



CGIAR Research Initiative on Accelerated Breeding

Annual Technical Report 2024

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Title: Annual Technical Report 2024: CGIAR Research Initiative on Accelerated Breeding

Suggested citation: CGIAR Research Initiative on Accelerated Breeding. 2025. Annual Technical Report 2024: CGIAR Research Initiative on Accelerated Breeding. Montpellier, France: CGIAR System Organization. <u>https://hdl.handle.net/10568/174241</u>



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The Artificial Intelligence (AI) software ChatGPT was used to support the editing of parts of this report, specifically to improve clarity, grammar, and style. ChatGPT was not used to generate the content of the report. All edits made with AI assistance were reviewed and validated by the authors to ensure accuracy, coherence, and alignment with the original intent.

Acknowledgements

This work is part of the CGIAR Research Initiative on Accelerated Breeding. We would like to thank all funders who supported this research through their contributions to the CGIAR Trust Fund: <u>https://www.cgiar.org/funders</u>.

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CGIAR Technical Reporting has been developed in alignment with <u>CGIAR's Technical Reporting Arrangement</u>. This annual report ("Type 1" Report) constitutes part of the broader CGIAR Technical Report. Each CGIAR Research Initiative/Impact Platform/Science Group Project (SGP) submits an annual "Type 1" Report, which provides assurance on progress towards end of Initiative/Impact Platform/SGP outcomes.

As 2024 marks the final year of this CGIAR Portfolio and the 2022-24 business cycle, this Type 1 Report takes a dual approach to its analysis and reporting. Alongside highlighting key achievements for 2024, the report also provides a cumulative overview of the 2022-24 business cycle, where relevant. This perspective captures the evolution of efforts over the three-year period. By presenting both annual and multi-year insights, the report underscores the cumulative impact of CGIAR's work and sets the stage for the transition to the 2025-30 Portfolio.

The 2024 CGIAR Technical Report comprises:

- Type 1 Initiative, Impact Platform, and SGP Reports: These annual reports present progress towards end of Initiative/Impact Platform/SGP outcomes and provide quality-assured results accessible via the CGIAR Results Dashboard.
- **Type 3 CGIAR Portfolio Practice Change Report:** This report provides insights into CGIAR's progress in Performance Management and Project Coordination.
- **Portfolio Narrative:** Drawing on the Type 1 and Type 3 reports, as well as data from the CGIAR Results Dashboard, the Portfolio Narrative synthesizes insights to provide an overall view of Portfolio coherence. It highlights synergies, partnerships, country and regional engagement, and collective progress.
- Type 2 CGIAR Contributions to Impact in Agrifood Systems: evidence and learnings from 2022 to 2024: This report offers a high-level summary of CGIAR's contributions to its impact targets and Science Group outcomes, aligned with the Sustainable Development Goals (SDGs), for the three-year business cycle.

The Portfolio Narrative informs the 2024 CGIAR Annual Report – a comprehensive summary of the organization's collective achievements, impacts, and strategic outlook.

Elements of the Type 2 report are integrated into the <u>CGIAR Flagship Report</u>, released in April 2025 at <u>CGIAR Science Week</u>. The Flagship Report synthesizes CGIAR research in an accessible format designed specifically to provide policy- and decision-makers at national, regional, and global levels with the evidence they require to formulate, develop, and negotiate evidence-based policies and investments.

The diagram below illustrates these relationships.



Figure 1. CGIAR's 2024 Technical Reporting components and their integration with other CGIAR reporting products.

Section 1: Fact sheet, executive summary and budget

Initiative name	Accelerated Breeding
Initiative short name	Accelerated Breeding
Initiative Lead	Michael Quinn (m.quinn@cgiar.org)
Science Group	Genetic Innovation
Start – end date	01 January 2022 – 31 December 2024
Geographic scope	Regions Central and West Asia \cdot North Africa \cdot

Southeast Asia and the Pacific · West and Central Africa

Countries

Afghanistan · Algeria · Angola · Argentina · Azerbaijan · Bangladesh · Benin · Bolivia (Plurinational State of) · Brazil · Burkina Faso · Burundi · Cambodia · Cameroon · Central African Republic · Chad · Chile · China · Colombia · Congo · Costa Rica · Cuba · Côte d'Ivoire · Dominican Republic · Ecuador · Egypt · El Salvador · Eritrea · Ethiopia · Gambia · Ghana · Guatemala · Guinea · Guinea-Bissau · Guyana · Haiti · Honduras · India · Indonesia · Iran (Islamic Republic of) · Iraq · Jordan · Kazakhstan · Kenya · Kyrgyzstan · Lao People's Democratic Republic · Lebanon · Liberia · Libya · Madagascar · Malawi · Mali · Mauritania · Mexico · Morocco · Mozambique · Myanmar · Nepal · Nicaragua · Niger · Nigeria · Pakistan · Panama · Paraguay · Peru · Philippines · Rwanda · Saudi Arabia · Senegal · Sierra Leone · Somalia · South Africa · South Sudan · State of Palestine · Syrian Arab Republic · Tajikistan · Tanzania, United Republic · Thailand · The Democratic Republic of the Congo · The Republic of the Sudan · The Socialist Republic of Viet Nam · Togo · Tunisia · Türkiye · Uganda · Uruguay · Uzbekistan · Venezuela (Bolivarian Republic of) · Yemen · Zambia · Zimbabwe

East and Southern Africa · Latin America and the Caribbean · South Asia ·

Score 2: Principal

Climate marker adaptation score¹

OFCD DAC

OECD DAC Climate marker mitigation score¹

OECD DAC Gender equity marker score²

Website link

Score 1: Significant The activity contributes

The activity contributes in a significant way to any of the three CGIAR climate-related strategy objectives – namely, climate mitigation, climate adaptation and climate policy, even though it is not the principal focus of the activity.

The activity is principally about meeting any of the three CGIAR climate-related strategy objectives – namely, climate mitigation, climate adaptation and climate policy, and would not have been undertaken without this objective.

Score 1A: Gender responsive

Gender equality is an objective, but not the main one. The Initiative/project includes at least two explicit gender specific outputs and (adequate) funding and resources are available. Data and indicators are disaggregated by gender and analyzed to explain potential gender variations and inequalities.

https://www.cgiar.org/initiative/accelerated-breeding/

¹ The Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC) markers refer to the OECD DAC <u>Rio Markers</u> <u>for Climate</u> and the <u>gender equality policy marker</u>. For climate adaptation and mitigation, scores are: 0 = Not targeted; 1 = Significant; and 2 = Principal. ² The CGIAR Gender Impact Platform has adapted the OECD gender marker, splitting the 1 score into 1A and 1B. For gender equality, scores are: 0 = Not targeted; 1A = Gender accommodative/aware; 1B = Gender responsive; and 2 = Principal.

These scores are derived from Initiative proposals, and refer to the score given to the Initiative overall based on their proposal.

EXECUTIVE SUMMARY

CGIAR breeding partnerships generate an estimated USD 40 billion in annual economic welfare gains. (Fuglie and Echeverria, 2024) This report outlines how the advancements introduced and pursued by the CGIAR Research Initiative on Accelerated Breeding between 2022 and 2024 have shaped the future of breeding within CGIAR, accelerating genetic improvements and delivering even more relevant and impactful solutions to farmers worldwide.

CGIAR's <u>Accelerated Breeding Initiative</u> was designed to deliver better-performing, farmer-preferred crop varieties while reducing the average age of varieties in farmers' fields. Each of the efforts undertaken by the Initiative was deeply interconnected, creating a cohesive and efficient ecosystem. In just three years, building on more than 50 years of CGIAR crop breeding expertise, Accelerated Breeding made significant progress in making CGIAR and its partners' breeding work more focused, efficient, and collaborative.

A key objective of Accelerated Breeding was to **optimize CGIAR breeding investments,** by ensuring that breeders work towards well-defined, achievable, and demand-driven targets.

Through the <u>REFOCUS</u> Work Package, CGIAR Centers' breeding pipelines were systematically mapped, along with the market segments and distinct, demand-driven Target Product Profiles (TPPs) they serve. This work established a clear, strategic link between breeding pipelines, TPPs, and market demands. The results are now consolidated in the <u>Breeding Portal</u>, a purpose-built platform that both provides and uses information to and from the <u>Global Market</u> <u>Intelligence Platform</u> (GloMIP).

This strategic alignment ensures that breeders are working within a structured, demand-driven portfolio – one that is impactful, in-demand, feasible to develop, and gender intentional.

At the same time, the <u>ReORGANIZE</u> Work Package focused on **streamlining breeding workflows** across CGIAR Centers. Drawing from industry best practices, a cross-cutting team identified key breeding processes and developed a standardized stage-plan with clear decision points that determine whether a product is ready to move to the next stage. Key Performance Indicators (KPIs) were defined for each stage gate, allowing for comparative analysis of breeding performance across crops and Centers.

This structured approach improved transparency and accountability. Data-driven decision-making was rationalized along the impact pathway and integration between team members was improved.

On the Trait Discovery and Development (TD&D) front, the <u>DISCOVER</u> Work Package optimized efforts by identifying high-impact traits through return-on-investment analysis, addressing bottlenecks through developing a set of best practices, and standardizing decision-making through a decision-tree for improved transparency and implementation.

The <u>ACCELERATE</u> Work Package made **impactful progress in optimizing pipelines,** with genetic gains reported over the three-year period. The majority of CGIAR breeding programs adopted rapid-cycle genomic selection and reduced cycle length. Programs optimized their breeding schemes to better align with TPPs, prioritizing earlier trait measurements when there were more selection opportunities. This helped guide better parental selections for the next cycle. On-farm verification considerably expanded, enabling robust assessments under farmer conditions and systematically capturing gender-disaggregated farmer feedback. These efforts led to the registration of over 900 new varieties in just three years. Cross-program learning was supported through quantitative genetics, enhanced data analytics, and integrated data management systems. Simulation tools and citizen science approaches further refined breeding strategies, driving faster genetic gains in CGIAR- National Agricultural Research and Extension Systems (NARES) collaborative breeding programs.

Effective crop variety development, dissemination and adoption depend on strong partnerships, particularly with NARES and the private sector, which are responsible for advancing, registering and scaling best varieties.

To **foster collaboration with partners,** the <u>TRANSFORM</u> Work Package conducted a global assessment of breeding networks, using objective criteria to systematize collaborations. The assessment covered 100 network partners, with a focus on sub-Saharan Africa. Partners responded by developing targeted capacity-building and improvement plans. These plans also helped in identifying funding opportunities to expand breeding efforts.

Annual high-level leadership consultations guided this work, ensuring strategic alignment. Standards for breeding partnerships were harmonized, promoting equitable and transparent collaboration in germplasm development; already adopted by several networks.

These efforts strengthened partners' roles in international breeding processes, with Centers playing a key supporting role.

The achievements of Accelerated Breeding are intricately linked and mutually reinforcing, significantly improving the way CGIAR crop breeding is conducted. Data-driven decision-making ensured that breeding investments focused on high-impact market needs. Standardized stage plans streamlined workflows across Centers, enabling breeders to operate in a coordinated and efficient manner. Trait discovery and genetic innovations identified the most valuable traits for future use. Cutting-edge tools and approaches drove higher genetic gains, strengthening every aspect of the breeding system. Stronger partnerships enhanced co-creation and wide ownership, ensuring that improved varieties reached farmers and generated substantial impact.

CGIAR breeding works with 21 crops and collaborates with over 1,200 partners. Every crop breeding network and partner has its own success story to tell. Between 2022 and 2024, partner countries released 934 crop varieties, addressing the needs of regions where 50 to 100 million people live on less than USD 2.15 per day. Many of these varieties were improved for climate resilience, or biofortified to combat malnutrition among women and children. These figures once again demonstrate the significant impact of breeding partnerships between CGIAR, NARES, and local seed companies.

	2022	2023	2024
PROPOSAL BUDGET D	\$33.69M	\$36.22M	\$39.09M
APPROVED BUDGET ¹ »	\$26.78M	\$27.72M ²	\$31.09M ²

¹ The approved budget amounts correspond to the figures available for public access through the <u>Financing Plan dashboard</u>.

² These amounts include carry-over and commitments.

Initiative-level theory of change diagram

This is a simple, linear, and static representation of a complex, non-linear, and dynamic reality. Feedback loops and connections between this Initiative and other Initiatives' theories of change are excluded for clarity.

CHALLENGE STATEMENT

- The primary goal of the Accelerated Breeding Initiative (ABI) and genetic innovation (GI) is to achieve higher rates of genetic gain by delivering farmer-preferred varieties and reducing the average age of varieties in farmers' fields. This enables real-time adaptation to climate change, evolving markets, and production systems. Currently, many farmers in target regions grow outdated varieties (>20–40 years old), missing the benefits of modern breeding. To encourage adoption, new varieties must deliver significant performance improvements, achievable only through accelerated genetic gain.
- Historically, adoption stemmed from clear improvements such as enhanced plant types or disease
 resistance. However, traditional breeding methods cannot deliver the transformative performance
 needed for complex traits essential to achieving benefits across CGIAR's five Impact Areas. These traits
 include climate resilience, biofortification, diverse environmental adaptability, end-use quality, and
 responsiveness to the needs of women, youth, and children. Achieving these goals requires optimized,
 data-driven breeding approaches, shorter breeding cycles, and a sharper focus on developing varieties
 tailored to specific environments, markets, and end uses.
- Focused, standardized approaches are critical to align CGIAR breeding efforts with funder priorities and
 maximize impact. Previously, this aim was hindered by the lack of unified methods for assessing
 opportunities across crops and Centers. CGIAR and GI now provide a framework for defining impact
 cases through market intelligence and implementing them.
- National Agricultural Research and Extension Services (NARES), especially in sub-Saharan Africa, vary
 significantly in capacity. Weaker NARES rely heavily on CGIAR for variety development, while stronger
 NARES seek greater influence over breeding strategies. Strengthening NARES capacities and fostering
 equitable CGIAR–NARES collaborations are both essential. These networks should also engage
 emerging small- and medium-sized seed enterprises (SMEs). Broader, more representative testing of
 candidate varieties under farmers' conditions, coupled with win-win partnerships between CGIAR,
 NARES, and SMEs, is vital for achieving higher genetic gains.

RESEARCH QUESTIONS

- Are the proposed market segments adequately addressing GxE?
- Are product profiles realistic?
- How can breeding investments be optimized across pipelines?
- Which traits can be improved through elite-by-elite crosses, and which require donor introgression?
- How can genetic gains for high-value traits be balanced with other adoption-critical traits?
- How should team interdependencies along the breeding pipeline be defined?
- What strategies best leverage specialized capabilities, attract talent, and build partnerships?
- How can team responsibilities be clarified effectively?
- What methods best measure pipeline performance and facilitate learning?
- How can NARES and SMEs be empowered to drive sustainable change?
- How should partnerships be prioritized to achieve scalable impact?
- What metrics best evaluate network and partnership performance?
- How can NARES and SME strengths be utilized better?
- How should investments match trait complexity across crop species?
- What are the most effective approaches for trait discovery and development (TD&D) optimization across crops?
- What key performance indicators track TD&D progress and drive best practices?
- How can genetic gain per year be maximized while maintaining variance?
- How should varieties align with product profiles and farmers' conditions?
- How can farmer feedback on variety performance be captured?
- How should breeding scheme optimization be sequenced?
- How can resources be balanced between PI and VI while leveraging investments?

SPHERE OF CONTROL

Work Packages

PACKAGE 1

ReFOCUS Aligning breeding teams and breeding objectives with farmers' needs.

WORK PACKAGE

ReORGANIZE breeding teams to drive efficiency gains.

VORK PACKAGE

TRANSFORM towards inclusive, impactful CGIAR-NARES-SME breeding networks.

WORK PACKAGE

DISCOVER: Trait Discovery and Deployment.

WORK PACKAGE 5

ACCELERATE population improvement and variety identification.

Tlaltizapan Experimental Station is used through the winter for drought and heat trials and through the summer for yield-trials and biofortification. Credit: Alfonso Cortés/CIMMYT

SPHERE OF **INFLUENCE**

END-OF-INITIATIVE OUTCOMES

ACTION AN

although Although and the state

END-OF-INITIATIVE OUTCOME 1

CGIAR-National Agricultural Research and Extensions Systems Breeding pipelines oriented towards specific market segments, enabling greater focus on farmers' needs, drivers of adoption, and impact.

END-OF-INITIATIVE OUTCOME 2

 CGIAR breeding portfolio ensures gender inclusiveness and increases gender intentionality through the candidate varieties that are being developed.

-OF-INITIATIVE OUTCOME 3

5 Breeding pipelines have increased the rate of genetic gain, providing seed systems actors with farmer-preferred candidate varieties with step change in performance under farmers' conditions.

END-OF-INITIATIVE OUTCOME 4

Breeding networks implement stronger partnership models where National Agricultural Research and Extensions Systems (NARES) and Small and Medium-sized Enterprises (SMEs) have increased contribution to the breeding process.

ND-OF-INITIATIVE OUTCOME 5

 Breeding pipelines use a revised organizational framework providing teams with operational clarity and effectiveness for pursuing breeding outputs.

END-OF-INITIATIVE OUTCOME 6

Breeding pipelines are supported by Trait Discovery and Deployment (TD&D) programs that deliver high-impact traits within elite parental lines.

Action Area Outcomes

ETIC INNOVATION

- 1 Research institutions, government analytical units, and scaling partners in the Global South have improved
- knowledge, skills, access to data, capacity to develop tools, innovations, and undertake research to support transformation of food, land and water systems contributing to livelihood, inclusion, nutrition, environmental and climate objectives.
- CGIAR-NARS-SME networks use market segments, target product profiles to orient variety development and deployment towards those that provide larger scale benefits across the 5 Impact Areas.
- National and private seed company breeding programs accelerate the development of varieties that provide larger scale benefits across the 5 Impact Areas.

SPHERE OF INTEREST

IMPACT AREAS

NUTRITION, HEALTH & FOOD SECURITY

 End hunger for all and enable affordable health diets for the 3 billion people who do not currently have access to safe and nutritious food.

POVERTY REDUCTION, LIVELIHOODS & JOBS

 Lift at least 500 million people living in rural areas above the extreme poverty line of US \$1.90 per day (2011 PPP).

GENDER EQUALITY, YOUTH & SOCIAL INCLUSION

 Close the gender gap in rights to economic resources on, access to ownership of, and control over land and natural resources, for more than 500 million women who work in food, land, and water systems.

 Offer rewardable opportunities to 267 million young people who are not in employment, education, or training.

CLIMATE ADAPTATION & MITIGATION

3

 Equip 500 million small-scale producers to be more resilient to climate shocks, with climate adaptation solutions available through national innovation systems.

• Turn agriculture and forest systems into a net sink for carbon by 2050, with emissions from agriculture decreasing by 1 Gt per year by 2030 and reaching a floor of 5 Gt per year by 2050.

NVIRONMENTAL HEALTH & BIODIVERSITY

 Stay within planetary and regional environmental boundaries: consumptive water use in food production of less than 2500 km3 per year (with a focus on the most stressed basins), zero net deforestation, nitrogen application of 90 Tg per year (with redistribution towards low-input farming systems) and increased use efficiency, and phosphorus application of 10 Tg per year.



Summary of progress against the theory of change

The Accelerated Breeding Initiative's (ABI's) purpose was to tackle a critical challenge: many farmers in target regions continue to grow outdated crop varieties, some over 20 to 40 years old. To address this, the Initiative improved focus, speed, partnerships and farmer involvement, ensuring that new, high-value varieties are developed and widely adopted across crop breeding networks in sub-Saharan Africa and South Asia.

This approach has been highly successful, with 934 new varieties developed and released by partner organizations across 65 countries between 2022 and 2024, directly benefiting regions where 50 to 100 million people live on less than USD 2.15 per day. To accelerate variety development and delivery, CGIAR breeding teams implemented key process improvements and strengthened the transition to improved crops. An indicator framework documented these organizational changes.

For the first time in CGIAR history, <u>its entire breeding portfolio has</u> been comprehensively captured and documented. This includes:

- CGIAR breeding Centers have mapped 157 breeding pipelines (>95 percent of the total) to 418 distinct market segments (from a total of 701 defined) and 418 Target Product Profiles (TPPs) – the package of traits delivered in an improved variety.
- Individual crop breeding strategies have been documented, linking Breeding Pipelines, TPPs, and Market Segments, and describing the level of emphasis given to each.
- Each TPP outlines priority traits identified through <u>stakeholder</u> <u>discussions held in 95 Product Design Team meetings</u>, reflecting those traits that are most impactful and in demand by farmers and end-users.
- Using the CGIAR Research Initiative on Market Intelligence's Global Market Intelligence Platform (GloMIP), a data-driven approach was applied, allowing to refocus breeding investments towards those with greatest opportunities for impact.

To consolidate and manage this information, a <u>Breeding Portal</u> was developed: a purpose-built data management platform providing real-time, transparent views of CGIAR breeding activities. Authorized internal users can update data, ensuring immediate visibility of the most recent information for external users through GloMIP, and fostering collaboration and alignment across teams.

Breeding teams began to review TPPs, so that they are in-demand, impactful, feasible to develop, and gender intentional. Linking breeding pipelines and TPPs to distinct market segments allows breeders to assess their relevance in view of distinct development indicators; poverty, malnutrition, area, production, value, and climate change impact. The information is used to direct resources toward higher-impact breeding pipelines and TPPs. By refining TPPs to focus on the most important, in-demand traits, breeding teams increase the likelihood of making greater strides forward on those traits that trigger farmer adoption.

Collaboration with Market Intelligence allowed us to improve the inclusion of gender perspectives. Acknowledging that many traits are in demand by women and men alike, 55 percent of the breeding teams were able to integrate insights from gender studies or on-farm trials; and 74 percent of the teams had access to gender expertise.

By capturing and documenting the entire CGIAR breeding portfolio, Accelerated Breeding significantly improved alignment, transparency, and strategic focus. These efforts increase the likelihood of developing the right varieties – those with the greatest potential for farmer adoption and significant benefit generation.

To develop these varieties faster, Accelerated Breeding introduced a range of innovations, integrating cutting-edge technologies and optimized breeding approaches. By October 2024, significant progress had been made across breeding teams. The implementation of key improvements, along with the percentage of breeding programs adopting each change, can be summarized as follows:

• The <u>average cycle time</u> was shortened from 54 to 41 months. Shorter cycle times are a crucial step in accelerating genetic gains, given that they increase the frequency and speed of identifying and intercrossing the best breeding materials, bringing programs closer to achieving TPPs faster and more efficiently.

- Programs increasingly used genomic profiles to predict variety performance (58 percent, up from 35 percent in 2022). Genomic selection enables breeders to (i) select parents for recycling earlier in the breeding process; (ii) increase the number of breeding materials assessed, thereby making it more likely to find those that have the desirable trait combinations; and (iii) focus further testing efforts on the most promising candidates.
- Breeding programs (74 percent) used <u>trait introgression</u> to introduce novel high-value traits into a highly elite genetic background which lacks these traits.
- Simulations enabled breeding teams (58 percent) to optimize breeding schemes. Accelerated Breeding utilized a worldclass purpose-built breeding simulation tool (AlphaSimR) from the <u>Roslin Institute</u>, which was further developed through a partnership between Roslin and the <u>Excellence in Breeding</u> <u>Platform</u>.
- Breeding teams (32 percent) brought <u>on-farm testing earlier</u> <u>into the breeding process</u>. This is a challenge given that farmer conditions are highly variable, and limited seeds are available at that stage of breeding. The teams succeeded by using modified trial designs. As a result, parental selection and candidate variety selection were informed by more relevant data.
- Implementing large-scale on-farm trials is highly resourcedependent. Between 2022 and 2024, the number of programs that executed on-farm <u>verification at more than 30 sites</u> almost tripled (now at 53 percent), using new trial designs and partnership approaches. Providing robust performance data to inform variety release decisions increases confidence among seed system actors, governments, and ensures that farmers' feedback is taken into account before such decisions are made.
- Accelerated Breeding facilitated agreement on a <u>recommended</u> <u>check strategy</u> that is now used by 90 percent of the programs to enable calculation of genetic gain per year.
- Breeding programs (93 percent) analyzed the <u>relevance of testing</u> <u>locations and environments</u>. Every location and environment is different, and it is important that candidate varieties are selected under representative environmental conditions.
- Plant breeding is a logistically challenging exercise with a very large number of physical samples being handled many times throughout the process. Mistakes are inevitable. 89 percent of the programs now use <u>genetic fingerprinting</u> as a very cheap and effective quality assurance approach.

The combined impact of these and other changes are that future varieties developed by CGIAR breeding programs will create step changes in performance, compared to current varieties, under conditions that are more relevant to the targeted farmers.

To improve breeding program effectiveness, organizational changes were made. In 2022, crop leads agreed on a common stage plan for product development. By 2024, 94 percent of research teams had adopted or partially integrated this harmonized terminology – an important shift from the previously inconsistent language across programs. A cross-cutting team identified the 26 most impactful indicators to measure breeding program performance and support high-level decision-making.

Insights from these changes and portfolio analyses show that betterstructured research agendas help identify KPIs that drive value creation and decision-making, even across CGIAR's highly diverse breeding programs.

Another core area was to strengthen partnerships and make them more equal to leverage synergies, pool resources, minimize duplication, and increase the level of ownership among partners.

Achieving a critical level of local ownership is crucial. It is NARES researchers and seed producers – not CGIAR – that are making decisions about which varieties are supported for delivery to farmers, which, in turn, increases the likelihood of the best varieties being made available to farmers. A lot of progress towards stronger, more equal partnerships has been made:

- Between 2022 and 2024, 100 NARES breeding programs underwent <u>systematic reviews by peers and experts</u>. These evaluations provided targeted recommendations to increase the effectiveness of programs, both individually and within their breeding network.
- Ninety-five meetings were held to <u>systematize product design</u> <u>approaches</u> at the national level. In addition to introducing new skills and approaches, the approach gave local partners a greater voice in defining the most relevant and impactful regional TPPs that are to be pursued by collaborative breeding networks. By the end of 2024, 83 percent of CGIAR Center crop teams stated that they had <u>systematized and increased the roles of NARES in Sub-</u><u>Saharan Africa and South Asia</u>.
- From a survey among <u>NARES</u> conducted at the end of 2024, the vast majority (>85 percent) were familiar with product design teams, the concept of market segmentation, and the use of standardized approaches to developing TPPs, defined breeding priorities and structured breeding efforts. Over 50 percent of respondents also participated in a network meeting where the advancement of candidate varieties, in line with jointly agreed TPPs, was discussed. Over 50 percent reported that the meeting was extremely useful and inclusive.

In just three years, Accelerated Breeding's efforts have made CGIAR breeding more focused on high-impact market segments and better aligned with developing the right crop varieties – with the right package of traits – to meet the needs of clearly defined target beneficiaries. The application of advanced breeding methodologies and tools is accelerating the rate at which breeding networks develop improved varieties exhibiting a step-change in performance. At the same time, stronger and more equitable partnerships systematically integrate NARES into decision-making. This increases local ownership, enhances breeding network efficiency, strengthens long-term capacity, and improves the likelihood that superior varieties will reach, and are adopted by, farmers.

These are the very changes that were captured in Accelerated Breeding theory of change: develop better varieties faster and use product specifications that drive greater adoption. Ultimately, this transformation will drive down the average age of varieties in farmers' fields, ensuring they are able to produce more productive and resilient crops with greater end use or nutritional value, and a better environmental footprint.

Progress against End of Initiative Outcomes

This infographic provides a concise summary of the Initiative's progress toward achieving its theory of change end of Initiative outcomes for the 2022-2024 period. By drawing on reported results, it offers a comprehensive synthesis of progress made against the established outcome targets, highlighting the Initiative's overall impact and key achievements at the conclusion of this three-year cycle.



EOIO 1

CGIAR-NARES breeding pipelines are oriented cowards specific market segments, enabling greater focus on farmers' needs, drivers of adoption, and mpact.



EOIO 2

Breeding pipelines use a revised organizational framework providing teams with operational clarity and effectiveness for pursuing breeding outputs.



EOIO 3

Breeding networks implement stronger partnership models where NARES and SMEs have increased contribution to the breeding process.



EOIO 4

Breeding pipelines are supported by Trait Discovery and Deployment programs that deliver high-impact traits within elite parental lines.



EOIO 5

Breeding pipelines have increased the rate of genetic gain, providing seed systems actors with farmer-preferred candidate varieties with a step change in performance under farmers' conditions.



EOIO 6

CGIAR breeding portfolio ensures gender inclusiveness and increases gender intentionality through the candidate varieties that are being developed. Accelerated Breeding built upon progress made by the Excellence in Breeding Platform to define and promote the concepts of market segments and TPPs across CGIAR-NARES small and medium-sized enterprise (SME) breeding networks.

The <u>Breeding Portal</u>, launched in 2023, captures the large and complex datasets that document breeding program activities, and makes the data openly accessible through <u>GloMIP</u>, developed by Market Intelligence. By late 2024, <u>nearly all (157; >95 percent) CGIAR breeding pipelines had been mapped</u> to distinct market segments and TPPs (418). These mappings define breeding strategies while detailing key traits that are to be maintained or improved.

Close to 100 Product Design Team meetings engaged NARES to validate market segments and create national TPPs, which helped refine sub-regional TPPs that are being pursued by CGIAR breeding networks.

This standardized approach establishes a single source of truth, aligning all CGIAR-NARES breeding pipelines, markets segments, and TPPs with each other and together with critical development indicators, while enabling real-time data updates. Traits were grouped into 15 value propositions, aligning efforts with CGIAR's five Impact Areas. The integration of the Breeding Portal and GloMIP enhances data-driven decision-making, sharpening the focus on farmer, processor, and consumer needs, key adoption drivers, and systematizing benefit estimates.

ReORGANIZE convened a process management working group to examine how CGIAR breeders operated. Rather than focusing on technical intricacies, the group concentrated on breeding program organization, performance monitoring, and empowering CGIAR breeders and scientists to deliver the crop varieties the world most urgently needs.

Drawing from industry best practices, ReORGANIZE introduced a <u>standardized organizational framework for product development</u>, including stage plans, stage gates and a common terminology to streamline product management across CGIAR breeding teams. The high-level process map was further refined using the SIPOC model (Suppliers, Inputs, Process, Outputs, and Customers) for each stage in the development process.

Essential skill sets required for each stage were identified, and key performance indicators developed to drive high-level decision making. These KPIs are being integrated into scalable Breeding Portal dashboards that allow extraction of information by crop, breeding pipeline, geography, and team.

The resulting shared framework, terminology and tools enhance transparency, accountability, and collaboration, while improving onboarding and facilitating scientific exchange across CGIAR breeding programs and partners. By the end of 2024, <u>80 percent of the research teams</u> fully or partially aligned and utilized the harmonized CGIAR stage gate terminology, an important result considering every program previously used their own terminology.

Accelerated Breeding introduced structured approaches to increase NARES and SMEs' participation in decision-making within CGIAR breeding networks. Emphasis was placed on defining TPPs and annual reviews, conducted through close to 100 product design and advancement meetings, aimed at ensuring full partner ownership of the network's development objectives and processes.

High-level leadership consultations, organized on behalf of the <u>Genetic Innovation</u> Science Group, brought together national programs, CGIAR Centers, regional bodies (West and Central African Council for Agricultural Research and Development [CORAF], Association for Strengthening Agricultural Research in Eastern and Central Africa [ASARECA], Centre for Coordination of Agricultural Research and Development for Southern Africa [CCARDESA]), universities, funders, and multilateral institutions to <u>co-develop plans and track progress</u>, formalized in Aide-Memoires. Insights from these meetings and the progress achieved were further informed by partner surveys.

<u>100 in-depth NARES capacity assessments</u> were conducted to enable partners to improve impact focus, national breeding effectiveness, and collaboration with international efforts. Among Center crop teams:

- Over 90 percent applied a common country prioritization tool to implement transparent partner engagement criteria.
- 83 percent reported jointly defining and reviewing market segments and TPPs with partners and strengthening the role of NARES in setting breeding priorities.
- 80 percent of crop research teams indicated significant progress in integrating NARES within targeted CGIAR-NARES-SME networks in sub-Saharan Africa.

Subgrants to high-capacity NARES increased partners' contributions to breeding efforts. A standardized network membership agreement provides a framework for partners achieving mutual goals.

Substantial progress was made to align Trait Discovery and Deployment (TD&D) efforts to specific TPPs, using both the emerging TPP data and insights provided by the Market Intelligence Initiative. An interconnected approach enabled the calculation of return on investment (ROI) for traits and introduced a likelihood-of-success analysis based on the effect and genetic basis of each trait. TD&D programs largely adopted this conceptual framework. It was successfully applied to <u>11 out of 21 CGIAR crops</u>. Wider integration of data-driven tools is still needed to translate this approach into a routine and factual decision-making tool.

Overall, DISCOVER made significant progress on:

- Strategic trait prioritization: DISCOVER captured and documented CGIAR's portfolio of TD&D efforts, linked traits to market needs, and conducted ROI analysis to optimize investments.
- Optimizing trait development: A review of twelve TD&D programs identified a key bottleneck in transitioning from QTL discovery to deployment. Best practices from wheat and rice have been studied to refine and leverage successful approaches to other crops.
- Structured decision-making: A decision tree framework defines key TD&D stages and gates and standardizes processes. When integrated into the Breeding Portal, it will enhance transparency, tracking, and help implementers and breeders make decisions and implement best practices.

Between 2022 and 2024, partner organizations in 65 countries registered a total of 934 crop varieties derived from CGIAR breeding pipelines. Sixty-three percent of the varieties were improved for climate resilience and 27 percent were biofortified and directed to lower malnutrition among women and children. Seventy-four percent were registered in low- and lower-middle income economies. Data integration allows us to conclude that, when scaled, these varieties could provide benefits to 50 to 100 million low-income people that live within the targeted market segments.

Variety registrations are no guarantee of multiplication and use but they are an important milestone. Many countries require variety registration for dissemination or commercialization. Also, given that the release partners are known, the uptake of the varieties can be tracked.

To achieve these varieties and accelerate genetic gain, CGIAR breeding teams carried out a wide range of improvements. Programs targeted at sub-Saharan Africa and South Asia, where the greatest emphasis was given, reduced the breeding cycle time from 54 to 42 months; implemented genomic selection (79 percent); used trait introgression (79 percent), breeding scheme simulations (79 percent) and on-farm sites at Early Testing (43 percent); executed on-farm verification at more than 30 sites (64 percent); implemented the recommended check strategy fully or partially (100 percent); executed genotype-by-environment analyses (100 percent); and used genetic finger printing for quality control (86 percent). The <u>average implementation rate of these improvements is 79 percent</u>.

Significant progress has been made in mainstreaming gender inclusiveness and increasing gender intentionality across CGIAR breeding.

CGIAR-NARES Product Design Teams include women and men representatives from diverse stakeholders and utilize gender insights from studies by the Market Intelligence Initiative. By 2024, 74 percent of the research teams were able to access gender studies or gender specialists.

Breeding teams are increasingly collecting gender-disaggregated data. Between 2022 and 2024, the proportion of on-farm trials collecting gender-disaggregated data rose from 14 percent to 55 percent. This data not only supports gender-informed variety selection but also informs TPP definitions, the targeted specifications for future varieties.

During the same period, 19-26 percent of breeding pipelines focused on biofortification or reducing cooking time – i.e. traits with gender differential impact. Seventy-five newly registered varieties were developed to reduce malnutrition in women and children.

Research from 2022 to 2024 also reveals that women and men often prioritize the same traits, or that a trait may equally impact women and men. To refine gender-differentiated benefit estimates, Accelerated Breeding clustered crop trait priorities into 14 distinct value propositions. This approach strengthens market intelligence, improving the ability to project benefits and ensuring that breeding innovations effectively serve all farmers and consumers.

WP1: ReFOCUS

RESEARCH QUESTIONS

- Do the proposed market segments adequately consider GxE?
- What target product profiles can realistically be developed?
- How can breeding investments be leveraged across breeding pipelines?
- What traits can be improved through elite-by-elite crosses? Which traits need to be introgressed from distinct donor lines?
- How can genetic gains be optimized for highest value traits, considering other traits crucial for adoption?



END-OF-INITIATIVE OUTCOME 1

 CGIAR-National Agricultural Research and Extensions Systems Breeding pipelines oriented towards specific market segments, enabling greater focus on farmers' needs, drivers of adoption, and impact.

END-OF-INITIATIVE OUTCOME 2

 CGIAR breeding portfolio ensures gender inclusiveness and increases gender intentionality through the candidate varieties that are being developed.

Work Package 1 progress against the theory of change

Product design and management provide essential strategic direction for CGIAR breeding programs, ensuring that investments and breeding strategies align with the needs of farmers and end-consumers. ReFOCUS played a key role in this regard by developing tools and frameworks to document breeding pipelines, define TPPs, and map them to distinct market segments.

ReFOCUS built on Excellence in Breeding's legacy and collaborated with Market Intelligence to standardize definitions of breeding pipelines, market segments, and TPPs across CGIAR-NARES-SME breeding networks. ReFOCUS staff worked 1:1 with breeding teams to <u>document their breeding strategies</u>. By the end of 2024, ReFOCUS had identified 157 breeding pipelines and 418 TPPs, each aligned 1:1 with a sub-regional market segment (418 out 701 defined).

Each TPP specifies trait requirements and targeted scores, categorized into <u>14 value propositions</u> that make breeding pipeline alignment with CGIAR's five Impact Areas transparent. This data-driven categorization was used for Impact Area tagging of breeding products, pipelines and the entire Portfolio within CGIAR's reporting system.

By the end of 2024, over 95 percent of CGIAR breeding programs have systematically <u>structured their pipelines around farmers'</u> <u>needs</u>, <u>adoption drivers</u>, <u>and impact</u>. Fifty-five percent of TPPs were <u>informed by gender</u> studies, gender specialists, or genderdisaggregated on-farm trial feedback. In collaboration with TRANSFORM, NARES were also familiarized with these approaches. Close to 100 <u>Product Design Team meetings</u> were conducted with NARES to validate market segments and develop around 400 national TPPs. These national TPPs are actively used to refine sub-regional TPPs created by CGIAR breeding teams. They thereby provide a systematic tool to align CGIAR and national priorities.

To manage this large amount of data, the Breeding Portal was developed and launched in 2023. It serves as a central platform to capture and report breeding pipeline data. It is integrated with the GloMIP, allowing impact assessments of breeding pipelines and market segments.

These insights are increasingly guiding data-driven decision-making in CGIAR breeding. In 2024, the data was used to drive pooled resource allocation recommendations, aligned with the relevance of crops to poverty, malnutrition and the need for climate change adaptation. Centers commented favorably on data-driven resource allocations and provided further suggestions for improvement.

With this work and by linking the Breeding Portal with GloMIP, CGIAR has enhanced its ability to estimate impact, opportunity, and benefits across breeding pipelines and market segments. These estimates are becoming integral to evidence-based decision-making, further strengthening CGIAR's breeding strategies.

WP2: ReORGANIZE

RESEARCH QUESTIONS

- How can team interdependencies best be defined along the breeding pipeline?
 How can specialized
- How can specialized capabilities best be leveraged, and talent and partnerships attracted and retained?
- How can team responsibilities be clarified?
- How can pipeline
- performance be measured and learned from?



END-OF-INITIATIVE OUTCOME 5

 Breeding pipelines use a revised organizational framework providing teams with operational clarity and effectiveness for pursuing breeding outputs.

Work Package 2 progress against the theory of change

In crop breeding, success does not only rely on technical expertise – it also depends on efficient organizational processes and strategic coordination. ReORGANIZE aimed to streamline CGIAR crop breeding by optimizing team structures, defining clear responsibilities, enhancing collaboration, and establishing robust performance measurement systems that established the wider contributions of teams and disciplines to overall achievements.

ReORGANIZE adopted industry-inspired techniques, including SIPOC models (Suppliers, Inputs, Process, Outputs, and Customers), to create a <u>unified stage-plan for CGIAR breeding pipelines</u>. This framework defines which breeding activities belong to cohesive process groups, ensuring clarity and efficiency. A harmonized stagegate system was established, covering 10 distinct stages – from gathering of market intelligence and trait discovery, to population improvement and variety development.

By 2024, over 80 percent of research teams had fully or partially adopted this harmonized CGIAR stage-gate terminology, enabling systematic reporting across all breeding pipelines. This common language fosters scientific exchange improving cross-program collaboration and allows new hires to integrate more readily into ongoing efforts.

The stage-gate system was used to collaboratively identify 26 key performance indicators (KPIs). These KPIs enable teams to track progress, assess individual and team performance, and identify areas for improvement. They are being integrated into scalable dashboards for CGIAR and partners that allow extraction of indicators by crop, geography or organizational units, and are drawn from information management systems that breeding teams use for their day-to-day work.

<u>ReORGANIZE mapped critical competencies</u> needed for successful product development, identifying skills gaps and strengths across breeding teams. This enables better resource pooling across crops and Centers, ensuring that expertise is efficiently allocated.

Different teams adopted <u>structured models such as the RACI Matrix</u> (Responsible, Accountable, Consulted, Informed) to define team roles, and the RAPID Model (Recommends, Agrees, Performs, Inputs, Decides) to improve decision-making clarity and inclusiveness. Twenty-nine percent of the research teams implemented these approaches fully, while 41 percent implemented them partially.

ReORGANIZE's theory of change intended to follow and influence gender trends within breeding teams. Because access to a suitable dataset was challenging, gender diversity was assessed using the Breeding Portal user base as a proxy. Among 255 Accelerated Breeding-related users, 31 percent were women. This figure may underestimate the true proportion of women scientists, as not all breeding-related disciplines require direct access to the Breeding Portal.

Implementing these structured frameworks and tools allows better operational clarity, effectiveness and communication in breeding networks.

CGIAR breeding teams are now better equipped to deliver improved crop varieties more effectively.

WP3: TRANSFORM

RESEARCH QUESTIONS

- How can NARES be empowered, and SMEs aligned to sustainable change ambitions?
- How can partners be prioritized and networks positioned for impact at scale?
- How can the performance of networks and partnerships be measured?
- How can the capacity and strengths of each NARES and SME be leveraged better?



END-OF-INITIATIVE OUTCOME 4

6 Breeding networks implement stronger partnership models where National Agricultural Research and Extensions Systems (NARES) and Small and Medium-sized Enterprises (SMEs) have increased contribution to the breeding process.

END-OF-INITIATIVE OUTCOME 6

6 Breeding pipelines are supported by Trait Discovery and Deployment (TD&D) programs that deliver high-impact traits within elite parental lines.

Work Package 3 progress against the theory of change

TRANSFORM made significant strides toward its core purpose, empowering NARES and better leveraging their capacity, strengths and knowledge in breeding networks. Indicators were collaboratively identified to measure the quality of CGIAR partnerships.

A network model was developed early on by the Accelerated Breeding Initiative. It draws on extensive consultations and incorporates established best practices. Now widely adopted by breeding networks in sub-Saharan Africa, the model promotes more equitable and effective collaboration by defining roles based on the comparative advantages of CGIAR and NARES. It promotes stronger participation of partners in variety development and decision-making and builds ownership.

To support implementation, several scalable innovations were developed, validated, and expanded, including: <u>transparent country</u> <u>priority setting criteria</u>, <u>Product Design Team meetings; regional</u> <u>market segment alignment meetings; partner breeding program</u> <u>assessments; annual multi-institutional leadership consultations;</u> <u>partnership health surveys; breeding operations costing tools;</u> scaling breeding operations subgrants; and <u>harmonized standards for</u> <u>network membership agreements</u>.

The first of these agreements was signed in 2024, with the African Root Tuber Banana networks endorsing the common terms. The agreement was signed by the International Potato Center (CIP), the International Institute of Tropical Agriculture (IITA), and 16 NARES.

The co-design of breeding priorities through Product Design Team and regional market alignment meetings ensured better alignment of partner priorities and greater investment in jointly prioritized market segments. In 2024, 83 percent of all CGIAR crop teams stated that they had jointly defined and reviewed market segments and TPPs with partners, thereby systematizing and increasing NARES' role in setting network breeding priorities. In a survey of sub-Saharan Africa partners, <u>more than 85 percent of the respondents</u> were familiar with Product Design Teams, the concept of market segmentation and the use of the standardized approach to developing TPPs. Over 50 percent of respondents have attended a regional Product Advancement meeting and of those that attended, over 50 percent reported the meeting was extremely useful and inclusive.

Breeding program assessments, operational costing projects, and direct subgrants allowed high-performing NARES programs to augment their roles and increase their involvement in regional breeding. Leadership consultations provided a secure framework for regular feedback and course correction.

TRANSFORM made significant progress toward its targeted outcomes. Moving forward, a more concerted effort is needed to enhance SME participation in breeding networks. Additionally, expanding this work from sub-Saharan Africa to South Asia and Latin America through region-specific approaches will be key to scaling impact globally. For further details about this workstream, see the "Partnerships" section of this report.

WP4: DISCOVER

RESEARCH QUESTIONS

- How can investments be rightsized for defined trait complexities and necessities, within and across different crop species?
- How can approaches to trait discovery and deployment be identified and optimized within different crop species?
- What are the most efficient and effective key performance indicators to monitor and analyze progress and encourage desired changes?



END-OF-INITIATIVE OUTCOME 6

Breeding pipelines are supported by Trait
 Discovery and Deployment (TD&D) programs
 that deliver high-impact traits within elite parental lines.

Work Package 4 progress against the theory of change

DISCOVER aimed to ensure that CGIAR-NARES breeding pipelines are supported by efficient and effective TD&D pipelines, delivering highimpact and in-demand traits through elite donor lines.

In 2022, DISCOVER conducted the first comprehensive assessment of CGIAR's TD&D activities and phenotyping assay development projects. This portfolio documented:

- Target traits and their intended geographies, market segments, and TPPs;
- Investment needs for each trait;
- Expert-estimated yield contributions if the trait was successfully deployed.

An initial <u>return-on-investment (ROI) analysis</u> was conducted for yield-related traits across multiple crops. This pilot approach, developed jointly by DISCOVER and Market Intelligence, linked traits to TPPs and market segments, estimated trait development costs, and incorporated expert yield projections. While the analysis helped TD&D programs prioritize investments, integrating financial analysis backed by reliable data remained a challenge.

The baseline TD&D portfolio provided a foundation for evaluating and refining scientific approaches at the trait level. Between 2023 and 2024, DISCOVER conducted key informant interviews across 12 TD&D programs to assess opportunities for optimizing trait delivery.

A major bottleneck was identified in transitioning from QTL discovery to QTL validation and deployment. Two programs – Wheat at CIMMYT and Rice at IRRI – overcame this barrier. These programs are now used to define best practices, including a forward breeding scheme developed by IRRI that could serve as a model for other CGIAR breeding programs working with complex traits. To improve TD&D project design and execution, DISCOVER developed <u>a decision tree</u>, structured according to TD&D stages and stage gates. A draft online version is available, guiding researchers through the key stages:

- 1. Trait genetic scoping (Good progress)
- 2. Developing resources and determining marker-trait associations (Good progress)
- 3. Genetic validation (Good progress)
- 4. Phenotypic validation and deployment testing (More progress needed)
- 5. Deployment of elite donors in breeding programs (More progress needed)

The decision tree is forward-looking, anticipating that abiotic stress tolerance may become increasingly important for yield gains in the future.

<u>Some TD&D programs</u> have already started integrating these stages and stage gate decisions into advancement meetings to track key performance indicators (KPIs). Additionally, the framework will be integrated into the Breeding Portal, ensuring that TD&D activities are systematically captured, monitored, and made more transparent and accessible.

By strengthening the linkages between trait discovery, validation, and deployment, DISCOVER is enhancing the effectiveness and impact of CGIAR breeding programs, ensuring that breeding efforts are aligned with market needs, genetic innovation, and long-term climate resilience.

WP5: ACCELERATE

RESEARCH QUESTIONS

- How can genetic gain per year be maximized and genetic variance maintained?
- How can varieties be selected that align with product profiles and farmers' actual growing conditions?
- How can feedback be captured to understand performance under farmers' conditions?
- · How can breeding scheme optimization be seque nced?
- How can resources be balanced between population improvement and variety identification, and breeding investments leveraged across pipelines?



CGIAR breeding portfolio ensures gender 11 **•** 12 **•** inclusiveness and increases gender intentionality through the candidate varieties that are being developed.

- 10 11 12 13 Breeding pipelines have increased the rate of
- genetic gain, providing seed systems actors with farmer-preferred candidate varieties with step change in performance under farmers'

Work Package 5 progress against the theory of change

Since 2022, CGIAR breeding programs have made strong progress toward optimizing breeding pipelines, incrementally increasing genetic gains through distinct interventions. In 2024, realized genetic gain was statistically significant and positive in approximately 62 percent of reported market segments, with 40 percent achieving annual genetic gain estimates exceeding 1 percent. Several improvements strengthened breeding effectiveness.

- Parental selection and breeding cycle optimization:
 - 58 percent of programs adopted <u>rapid-cycle genomic selection</u> to reduce breeding cycle time, and a further 32 percent are establishing the datasets required to execute genomic selection. This is quite different to 2022, when only 35 percent of the breeding programs were experimenting with genomic selection.
 - Breeding cycle time reduced from 54 to 42 months between 2022 and 2024, with potential for further reductions.
 - Fifty-eight percent of breeding programs made changes in their breeding schemes in at least one pipeline, supported by simulations.
- Germplasm sharing and testing strategies:
 - Eighty-six percent of programs implemented a germplasmsharing strategy across pipelines.
 - Programs are progressively aligning breeding schemes with TPPs; ≥75 percent of essential traits are now measurable at the early testing stage. Thirty-two percent of teams have begun to use on-farm testing during the early testing stage, using partially replicated (p-rep) designs.

- Ninety-five percent of the crop teams conducted genotypeby-environment analyses; 37 percent of these with more than three years of data. Eighty-nine percent of the crop programs have a <u>check strategy</u> in place.
- On-Farm verification and varietal deployment:
 - More than 90 percent of programs conducted on-farm verifications, with 53 percent meeting or exceeding the recommended minimum 30-farms per genotype. As a result, performance under farmer conditions was assessed more representatively and gender-disaggregated preferences were systematically captured.
 - Between 2022 and 2024, 179 partner organizations in 66 countries registered a total of 939 varieties for commercialization or not-for-profit dissemination. When scaled, they could cover 16-26 percent of the crop area in target countries, and more specifically market segments where 50 to 100 million low-income people live.

Cross-program learning was enabled through several cross-cutting interventions. Quantitative genetics experts supported breeding scheme design and optimization. A breeding analytics teams focused on enhancing data quality standards and analytics. Integrated data management systems were developed including: the Program Management Platform (PMP) which increases transparency across diverse funding sources; the Breeding Portal, which centralizes CGIAR breeding portfolio; and the Breeding Scheme Manager, which documents and refines breeding schemes.

Several challenges remain, such as biological and logistical hurdles, environmental variability, and the availability of representative testing locations. Breeding remains a numbers game - for the number of candidate varieties evaluated and the number of environments utilized - and is therefore highly resource dependent.

WORK PACKAGE	PROGRESS RATING & RATIONALE			
1	On track			
	Proportion of targeted breeding pipelines clearly mapping to TPPs and market segments: targeted 75 percent; achieved 95 percent.			
	Proportion of targeted programs that have reviewed and updated breeding focus and investments: targeted 75 percent; achieved 95 percent.			
	Proportion of gender-intentional breeding pipelines within the entire portfolio: targeted 25 percent; achieved 55 percent.			
2	On track			
	Proportion of targeted breeding networks implementing new organizational improvement tools: targeted 80 percent; achieved 94 percent.			
	Proportion of professional roles within breeding teams occupied by women: targeted 35 percent; achieved 31 percent. Note the achieved value is an estimate based on Breeding Portal users and may not include all breeding personnel.			
3	On track			
	Number of NARES improvement plans completed: targeted 73; achieved >100.			
	Proportion of targeted breeding networks in sub-Saharan Africa that have updated roles of NARES, CGIAR, and SMEs in breeding networks: targeted 80 percent; achieved 80 percent.			
4	Delayed			
	Number of publications of targeted TD&D pipelines advancing best practice: target not defined; achieved 332.			
	Proportion of targeted programs with lists of CGIAR TD&D projects that have been categorized after prioritization: targeted 80 percent; achieved 82 percent.			
	Incorporating the best TD&D practices into <u>a decision tree</u> has been slow given the complexity of doing so across crops and breeding systems.			
5	On track			
	Proportion of breeding pipelines that have implemented systems to measure realized genetic gains for farmer-relevant conditions: targeted 70 percent; achieved 89 percent.			
	Proportion of targeted pipelines that have adjusted their evaluation schemes, so they better capture TPP traits of Target Population of Environment (TPE) conditions: targeted 80 percent; achieved 95 percent.			
	Proportion of crops that have used gender-disaggregated feedback in the selection of CGIAR variety candidates, in that particular year. Targeted 50 percent; achieved 55 percent.			
	Cumulative number of new varieties registered and accessible to seed systems: targeted 700; achieved 934.			
Definitions				

- Progress largely aligns with Plan of Results and Budget and Work Package theory of change.
- Can include small deviations/issues/ delays/risks that do not jeopardize success of Work Package.

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On track



Delayed

- Progress slightly falls behind Plan of Results and Budget and Work Package theory of change in key areas.
- Deviations/issues/delays/risks could jeopardize success of Work Package if not managed appropriately.



- Progress clearly falls behind Plan of Results and Budget and Work Package theory of change in most/all areas.
- Deviations/issues/delays/risks do jeopardize success of Work Package.

Section 4: Quantitative overview of key results

This section provides an overview of results reported and contributed to, by the CGIAR Initiative on Accelerated Breeding from 2022 to 2024. These results align with the <u>CGIAR Results Framework</u> and Accelerated Breeding's theory of change. Further information on these results is available through the <u>CGIAR Results Dashboard</u>.

The data used to create the graphics in this section were sourced from the CGIAR Results Dashboard on 04 April 2025. These results are accurate as of this date and may differ from information in previous Technical Reports. Such differences may be due to data updates throughout the reporting year, revisions to previously reported results, or updates to the theory of change.

OVERVIEW OF RESULTS BY CATEGORY



NUMBER OF RESULTS BY IMPACT AREA CONTRIBUTION



• 2 = Principal: Contributing to one or more aspects of the Impact Area is the principal objective of the result. The Impact Area is fundamental to the design of the activity leading to the result; the activity would not have been undertaken without this objective.

• 1 = Significant: The result directly contributes to one or more aspects of the Impact Area. However, contributing to the Impact Area is not the principal objective of the result.

• **0 = Not targeted:** The result has been screened against the Impact Area, but it has not been found to directly contribute to any aspect of the Impact Area as it is outlined in the <u>CGIAR 2030 Research and Innovation</u> strategy.

• Not applicable: Pertains to 2022 reported results when only information on Gender and Climate impact area tagging was available.



GEOGRAPHIC FOCUS OF RESULTS

One result can impact multiple countries and can therefore be represented multiple times.

INNOVATIONS BY TYPOLOGY AND NATURE



TECHNOLOGICAL INNOVATION
 Innovations of technical/material nature, including varieties/breeds, crop and livestock management practices, machines, processing technologies, big data, and information systems.

- POLICY/ORGANIZATIONAL/INSTITUTIONAL INNOVATION Innovations that create enabling conditions, including policy, legal and regulatory frameworks; business models; finance mechanisms; partnership models; public/private delivery strategies.
- CAPACITY DEVELOPMENT INNOVATION
 Innovations that strengthen capacity, including farmer, extension or investor decision-support services; accelerator/ incubator programs; manuals, training programs and curricula; online courses.
- OTHER INNOVATION Unknown or the type does not work for the innovation.



NUMBER OF INNOVATION USERS BY ACTOR TYPE



KNOWLEDGE PRODUCTS BY TYPOLOGY AND THEIR FAIR SCORES



NUMBER OF INDIVIDUALS TRAINED BY THE INITIATIVE





ACCELERATED BREEDING'S EXTERNAL PARTNERS

This diagram maps the key external partners of the Accelerated Breeding initiative, organized by partner type. The numbers in brackets represent the number of results each partner has contributed to, reflecting the scale and diversity of collaborations. To allow for a clearer view, a maximum threshold of eight partners was applied for each typology. The list of partner acronyms is <u>available here</u>.

Partnerships and Accelerated Breeding's impact pathways

CGIAR's impact pathway for breeding is dependent on effective partnerships with research and scaling partners, especially given that CGIAR does not have a mandate to release and disseminate crop varieties. Accelerated Breeding achieved its goal of <u>80 percent</u> <u>of targeted breeding networks</u> implementing documented steps towards stronger partnership models. Several steps led to increased breeding capacity and greater scientific, operational, and decisionmaking contributions by partners.

Taking stock of the breeding partnership landscape

Accelerated Breeding's TRANSFORM Work Package focused exclusively on strengthening collaboration between CGIAR and its breeding partners. TRANSFORM took stock of global breeding networks and established an objective method for assessing the capacity of network members and their potential role in regional breeding efforts. Fifty-five regional crop breeding networks were identified, with 50 percent in sub-Saharan Africa, spanning 23 crops across 83 countries. <u>Participating countries were categorized for</u> prioritization purposes into Level 1, 2 and 3 based on crop area and World Bank income level.

Since 2019, over 120 NARES breeding programs and 25 NARES stations in Level 1 and 2 countries underwent peer assessments, using <u>a standardized evaluation framework</u> developed by TRANSFORM. These assessments resulted in tier categorization of breeding programs and <u>customized improvement plans</u> that included recommendations to modernize breeding programs with capacity building support provided by Initiatives within the Genetic Innovation Science Group. The assessments guided network roles and responsibilities based on the capacity and comparative advantage of each network member.

Innovations to align breeding efforts with national priorities

Key innovations were introduced to improve alignment between CGIAR breeding efforts and national priorities. <u>National Product</u> <u>Design Team meetings</u> were introduced, bringing together NARES and CGIAR scientists, the private sector, universities, farmer groups, processors and social scientists, to define national market segments and TPPs. This further developed the capacity of national institutes to define breeding priorities while fostering greater ownership and use of new varieties. Close to 100 such meetings were held between 2022 and 2024, generating over 400 individual TPPs. National TPPs guided the work of CGIAR breeding pipelines. This ensured CGIAR breeding efforts were directly responding to country needs and priorities. Jointly made variety advancement decisions drew upon these TPPs.

A widely disseminated survey found that over 85 percent of partner teams are now familiar with modern breeding approaches such as Product Design Teams, market segmentation, and the use of a standardized TPP template. Over 50 percent of respondents have attended a regional Product Advancement meeting, with over half rating the meeting as extremely useful and inclusive. Over a third of NARES breeding programs from Level 1 and Level 2 priority countries were fully assessed using the TRANSFORM framework and have developed a <u>customized modernization plan</u>, while another third are still engaged in the process.

CGIAR responses to the partnership survey indicate that all breeding Centers worked closely with NARES to align efforts, reduce duplication, and maximize impact. Overall, CGIAR teams reported a growing sense of collegiality and engagement. The root-tuberbanana and dryland crops networks worked with TRANSFORM to formalize <u>a standardized network membership agreement</u> that fosters the pooling of resources, common breeding standards, data and germplasm sharing.

Identifying new funding opportunities

Funding remains a concern for many NARES. Approximately 22 percent rely on CGIAR for more than 50 percent of <u>their operational</u> <u>budget</u>. Concerningly, over 50 percent reported a decline in government funding. NARES leveraged TRANSFORM assessments and improvement plans to seek new sources of funding and assume greater responsibility in the international breeding effort. For example, the National Agricultural Research Organisation (Uganda) (NARO) secured support for program modernization through Crops to End Hunger (CtEH) and funding for training.

Institutionalizing high-level leadership engagement

To assess and improve the quality of CGIAR-NARES partnerships, Accelerated Breeding initiated <u>annual Leadership Consultation</u> <u>meetings</u> in 2022. These meetings brought together NARES leaders from more than twenty countries in sub-Saharan Africa, representatives from CGIAR crops and the principal SROs in SSA (CORAF, ASARECA, and CCARDESA), local universities and other development partners such as AGRA, FAO and funders. The outcomes from these meetings were formally captured in publicly available Aide-Memoires (<u>Nairobi 2022</u>, <u>Marrakesh 2023</u> and <u>Dubai 2024</u>). They identified areas for improvement which guided TRANSFORM's work.

Other strategic partnerships: universities

TRANSFORM collaborated with top African universities (University of Ghana, Makerere University, and University of KwaZulu-Natal) to build capacity for future crop breeders.

ReFOCUS partnered with Wageningen University's Global Yield Gap Atlas to assess climate change impacts on Africa's sorghum-growing regions.

ACCELERATE worked with the University of Queensland and the Breeding Program Assessment Tool (BPAT) team to track progress and improve breeding efficiency. It also engaged industry and research institutes to integrate advanced technologies into CGIAR breeding.





ACCELERATED BREEDING'S INTERNAL NETWORK OF COLLABORATIONS

This diagram presents the internal collaborations of Accelerated Breeding with other CGIAR Initiatives, Impact Platforms, and Science Group Projects. Connections are sized according to the number of shared reported results, highlighting the depth of collaboration across the CGIAR Portfolio. A results threshold filter is applied (set to a minimum of three results) to focus the view on the most significant collaborations. Thicker lines represent stronger collaborative links based on a higher number of shared results.

Portfolio linkages and Accelerated Breeding's impact pathways

Accelerated Breeding developed improved varieties and as such was the core of Genetic Innovation Initiative. It had strong linkages with each of the other Genetic Innovation Initiatives, with Science Group Projects, and with Initiatives from CGIAR's other Science Groups. It was through these linkages that Accelerated Breeding had impact. For example, insights from the Market Intelligence Initiative were used to set breeding objectives, both for variety development and TD&D. Once superior varieties were developed, it was the seed system, supported by the CGIAR Research Initiative on Seed Equal, that ensured successful delivery to farmers. Accelerated Breeding used the tools and services provided by the CGIAR Research Initiative on Breeding Resources. Important linkages also existed outside of the Genetic Innovation Science Group. For example, by collaborating with the CGIAR Research Initiative on Plant Health, breeding teams were rapidly informed of emerging pathotypes requiring resistance breeding. Conversely, field breeders alerted Plant Health scientists of emerging epidemics or of incursions and the emergence of novel pathotypes in a region.

Accelerated Breeding acknowledges that delivering improved genetics alone is insufficient to ensure agricultural success. CGIAR-NARES collaborations with Initiatives such as the Excellence in Agronomy platform reinforced holistic interventions, ensuring that new varieties performed optimally in farmers' fields. This highlights a broader systems approach, integrating breeding innovations with agronomic best practices to maximize impact.

1. Market intelligence and breeding alignment

A major aspect of Accelerated Breeding's Portfolio linkages was the integration of market data and intelligence from the <u>Market</u> <u>Intelligence Initiative</u>, to inform breeding decisions. <u>ReFOCUS</u> <u>worked extensively with Market Intelligence's Work Package 1</u> to systematically define and document crop market segments across sub-regions, using a standardized framework of eight criteria that considered crop use, location, and production practices. This effort led to the identification of 701 distinct and active market segments, ensuring that breeding programs were aligned with farmer, processor, and consumer needs.

ReFOCUS and TRANSFORM further worked with Market Intelligence's Work Package 2 to establish TPPs for each market segment. The structured classification of traits – essential, improve traits, essential threshold traits, and nice-to-have – ensured that breeding pipelines focused on delivering varieties that provide an impactful, farmeror market-demanded advantage over currently grown varieties, and so merit investment. The resulting 418 active TPPs serve as a foundation for targeted breeding efforts, linking market needs directly to breeding objectives. Additionally, ReFOCUS identified 157 active CGIAR breeding pipelines and worked with Market Intelligence's Work Package 4 to assess the effectiveness of pipelines based on impact, feasibility, and <u>gender responsiveness</u>. Market Intelligence's Work Package 4 contributed by providing data-driven priority indexes to help prioritize crop investments.

2. Standardization and transparency in breeding processes

The harmonization of terminology and stage definitions across the Genetic Innovation Initiatives was a key achievement of ReORGANIZE. By implementing a stage-gate plan and a SIPOC model, transparency and communication between the Market Intelligence, Genebanks, Seed Equal, and Breeding Resources Initiatives significantly improved.

Alignment with the Root-Tuber-Banana breeding project – achieved by taking a consistent approach to how work is structured (e.g., using the same Work Packages) and standardizing deliverables, including key indicators to measure progress – served as a proof of concept for broader dissemination of ReORGANIZE tools and methodologies. These tools and frameworks were further shared among CGIAR Centers, NARES, and Advanced Research Institutes, promoting a standardized, more effective approach to breeding processes.

3. Strengthening partnerships and capacity development

From 2022 to 2024, TRANSFORM increasingly focused on fostering CGIAR-NARES collaboration across the whole of CGIAR's Genetic Innovation Science Group. With TRANSFORM support, partnership and capacity development efforts now extend across multiple Initiatives, including the Breeding Resources, Market Intelligence, and Seed Equal Initiatives. A key example of this integration is the incorporation of seed systems work into regional networks, which was a central discussion point during the third CGIAR-NARES leadership meeting led by Accelerated Breeding. This exemplifies how Portfolio linkages can be strengthened by actively working towards expanding partnerships and enhancing collaborative efforts. TRANSFORM also worked closely with the CapSha Accelerator to establish the <u>Collaborative Breeding Leadership Program</u> (CBLP), further enhancing capacity-building efforts in breeding networks.

4. Trait discovery, deployment, and data-driven decision-making

DISCOVER worked on the critical role of TD&D in breeding pipelines. Extensive data contributions from CGIAR breeding programs enabled DISCOVER to build a robust portfolio of traits and conduct key informant interviews to refine trait priorities. <u>Market Intelligence</u> worked with DISCOVER to develop a return-on-investment model for traits, incorporating levels of selection as a key metric.

5. Collaboration with the Breeding Resources Initiative

The Breeding Resources Initiative provided specific tools and services in support of modern breeding approaches. Accelerated Breeding worked closely with the Breeding Resources Initiative to:

- Clearly define and quantify breeding teams' needs.
- Co-design and promote a new Breeding Resources-sponsored analytical pipeline called <u>Bioflow</u>.
- Promote <u>common service provision</u> for genotyping and nutritional analysis, as provided by Breeding Resources.
- Assess NARES infrastructure to prioritize <u>CtEH</u> investments.
- Evolve the functional requirements for data management systems.

The interconnectedness of these Work Packages and Initiatives illustrates a comprehensive and collaborative approach to modernizing breeding efforts. Accelerated Breeding strengthened linkages across the CGIAR Portfolio by aligning market intelligence with breeding strategies, standardizing processes, fostering partnerships, leveraging data-driven trait discovery, and optimizing pipelines.



Providing African farmers with better varieties faster.

Accelerated Breeding developed a data-driven approach to aligning breeding objectives with the needs of over 100 million farmers and consumers in Africa.



Primary Impact Area



Contributing Initiative

Market Intelligence

Contributing Centers

Contributing external partners

Acharya N. G. Ranga Agricultural University (ANGRAU) Agricultural Research Corporation (ARC) · Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) · Bangladesh Institute of Nuclear Agriculture (BINA) · Bangladesh Rice Research Insitute (BRRI) · Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA) · Centre national de recherche agronomique (CNRA) · Council for Scientific and Industrial Research-Savanna Agricultural Research Institute (CSIR-SARI) · Council for Scientific and Industrial Research (Ghana) (CSIR) · Department of Research and Specialist Services (Zimbabwe) (DR&SS) · East Africa Seed Company Ltd. (EASEED) · Ethiopian Institute of Agricultural Research (EIAR) · Indian Agricultural Research Institute (IARI) · Indira Gandhi Krishi Vishwavidyalaya University (IGKVV) · Institut d'Economie Rurale (Mali) (IER) · Institut de Recherche Agronomique de Guinée (IRAG) · Institut National de la Recherche Agronomique du Niger (INRAN) · Institut National de Recherche Agricole du Benin (INRAB) Institut National pour l'Etude et la Recherche Agronomiques (INERA DRC) · Institute of Agricultural Research (Nigeria) (IAR) · Institute of Agricultural Research for Development (IRAD) · Kenya Agricultural and Livestock Research Organization (KALRO) ·

Mozambiques Institute of Agricultural Research (IIAM) · NALWEYO SEED Company (NASECO) · National Agricultural Research Organisation (Uganda) (NARO) · National Cereals Research Institute (NCRI) · National Crops Resources Research Institute (NACCRI) · National Root Crops Research Institute (NRCRI) · National Wheat Research Program (NWRP) · Nepal Agricultural Research Council (NARC) · Punjab Agricultural University (PAU) · Rwanda Agriculture and Animal Resources Development Board (RAB) · The National Agricultural Study and Research Institute (INERA) · University of Abomey Calavi (UAC) University of Queensland (UQ) · West and Central African Council for Agricultural Research and Development (CORAF/ WECARD) · Zambia Agriculture Research Institute (ZARI)

Geographic scope



Regions: Central and West Asia and North Africa (CWANA) · East and Southern Africa (ESA) · Latin America and the Caribbean (LAC) · South Asia (SA) · Southeast Asia and the Pacific (SEA) · West and Central Africa (WCA) CGIAR breeding partnerships have a profound global impact, contributing to food security, nutrition, climate resilience, and poverty reduction. This impact is now further amplified through key innovations introduced by the CGIAR Research Initiative on Accelerated Breeding, in collaboration with the CGIAR Research Initiative on Market Intelligence. These innovations enable breeders to better understand the needs of farming communities and develop high-impact crop varieties faster. By transforming breeding processes, CGIAR Centers and partners have enhanced effectiveness and responsiveness to agricultural challenges. This is feeding into CGIAR's extensive partnership network that, between 2022 and 2024 alone, registered varieties that are relevant to 50-100 million low-income people.

Breeding is a powerful tool that helps farmers adapt to climate change, enhance food security, build resilience, and improve income. Improved crop varieties have been the main technology through which CGIAR crop Centers, in collaboration with their national counterparts, have made <u>welfare impacts over the past decades</u>. Approximately 40 percent of all modern varieties in the developing world originate from such collaboration, generating an economic surplus of USD 40 billion annually.

Breeding, however, is also a costly endeavor that needs to be carefully targeted to be successful. This is particularly true in Africa where the needs of farmers, users and growing environments are highly diverse, and a wide range of crops are cultivated; and yet breeding investments often rely on scarce public funds.

How can we provide farmers with better varieties faster? Over the past three years, CGIAR and local breeding communities have tackled this challenge – not just in theory but also in practice.

Take beans, maize or cassava, for example, staple foods for millions of smallholders in Africa. Who needs what type of variety? This seemingly simple question has a complex answer. A variety must be tailored to both how it is grown and how it is consumed. Social and economic factors influence the choices of farmers and consumers, which sometimes vary even within the same village.

Even without solid data, a genuine commitment to finding the right answer can go a long way. In this case, it was the determination to gather diverse stakeholder insights on the future varieties needed by African farmers that made the difference. Teaming up across the breeding community, 16 countries mobilized over 90 expert consultations, involving farmer organizations, extension staff and local processors. They captured these insights systematically, introducing many to the concept of market segments and Target Product Profiles (TPPs).

Market segments and target product profiles define the unique combinations of grower and consumer requirements for a given crop in a particular country or region. They allow comparisons across countries and extraction of similarities. Most importantly, grassroot information, originating from stakeholder consultations, can be combined with indicators such as agroecological zones, hectares cultivated, average yields, the number of people in poverty or undernourished, or the expected climate change impact.

Connecting the dots was key – and that is exactly what the research community achieved. The result? Grassroots feedback suddenly had a much louder voice. Some market segments affected just a few thousand people, while others impacted millions, including some of the world's poorest communities. At the same time, the TPPs revealed a critical insight: the traits most valued by farmers did not always align with the priorities breeders had been targeting.

With such data-driven insights at hand, also beyond Africa, establishing a locally informed breeding strategy became easier. For example, the International Center for Tropical Agriculture's (CIAT's) bean breeding program previously managed four overlapping breeding pipelines, breeding for the same market segments. After mapping market segments, the program streamlined its focus, aligning each pipeline with the most critical traits and limited market segments, while serving a greater number of potential beneficiaries.

Indeed, this feedback suggests that resources can be strategically focused on fewer, more impactful pipelines, ultimately delivering better varieties to farmers faster – turning into reality the very ambition breeders set out to achieve.

Variety development is an iterative process, with each breeding cycle building on the progress of the last. The faster the cycle turns, the greater the potential for improvement. Whether for climate adaptation, high-value market traits, or resistance to emerging crop diseases, understanding which traits communities prioritize in each market segment allows breeders to incorporate them early in the process. This not only accelerates the breeding cycle but also ensures that new varieties are selected based on data that reflects farmers' needs and real-world conditions.

Likewise, with these datasets in hand, it becomes much easier to pinpoint the benefits of the more than 900 crop varieties registered by CGIAR partners between 2022 and 2024 across 66 countries. Once scaled, these varieties could benefit as many as 50–100 million people who need them most.

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It's actually quite simple. We are running faster in the right direction, a direction we would not have known with such precision if we had not teamed up as a community across crops, countries and institutions to acquire more systematic stakeholder input and make some truly insightful data linkages. Combined with cutting-edge breeding tools, it will make forthcoming crop varieties even more impactful.

Clare Mukankusi, Global Breeding Lead – Common Bean, The Alliance of Bioversity International and CIAT



2022 key result story

Cultural transformation in CGIAR and national programs drives collaborative breeding networks to deliver towards national, CGIAR, and SDG 2030 goals



2023 key result story

Transforming breeding partnerships for greater impact



