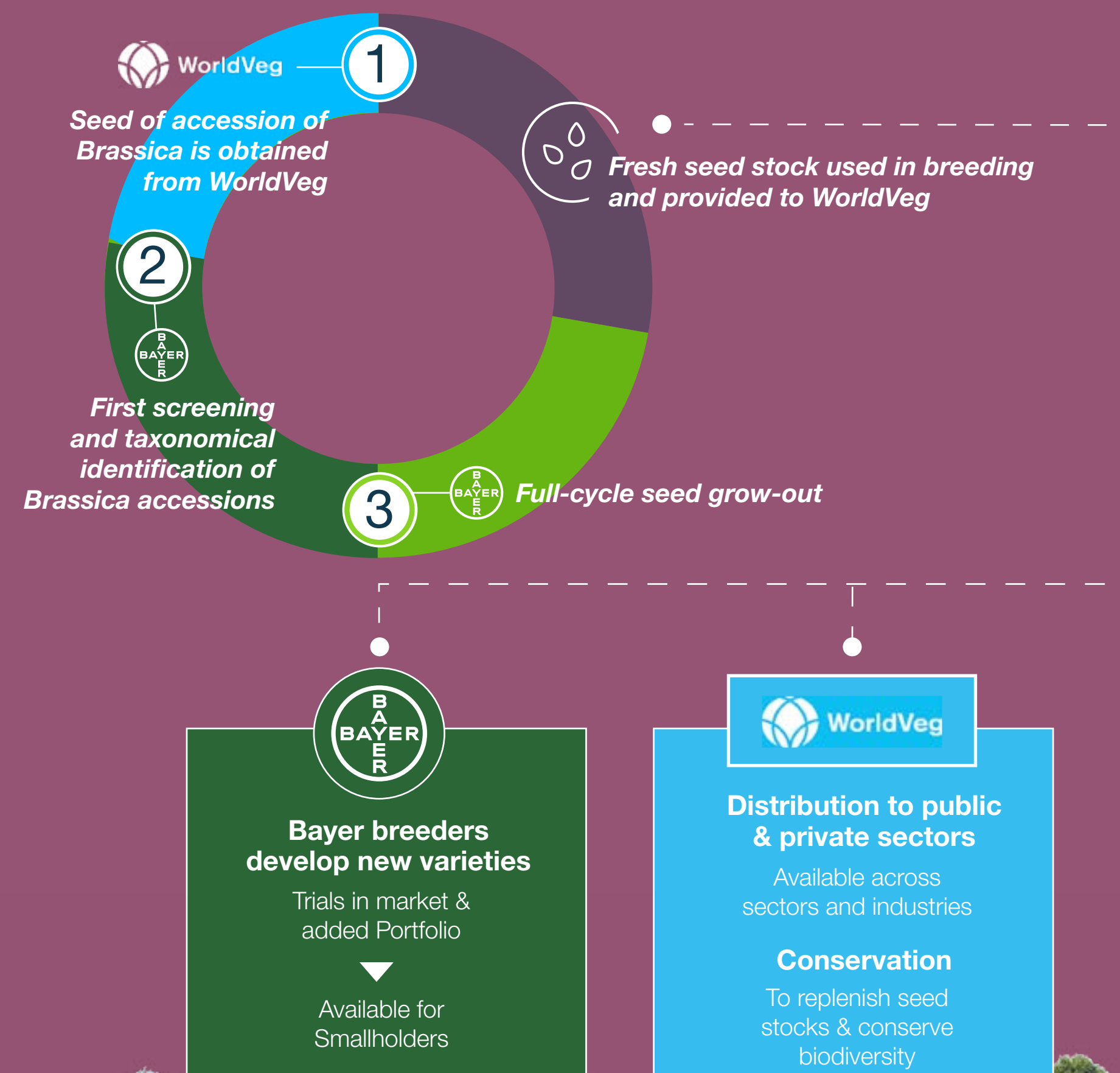
This collaborative approach not only benefits biodiversity conservation but also supports smallholder farmers. By evaluating the unexplored genetics of the WorldVeg material, our breeders can develop new, resilient seed varieties tailored to smallholder farmers' specific growing conditions and needs. Farmers will thus be able to secure yields and provide food for their families and communities, overcoming the challenges of a shifting climate and contributing to global food security.



[Learn more about the World Vegetable Center.](#)

Saving Brassica for biodiversity, sustainability, seed innovation, and food security

Working with seeds



Moving towards more sustainable operations

Our Vegetable Seeds R&D Green Farm in Woodland, California is driving regenerative practices in vegetables

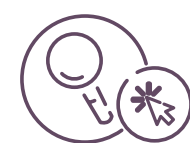
At our Woodland, California Vegetables Research and Development site, a dedicated team of Bayer employees is working to develop healthy and delicious vegetable varieties while actively seeking new solutions to responsible and sustainable farming practices. Recognizing the importance of biodiversity in agroecosystems, the team has adopted a proactive approach to promote a thriving and balanced ecosystem.

Low biodiversity can lead to instability, pest outbreaks and many other problems. In contrast, systems high in biodiversity tend to be more dynamically stable – the variety of organisms provide a natural form of checks and balances – helping to prevent one species from overwhelming the system.

The holistic Green Farm approach focuses on maintaining and increasing biological diversity within the farming system and includes agricultural practices such as reduced tillage, cover cropping, refugia habitat for pollinators and beneficial insects, companion cropping for integrated pest management as well as modern irrigation systems and fertilization.

After three years of implementing the Green Farm initiative, many positive benefits have been observed, including control of persistent weeds, reduction of soil compaction, improved drainage, higher soil water retention and improvement in pest and disease management.

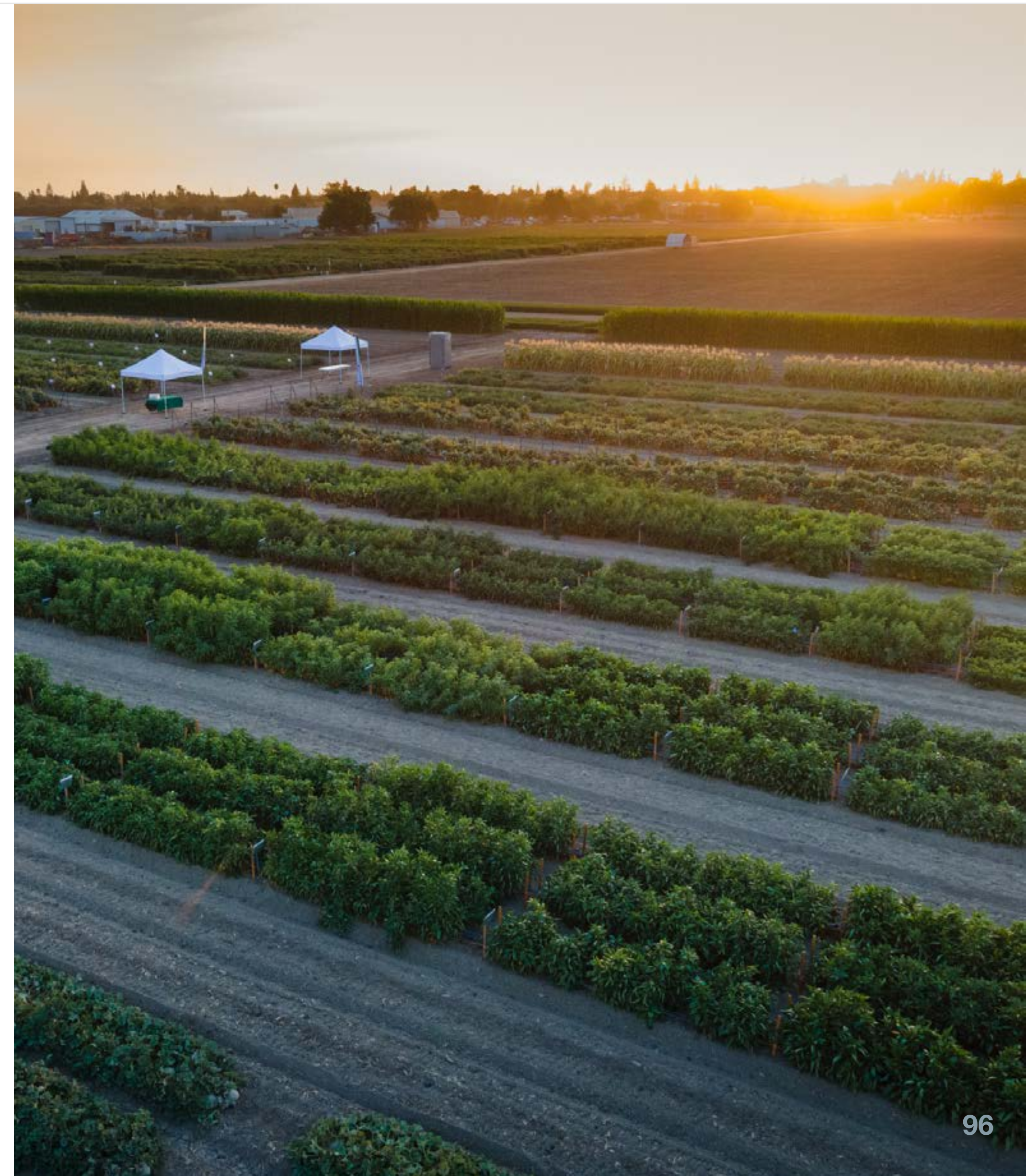
The team is now expanding their efforts, increasing acreage and further exploring the benefits of sustainable farming practices. The goal is to share the learnings and knowledge throughout the community and across Bayer sites so that everyone can benefit from Green Farm.



[Read more about our Woodland California Vegetables Research and Development Site here.](#)



[Learn more about our Moraleda pole bean variety that can also have a positive impact on soil health](#)



Collaborating for nature positive

Reconciling biodiversity and agriculture is a complex task. We are making progress by gaining valuable experiences through our initiatives and collaborations, whilst finding a way to integrate those learnings into our crop system solutions for impact at scale. We learned that farmers struggle with too strict and inflexible biodiversity incentive schemes, which might even not be impactful. To overcome this hurdle, more flexible and financially appealing incentive schemes need to be developed. In addition, a better understanding of the impact of biodiversity friendly farming practices is needed to ensure that incentives are directed to the most impactful measures.

In this context, modern monitoring methodologies, such as collecting eDNA, sample analysis with DNA meta-barcoding and using acoustic or optical sensors are promising technologies, because they enable species monitoring in a more scalable and affordable way. We will be testing these technologies in various initiatives and research collaborations.

We are proud of enabling the trade of deforestation and conversion-free (DCF) soybeans with a high level of transparency and traceability, and we hope that the demand for those types of commodities will increase – to the benefit of farmers and nature. Through focused and long-term efforts to preserve genetic resources, we are helping farmers to grow more resilient, high-yielding and nutritious crops. We cannot address this complex challenge alone – and we look forward to exchanging ideas, learning from experts and collaborating with partners to make a change for the better.



[See the Annex for more examples of our collaborations supporting biodiversity conservation](#)



[Learn more about our strategic ambition for biodiversity](#)

Have questions or would like to discuss our work on Biodiversity directly?
Please reach out!



[Engage on LinkedIn](#)

BÄRBEL HUNDT,
Biodiversity & Soil Health Venture Lead

Conserving Water: Agriculture's Most Essential Input

The scarcity of fresh water affects farmers around the world. Water shortages are not only caused by the growing demand of this resource, coupled with climatic changes, but also by the deterioration of water quality, which reduces the quantity of water that can be used safely. The agricultural sector accounts for nearly 70% of global freshwater consumption and therefore has a central role to play in addressing water challenges – all while it continues to deliver on food production and ensure global food security. At Bayer, we recognize the importance of water challenges and are committed to helping alleviate the global water crisis.

**Our work towards conserving
water contributes to the following
U.N. Sustainable Development Goals:**



Sustainability Challenges

Water scarcity is emerging more and more as a critical challenge driven by a range of demographic and economic pressures (e.g., population growth, rising wealth, increased meat and dairy consumption and expanding biofuel production) that increase water demand and put high pressure on water resources. The deterioration of water quality also reduces the quantity of water that can be used safely.

As the global population grows and the planet warms up, water resources are expected to dwindle even further, leading to a 40% gap between supply and demand in 2030. The agricultural sector, which accounts for nearly 70% of global freshwater consumption, is central to addressing these challenges. To meet the growing demand for food, agriculture needs to use water resources more effectively and become more water-efficient and more productive – especially in water-scarce regions.

Our Approach

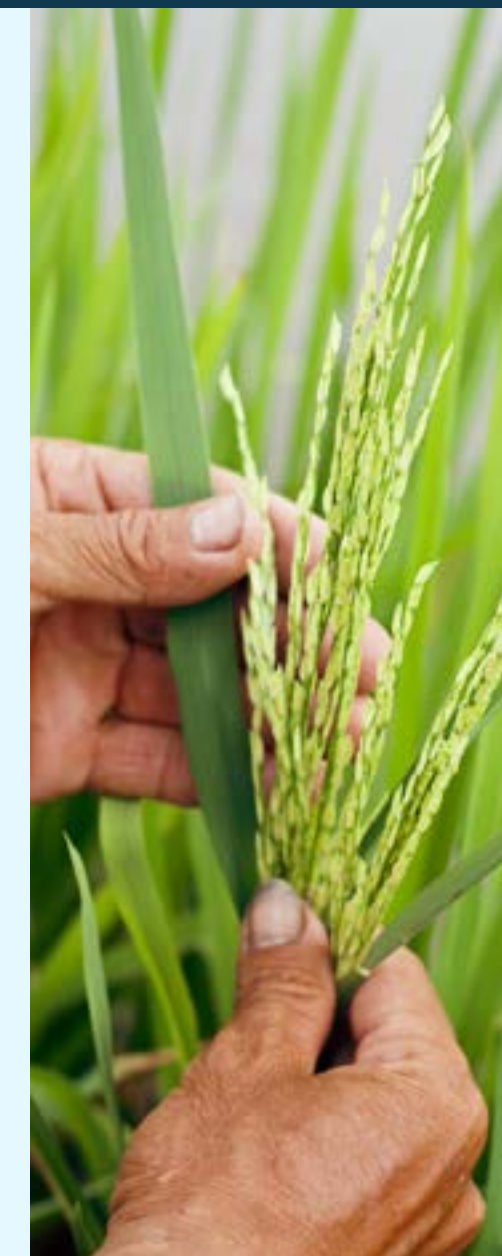
We aim to build water resilience through a holistic water strategy that anticipates potential water-related risks and levers our innovation skills to build business opportunities while adding value to society.

At the [UN Water Conference](#) held in New York in March 2023, we released [our new water strategy](#) that aims to have a transformational impact that goes beyond our own operations and reflects our willingness to contribute to climate resilience and more sustainable water usage. Our efforts will encompass all water dimensions along the entire value chain, from our own operations to the farmers we work with.

To this end, we will incorporate water into our investment processes; provide safe water, sanitation and hygiene (WASH) to our employees, setting context relevant water targets for our own operations; and make use of our strong water partnerships to ensure appropriate private sector engagement and action on water.

Main Levers (in Agriculture)

- **Innovation** in seeds and crop protection portfolio
- **Leveraging partnerships** and **advancing water-efficient agriculture**
- **Digital enablement** and promotion of **Good Agronomic Practices**
- **Future-proofing** of sustainable food production



Our commitment in agriculture:
Improve water use per kg of rice crop by

25%
in 2030

by transforming rice-cropping systems for our smallholder customers in the relevant regions where Bayer operates



Progress

Our vision “Health for all, Hunger for none” cannot be achieved without building a water resilient agriculture. Aiming to protect water resources and improve water use-efficiency, Bayer has enshrined water at the core of its strategy and set an ambitious water target beyond our own operations. Our innovative potential is used to develop scientific solutions that help build more water resilience in agriculture. In addition, we leverage our partnerships to ensure engagement & action on water and join efforts to build, test and promote solutions and agronomic practices that have the potential to drive a more water efficient agriculture.

The water crisis: Growing sufficient crops in the age of water scarcity

Agriculture takes the biggest drink of all

Perhaps it's a little ironic that while the beautiful blue planet that sustains so much life is nearly 71% covered in water, most of it is unusable for the bulk of its inhabitants. This precious resource is getting ever scarcer as demand increases and water supply is affected by a decrease in quantity or quality.

Climate change and variability have the potential to aggravate the water crisis and add additional pressures on water availability, accessibility and demand.

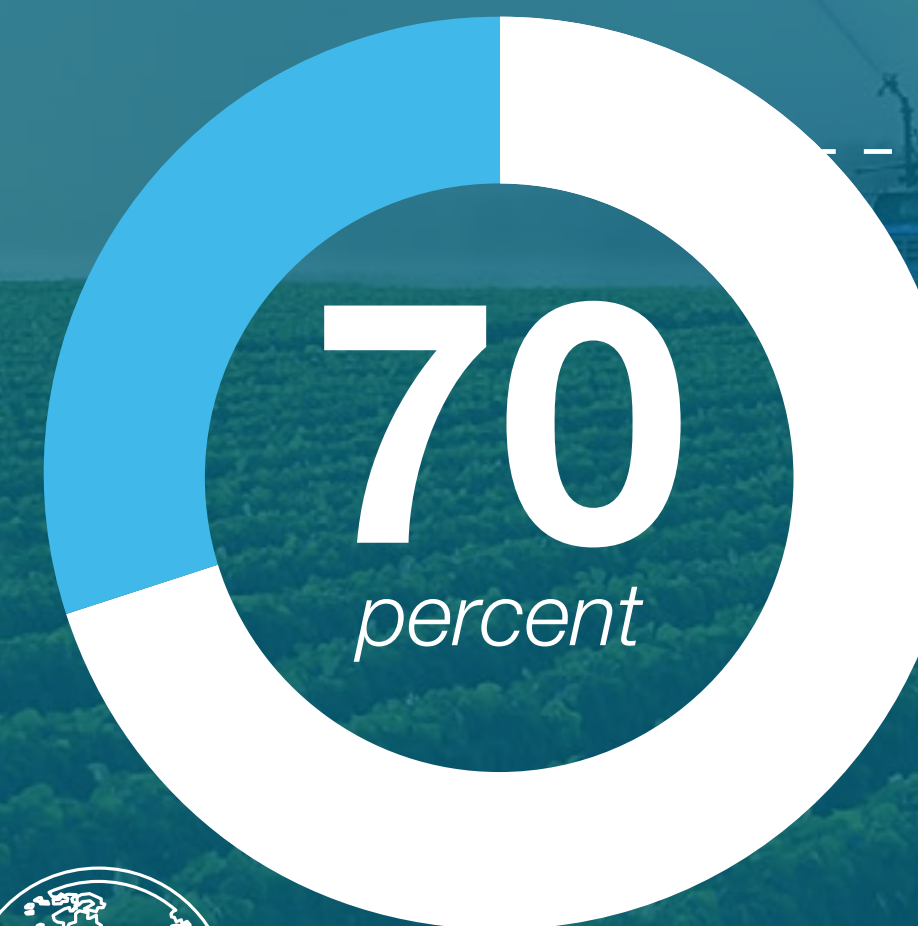
As a major water consumer accounting for 70% of global freshwater withdrawals, primarily for irrigation, the agricultural sector is among the most vulnerable sectors. The disturbance of the hydrological cycle will have dramatic impacts in terms of crop losses, shifts of cultivation land and growing conditions, pest incidence and volatility of prices, among others. While the severity of water losses will vary depending on region, the impact will be felt at the global scale in terms of food shortages, mass migration and increasing risk of conflicts and economic crises. Next to the implications on water-use efficiency and water availability, agricultural production systems are also known to be closely linked to water quality concerns. From this perspective, water scarcity is not only caused by the physical insufficiency of the resource, but also by the deterioration of water quality, reducing the quantity of water which can be used safely.

Less than
1% of Earth's water is available for humans



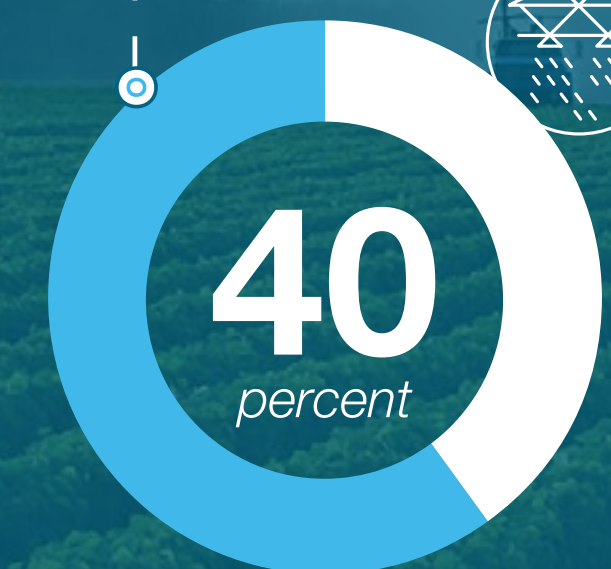
Source: The World Bank

Agriculture accounts for nearly



of global water withdrawals, primarily for irrigation.

Irrigated agriculture contributes to



of the food worldwide.



Source: UN World Water Development Report 2022

Curbing agriculture's oversized thirst

Without evolving agriculture's tools and practices or a concerted effort to protect and make more efficient use of water resources, the global food system is potentially at risk. Though the statistics may seem daunting, we believe that the situation can be overturned. Today's farmers are producing significantly more and higher-quality food per hectare than just four decades ago – thanks to an evolution of practices and technology.

With our potential to develop innovative, scientific solutions that help build greater water resilience in agriculture, Bayer is uniquely positioned to achieve significant impact at scale. We see the opportunity to partner with farmers and other stakeholders to provide solutions that make agriculture more water-efficient and productive in water-scarce regions, allowing farmers to continue their livelihoods while staying within local water constraints. **This is clearly reflected in our commitment to driving positive change in water-scarce local cropping systems in the relevant regions where we operate.** Starting in India, we will focus on transforming local rice cropping systems for our smallholder customers. **We have set ourselves the ambitious target of improving water use per kg of crop by 25% in 2030.**

We will leverage our expertise and innovative seeds and crop protection portfolio, promote the use of efficient water management systems and capitalize on our digital farming solutions. Together with our partners, we will strive to promote water-smart solutions and enhance best practices for better and responsible water use.



Innovation in seeds and crop protection portfolio



Leveraging partnerships and advancing water-efficient agriculture



Digital enablement and the promotion of Good Agronomic Practices



Future-proofing of sustainable food production

In 2020, the World Economic Forum declared the water crisis a

Top 5
global risk

in terms of social, economic and environmental impact.

“The agricultural sector is by far the biggest consumer of water. We will not be able to bring the company vision ‘Health for all, Hunger for none’ to life without focusing on the water problem.”

Matthias Berninger, 2020

Global Head of Public Affairs, Science, Sustainability & HSE

1.8B people
by 2025
living in regions with absolute water scarcity

Innovation in seeds and crop protection portfolio

Breeding for water-smart solutions

Our plant scientists today routinely advance solutions that help farmers combat environmental challenges such as pests, disease or drought. Plants bred to be adapted to certain climates or more resistant to changing environmental conditions have better chances of survival in the field, which leads to more productive harvests. Some examples of Bayer plant breeding with an impact on water include:

Arize hybrid rice

Our plant scientists continue to pursue modern breeding methods to develop locally adapted hybrids that have higher flooding and stress tolerance.

For example, our Arize® hybrid rice seed AZ 7006 is specially designed to survive even in extreme flood conditions, producing consistent yields despite unfavorable weather conditions. This helps safeguard the nutrition and livelihoods of people in countries struck by weather-related calamities such as the Philippines, India and Bangladesh.

Cotton

Cotton is another example where we continuously strive for further improvements through breeding and technology advancements. As seen in the figures to the right, with our focus on improving water efficiency,


our cotton commercial varieties deliver improved water productivity compared to average market performance.

Aryaman Tomato

Seminis® Aryaman is a tomato hybrid that is designed to help small-scale growers with its early maturity, yield increase and better crop protection management through its disease resistance package. With its excellent fruit quality attributes, this variety also contributes to the reduction of food loss. We expect the variety to mature a week earlier, which would potentially save ~6.5% of water per acre. Additionally, the Aryaman variety could increase yield by up to 10-15% while reducing losses by 8-9%. These results are based on 62 trials conducted by Bayer from 2016 to 2019 in the west central region of Maharashtra, India, a primary target market.

High performance of our Deltapine cotton varieties in reduced and limited moisture conditions

Our **'Racehorse variety' DP 2021 B3XF** vs **Market average** under 90% and 60% ET* irrigation treatment for the 2019 growing season

39%  *higher water productivity (amount of yield per unit of water used)*

Profit difference of **925\$/ha** 

Our **'Work horse variety' DryTough™ variety DP 2044 B3XF** under 0% ET irrigation treatment for the 2019 growing season

17%  *higher water productivity (amount of yield per unit of water used)*

Profit difference of **221\$/ha** 

Calculations based on A&M University crop budgets, USDA data, Bayer cotton trials.

Prices differentiation based on high quality of Bayer cotton.

*ET = evapotranspiration, representing the amount of water that is supplied to a plant. If a crop receives 0% ET, it means no water is provided through irrigation and the plants rely solely on natural rainfall.

Helping smallholder farmers in India produce more with less



10-15%
*increase in yield**



8-9% less
non-marketable fruits



6.5%
*of water saved potentially***

100%-win rate. All comparisons are head-to-head comparisons of Seminis® Aryaman, Seminis® Garv and a leading competitor variety. Based on 62 trials in 2016-2019 by Bayer in the primary target market - central west India (Maharashtra region)

*Calculated average yield/ha - Aryaman: 45 tonnes/acre or 111.197 tonnes/ha (3,000 boxes of 15 kg); Garv: 39 tonnes/ acre or 96.371 tonnes/ha (2,600 boxes of 15 kg); Leading competitor variety: 42 tonnes/ acre or 103.784 (2,800 boxes of 15 kg)

**This is an approximate calculation on water efficiency compared to Seminis® Garv and a leading competitor variety. Approximate liter of water required per acre for Aryaman: 600,000 liters while for Seminis® Garv and a leading competitor variety: 642,000 liters. These tentative calculations depend on precipitation from that season and the average rainfall (RF) in Maharashtra is 600 mm. This water calculation is based on 6,000 plants per acre and 6,000 drippers per acre with 2 liters per hour discharge capacity and irrigation on alternate days for one hour.

Leveraging partnerships and advancing water-efficient cropping systems

Transforming rice-cropping systems

Rice is a staple crop for more than half the world's population. What seems like a simple bowl of grains is essential daily nutrition for billions. To meet this need, 11% of cultivated land worldwide (159 million hectares) and up to a whopping 43% of the total water used for irrigation goes to irrigated rice.

Flooding rice is the most common cultivation system. It is also a method that is land, water, labor, capital and energy intensive — and less profitable as resources become increasingly scarce. Over the next two decades, it is necessary to move to a more economically viable and sustainable rice production method if we are to ensure its availability, mitigate climate change and improve the quality of life of smallholder rice farmers around the world.

One of the most promising solutions to these challenges is Direct Seeded Rice (DSR). DSR is a modern, technology-driven and less resource-intensive cultivation system. To help farmers transition to direct seeded rice, we launched the **DirectAcres program**, starting in India, with the vision of shaping the future of rice and transforming its cultivation. With

our portfolio of high-yield rice hybrids that can be directly seeded, such as Arize® 6444 Gold and Arize® 6585 ST, we are working to provide rice farmers with breeds that require less water, energy and labor than conventional transplanted rice, while also reducing GHG emissions.

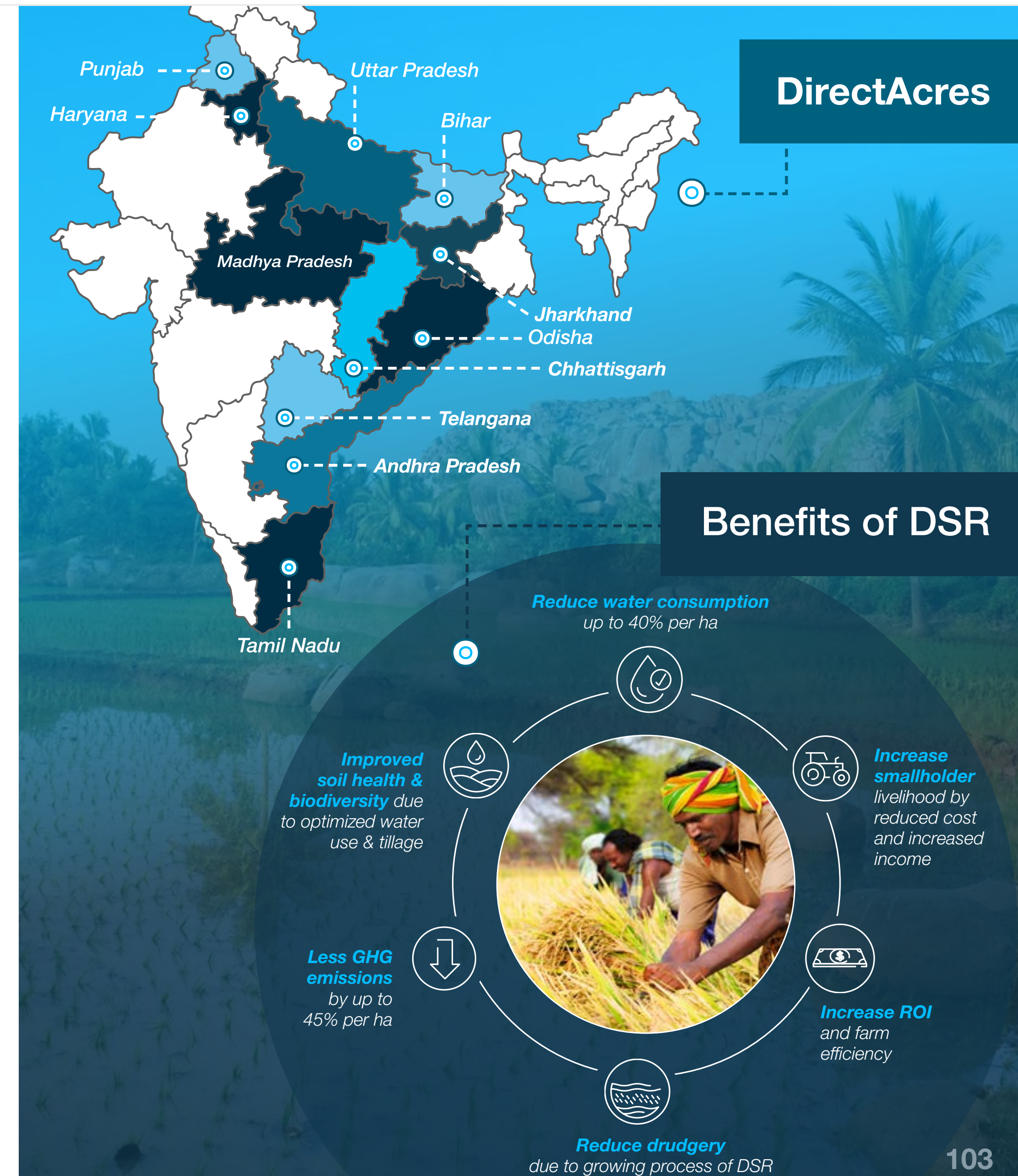
Our ambition is to continue developing high-performing seeds bred specifically for the system and tailored to different farm environments – supported by safe, effective and targeted crop protection products. Empowered by innovation, our tailored system will be digitally enabled, grounded in sustainability, and promoted by partnerships.

In 2022, we successfully piloted DirectAcres on 800 hectares, achieving a 99% plant establishment rate, and we plan to expand the program to cover 10,000 hectares in 2023 and 1,000,000 hectares by 2030.

In addition to our DirectAcres initiative, we are also driving the "Sustainable Rice" initiative where we promote sustainable management practices that help reduce water consumption in rice cultivation. We encourage farmers to adopt climate-smart techniques such as Direct Seeded Rice (DSR) and Alternate Wetting & Drying (AWD), which not only help reduce water usage but also mitigate greenhouse gas emissions.



[Learn more about our sustainable rice initiative in the GHG chapter](#)



3.2B

people worldwide rely on rice as essential daily nutrition

43%

of the world's irrigation water withdrawals goes to irrigated rice



Collaborative Solutions for Sustainable Rice Farming

At Bayer, we believe the transformation of rice farming requires a collaborative approach among experts across the industry and beyond to make the best solutions accessible to rice farmers and advance adoption.

Through our partnership with the International Rice Research Institute (IRRI), we have participated in the Direct Seeded Rice Consortium (DSRC) since 2018.

IRRI has developed the DSRC technology platform to improve crop management practices and maximize the advantages of direct seeded rice—enhancing both the economic and ecological sustainability of rice production in Asia. Through this platform, we provide access to our proprietary genetic materials (hybrids), seed and drone technologies, as well as in-kind activities for DSRC research and testing.

Building on the successful work with IRRI, at the annual COP27 conference held in November 2022 in Egypt, **we announced together with the U.S. Agency for International Development (USAID) a partnership to improve the quality of life of smallholder rice farmers through the introduction, on-farm testing and scaling of improved, climate-smart rice varieties and agronomic practices.**

With up to \$8.5M committed from USAID to fund this project, Bayer committed up to \$4 million of in-kind support for the four-year project, which will run through 2026. Bayer will share knowledge as well as rice hybrids and digital capacity to the research network, receiving farmer feedback from the different geographic locations.

Fighting water scarcity in Africa with maize that thrives on less

In Africa, maize is the most widely-grown food crop—more than 300 million people depend on it as their main food source. But drought and insects routinely threaten its production, impacting yields and leading to crop failure.

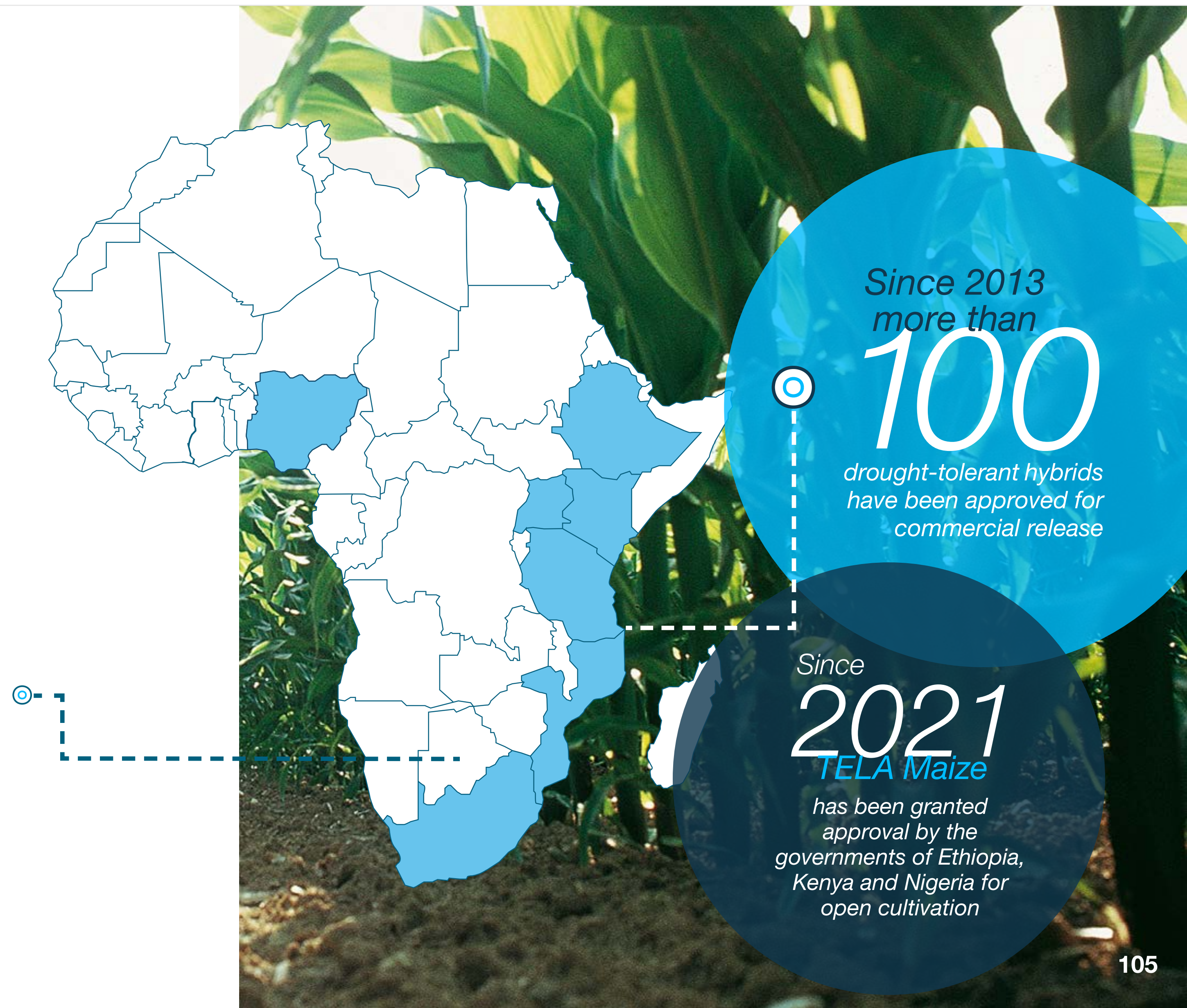
We are helping address the twin issues of water scarcity and destructive pest infestations through research and development of water-efficient technologies and products.

Through Water Efficient Maize for Africa (WEMA, now operating as the TELA Maize project), a public-private partnership supported by the Bill and Melinda Gates Foundation and the United States Agency for International Development (USAID), we are helping protect harvests in water-limited conditions. The project uses conventional and advanced plant breeding together with biotechnology in the development of maize varieties designed to tolerate drought and resist pests. The program helps these smallholders acquire locally-adapted maize hybrids from local African seed companies without paying a trait royalty fee, allowing them to feed their families and communities and thus improving food security as well as their livelihoods, even in the presence of drought conditions.

Since 2013, more than 100 drought-tolerant hybrids have been approved for commercial release in Ethiopia, Kenya, Mozambique, Nigeria, South Africa, Tanzania and Uganda. TELA Maize has been granted approvals by the regulatory authorities in Ethiopia, Kenya and Nigeria for open cultivation, with the likelihood of commercial introductions in 2024 and 2025 to provide greater accessibility to smallholder farmers in those countries.



[Read more about TELA maize and the partnership](#)



Partnering to incentivize water efficiency

Over the last 12 months, Australian cotton growers experienced periods of hot, dry weather, tropical cyclones and above average heavy rainfall. While weather volatility is nothing new for Australian cotton growers, with climate extremes predicted to continue in the future, using water more efficiently – across all weather variations – continues to be top of mind.

Over the last two years, **Bayer has partnered with Goanna Ag to provide myBMP-certified* cotton growers access to the Water Use Efficiency Grant program.** Through the grant, Bayer provides a 12-month subscription to two Goanna Ag GoField Plus units, for each cotton farming enterprise. The unit includes a soil moisture probe and a crop canopy temperature sensor, both with infield-connected sensors.

While soil moisture probes are widely implemented in Australia, the introduction of the canopy temperature sensor is a differentiator. The GoField technology indicates when there are critical plant stress levels at which crop performance will be impacted. Algorithms are used to predict when the moisture stress threshold will be exceeded, enabling

optimization of irrigation timing. The result is a more profitable, sustainable cotton production system. The Water Use Efficiency Grant program plays an important role in Bayer’s broader commitment to supporting sustainable practices in the cotton industry and aims to encourage growers to implement water-saving practices on their farm using key insights from the Goanna Ag technology.

“Based on a mix of the crop stage, weather outlook and the moisture probe, we can make an educated decision about when or when not to irrigate. Everything is factored in.”

– Cotton grower, Australia

“The sensors gave us the right time to water the plant without stressing it. The primary goal is to grow a healthy plant. It allows us to stretch the irrigation scheduling out and also adjust it earlier if needed...”

– Cotton grower, Australia

*myBMP is a voluntary farm and environmental management system which provides self-assessment mechanisms, practical tools and auditing processes to ensure that Australian cotton is produced according to best practice.



[Learn more about this project at the Goanna Ag website](#)

Water Efficiency Grant

500
sensors

+

140,000 ha
of cotton covered by the
program in its first two seasons

+

26,000
megaliters
of irrigation

=

**Water savings or
redemption of**

10%

Based on a 2022 survey involving a sample of local cotton growers who have been using the Goanna Ag technology, grower feedback shows promising results:

81%

of respondents reported positive impact on their farm from using sensors

68%

stated their irrigation scheduling approach changed as a result of using the technology

90%

see water use efficiency as extremely important, and are taking action to improve efficiency on their farm

Applying precision in irrigation to save water and farmer spend

Automation with smart irrigation technology allows water and crop protection products to be applied precisely: in the right quantity, in the right place, and at the right time. Moreover, it can offer various benefits, such as improved efficiency, reduced environmental impact, remote management and data-driven decision-making.

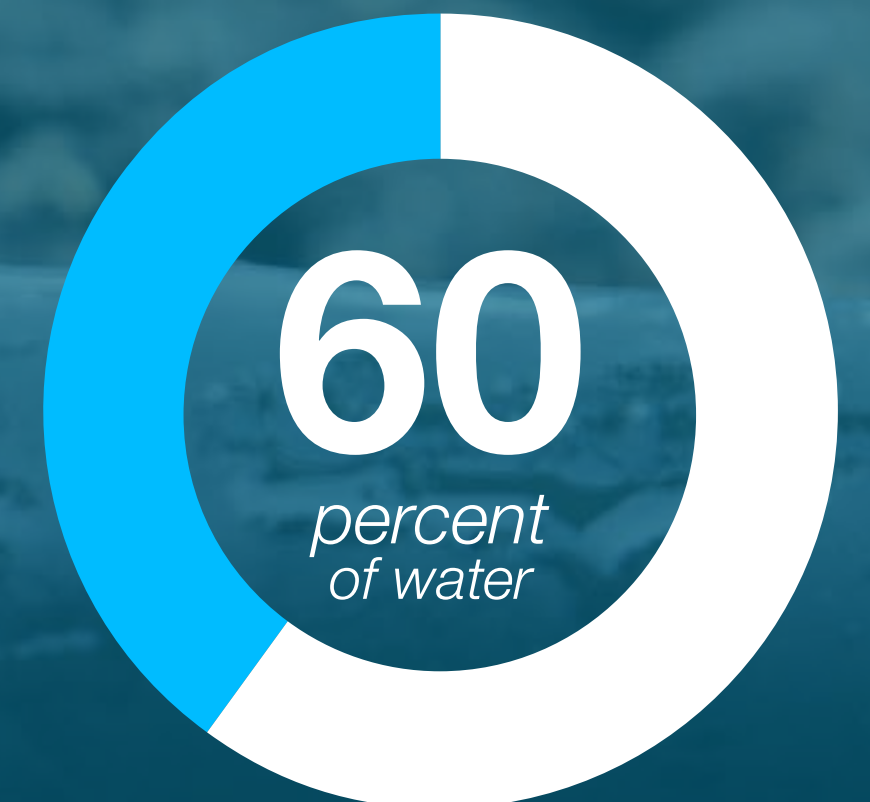
In collaboration with Netafim, we're developing new modes of targeted application. As part of the new, innovative system DripByDrip, growers use drip irrigation, which delivers water and crop protection where it is needed most, directly at the roots. This precise application requires less chemical product and reduces evaporation and runoff while using 60% less water compared to traditional irrigation. Based on our findings from 2019, precision irrigation does not only contribute to significant water savings, but also to optimization of energy, labor, and use of inputs such as pesticides and fertilizers.



Did you know?

Crop protection can be applied directly to different target areas, including the seed, the plant, the soil or even the roots.

As part of the DripByDrip system, growers use drip irrigation, which saves up to





Digital enablement and adoption of Good Agronomic Practices

With our digital farming platform Climate FieldView™ we are helping farmers to improve their yields through data support. The sensor-based collection and storage of large volumes of machine-generated agronomic data now takes place directly at the farmers' accounts. The data collected from Climate FieldView™ is being used to develop tools that can help farmers fine tune the operations and management of their farms in regard to precision use of crop protection products and seed placement.

In addition, Data Manager, a new feature scheduled for a U.S. release in early 2024, will provide operational and field-level practice data in a single place regardless of the source used at collection. These new layers for tillage and irrigation drive new opportunities for FieldView users to track sustainable practices and enhance the view of their farm with flexibility. Climate FieldView™ is currently available in North America, South America, Turkey, South Africa, Europe and Australia.

Working with Hydrosat to optimize water use with Irriwatch technology

Bayer is working with Hydrosat, a specialized company in irrigation scheduling, to optimize water management in our seed production and conduct commercial proof of concepts in vegetables and rice. Bayer is utilizing the product IrriWatch and its data-driven field insights, which are generated through satellite imagery processed with an algorithm called SEBAL. This algorithm enables calculations of root zone soil moisture and crop productivity, providing valuable information for irrigation recommendations to help optimize crop growth, field uniformity, yield and quality. This spatially distributed data is the basis to compute efficient and productive use of water along with sustainability indicators.

Saving water through integrated weed management and conservation tillage

Integrated weed management

Because weeds compete with crops for water, light and nutrients, our Integrated Weed Management aims to help farmers optimize water use and reduce reliance on a single weed control method by promoting a combination of strategies that include the use of crop rotation, seeds and traits, digital enablement and diverse chemical and biological herbicides. Through new modes of action, digital technologies and agronomic practices, we aim to provide growers around the world with new and innovative weed management services that support their short- and long-term needs and goals. Bayer is raising the bar and has committed to invest around €5 billion in the current decade to research additional weed control methods and provide farmers with more options in the future.

Conservation tillage

Conservation tillage systems, including strip-till and no-till, are agricultural practices that offer important environmental benefits, with water conservation being one of the positive outcomes. The adoption of adapted tillage techniques reduces run-off, increases infiltration rates and decreases the evaporation of water in the soil. This contributes to improved soil moisture and soil quality, as well as less water required for irrigation,¹ which ultimately means operational savings for farmers.

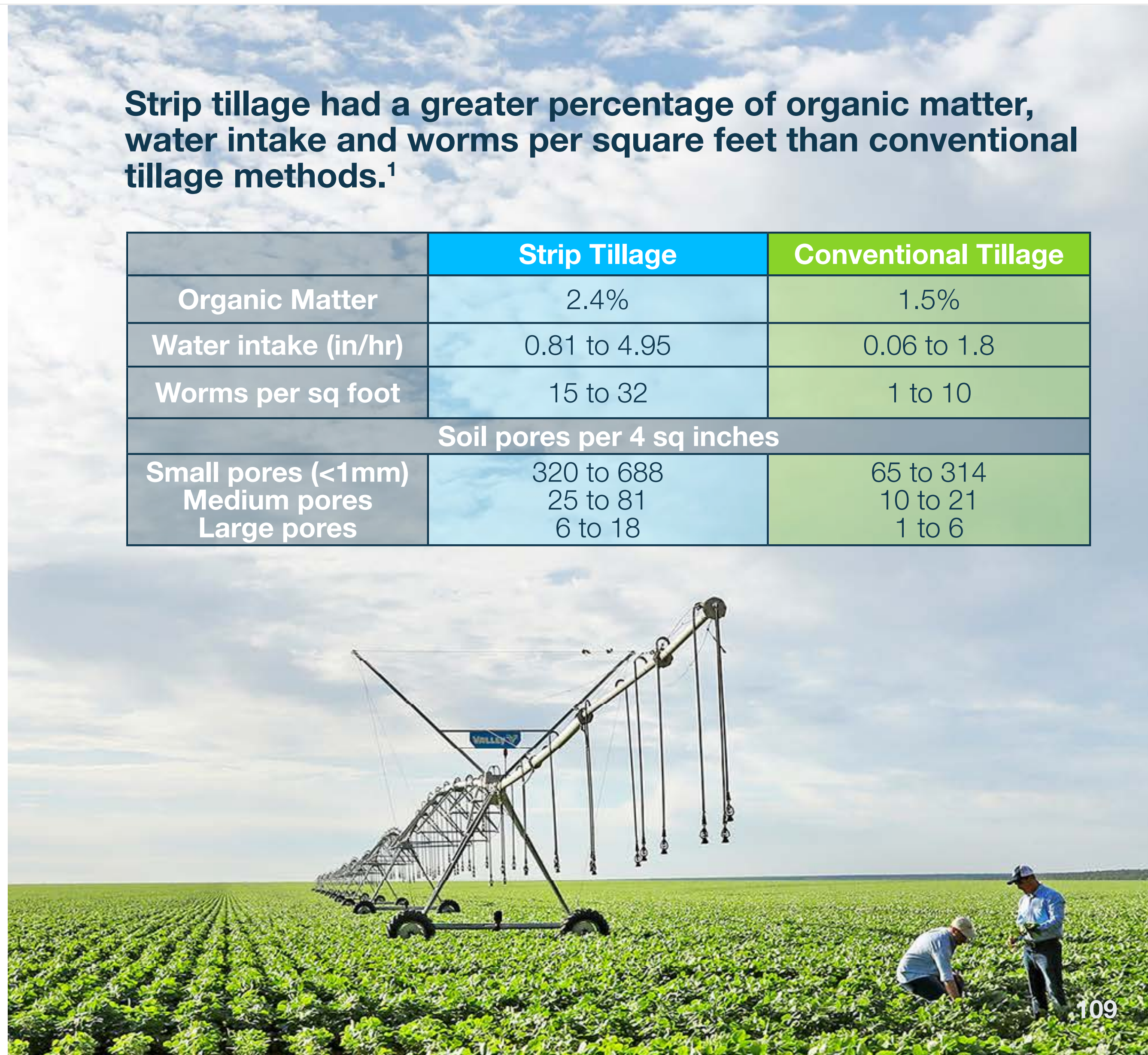


Our Bayer Carbon programs further encourage these efforts by incentivizing farmers across the globe to practice climate-smart solutions including the adoption of conservation tillage practices.

¹National Summary Corn Production and Strip Tillage in the Western Plains

Strip tillage had a greater percentage of organic matter, water intake and worms per square feet than conventional tillage methods.¹

	Strip Tillage	Conventional Tillage
Organic Matter	2.4%	1.5%
Water intake (in/hr)	0.81 to 4.95	0.06 to 1.8
Worms per sq foot	15 to 32	1 to 10
Soil pores per 4 sq inches		
Small pores (<1mm)	320 to 688	65 to 314
Medium pores	25 to 81	10 to 21
Large pores	6 to 18	1 to 6



Future-proofing of sustainable food production

Empowering sustainable agriculture through the farms of the future

Across our global [Bayer ForwardFarming](#) network of independent, modern sustainable farms, we partner with entrepreneurial farmers to demonstrate how the implementation of innovative agriculture tools and practices can benefit the farmer, environment and society.

On the Agrícola La Hornilla ForwardFarm outside of Santiago, Chile, Cristián Allendes works with his sons on his abundant fruit farm to meet the expectations of a demanding market — a task made increasingly difficult by water scarcity. According to the University of Chile, almost 80% of the national territory is affected by drought, meaning successful, sustainable farmers must take efforts to ensure water efficiency and conservation.

Part of the success of the Agrícola La Hornilla farm is due to its high-density planting and the use of a drip irrigation system, which precisely controls and distributes the necessary amount of water and fertilizers while also reducing run-off and erosion.

Guided by satellite monitoring, the use of low-water-volume crop protection application equipment such as electrostatic machines also contribute to the Allendes family's water-saving efforts. These technologies allow the application of crop protection products in a sustainable and efficient way that uses significantly less water — on average 500 liters

per hectare compared to 1,000 liters in conventional applications — and provides better coverage and adherence of the products. Because of these water conservation efforts, more hectares are covered with less water each day, resulting in less labor and potentially greater economic benefit for the Allendes' farm while reducing their consumption of the scarce Chilean water resources.

In our Bayer Forward Farms, we promote the adoption of innovative solutions and technologies to conserve water resources as well as preserve water quality.

Visit one of our [Forward Farms virtually](#) to see what we do to protect water bodies and read in our [Sustainable Pesticide Management at Bayer Report](#) how we live the International Code of Conduct on Pesticide Management by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO).

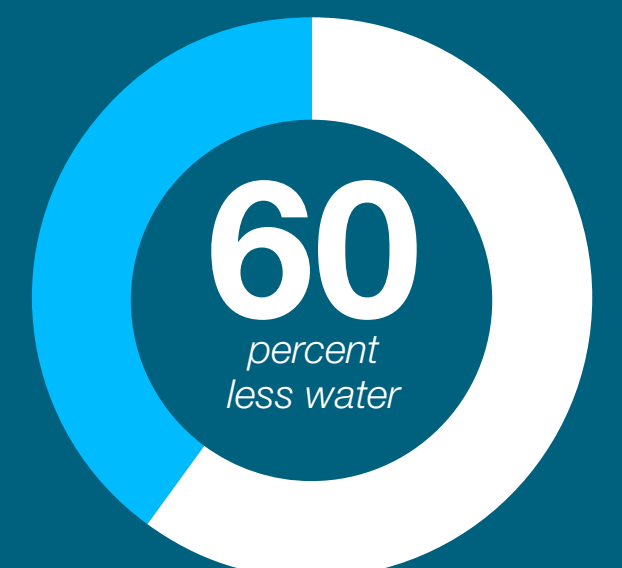


Collaborative research and knowledge sharing

Research and knowledge sharing is another aspect that we strongly invest in. We are in constant dialogue with farmers and other partners.

The [Gothenburg Center](#) is a great example of, and was designed for, our knowledge transfer efforts. The Center in Gothenburg, Nebraska is an ideal location to monitor the impact that water, or lack thereof, has on maize, wheat and soybean cropping systems. Scientists conduct [research](#) and demonstrations year-round to provide information for farmers to help use water more efficiently through increased annual yields and better management of irrigation. Collaborative efforts with local universities as well as adding more sustainable soil health practices into irrigated and dryland cropping systems are also important initiatives at Gothenburg.

By implementing drip irrigation systems, we've empowered farms in Chile, Spain, China and the Netherlands to use up to

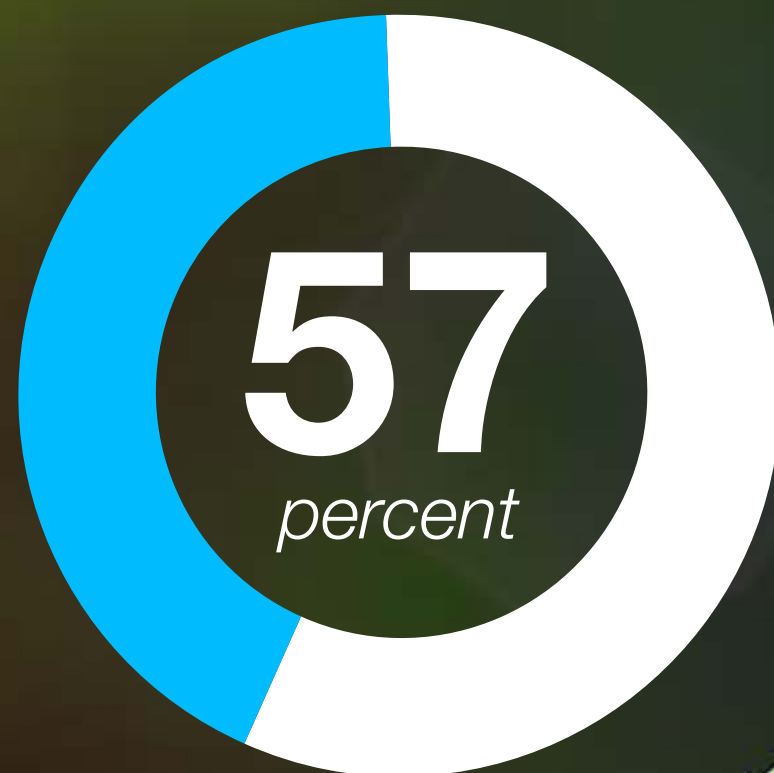


Responsibly watering the world's food supply

It's clear we need to curb the thirst of agriculture—for our food supply and for our planet. **Agriculture's vulnerability to water scarcity is already a reality; and the projections of food demand coupled with climate change will only exacerbate the crisis we are facing.**

But we're optimistic as innovations in agriculture have already shown benefits to water conservation. Through partnerships, research and innovation focused on improving water efficiency and productivity with more resilient crops, advanced crop protection products, biostimulants, and promoting modern irrigation and good agronomic practices—a water-secure future for agriculture is within reach.

By 2050, more than 9 billion people are projected to be inhabiting the planet—requiring



more water to sustain the population with current production practices.



Learn more about our efforts on conserving water



[Bayer Partnership with IRRI](#)



[Bayer Forward Farming](#)



[Goanna Ag Partnership](#)



[Sustainable Rice Initiative](#)



[Drip Irrigation Systems](#)

Have questions or would like to discuss directly with us our water conservation efforts? Please reach out!



MEHDIA MOUNIR,
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Promoting Sustainable Use

Crop protection products are essential for safeguarding crops, improving yields and protecting farmers' livelihoods amidst climate change and limited arable land. However, if these products are not used properly or if counterfeits are used, they can pose risks for farmers' yields, human health and the environment. In a world of growing food demand, it is imperative that agricultural practices remain safe and sustainable.

At the Crop Science division of Bayer, we promote the effective, safe and responsible use of our products in order to support agricultural productivity and protect human and environmental health.

Our work on promoting sustainable use contributes to the following U.N. Sustainable Development Goals:



Sustainability Challenges

The sustainable use of crop protection products starts with the selection of authentic and registered products, followed by a proper handling and adequate protection during their application. The use of counterfeit products or the improper use of original crop protection products can have adverse effects for agricultural productivity as well as human and environmental health.

Addressing these challenges requires continuous innovation to develop more targeted, environmentally-friendly crop protection products **that can be used in safe ways**. Additionally, farmers need **improved access to these innovations**, delivered through effective local structures, education, training and certification in sustainable use.



Our Approach

We take a sensible approach to safeguard sustainable use that encompasses diligent product stewardship and anti-counterfeit management – both important building blocks of sustainability in agriculture.

In stewardship, much emphasis is on our products' use phase, in alignment with Food and Agriculture Organization of the United Nations ([FAO](#)) [guidelines](#). For example, we provide training on proper handling of our crop protection products to farmers, dealers, and applicators around the world. We also foster the innovation in application technologies (e.g., through drone spraying and targeted, digitally-enabled application technologies) which can have an additional positive effect on sustainable use. Resistance management and integrated pest management are further building blocks of our engagement, as well as the responsible management of empty containers. We record and follow-up on any adverse incidents reported to us related to the use of our products. Additionally, we take preventive measures to safeguard the integrity of our products against counterfeiting, such as enhanced product authentication.

We actively engage with regulatory bodies and collaborate with a range of industry stakeholders to promote sustainable practices.

Progress

We have made progress across many areas. To name a few highlights: in 2022, we once again increased the number of people trained on safe use globally. We reached more than 3.4 million external contacts, including 2.7 million smallholder farmers. Our Safe Use Ambassador Program won the international Gold Standard Award for Corporate Citizenship 2023, recognizing the positive impact it has for people in low- and middle-income countries (LMICs). Further, we are advancing the adoption of innovative application technologies in agriculture at a broader scale, including supporting the increased use of technology such as drones (e.g., with specific drone use-approved formulations of our products) or the training and certification of professional spray service providers — especially in smallholder countries. Further, as an industry leader, we have progressed with the Sustainable Pesticide Management Framework, which is geared to support LMICs in capacity building and thus to spur innovation, responsible and sustainable use, and countries' reduced reliance on highly hazardous pesticides.

In 2023, we set a new milestone in transparency by publishing our first [report on Sustainable Pesticide Management](#) at Bayer, which details how we live the FAO-WHO International Code of Conduct on Pesticide Management as a company, including tangible examples of our stewardship activities along the full life cycle of our crop protection products.

Safeguarding the complete lifecycle: An unwavering commitment to product safety

Once a crop protection product reaches the market, its label provides crucial information regarding its safe use and intended purpose. This information includes product handling and application, as well as specific requirements such as the use of personal protective equipment. Potential human and environmental issues as well as the development of pest and weed resistance can arise if crop protection products are not applied in adherence to the label instructions.

Another challenge is the prevention of counterfeit products in the market. Various measures are implemented to address this issue, especially at the sales & distribution and product disposal stages of the lifecycle. These measures include awareness campaigns, trainings, product authentication technology and collaboration with regulatory authorities as well as law enforcement agencies. These steps aim to protect farmers from the potential risks caused by counterfeit products.

All these challenges are closely related to the degree of professionalization in agriculture: whereas professional large-scale farmers have the knowledge and technology to handle crop protection products correctly, millions of smallholder farmers around the world may face difficulties and hence require more intense stewardship.

At Bayer, we are broadly addressing these challenges in collaboration with a variety of partners within the agricultural industry.

¹OECD, *Joint Working Party on Trade and Environment: New digital technologies to tackle trade in illegal pesticides*, 2020, p. 12.

²Internal estimation



*Insects, weeds and diseases have evolved resistance to many pesticide classes, leading to **increased control costs for farmers and a need for alternative control methods.***

This challenge is worsened due to increasing costs of developing novel pesticides.



*Illegal or counterfeit crop protection products are estimated to account for up to **15% of products sold**,¹ while illegal seeds make up as much as **10% of products sold**.²*



Safety and sustainable use are imperatives for our business

Promoting product stewardship

Safety is an essential part of any industry, but it is of paramount concern when it comes to our food supply. Because of the scale and reach of the agricultural industry, the effective, safe and sustainable use of our products is of utmost importance to Bayer.

Effective product stewardship practices directly support the availability of high-quality products, services and best practices by promoting compliance with legal and regulatory requirements, good agricultural practices, maximizing product potential and sustainability, and minimizing risk.


Our Product Stewardship Commitment is based on the FAO Code of Conduct on Pesticide Management, the CropLife International Plant Biotechnology Code of Conduct and the Universal Declaration of Human Rights.

In collaboration with CropLife International, we promote effective stewardship worldwide, bringing impactful programs to local farming communities and actively supporting a healthy environment through firsthand stewardship actions.

What is sustainable use?

Our definition of sustainable use in agriculture encompasses the safe and responsible management of crop protection products in their use phase. This includes handling and application, product disposal and counterfeit prevention.

 [Read more about our commitment to product stewardship.](#)

 [You can learn more about how these programs are having a positive impact in their communities and on the environment on the CropLife International Stewardship Website](#)

Product Life Cycle



Our commitment to product stewardship is across the board

Authentic inputs as key enablers for sustainable agriculture

Authentic crop protection products and seeds undergo rigorous testing and strict regulatory evaluation before entering the market, ensuring safe and high-quality standards.

The presence of counterfeit products in global agricultural markets is therefore a cause of concern. These fake items can contain harmful substances not disclosed on the label, posing risks to farmers, consumers and the environment. For example, counterfeit seeds lead to reduced yields and inferior produce quality, negatively affecting food production and the livelihoods of farmers.

We take a strong stance against illegal activities and employ a comprehensive strategy to combat counterfeit products. We cooperate closely with government agencies, law enforcement, NGOs, intermediaries and other institutions to prevent production, transport, trade and use of counterfeit items. At the farmer level, we go beyond raising awareness by introducing innovative technologies that empower farmers to authenticate original products.

Preventing counterfeit products fosters sustainable agriculture, ensures a reliable food supply and supports the pursuit of the UN Sustainable Development Goals.



Bayer strives to combat counterfeit crop protection products and seeds



CropLife Europe: stopping counterfeit and illegal pesticides



Digital farming for the future

Increasing productivity and operator safety through innovative technologies

Innovative application techniques combined with digital solutions help increase productivity and determine the right application volume of crop protection products at the right place and the right time. Our advancements in precision application technology have a focus on ground and aerial autonomous machinery, as they minimize operator exposure during pesticide application.

Further improvement across these methods and the introduction of real-time farm data will steadily increase the precision and accuracy of product application. Some of the most promising technologies are drones that hold the potential to significantly improve efficiency and replace handheld application in many regions, especially in LMICs. Moreover, these developments are well-suited for smaller fields, but we also see interest from large-scale farmers in developed countries. We expect that labor shortages and costs will further push these new options. **All the data and connectivity mean we are empowering farmers to produce more with less.**

We partner with major drone-producing companies and professional drone spray service providers to provide farmers with reliable and safe high-quality spray applications in countries where regulatory systems allow such applications. However, drone spray is a technology still under development. We work with regional CropLife organizations, such as CropLife Asia and CropLife America, to establish guidance documents for the safe application of crop protection products via unmanned aerial systems (UAS). We contribute to further defining operator safety via drone spray by taking into consideration exposure sources such as frequent refills, transport or battery exchanges.

Supporting farmers through knowledge transfer and professionalization

Safe use trainings

We take great care in educating farmers, operators and consumers, in accordance with the [International Code of Conduct for Pesticide Management](#), and we leverage new technologies to do so.

Through targeted training courses, we show how to use our products both effectively and safely to maintain applicator health, healthy plants and increase yield and quality of their harvested goods. Training can be adapted depending on the target audience, a particular product or plant, and can cover such varied topics as safe product handling during use, transport, storage and disposal, as well as proper protective clothing and emergency first aid measures.

[Safe use trainings](#) are an important lever to share knowledge with growers. Our safe use trainings also include field workers, seed treatment professionals, distributors, retailers and further stakeholders who are in direct contact with our products. We are fostering best practice exchange and capacity-building on the safe use and disposal of crop protection products, with a focus on LMICs. This includes holistic platforms like [Better Life Farming](#), as well as stewardship-specific tools like Bayer [DressCode](#) (a web-based tool that gives farmers label-conform instructions about the personal protective equipment (PPE) to use in their individual situation). To maximize our impact and reach, we collaborate with local universities to train agriculture students, aiming to create a network of [Bayer Safe Use Ambassadors](#) who in return transfer their knowledge by training thousands of smallholder farmers in their communities.

These large-scale training programs are especially important in low and middle-income countries with no or little regulation on the use and application of crop protection products. We see the professionalization of agriculture as a major driver in behavioral shifts when using crop protection products and required PPE. Both the increased use of novel technology, such as drones or larger tractors, as well as a training and certification of professional spray service providers, can increase the effective, safe and sustainable use of our products in the future.

Our flexible approach to offer on-site as well as virtual trainings, and the use of digital tools enabled us to reach more than 3.4 million external contacts worldwide (e.g. farmers, field workers, distributors, retailers and other stakeholders in the agriculture industry), including around 2.7 million smallholder farmers in 2022.

Digitalization as a lever for knowledge transfer and reach

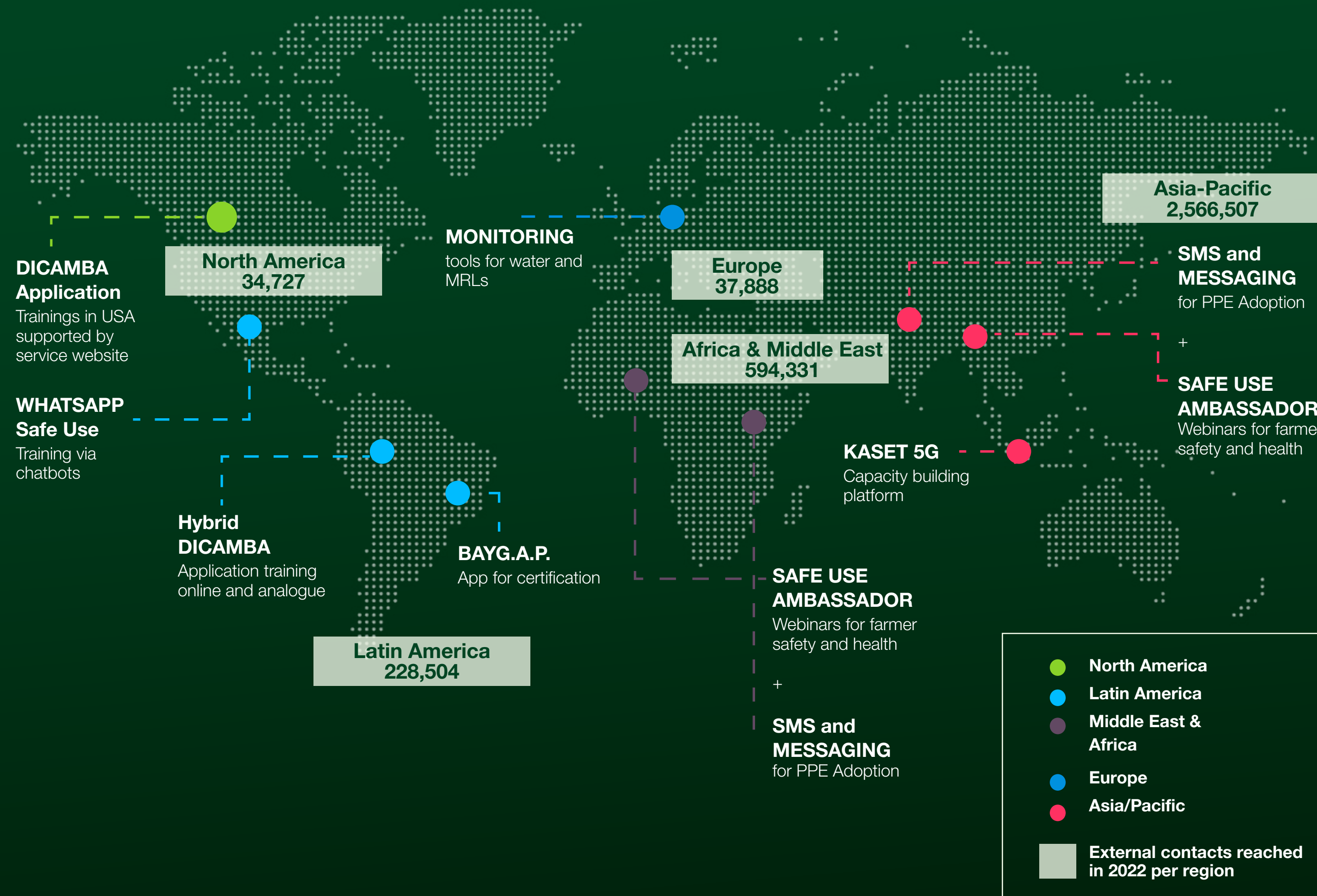
As our world gets more digitalized, we are exploring and leveraging new ways of building capacity and raising awareness. We have implemented WhatsApp trainings and messaging campaigns (SMS) and use webinars as critical additions to our face-to-face trainings and outreach activities. Using only a smartphone or tablet, farmers in Africa, Asia, and South America can record pest and disease data, receive regional agronomic advice, and chat with knowledgeable experts. This has the potential to provide smallholders with a level of data and insights similar to those currently accessible to farmers in developed economies.

Reached more than
3.4M
external contacts
in 2022

More than
2.7M out of the **3.4M**
contacts reached in 2022 **were**
smallholder farmers



Safe Use Trainings Global Outreach



Incident monitoring and management

We market only products that meet our high safety standards, but we also care about their real-world use by our customers. We monitor and follow up on any report about adverse events or misuses. For that, we need reliable data that tells us how, when, where and how often incidents occur.

We collaborate with external partners like universities, as well as environmental and regulatory authorities, to gather monitoring data on residues of our products in water and agricultural produce. Expanding our database, we work with poison control centers and rural doctors, providing tools for reporting poisonings related to crop protection.

Incidents worldwide are tracked through our internal management system, encompassing data from poison control centers and reports from our network of colleagues and external partners. We encourage incident reporting through sales staff, hotlines, and source additional information from media reports, and medical professionals trained in our Safe Use Ambassador Program.

Our incident management system and product use review form the basis of our safety monitoring and improvements. We analyze data to identify issues and hotspots, and we derive learnings to develop targeted stewardship measures. These measures may include enhanced training, formulation changes, revised application recommendations, use limitations or even product withdrawal following the FAO-WHO Code guidelines.

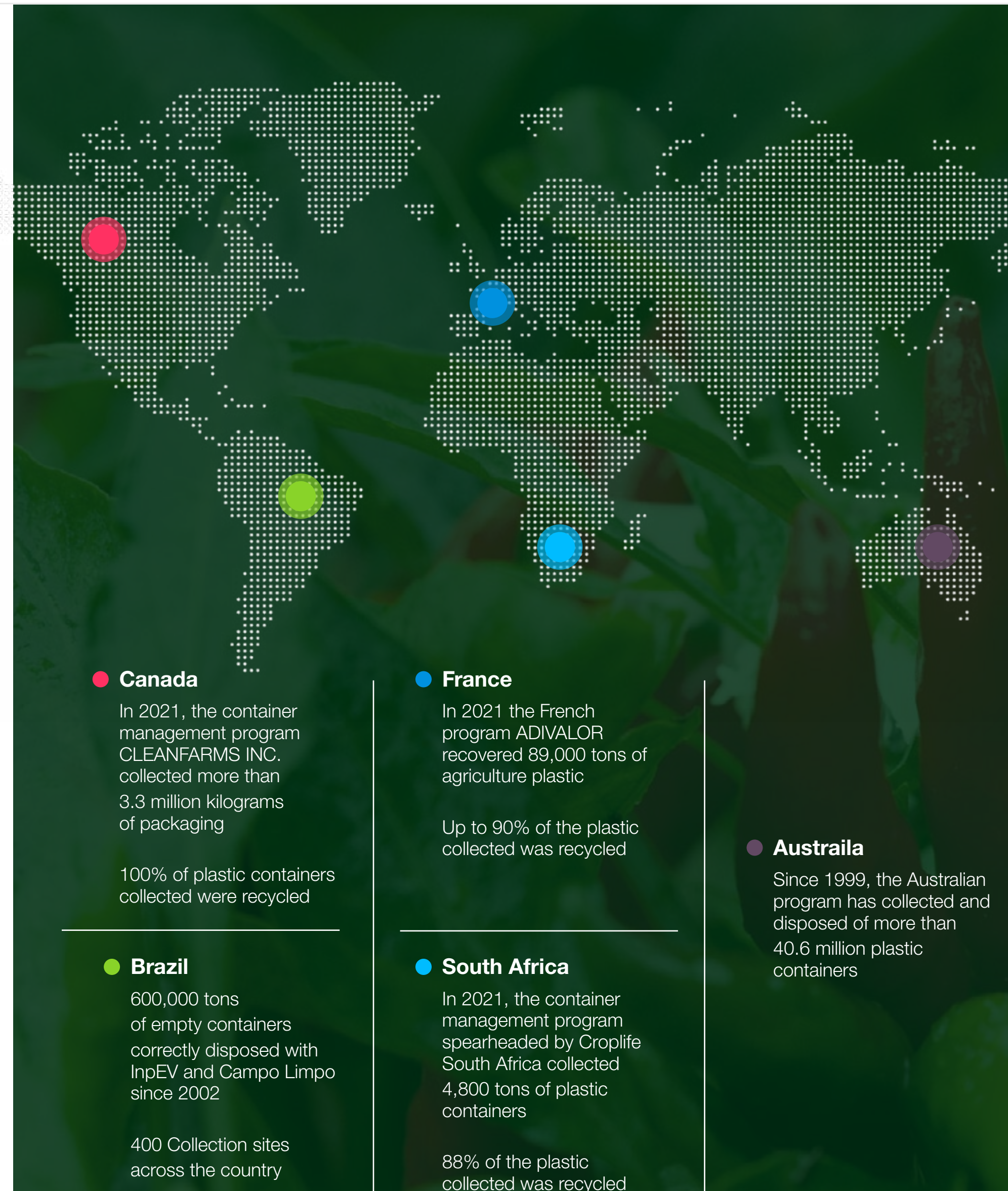
Empty container management

Collecting empty containers

We know that once our crop protection product is applied and the container is emptied of its contents, our responsibility for it doesn't end. For us, product stewardship includes facilitating safe disposal of empty containers.

As part of our Responsible Use training, we not only instruct on the proper handling and application of our products, but also on the safe disposal of empty containers. We actively support programs to safely recycle and if not feasible, encourage the safe disposal of empty packages and containers in accordance with local regulations. We also promote responsible empty container management systems, especially in countries with less regulated waste management systems. **Our goal is that anyone who uses our products has the information and access needed to safely dispose of product containers when finished.**

Together with the CropLife International industry association, we support the safe disposal of empty crop protection product containers in more than 60 countries. This partnership has also facilitated the development of environmentally friendly packaging design programs, the implementation of training courses for distributors and farmers in the proper handling of crop protection product containers, and the testing of plastic recycling options.



Establishing and activating local waste management systems was particularly successful in Brazil, Canada, China, France, Germany and Australia. A common success factor among these systems is the presence of national legislation, which requires the establishment of nationwide empty pesticide container management systems.

In Brazil, the non-profit InpEV (National Institute for Processing Empty Packages) program has reached a recycling rate of 94%, being the most successful program worldwide. The example of China shows how container management systems can achieve remarkable progress in just a few years. Within two years of implementation, the country has already become one of the leading nations globally in terms of collecting packaging waste. In Asia, Bayer is working closely with CropLife Partners to advise governments on the implementation of Extended Producer Responsibility (EPR) initiatives that aim to overcome challenges in the agricultural sector.



Integrated resistance management

Championing an integrated approach to pest management and weed resistance

Resistance is the naturally occurring, inheritable adjustment in the ability of individuals in a pest population to survive a treatment with exposure to a plant protection product that would normally exert effective control.

This means that without proper controls, our crop protection products could lose effectiveness over time. We support the implementation of Integrated Pest Management (IPM) measures including resistance management tools for all Bayer products and services. As part of these measures, we develop and implement IPM guidance based on the CropLife and Resistance Action Committees. This includes training farmers and others on proper resistance management and researching issues related to resistance and collaboration with stakeholders.

Weed resistance management is of equal importance to our customers. Driving research and innovation in this critical field is our Weed Resistance Competence Center (WRCC). WRCC specialists are dedicated to advancing our expertise as a business, both in the lab and in the field, to stay ahead of the ever-evolving challenges that farmers face in weed control. However, we understand that these challenges cannot be solved alone. The WRCC cooperates globally with leading institutions and weed scientists to expand its capabilities and collaborate to solve many different weed management issues.



Ethical marketing and sales as a foundation of trust

Setting and adhering to high safety and sustainability standards everywhere

We wouldn't be a leading global company without our customers' trust. We adhere to ethical sales and marketing practices that meet the standards set by external regulations and codes of practices, in particular with the laws and regulations for advertising and marketing practices, the applicable global, regional and local industry codes relevant for our business, as well as data protection and privacy of customer or consumer information. We apply strict internal guidelines and regulations through the Bayer corporate compliance policy, Bayer Societal Engagement (BASE) principles, the Group Regulation "Integrity & Responsibility in Communications and Marketing" and our published Group Regulation on Product Stewardship Commitment, Principles and Key Requirements.



We strive to review all advertising and promotional materials internally for **accuracy, appropriateness and compliance** before release outside the company.



Technical and commercial Bayer staff are enabled to provide the **appropriate advice, support and training** to their Business Partners, such that they are adequately qualified to present information on Bayer products and services to their customers.



We are aiming at making **advertising, promotion and informational materials clear and consistent**. We avoid any statement or visual presentation which is likely to mislead or create misunderstandings by buyers/users.

Taking action against counterfeiting

Preventing the use of counterfeits through reliable product authentication

The Bayer Safety Seal enables farmers and distributors to distinguish original Bayer crop protection products and seeds from counterfeits. This technology employs optical security features and a QR code that can be scanned via the Bayer Seal Scan App. The App provides reliable information about the product authenticity conveniently and in local language. The Bayer Safety Seal is found on all Bayer crop protection products sold in bottles in Europe, Middle East, Africa and Latin America regions, as well as parts of Asia Pacific.

In 2021 we expanded the technology to include selected solid crop protection products in some high-risk markets. A year later, the technology was expanded to Europe for maize and oilseed rape seeds.

Our plan for 2023 is to implement the Bayer Safety Seal on sunflower seed bags for Europe and on maize seed bags for Brazil. Feasibility studies are ongoing for further roll-out on maize in Africa and North Latin America as well as for vegetable seeds.

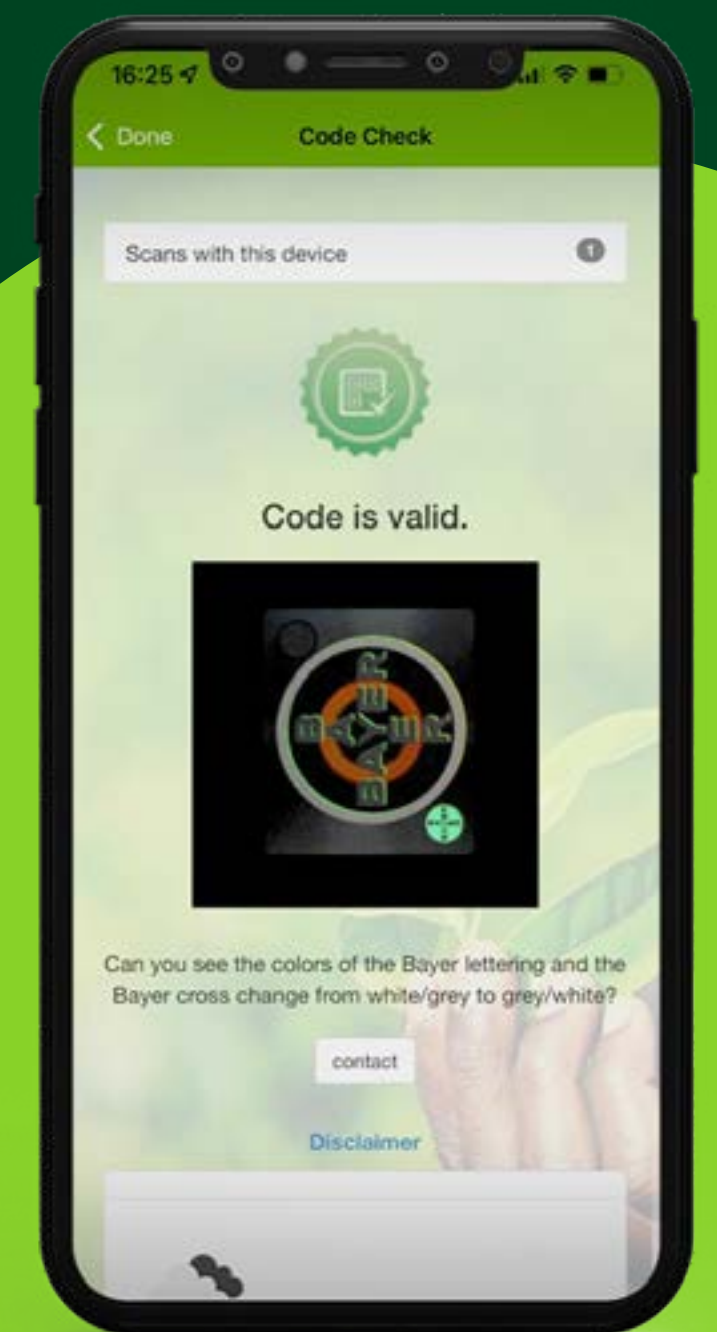


○ Safety Seal as an enabler for digital transformation in agriculture

As a next step, the Safety Seal Technology is planned to provide farmers with location and product specific information, such as weather and soil conditions, product name, batch number and production date, quality data, use instructions, stewardship recommendations and crop system information, amongst others.

Combining the physical product with digital information will increase customer confidence and customer experience significantly. Moreover, broadening the data behind the QR code of the Bayer Safety Seal also avoids the need to scan multiple codes for different purposes and provides convenient digital access to use-instructions and other information, for example on safety or quality, and recommended retail prices.

The Safety Seal technology can also be integrated into other existing digital solutions and applications, such as Climate FieldView™. By combining the physical product with digital information and expertise, we are enabling digital transformation in agriculture.



Collaborative partnerships for sustainable use

Fulfilling the FAO-WHO Code, and in line with our Stewardship Commitment, we collaborate and partner with various stakeholders to promote the responsible use of our products and services. The stakeholders we engage with include governments, regulators, farmers' associations and industry players.



CropLife International, Local Governments & Regulators:

Through this industry association, we collaborate with national authorities and other stakeholders to build capacity in line with the FAO-WHO Code, and encourage authorities to take on their responsibility to provide effective structures for the management of crop protection products. We support authorities in LMICs in implementing frameworks, exchanging on best practices or collaborating with poison control centers.



BayG.A.P. Service Program:

Launched in 2015 in partnership with GLOBALG.A.P., the program addresses the ongoing challenges farmers face when working towards obtaining verified produce for the market. Today we work with 40 global and local food value chain partners to provide trainings to small- and medium-sized farms around the world.



Bayer ForwardFarming Network:

We partner with independent farmers to show how tailored solutions, modern tools and practices, proactive stewardship measures and partnerships are enabling farmers to run successful businesses.

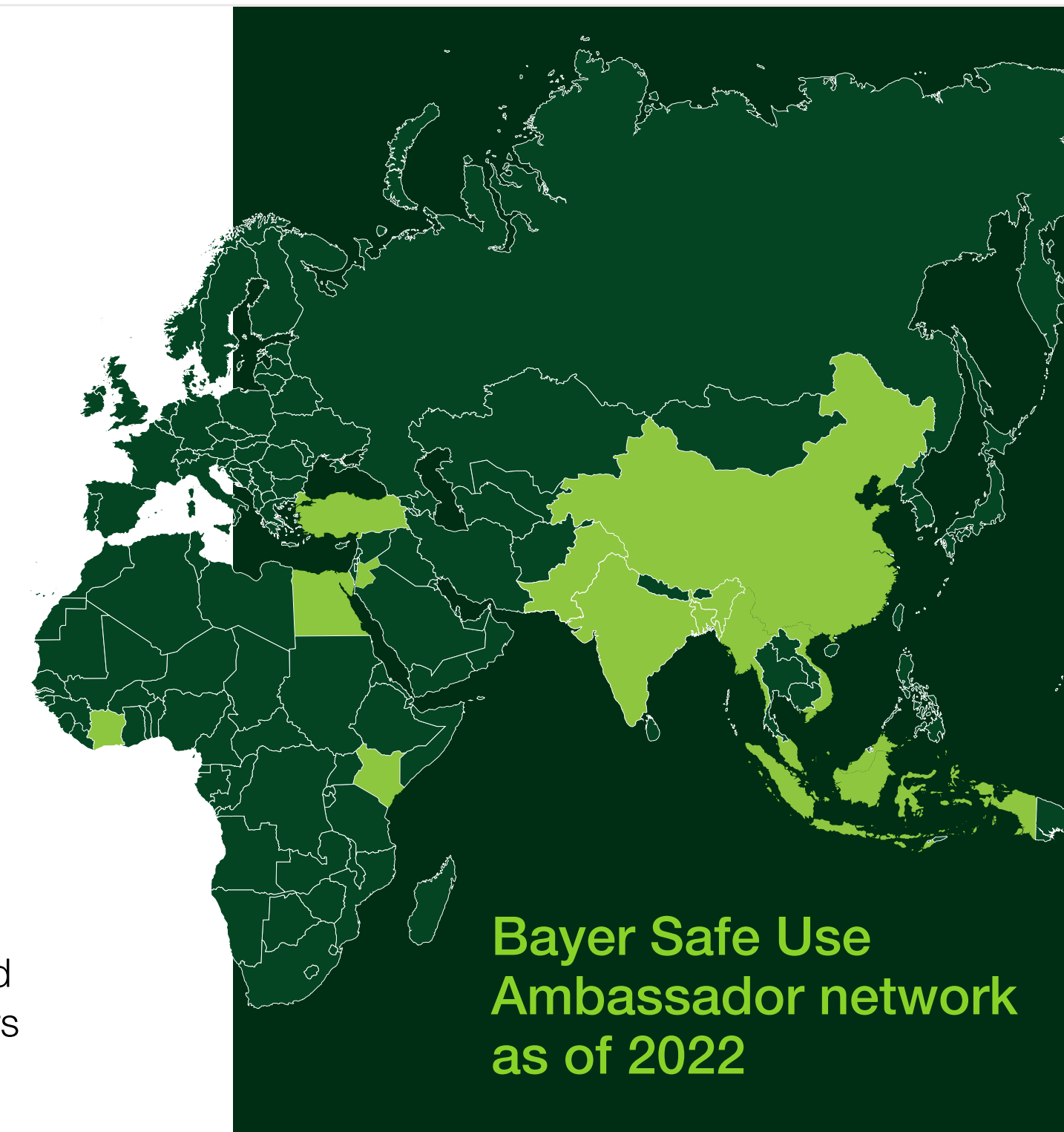


Bayer Safe Use Ambassador:

Launched in 2017, the program aims to advance farmer safety by training diverse stakeholders like agriculture and medical students, agronomists and rural medical practitioners as 'Safe Use Ambassadors'. Since the program's start in Asia, we've initiated collaborations with **53 universities in 13 countries** throughout Asia-Pacific, the Middle East and Africa. **Every year, 3,000-5,000 students and professionals participate in our program** and in 2022, over 1,000 people from across the world participated in our webinars (including side events).

Bayer Safe Use Ambassador Program was recognized with the international Gold Standard Award for Corporate Citizenship 2023 across industries — its 6th award in five years. This unique stewardship program brings us one step closer to realizing our vision of "Health for all, Hunger for none" by seamlessly bridging the agricultural and medical sectors and advocating for global farmers' health and safety.

Our most recent accolade, bestowed by the Public Relations and Communications Association (PRCA) Asia Pacific and Public Affairs Asia, further confirms our position as a global leader and underlines our commitment for effective community engagement.



Driving change together

Pioneering product stewardship and counterfeit prevention for the future

In this chapter, we provided an overview on our programs, initiatives, digital tools and partnerships for the effective, safe and sustainable use of our products. While we already play an important role in promoting sustainable use, we are committed to improving even further. Guided by our Bayer vision "**Health for all, Hunger for none**", we will continue to encourage, facilitate collaboration and raise awareness on the sustainable use of our products.

However, our industry cannot do it alone. At Bayer, and together with our partners, we will continue to build local capacity where needed to ensure safety and improve the professionalization and productivity of agriculture.

Effective stewardship and anti-counterfeit measures require a multi-stakeholder effort. National governments have a key role to play in providing effective legislation, regulatory systems and other structures to enable and drive sustainable pesticide management at scale. While many developed countries have effective structures in place, some LMICs are struggling. We need engaged national authorities and strong local and global partners that build effective structures, legislation and regulation to foster innovation and professionalization in the agricultural sector. This will, in turn, foster productivity gains for farmers. In times of a growing world population that is facing food security challenges through climate change and disrupted supply chains, the need has never been greater.



Learn more about our efforts on sustainability



[Product responsibility in practice on the Damianshof ForwardFarm \(bottom of page\)](#)



[Group Regulation on Product Stewardship Commitment, Principles and Key Requirements](#)



[Sustainable Pesticide Management at Bayer](#)



[Growing Matters – BeSure! Product Stewardship Coalition](#)



[Counterfeits in Agriculture](#)



[Determining Safe Use of Pesticides](#)



[Bayer Position on Product Stewardship in the Agricultural Business](#)



[Promoting Stewardship | CropLife International](#)

Have questions or would like to discuss directly with us our efforts to a more sustainable use? Please reach out!



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Annex

Demonstrating sustainable agriculture in practice

Our vision is to lead the way in sustainable agriculture and demonstrate the importance of regenerative agriculture. We believe the best way to achieve this is by pioneering new system solution approaches in the field. We are growing a global network of independent farmers to demonstrate how modern, sustainable agricultural practices can benefit farmers, the environment and society on fully operational farms.

Through our global **network of Bayer ForwardFarms** we aim to inspire a greater amount of farmers to adopt regenerative agricultural systems that produce more with less while restoring nature. Bayer ForwardFarming (BFF) serves as a knowledge platform where farmers, value chain partners, academia, scientists and civil society can engage in dialogue and experience modern sustainable agriculture through first-hand experiences on independent farms around the world.



[Learn more about Bayer ForwardFarms](#)



[Celebrating 5 years of Bayer ForwardFarms](#)

At these farms, we are demonstrating how sustainable farming practices can contribute towards:



Carbon neutral agriculture: In the last seven years, the Bayer ForwardFarming program has played an integral part in the Bayer Global Carbon Initiative to reduce greenhouse gas emissions in agriculture, through regenerative practices and the adoption of farmer-centric, climate-smart agricultural practices and technologies.

Environmental impact reduction: Practices applied at Bayer ForwardFarms reduce the environmental impact of crop protection by relying on modern sustainable solutions. Additionally, through integrated crop management practices (such as crop rotation and cover crops), precision application and digital tools (e.g., [MagicScout](#) and [MagicTrap](#)) as well as by complementing chemical crop protection with biologicals, we aim for crop protection to be applied in the right amount and only when needed. We also strive to ensure safe and responsible use of crop protection products by demonstrating best practices in product stewardship.

Water conservation: No-till practices have been shown to increase water use efficiency in row crops such as wheat and maize. Additionally, we aim to preserve water quality and quantity by implementing systems tailored to local conditions that reduce the amount of water used and protect the environment from any unintentional exposure to crop protection products.

Soil health: Crop rotation and cover crop management are regular regenerative agricultural practices at the Bayer ForwardFarms. The latter also helps to reduce the negative impacts of wind and flood erosion. In addition, soil analysis is conducted regularly for optimal fertilization to improve soil health and productivity on the farms.

Biodiversity conservation: Many activities implemented through Bayer ForwardFarming partnerships in Latin America and Europe have contributed to obtaining deeper insights to improve nature conservation measures, such as flowering strips, insect hotels, beetle banks, bird nesting aids and skylark plots.

While each Bayer ForwardFarm may be unique in the crops it grows, the land it farms and the community it serves, all participating farmers share a common passion for advancing regenerative agricultural practices.





Our Growing Global Network

Activation of 5 new ForwardFarms in 2023

Latin America (6)

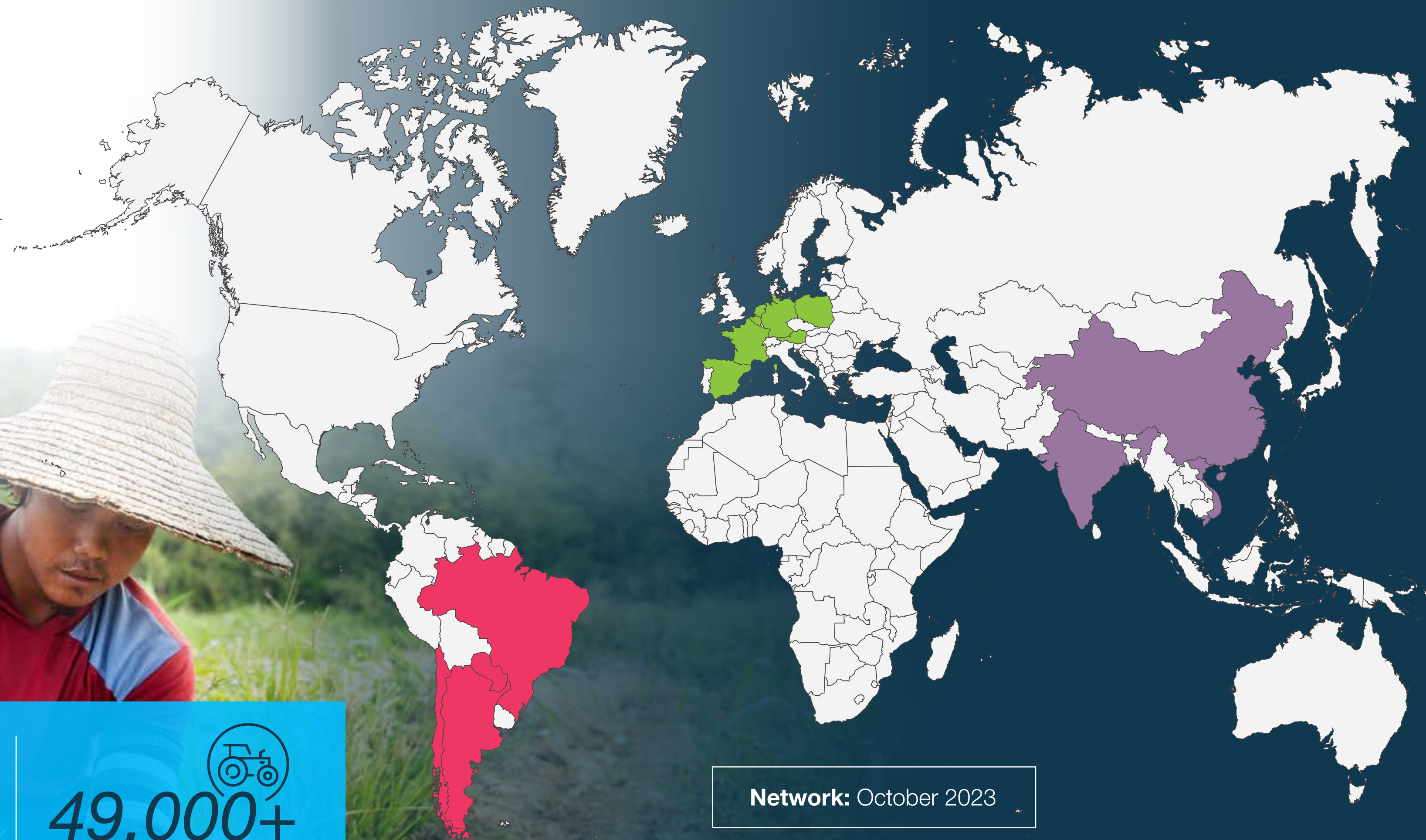
Argentina (1)
Brazil (2)
Chile (2)
Paraguay (1)

Europe (17)

Austria (1)
Belgium (1)
France (6)
Germany (4)
Netherlands (3)
Poland (1)
Spain (1)

Asia/Pacific (6)

China (4)
India (1)
Vietnam (1)



29 independent farms

in 14 countries are part of the BFF network



Main crops in almost

10K hectares of independent farmland



49,000+ ForwardFarm visits



Network: October 2023

Prime examples of innovation

Enhancing soil health & farmer wellbeing with Moraleda beans

Beans are a significant crop globally, and India is one of the largest producers. Besides their **importance for human health**, bean cultivation can potentially have a **positive impact on soil health**. Research suggests that cultivating **leguminous crops such as beans or peas can help fix biological nitrogen¹ levels in the soil**, which is crucial for plant health. The Vegetables by Bayer team in India took a unique approach to promote the Moraleda pole bean variety and **educate smallholder farmers about the benefits of intercropping²** with leguminous crops, helping them to enhance their soil health, increase their yields and livelihoods with minimal additional cost. In many parts of India, tomato and grape farmers were previously intercropping with local cucurbits and gourds but faced challenges with lower yields and plant viruses. Over the course of two years, approximately 5,000 tomato and grape farmers adopted the approach to replace their cucurbit and gourd crops with Moraleda pole beans – signaling that it is now a widely accepted model in the region.



For another biodiversity example, read about bitter gourd cultivation

¹Wagner, S. C.. (2011) *Biological Nitrogen Fixation*. Nature Education Knowledge 3(10):15.

²Intercropping involves growing two or more crops together to maximize yield and resource utilization.



Breeding solutions towards sustainability: Helping vegetable growers produce more with less

Bayer’s solutions on breeding towards sustainability are helping farmers to produce more with less, potentially improving their productivity and generating more income. Some examples:

- Our **Hot Pepper Seminis® SVHA9093** could help growers in India with higher yields and cost reductions. Trials comparing it with a competitor variety, showed **27% more produce potential³** (combined 1st & 2nd harvest). Due to its high resistance to Chili Leaf Curl Virus (CLCV) and Chili Veinal Virus (CVMV), it enabled growers to improve their crop protection management program, resulting in **33% potential cost reduction.⁴** While additional trials are needed to confirm these results, these initial trials encourage us that SVHA9093 may be able to provide a valuable impact by helping smallholders protect their harvests and income potential, as well as help them produce more with less crop protection inputs.
- Our trials in Mexico showed that the **Seminis® tomato variety, SVTE8444**, matured early and **potentially produced up to 22% higher⁵** than another Seminis variety, **SV8579TE**. This variety has become key for Mexican farmers due to outstanding yield potential which can result in **36% more potential income⁶** for the grower.
- In California, the high yield potential variety **Minister Onion** can produce up to **10% more per acre** than the previous Seminis® brand onion generation, Caballero.⁷ This means that the Minister Onion could use up to **200 acres less** to meet California onion needs,⁸ as opposed to the Caballero variety, showing our improvement in offering solutions with potential increased productivity.

Performance may vary from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower’s fields. Bayer, Bayer Cross, Seminis & Leaf Design® and Seminis® are registered trademarks of Bayer Group. ©2023 Bayer Group. All rights reserved.

[Learn about our examples of improving productivity in processing tomatoes](#)



³In five grower trials in 2020-2021 in Guntur city of Andhra Pradesh State, India, comparing Seminis® SVHA9093 and the competitor variety, US 341 F1 hybrid chili, SVHA9093. Yield increase calculations: 1900 kg per acre (SVHA9093 1st & 2nd picking) - 1500 kg per acre (competitor variety 1st & 2nd picking) / 1500 kg per acre (competitor variety 1st & 2nd picking) = 0.27 or 27%.

⁴In five grower trials in 2020-2021 in Guntur city of Andhra Pradesh State, India, comparing Seminis® SVHA9093 and the competitor variety, US 341 F1 hybrid chili, SVHA9093. Spray cost calculations: \$266.7 USD per acre (20 sprays) (Seminis® SVHA9093) /\$400 USD per acre (30 sprays) (competitor variety) = 67% thus 33% less spray than competitor variety.

⁵Data from 21 Bayer trials in 2020-2021 in Sinaloa (Mexico). High yield potential – Seminis® SVTE8444 produced 20.9 kg per plot while Seminis® SV8579TE produced 16.22 kg per plot. Seminis® SVTE8444 produced 22% more per plot than Seminis® SV8579TE.

⁶High income potential – Seminis® SVTE8444 significantly outperformed Seminis® SV8579TE in total fruit income potential & more specifically the XL fruit class. If the yield advantage and other factors remained consistent with the trials, these benefits could generate 36% more income than Seminis® SV8579TE in XL fruit class. Total income in XL fruit class: Seminis® SVTE8444 = 8.736USD [7.8 kg (wt.) x 1.12USD (price per kilo)]; Seminis® SV8579TE = 5.6 USD [5 kg (wt.) x 1.12 USD (price per kilo)].

⁷Based on 12 internal trials across California (2017-2021) compared with Caballero onion.

⁸If the yield advantage and other factors remained consistent with the trials, these yield benefits could support less land requirement: calculation reference: 39,237,836 (CA population) x 20lbs (US annual per person) = 784,756,720 (785M lbs of onions to feed just CA).

Caballero = 784,756,720 (lbs to feed CA)/88.2 lbs/m2 = 8,897,468 (8.8M m2) or 2,199 acres
Minister 784,756,720 (lbs to feed CA)/97 lbs/m2 = 8,090,275 (8.1M m2) or 1,999 acres

Prime examples of sustainable innovation

Innovative solutions to help farmers reduce food loss and waste – on and beyond the farm



Vegetables by Bayer is offering innovative seed solutions that can help tackle food loss and waste, as the following examples show:

- Three melon varieties from open field production could help tackle food loss, as they have shown field loss reduction in our trials: **Manchester (SVMA6874)** demonstrated **up to 22% loss reduction⁹** in Spain, compared to the main competitor variety in the region, due to less deformed and small fruits. Also, when compared with our internal checks, some varieties have shown improvements in food loss reduction. In Spain, **Albizu** demonstrated loss reduction in the field due to Albizu's great fruit uniformity: up to approx. **59% loss reduction** compared to Verdasco and **up to approximately 31%** compared to Edecos, both our previous varieties.¹⁰ In France, **Belcanto** demonstrated up to approximately **10% loss reduction¹¹** in the field, compared to a previous Bayer variety, Funambul. This is due to Belcanto's exceptional field flexibility.
- **Strabena**, a specialty red tomato with excellent vine attachment and good shelf life, which reduces the need for plastic packaging and protects against losses during processing & handling.

Performance may vary from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields. Bayer, Bayer Cross, Seminis & Leaf Design® and Seminis® are registered trademarks of Bayer Group. ©2023 Bayer Group. All rights reserved.

⁹Based on Nine internal trials from 2019-2021 in Murcia & La Mancha in Spain. Calculation reference: Manchester production of field loss: 3242,5 Kg/Ha | Competitor production of field loss: 4186,1 Ka/Ha | $3242,5 \times 100 / 4186,1 = 77,45\%$ | $100\% - 77,45 = 22,55\%$.

¹⁰Based on 12 internal trials, under open field conditions, from 2018 and 2019 in Murcia (Spain). Calculation reference: Albizu production of field loss: 2351,49 Kg/Ha versus 5818,76 Kg/Ha for Verdasco | $2351,49 \times 100 / 5818,76 = 40,41\%$ | $100\% - 40,41\% = 59,59\%$. Albizu production of field loss: 2351,49 Kg/Ha versus 3440,89 Kg/Ha for Edecos | $2351,49 \times 100 / 3440,89 = 68,33\%$ | $100\% - 68,33\% = 31,67\%$

¹¹Data from 20 internal trials from 2019 to 2021 in France. Calculation reference: average Net yield/Food loss (t/ha): Belcanto Commercial Yield: 92% and 8% food loss | Funambul Commercial Yield: 82% and 18% food loss

/// *Vegetables by Bayer*



Seed resilience for Rwanda

Around the world, smallholder farmers face many challenges accessing high quality seeds – as well as the knowledge and techniques to properly cultivate them. In Africa, improved varieties of vegetables, potatoes, cereals and pulses could help to increase food and nutrition security and provide new economic opportunities to smallholder farmers.

In 2023, the International Seed Federation (ISF) and the non-profit organization Fair Planet partnered on a “Seed Resilience” project which aims to contribute to the establishment of local and more resilient food systems, starting with access to high-quality seeds, paired with training on Good Agricultural Practices (GAP). Through its corporate giving program, Bayer donated sufficient funding to kick start the first year of this 5-year program, encouraging other industry members to join.

Developed and implemented successfully in Ethiopia and Tanzania – endeavors that were also supported by Bayer – Fair Planet will apply its unique training methodology to train lead farmers on their own farmlands throughout the growing season, with weekly visits and technical support from Fair Planet and local experts.

Access to improved varieties will allow Rwandan farmers to **produce and sell locally-adapted crops with significantly higher yields and better produce quality**. The selected staple crops provide essential nutritive values to the local population: **fresh vegetables for vitamins and fibers, pulses for proteins and soil fertility improvement and cereals and potatoes for carbohydrates**.



Bringing ISF's Seed Resilience Project to Life in Rwanda - Seed World

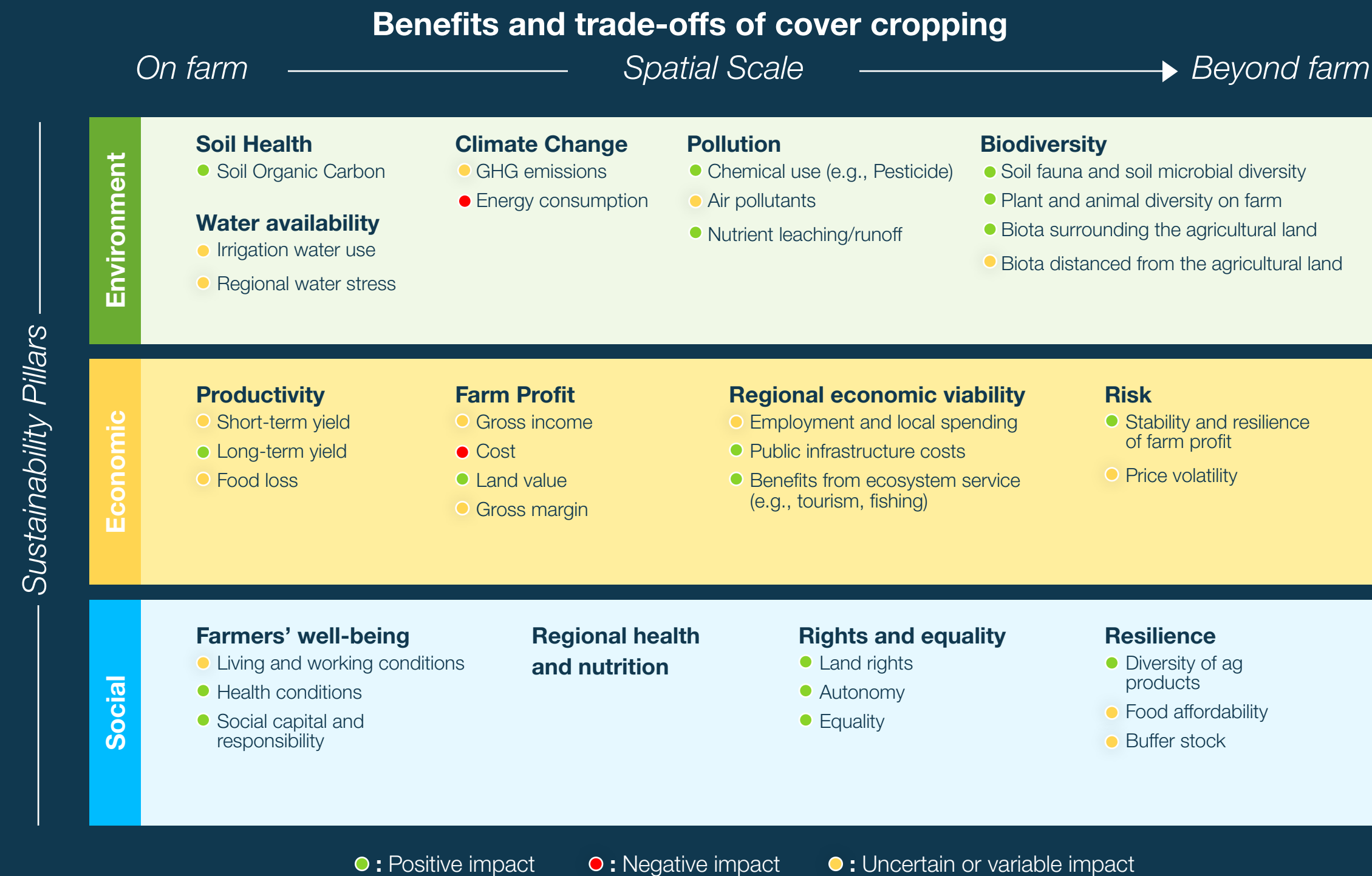


Partnering up with ETH Zürich and IFPRI to find new solutions

How can we enhance biodiversity and resilience in intensive farming systems? To tackle this challenge, we collaborated with the International Food Policy Research Institute (IFPRI) and ETH Zürich to identify promising approaches that reconcile agricultural production and biodiversity conservation – all while taking into consideration farmers' perceptions and realities.

Farmers revealed that their most widely-implemented practices include reduced chemical inputs, cover crops, crop rotation and reduced or no tillage, as well as the conservation or restoration of habitats such as forests, permanent grassland and flower — or buffer strips. The farmers recognize these measures and practices can have beneficial effects on input costs, soil health, water quality and insects such as pollinators. This was partly confirmed by scientific meta-analysis that looked at the effects of measures such as cover crops or crop diversification. However, not all studies confirm a positive correlation between those measures and yield or profitability. In the light of these findings, we aim to provide farmers with tailored information and expertise to better predict the outcome of their respective measures, and to decide whether a certain measure makes sense to implement.

The main limitations for a wider adoption of biodiversity-enhancing measures – particularly those related to habitat preservation or restoration – are the financial risks associated with potential negative effects on crop yield and extra costs and efforts of implementation and maintenance. Policies intended to increase adoption rates of biodiversity measures are often considered strict and inflexible, and mostly do not cover the varying opportunity costs that farmers face when adopting those measures. Additionally, current market conditions do not support a more widespread adoption of measures and practices. However, carbon markets and food-chain company commitments around regenerative agriculture might have a positive impact in the future. **Overall, farmers' willingness to adopt biodiversity-enhancing practices could be increased by providing support to make the practices more viable and financially appealing.**



Transparency about benefits and trade-offs along the 3 dimensions of sustainability is key to better assessing biodiversity-friendly farming practices. The graphic above shows an assessment framework which can create this transparency using the example of cover cropping.

Further sources:

- [Biodiversity Approach | Bayer Global](#)
- [Enhancing Biodiversity and Resilience in Intensive Farming Systems: Results from an ETH Zürich-IFPRI Collaborative study](#)
- [Enhancing Biodiversity & Resilience in Agriculture – World Food System Center | ETH Zurich](#)
- [Biodiversity indicators for result-based agri-environmental schemes – Current state and future prospects - ScienceDirect](#)

Glossary

Regenerative agriculture

An outcome-based production model system, which holds improving soil health at its core and aims to increase resilience. Other key aspects include mitigation of climate change through greenhouse gas emissions reductions and increased carbon removals, maintaining, preserving or restoring on-farm biodiversity, conserving water resources through improved water retention and decreases in water run-off, and improving the social and economic well-being of farmers and communities.

Nature positive

A measurable outcome where aspects of the natural world, including species and ecosystems, are being restored and where nature is regenerating rather than declining.

Sustainable agriculture

For Bayer, sustainable agriculture refers to a number of farming practices that, while delivering on food security and nutrition for the present population, do not compromise the economic, social and environmental foundations that will allow future generations to meet their own needs. Sustainable agriculture needs to be profitable for farmers to ensure their livelihood and rural development, to guarantee food security and nutrition to a growing population and to safeguard the environment.

The broad nature of sustainable agriculture means other terms, such as regenerative agriculture, have started to emerge that focus on optimizing certain dimensions under sustainable agriculture. Regenerative agriculture has re-merged as the new term of art for agriculture production systems that focus on improving soil health as a top priority.

Intensification

Throughout the report, we use the word intensification in different contexts (e.g. agricultural intensification, land-use intensification, sustainable intensification, intensive farming systems, intensive agriculture).

IPBES defines agricultural & land-use intensification as follows:

Agricultural intensification:

The process of increasing the use of capital, labor, and inputs (e.g., fertilizers, pesticides, machinery) relative to land area, to increase agriculture productivity ([EUROSTAT, 2018](#)).

Land use intensification:

Activities undertaken with the intention of enhancing the productivity or profitability per unit area of land use, such as in agriculture, including intensification of particular land uses as well as changes between land uses. ([Martin et al., 2018](#)).

Increasing the agricultural productivity per area of land is not only achieved by increasing the use of capital, labor, and inputs, but also by introducing structural changes such as increasing field sizes, lowering crop diversity, removing hedges, field trees or field margins, which lead to an overall homogenization of landscapes. Recent research confirms that those structural changes have a strong contribution to the decline of insects ([Cardoso et al. \(2020\)](#); [Raven et al. \(2021\)](#)).

In the case of the [sustainable intensified management systems](#) mentioned in the report, we worked on both aspects: optimizing the use of capital, labor and inputs as well as increasing the structural diversity of the agricultural land by introducing wider rotations and cover crops which led to improved social, economic and environmental outcomes compared to the “business as usual” cropping system.

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**Crop Science, Sustainability
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