



**WORLD COFFEE
RESEARCH**

STRATEGY 2021-2025

Enhancing Country Competitiveness to Bolster Origin Diversity

EXECUTIVE SUMMARY

OUR MISSION AND GOAL

World Coffee Research was formed by the coffee industry in 2012 to grow, protect, and enhance supplies of quality coffee while improving the livelihoods of the families who produce it.

OUR STRATEGIC AIM

In 2021-2025, our strategic aim is to preserve origin diversity in the face of the climate crisis by accelerating innovation for coffee agriculture to enhance the productivity, profitability, and quality of coffee across major market segments in multiple, strategically targeted countries.

Why is origin diversity the focus of this strategy? If fewer countries are producing more of the world's coffee, it makes it harder to find the unique flavors that coffee drinkers want and coffee businesses rely on. It creates significant risk to stability in coffees supplies. It also consolidates the benefits of agricultural productivity, profitability, and quality gains in the hands of fewer farmers and limits the distribution of benefits from coffee export revenue for countries. Aligning global efforts to accelerate agricultural innovation across multiple origins to ensure stable supplies of quality coffee benefits coffee businesses, coffee farmers, coffee nations, and drives consumer engagement.

In genetics, in agricultural systems, and in global economics alike, diversity confers resilience. The stakes have never been higher than they are today for a tree crop like coffee: a coffee plant put into the ground today will suffer the full brunt of climate change over the next three decades, and so will farmers. But coffee agriculture also has the potential to contribute substantially to global climate mitigation goals. Coffee agriculture and coffee businesses need to build resilience and creatively drive innovation to achieve our climate goals to thrive in the 21st century. The strategic alignment of collaborative agricultural R&D efforts to support origin diversity contributes in significant ways to achieve this and distribute the benefits across the value stream.

OUR OBJECTIVES

We will achieve this aim through an agricultural R&D program that advances three interconnected objectives:

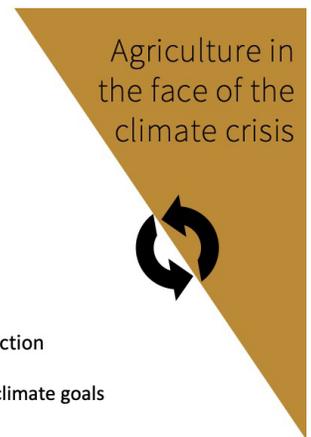
- Enhance the productivity of climate-resilient coffee production in order to increase farmer profitability, the linchpin of farmer economic sustainability
- Improve the quality potential of coffee trees for different market segments (from commercial to premium to specialty, encompassing both arabica and robusta)
- Mitigate supply chain risk by enhancing the competitiveness of strategically selected countries from the Americas, East Africa and Asia and driving an innovation agenda toward climate goals

OUR APPROACH

Stable supplies of quality coffee are critical for the global coffee industry; a stable industry is critical for supporting the livelihoods of coffee farmers. But the challenges of the climate crisis, price volatility, the limited availability and accessibility of farmer-friendly technologies, and new trends and opportunities in the market require agricultural innovations that respond to both farmer and industry needs.

Our 2021-2025 strategy responds to these needs by positioning WCR as a bridge between industry market demand and national research programs to bring tools and approaches with proven track records in other crops, including user-led design, to accelerate progress in coffee agricultural research, driving value for the global industry, from farmers to consumers.

Through advocacy, leverage, and direct research, WCR will support strategic countries to design and deliver relevant agricultural innovations. In doing so, WCR will meaningfully contribute to the enhanced competitiveness of key countries and their ability to address major threats to supplies of quality coffee and that improve resilience and profitability for coffee farmers.



COFFEE AGRICULTURE IN TRANSFORMATION

Climate change is the crisis of our time. The climate crisis is the single biggest long-term threat to coffee, but it is a mistake to consider it a problem of the future. As coffee farmers well know, climate change is already increasing the disproportionate risk that farmers bear in the coffee value stream. Nearly every coffee production area on Earth is already experiencing increases in weather variability, which pose major threats to both plants and people. Increased variability makes farm planning more difficult and more risky. Meanwhile, changes in extreme weather—heat waves, drought, and flooding in particular—can dramatically lower yields in a given year, leaving smallholder farmers vulnerable to economic shocks and food insecurity, and heighten the physical risks to coffee workers. The combined impact of these changes is threefold: Reduced quality, reduced productivity, and increased economic vulnerability. Alternatively, coffee can also be a part of the solution—and including climate goals in innovation design can accelerate this through greater carbon sequestration in the production system, reduced emissions, or both. Acting on these possibilities can avert the alternative, where reduced quality, reduced productivity and increased vulnerability leads to a loss of diversity in producing country origins as farmers and countries struggle to keep up. There are significant opportunities for targeted research and development to address the question: How do we mitigate coffee agriculture’s contributions to global emissions and make coffee more resilient to the variability we already have, which is an excellent predictor for medium-term future conditions? They include understanding which of today’s coffee varieties have the most stable performance despite increased climate variability and creating new varieties that will be better adapted to this variability. But they also include efforts to improve productivity and generate alternatives to land-use conversion—the single largest contributor of carbon emissions from agriculture globally. None of these efforts will suffice if they are not also paired with strategic efforts to improve access to improved planting material, especially among the majority of the world’s coffee producers who are smallholders.

Coffee agriculture is at a crossroads. The ability of innovations to address the challenges and opportunities faced by coffee agriculture will, to a significant degree, determine the course of coffee production over the next five decades. The climate crisis and low prices are putting unprecedented pressure on farmers and their farms, who in many cases have not received much in the way of either improved farm technologies or technical support to sustain them; meanwhile globalization gives coffee farmers other opportunities for how to make a living. As the economist Jeffrey Sachs points out, under a business-as-usual pathway, this consolidation is likely to continue, resulting in less variety in origins, in tastes, and in quality, with a potential dampening effect on demand; lost smallholder knowledge; and heightened supply risks of large-scale disruptions and greater price volatility.¹

We are starting from behind because so little investment has been made in agricultural research for coffee compared with the massive global value of the crop. Coffee farmers and agricultural systems have limited resilience potential to sustain continued cumulative small crises, let alone regional or global catastrophes like widespread disease epidemics or multi-year droughts.

Which origins will successfully navigate this transition? Which farmers in those origins? What will the consequences be for coffee roasters and drinkers—for flavor, for sustainability, for business? **There is little doubt that coffee agricultural R&D, and where and how it is applied, will influence the outcomes.**

Fundamental to these dynamics is the fact that coffee isn’t keeping up with agricultural growth overall in most countries. In many, agriculture is a major driver of overall economic growth – but coffee is falling behind other crops. This should be a clear warning signal to businesses that rely on coffee: Many key origin countries are not investing in coffee compared with other crops, and coffee farmers could be better off switching to other kinds of farming (if not exiting coffee altogether). But on a brighter note, it also signals that many countries have the systems in place to enable coffee agricultural growth.

¹ Sachs, J., Cordes, K.Y., Rising, J., Toledano, P., and Maennling, N. (2019). *Ensuring Economic Viability and Sustainability of Coffee Production*. Columbia Center on Sustainable Investment.



Working with and through national partners. Globally, coffee agriculture depends on the investments that individual countries make in their coffee sectors, as well as farmers and other value stream actors, for example through production or export taxes that are re-invested in local R&D efforts. The role of these investments is not likely to diminish in the coming years. Coffee roasters and coffee farmers rely on national coffee agricultural research programs to generate agricultural innovations to improve profitability, productivity, and quality and to ensure those innovations get to farmers. In some countries, national programs are also the primary source of seeds, which reduces available budget for conducting research. Limited investment combined with seed system regulation can restrict farmer access to good quality plants and seeds. But new technologies, for example inexpensive DNA fingerprinting, can be applied within national systems to both reduce costs and increase plant quality. National programs can also benefit significantly from adopting new approaches and tools in coffee breeding to accelerate their progress with the often limited germplasm available to them.

The disconnect between national and industry priorities. It is understandable that national agricultural research programs are oriented to focus on priorities set by national stakeholders. With limited budgets, institutes focus resources on the most strategic areas to drive value for farmers, focusing primarily on production traits, and have fewer resources to engage outside their borders with the broader industry to consider alignment with industry quality priorities. In addition, agricultural research programs focused on coffee have historically been very cautious with international collaboration. While for coffee businesses, investments in coffee agricultural R&D are largely precompetitive, for countries they are fundamentally competitive with neighboring nations. All of this has produced a historical reality in which there have been limited mechanisms for the priorities of coffee roasters/coffee product developers to be integrated into or inform technology design, including the development of varieties.



WCR'S VALUE PROPOSITION

For coffee businesses that want to secure a differentiated supply of quality coffee while enhancing and distributing the economic benefits of coffee for farmers, World Coffee Research drives a global R&D agenda to support origin diversity. It does this by connecting and aligning the needs and interests of farmers, coffee businesses, and coffee-producing countries to produce or enable relevant innovations that meet the needs of both industry and farmers and to leverage agricultural investments for the benefit of coffee.

WCR IS A BRIDGE

WCR proposes through this strategy to **serve as a bridge between industry market demand and national research programs, connecting ends of the value stream to define a shared vision.** Though many countries successfully export coffee, their research systems are underfunded and generally lack the ability to receive clear demand signals from buyers and consumers. By aligning the interests of industry with the priorities of national coffee programs, WCR can drive value for farmers, producing countries, and coffee businesses large and small.

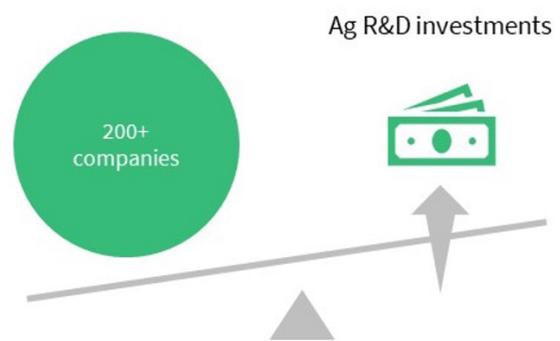
One of the most powerful ways to achieve impact is to **co-develop technologies.** User-led design ensures that, for example, both farmers and coffee roasters (coffee’s two “end users”) provide input into the development of variety profiles that respond to the needs of both. This focused attention to end users increases the likelihood of adoption—farmers can be confident in field performance and in having a ready and available market to sell into as they observed industry input to the design. And finally, it increases buy-in at a national level, ensuring higher likelihood that new varieties will be widely disseminated.



WCR IS A LEVER

Collective investment creates the opportunity to unlock new investment. WCR’s compelling portfolio of member companies—over 200 coffee roasters, retailers, suppliers, and allied businesses from around the world, representing some of the world’s biggest coffee brands—gives the organization the ability to mobilize additional resources from national, international, public, and private sources toward critical activities relevant to the shared global R&D agenda.

Given the significance of the value of coffee exports for many countries, there is strong alignment among governments to support coffee R&D, if they know the investment will deliver value. And many coffee exporting countries, especially in Africa and Asia, have a strong enabling environment for agricultural growth in general as well as many of the ingredients needed to provide stronger support for the coffee sector. WCR will advocate within key geographies for support to sustain and strengthen national R&D infrastructures in order to exert a powerful leverage effect to accelerate agricultural innovation for coffee. WCR will also advocate for advanced upstream research resources that have potential to increase the impact of our programs and partnerships.



WCR ADVANCES COFFEE’S SUSTAINABILITY AGENDA

Agricultural research is a primary driver of: improved productivity and profitability, climate resilience and adaptation, reduced greenhouse gas emissions, and soil health and conservation, among other critical factors. It helps identify which approaches to coffee farming produce the largest benefit for the least cost (in terms of financial, human, and natural resources). That knowledge is essential for transforming coffee agriculture in ways that anchor stable and inclusive economic growth across rural economies and drive positive change to meet the United Nations’ Sustainable Development Goals (SDGs).

Agricultural R&D tackles the climate crisis head-on with technologies that help farmers adapt to changing climates. And it

can contribute to climate mitigation goals such as reducing GHG emissions and improving carbon sequestration on farms. Economic, environmental, and social sustainability in coffee producing countries requires a tailored agricultural R&D agenda, and WCR’s efforts will support countries and the industry to meet their sustainability commitments. The knowledge, technologies, resources, and efficiencies generated by agricultural R&D flow down through the entire value stream. While nearly all of the 17 SDGs hold some relevance for coffee agriculture, eight of them are especially impacted by the results of coffee agricultural research and development, which is a critical upstream activity enabling sustainable agricultural development. WCR’s research agenda directly contributes to the eight SDGs shown here.



STRATEGIC AIM

PRESERVING COFFEE ORIGIN DIVERSITY

In genetics, in agricultural systems, and in global economics alike, diversity confers resilience.

Aligning global efforts to accelerate agricultural innovation across multiple origins to ensure stable supplies of quality coffee benefits coffee farmers, coffee businesses, and coffee nations, and drives consumer engagement. Agricultural R&D by itself cannot guarantee the preservation of origin diversity. But it is an essential enabler—it is hard to see how any coffee-exporting country can achieve sustainable production and remain competitive in the 21st century without it.

Origin diversity for countries and farmers

When production is concentrated in only a few countries, it also consolidates the benefits of agricultural productivity, profitability, and quality gains in the hands of fewer farmers and limits the distribution of benefits from coffee export revenue for countries. The economic benefits to coffee producing countries of coffee exports are significant. In Honduras, Nicaragua, Uganda, Ethiopia and Burundi, the value of coffee exports is between 16-33% of the value of all exports (ICO 2019). This revenue contributes to everything from schools to roads to hospital buildings. And the revenue from coffee is spread across a country's economy, from

rural areas to port cities—from nurseries, to farms, to mills, to warehouses, to ports. When coffee makes up a large share of a country's export revenue, it is contributing to nearly every part of public life. When countries do not invest in research and innovation, their coffee sectors falter and eventually fall behind others.

And clearly, farmer success underpins a country's competitiveness. Farmers are the critical actor in the value stream, the original source of value. In order for origins to be strong, we need vibrant, profitable coffee producer communities. Maintaining and growing farmer profitability is necessary to maintain the viability of diverse origins, and new technologies must therefore be relevant for farmers and responsive to the realities of climate change to improve stability in yields to reduce economic shocks



Global production 1990-2018
Source: ICO, 2019

for farmers. But it would be difficult—maybe impossible—for any country to support farmer success without research. As a Nebraska farmer put it, testifying before the US Congress in 2017: “We need three things to get American agriculture growing: sun, rain, and research.”

Origin diversity for quality

If fewer countries are producing more of the world's coffee, it makes it harder to find the unique flavors that coffee drinkers want and coffee businesses rely on. Coffee quality drives coffee business regardless of which market segment (commercial, premium, specialty) the business serves. Nearly all coffee roasters require some mix of two things: Consistency and differentiation. A 2020 global stakeholder consultation undertaken by World Coffee Research revealed considerable anxiety among roasters and green coffee suppliers that coffee quality and consistency are declining globally, regardless of whether they are procuring coffee for blends or single origin offerings.

“Washed coffees from Central and South America have played an important role in our business for 100 years. Today, we are scrambling to help those countries remain sustainable.” —US premium coffee roaster

Origin diversity for risk management

If fewer countries are growing more of the world's coffee, it creates significant risk to stability in coffees supplies. In the wake of the COVID-19 pandemic, it has perhaps never been clearer how vulnerable global coffee value streams are to the risk of disruption. The possible risks from weather alone illustrate the point: the disastrous impact to harvests of drought, to roads and infrastructure of flood damage, to trade routes of tropical ocean storms, or to lives of hurricanes and other disasters. And the risk is amplifying due to the climate crisis. Undifferentiated commodity coffee is just as exposed to risk as unique, single origin coffees at a national level. Diversity is a hallmark of resilient systems. Sourcing across multiple geographies is, as most buyers are already very aware, a key way to manage the risk of supply chain disruption.

But it is increasingly challenging for many coffee exporting countries to remain competitive. There is a growing gap between highly efficient producing countries like Brazil and Vietnam, which produce on average 1.5-2 metric tons of coffee per hectare, and nearly every other region in the world, where average yields hover around 0.5 metric tons/hectare. Some of these origins are severely threatened today—including many famous for their quality, like Kenya, El Salvador, and Costa Rica. The most efficient producers are able to turn a profit while others operate at a loss—further consolidating their advantage.

“There are wars, coronavirus, crop failures, and then we have to go someplace else.” — Green coffee supplier

OUR STRATEGY

WCR’s 2021-2025 strategy responds to the threat of eroding origin diversity through a strategic focus on accelerating innovation for coffee agriculture with three key objectives:

- **Objective 1.** Enhance the productivity of climate-resilient coffee production in order to increase farmer profitability, the lynchpin of farmer economic sustainability
- **Objective 2.** Improve the quality potential of coffee trees for different market segments (from commercial to premium to specialty, encompassing both arabica and robusta)
- **Objective 3.** Mitigate supply chain risk by enhancing the competitiveness of strategically selected countries from the Americas, East Africa and Asia and drive innovation to achieve climate goals

OUR GEOGRAPHIES

WCR will support the strengthening of agricultural R&D across multiple focus countries simultaneously in order to support the competitiveness of diverse origins. Our strategy embraces a concept of working deeply, with higher levels of effort, in strategic geographies where the paths to measurable gains in production, quality and farmer profitability are clear. This means not just identifying those geographies, but also the partners within them who are aligned with our objectives and who have established mechanisms to get innovations into the hands of farmers. In particular, this will mean prioritizing countries that have made national commitments to shoring up coffee production and where the enabling environment is such that there are clear pathways for innovations to reach farmers.

Targeted research efforts will be focused on coffee producing countries poised for progress and that represent strategic locations where stronger R&D is needed to underpin production levels/stability to global coffee supplies, to enhance profitability for farmers, and to enhance quality for all three major segments of the industry. This does not mean abandoning other geographies; but it does mean exerting higher levels of effort in some countries. This strategy distinguishes between **focus countries** and **strategic partners**.

Focus countries are specific countries identified for targeted support to ensure their contribution to global coffee supply stability (in other words, to support their competitiveness as an exporting origin). Focus country investments can be expected to have some spillover impact in neighboring countries through regional networks, such as breeding hubs. WCR will focus resources on **at least two focus countries per world region** for washed arabica and robusta, and at least one per region for natural arabica exports.

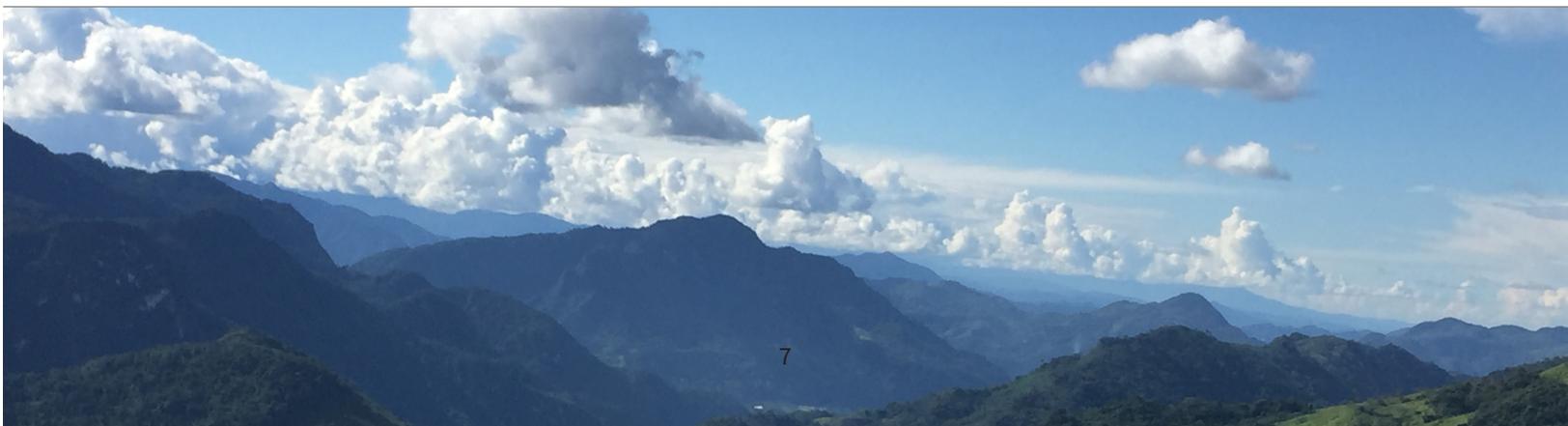
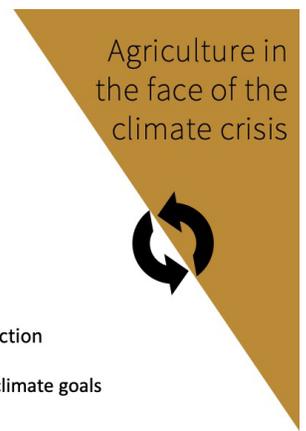
Strategic partners are relevant institutions—either national, regional, or global—with unique contributions and skills to advance the shared global coffee agricultural research agenda. Typically, WCR engagement with a strategic partner will focus on addressing cross-cutting challenges that transcend national borders to manage supply risks, for example, climate change mitigation, adaptation for variable/extreme weather, coffee genetics, coffee diseases/pests such as coffee leaf rust, and the molecular basis of coffee quality. It could also include research efforts for innovations that reduce reliance on pesticides, such as biocontrol options for control of pests and diseases.



Grow, protect and enhance supplies of quality coffee while improving the livelihoods of the families who produce it.

Preserve origin diversity by accelerating innovation for coffee agriculture in multiple, strategically targeted geographies

- 1 Enhance profitability of climate-smart coffee production
- 2 Improve quality across market segments
- 3 Mitigate supply risk and drive innovation to achieve climate goals



Focus countries

Within 11 identified focus countries, WCR will build stronger, deeper partnerships along the value stream, from research institutes to extension organizations, exporters, and other businesses like nurseries. In each country, we expect to both broaden and deepen national efforts on breeding, agronomy and farmer-level technology testing and diffusion to generate innovations focused on improving producer productivity, profitability, and quality in response to industry demand. In particular, WCR will seek to consolidate and align research investments across the supply chain to catalyze greater efficiency and complementarity. WCR will also work closely with major funders (such as development donors) to promote deeper investment and ensure that public investment contributes to strengthening the coffee sector for the long term.

Focus country criteria. Focus countries are selected on the basis of willingness and interest in partnering with WCR (including co-investment) as well as key metrics indicating their competitive position, including export volumes, coffee export value as a percentage of all exports, agricultural GDP growth, total factor productivity growth, and research intensity. (Full criteria available upon request.)

Global leadership

Even while aligning investments with focus countries and key strategic partners, WCR will maintain a global outlook. First and foremost, WCR will **drive a global strategy** to enhance the stability and quality of world production. WCR will also consolidate and elevate shared concerns where a research and development agenda can contribute—for example, in addressing knowledge and data gaps in the coffee sector’s climate mitigation agenda.

Capacity strengthening. WCR connects coffee’s global scientific community to identify new opportunities and networks for collaboration. WCR strengthens the research community through technical information sharing and best practices, including linkages among multiple stakeholders to advance the sector. These networks and platforms are available to all producing countries to access information and expertise. As we gain insight and generate learning, WCR will continue to make this available to the broader research community, regardless of focus-country status. Where non-focus-country governments want to accelerate progress and there is alignment with existing WCR programs, partners may access WCR’s expertise to enhance R&D capacity.

Our 11 focus countries



WHAT WE DELIVER

WCR continues to place the highest priority on guiding development of relevant technologies and actionable knowledge and fostering a global network for advancing innovation. Our technical focus remains the same as since our founding—genetic improvement to improve quality and production traits that increase profitability and climate resilience for farmers. Our focus extends to the systems that provide farmers with access to improved varieties—the entire innovation pipeline, from breeding through field trials, to nurseries and seed value chains.

With an eye to the challenges and opportunities of future production systems, WCR catalyzes the creation of new varieties that are:

- Higher quality for roasters and consumers
- More profitable for farmers
- Climate resilient



Seed system strengthening, seed lot clean-up, and training

1-3 years to farmers' fields



Field trials (on station/ on farm) and cupping

5-7 years to farmers' fields



National program modernization, tools and methods, variety candidates

10-30 years to farmers' fields



IMPACT AT SCALE

WCR invests in and advocates for agricultural R&D to increase productivity and quality to contribute to the economic sustainability and climate resilience of coffee farmers. Economic and environmental sustainability are critical dimensions of sustainable livelihoods. **Agricultural R&D investment, particularly variety improvement, provides impact across these dimensions at scale.**

How does enhanced productivity advance the economic sustainability of coffee farmers? If a farmer can use fewer inputs to produce the same amount of coffee, or use the same inputs to produce more coffee, s/he will have improved productivity. Low productivity farmers cannot cover their costs in low price environments, frequently leading to increased debt or a departure from farming. For a cash crop like coffee, improved productivity is often directly correlated with improved income, whether it's from lowered cost of production, increased production (e.g., more coffee to sell), or labor savings that allow the farmer to pursue other income-generating activities. For all farmers, improved productivity contributes to economic stability, which is a critical dimension of sustainable livelihoods.

How does increased productivity lead to increased climate adaptation and mitigation? Improved productivity contributes to higher incomes that allow farmers to accumulate savings or invest in other economic activities or on the farm, providing insulation against climate-related shocks and disruptions. At a regional and global scale, higher productivity also means producing more coffee from less land overall, avoiding land-use conversion and deforestation, which are major contributors of coffee agriculture to climate change. Integrating understanding of how varieties perform in production systems designed to reduce emissions footprints and contribute to carbon sequestration are critical parts of the equation as we improve productivity in the 21st century. Improved productivity is therefore essential for both adaptation to and mitigation of climate change.

How does improved quality advance the economic sustainability of coffee farming? Improved varieties produced widely in a region can contribute to regional differentiation, enabling farmers with lower capacity to receive price improvements because the region itself will fetch premiums. High quality varieties allow farmers to grow a product for which they have confidence there is market demand, which can be the context in which post-harvest handling systems start to form to allow for additional differentiation of the product. Variety improvement is a rising tide that lifts all boats.

How does variety improvement provide economic and environmental sustainability impacts at scale? Across an entire economy, agricultural R&D is critical for driving economic opportunity at scale, meaning it can impact millions of farmers. The potential for transformational impact of agricultural R&D is highest in low-income countries where there are many more smallholder farmers. In low and lower middle income countries where coffee exports generate significant export revenue, coffee has the potential to be an important contributor of economic opportunity, where collectively there are millions of smallholder farmers who

stand to either benefit from or exit coffee production to pursue other opportunities. Given the economic structural transformation that will come to many coffee producing countries in the next 10-15 years, ensuring that coffee agriculture is a robust, commercially vibrant option for farmers is critical so strengthening national breeding program capacity to produce new, more productive, climate resilient varieties now is paramount to the long-term sustainability of the industry dependent on these origins.

Why is variety improvement the best investment for economic and environmental sustainability impact at scale? For a global organization like WCR, variety development is resoundingly the most strategic investment. First, crop varieties are an essential source of resilience against shocks and stresses—such as drought, high heat or disease—for lower-resource farmers. Improved varieties, such as those with disease or pest resistance traits, can allow farmers who are unable to implement other management options to save their crops. Varieties are also critical to helping farmers become and remain successful through increased productivity. Varieties can offer high yields and provide stable performance in many production areas, thus can be rolled out at scale across a country. Once agronomic management is optimized, productivity increases over the long term rely on the continual creation of new coffee varieties that can produce more coffee with fewer or a fixed level of inputs. With greater wealth in the coming decade, more farmers will optimize their farm management. Continued success after agronomic optimization will be through new varieties. But because variety development is a 10-30 year process, it is urgent that coffee producing countries build stronger breeding pipelines now to assure their future competitiveness and sustainability. WCR ensures the value of industry's agricultural R&D investments by bringing tools and approaches with proven track records in other crops to accelerate progress in coffee breeding.

How does inclusive design ensure innovations are relevant and deliver value for a diversity of farmers? Involving the users of new technology in its design is called inclusive design. Inclusive design ensures relevance. Varieties designed with the input of those who will be growing the plants and those who will be roasting the beans are much more likely to deliver value and benefits to both end-users. Inclusive design also leads to trust and stability—when a farmer knows that a variety is demanded by buyers, and when buyers know that a variety meets farmers' needs, both sides are more likely to feel secure in their transactions.





Using advances in agricultural science, it is possible to dramatically improve coffee yields, coffee quality, climate resilience, and farmer livelihoods.

