



INITIATIVE ON
Breeding Resources



CGIAR Initiative on Breeding Resources

ANNUAL TECHNICAL REPORT 2022



CGIAR Technical Reporting 2022

CGIAR Technical Reporting has been developed in alignment with the [CGIAR Technical Reporting Arrangement](#).

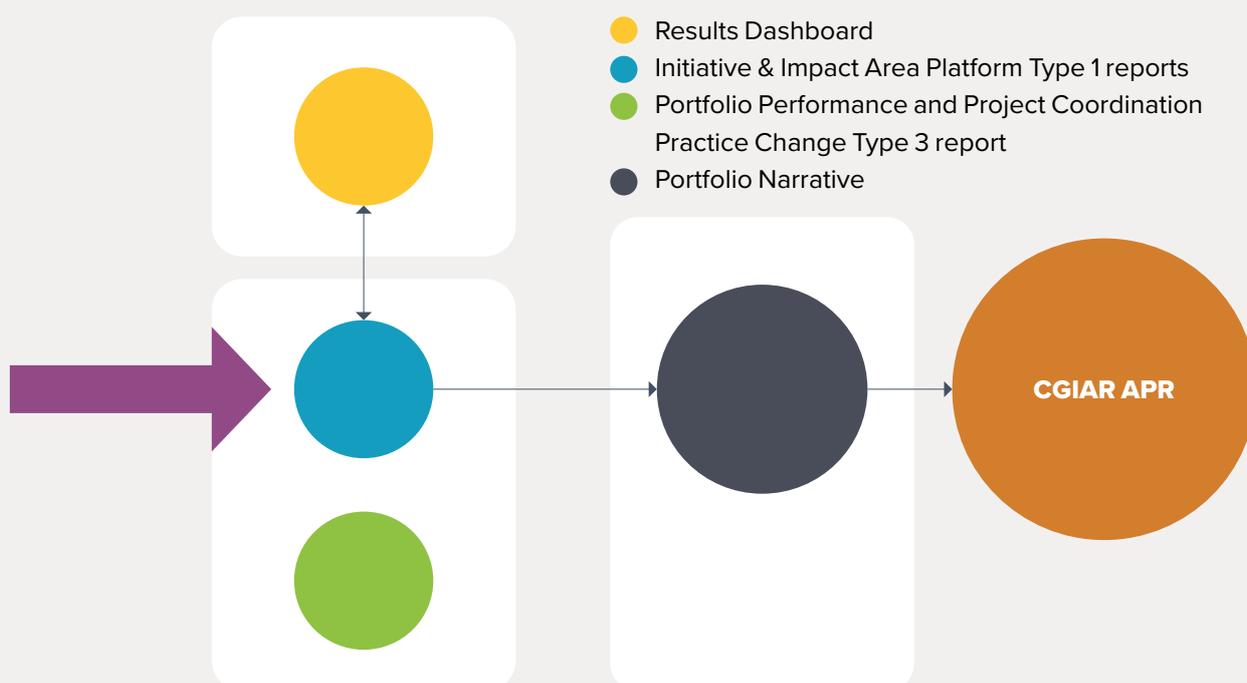
This Initiative report is a Type 1 report and constitutes part of the broader CGIAR Technical Report. Each CGIAR Initiative submits an annual Type 1 report, which provides assurance on Initiative-level progress towards end-of-Initiative outcomes.

The CGIAR Technical Report comprises:

- Type 1 Initiative and Impact Area Platform reports, with quality assured results reported by Initiatives and Platforms available on the CGIAR Results Dashboard.

- The Type 3 Portfolio Performance and Project Coordination Practice Change report, which focuses on internal practice change.
- The Portfolio Narrative, which draws on the Type 1 and Type 3 reports, and the CGIAR Results Dashboard, to provide a broader view on portfolio coherence, including results, partnerships, country and regional engagement, and synergies among the portfolio's constituent parts.

The CGIAR Technical Report constitutes a key component of the CGIAR Annual Performance Report (APR).



US\$	2022	2023	2024
Proposal Budget from initial submission	US\$18,649,000	US\$21,496,000	US\$21,855,000
Approved 2022 Budget	US\$6,956,193		

2022 Disbursement Target based on Approved FinPlan

Section 1 Fact sheet

Initiative name	Breeding Resources
Initiative short name	Breeding Resources
Action Area	Genetic Innovation
Geographic scope	<p>Regions targeted in the proposal: This initiative does not have regions targeted in the proposal</p> <p>Countries targeted in the proposal: This initiative does not have regions targeted in the proposal</p>
Start date	Jan. 1, 2022
End date	Dec. 31, 2024
Initiative Lead	Young Wha Lee – y.w.lee@cgiar.org
Initiative Deputy	Sharifah Syed Alwee – s.syedalwee@cgiar.org
Measurable three-year End of Initiative outcomes (EOI-Os)	<p>EOI-O 1: Quicker variety development by CGIAR-NARS breeding programs. Reduced breeding cycle time, enabled by Breeding Resources services and technologies.</p>
	<p>EOI-O 2: Improved capacity of CGIAR-NARS breeding programs to address climate change. This outcome will be accomplished by data-driven breeding that integrates genomic, phenotypic, and environmental data at major decision points in the breeding cycle.</p>
	<p>EOI-O 3: Improved performance of varieties produced by CGIAR-NARS breeding programs. Increased precision and speed of breeding will improve the quality of and market demand for varieties. Prospective indicators to detect changes in speed and precision along the breeding product pipeline will be developed with Accelerated Breeding Initiative (ABI).</p>
	<p>EOI-O 4: Improved cost-effectiveness of CGIAR-NARS breeding program. Cost-effectiveness is a ratio of cost to performance. Improvements are achieved by reducing cost or increasing performance of breeding programs.</p>
	<p>EOI-O 5: CGIAR-NARS breeding program leadership on Impact Areas. This outcome is internally directed toward improving the operation of breeding programs in such Impact Areas as gender equality and environmental management.</p>
	<p>EOI-O 6: Increased capacity of NARS breeding programs. The ability of NARES to access and use the services and technologies established by Breeding Resources.</p>
	<p>EOI-O 7: Ongoing improvement of CGIAR-NARS breeding programs, The contribution of Breeding Resources services and technologies to achieving modernization targets set by ABI.</p>

OECD DAC Climate marker adaptation score*	Score 1: Significant: 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.
OECD DAC Climate marker mitigation score*	Score 0: Not targeted: The activity does not target the climate mitigation, climate adaptation, and climate policy objectives of CGIAR, as put forward in its strategy.
OECD DAC Gender equity marker score*	Score 0: Not targeted: The Initiative/project has not been found to target gender equality. However, as a minimum requirement for all Initiatives/projects: (i) a gender analysis was conducted; (ii) its findings should be used to ensure that, at a minimum, the Initiative activities/interventions do no harm and do not reinforce gender inequalities; and (iii) data that is collected is gender disaggregated.
Website link	https://www.cgiar.org/initiative/breeding-resources/
<p>*The Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC) markers refer to the OECD DAC Rio Markers for Climate and the gender equality policy marker. For climate adaptation and mitigation, scores are: 0 = Not targeted; 1 = Significant; and 2 = Principal. 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.</p>	



CIMMYT Senior Scientist and Cropping Systems Agronomist, Nele Verhulst (blue shirt), shows the benefits of conservation agriculture to visitors at CIMMYT's experimental station in Texcoco, Mexico. Photo credit: Francisco Alarcón / CIMMYT



Section 2 Initiative progress on science and towards End of Initiative outcomes



Overall summary of progress against the theory of change

CGIAR-NARES breeding networks must proactively breed for changing climate conditions and market demands in addition to yield and nutrition, to meet the complex and multi-trait product profiles demanded by today's end-users. Breeding Resources is an initiative to develop enabling services such that CGIAR-NARES breeding

Rice Straw
Photo credit: IRRI

networks can meet those demands, by fully leveraging advances in contributory fields that have revolutionized modern breeding into a data-driven enterprise.

Our value proposition rests on the fact that many of the technologies that define modern breeding are crop-agnostic and Center-agnostic. Those technologies are best delivered and scaled as a

centrally coordinated service, rather than duplicating the infrastructural and personnel investments required for those technologies across multiple institutions. In some cases, the technologies are commercially sourced. Given the high cost of maintenance, depreciation, and other related costs in a highly heterogeneous landscape of technologies and tools, sustainable operations cannot be achieved without some level of consolidation and standardization.

Breeding Resources envisioned six core services in **Work Package 2** to support CGIAR-NARES networks. Significant progress was made on the establishment of 4/6 services: genotyping, nutrition testing, genome sequencing, and drone phenotyping. Two of the four (genotyping and sequencing) are in active use. Two services – Breeding Analytics and Bioinformatics – had scope changes (see Section 7), but we plan to still make progress on best practice standardization through the Breeding Analytics process team (launched as a part of **Work Package 3**). Each service will be fully costed and developed according to a sustainable business model (**Work Package 1**), with data requirements reflected in the development of the Enterprise Breeding System (**Work Package 4**), and supported with a capacity development plan (**Work Package 5**).

The high-volume datasets that characterize modern breeding must be actively managed for fast turnaround and data flow, so that major decision points in the breeding process can be supported by the best available data and analyses. In **Work Package 4**, we also made significant progress towards digitizing CGIAR breeding programs by putting the Enterprise Breeding System into open use at the International Maize and Wheat Improvement Center (CIMMYT), the International Rice Research Institute (IRRI), AfricaRice and the International Institute of Tropical Agriculture (IITA) for rice, wheat, and maize. Adoption was supported

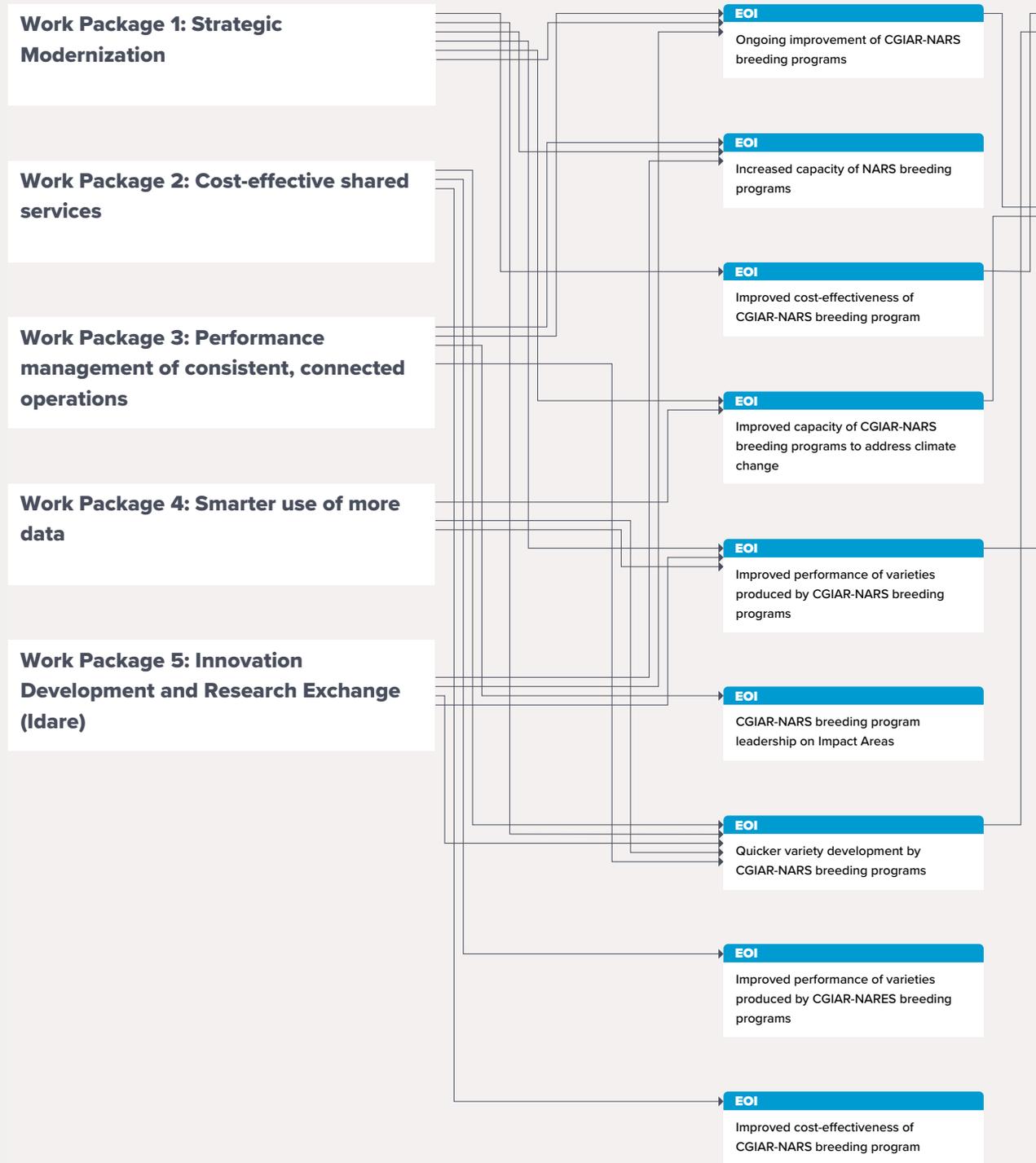


by an extensive training program, a dedicated Help Desk to resolve blockers in daily use, and monthly tracking of usage metrics to troubleshoot adoption bottlenecks, setting the stage for expansion to additional Centers and crops in 2023.

We are keenly aware that to achieve lasting changes in breeding operations, access to new technologies is not enough. We must also invest in people and ways of working. In **Work Package 3**, we delivered institutional innovations for structured change implementation. In 2022, we established the Breeding Process Model, which provides a joint decision-making structure for collaboration, deployment, and improvement of Genetic Innovations processes. Four process improvement teams were launched in the areas of lab, trialing, and nursery support, and breeding analytics, and product development (led by **Accelerated Breeding REORGANIZE**), each with a core group of representatives across Centers and a mandate to harmonize practices and activities in their respective expertise areas. By building trust through sharing of information and decisions, we have a basis from which to establish validated best practices as institutional knowledge in local settings, raising the bar for breeding and operational excellence across CGIAR and partners.

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.



Teams from CGIAR's three Action Areas — System Transformation, Resilient Agrifood Systems and Genetic Innovation — worked to develop an improved set of Action Area outcomes in October 2022. Since this was near the end of the reporting cycle for 2022, it was decided not to update the theories of change based on these new Action Area outcomes.

The exception to this is Genetic Innovation — for this Action Area, as the new outcomes had already been widely discussed among the relevant Initiatives, and with its advisory group of funders and other stakeholders, the decision was made to update their outcomes in time for the 2022 reporting cycle.

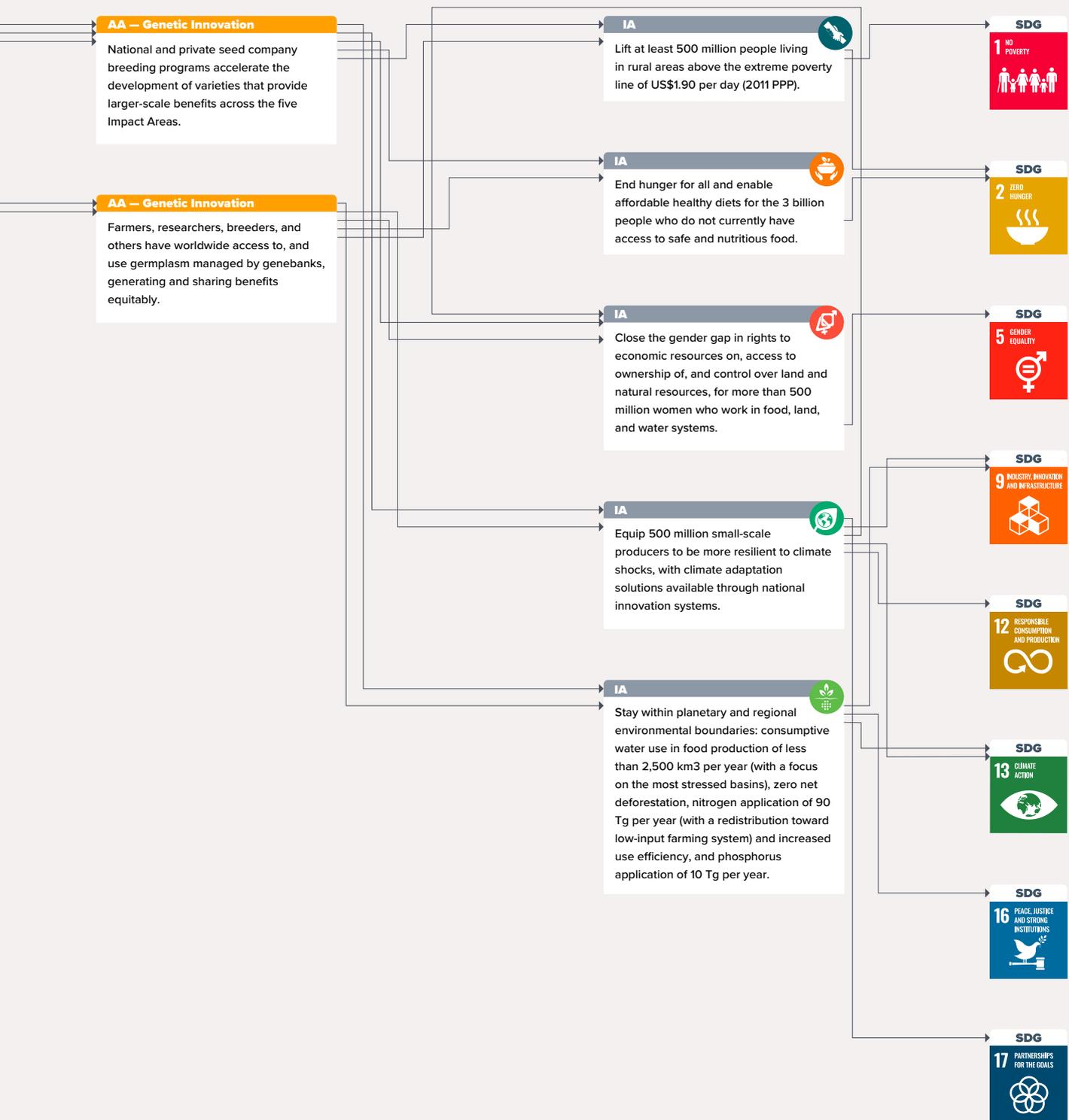
EOI — End of Initiative outcome

AA — Action Area

IA — Impact Area

SDG — Sustainable Development Goal

-  Nutrition, Health, and Food Security
-  Poverty Reduction, Livelihoods, and Jobs
-  Gender Equality, Youth, and Social Inclusion
-  Climate Adaptation and Mitigation
-  Environmental Health and Biodiversity



Progress by End of Initiative outcome

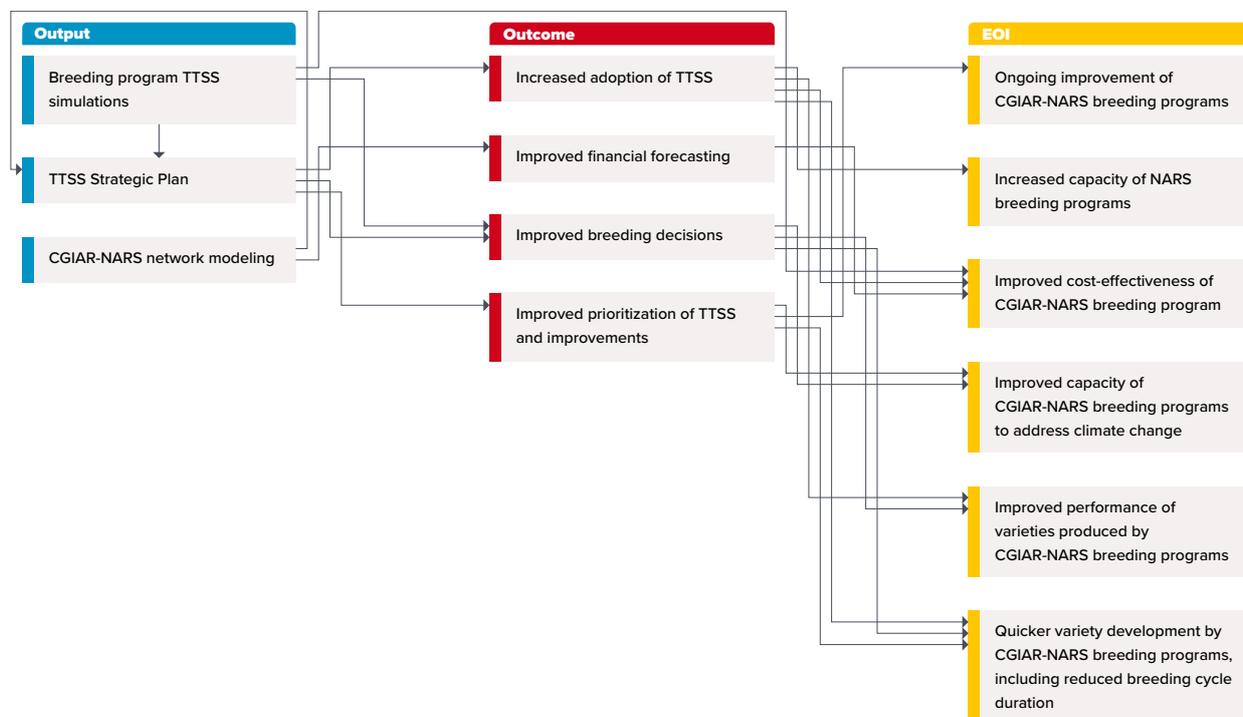
<p>EOI-O 1 Quicker variety development by CGIAR-NARS breeding programs</p>	<ol style="list-style-type: none"> 1. Sequencing service was established and produced reference genomes to aid the development of standard marker panels for genomic selection. 2. Genotyping service increased customer volume 3x and is prepared to scale to support genomic selection in 2023 with an online sample submission portal. 3. New services were piloted in drone phenotyping and nutrition testing.
<p>EOI-O 2 Improved capacity of CGIAR-NARS breeding programs to address climate change through data-driven breeding</p>	<ol style="list-style-type: none"> 4. Process teams in trialing and nursery services, and lab services were established, setting the stage for harmonization of data generation protocols and workflows for consistent and high-quality data. 5. A new data management system went into production usage for the first time, enabling digitization and data workflows for maize, rice, and wheat programs. 6. Consensus built around establishing a data lake and catalog in 2023 to facilitate complex analytics and data interoperability, and bilateral funding was approved to support it from Crops to End Hunger.
<p>EOI-O 3 Improved performance of varieties produced by CGIAR-NARS breeding programs</p>	<ol style="list-style-type: none"> 7. We implemented robust capacity building programs in data management, genotyping sampling logistics, and the application of continuous improvement principles to breeding operations. <p>All these services and technologies support the three EOI outcomes through enabling greater speed in breeding operations, more accurate breeding decisions, and more complex analytics for increased breeding precision to fit market demand.</p>
<p>EOI-O 4 Improved cost-effectiveness of CGIAR-NARS breeding program</p>	<p>Cost-effectiveness is a ratio of cost to performance. Improvements are achieved by reducing cost or increasing performance of breeding programs. To reduce cost, we centralized data generating services in sequencing and genotyping, and further piloted the shared service cost Center model with the International Food Policy Research Institute (IFPRI)-HarvestPlus for nutrition testing. For improving performance, process teams in trialing and nursery services, and lab services were established, setting the stage for harmonization of data generation protocols and workflows for consistent and high-quality data. We also ran extensive continuous improvement training for improved breeding operations and increased mechanization.</p>

<p>EOI-O 5 CGIAR-NARS breeding program leadership on Impact Areas in improving gender equality and environmental management at the workplace</p>	<p>We produced a gender inclusion checklist for farm operations to guide station leaders in their improvement efforts in this area. In 2023, we will develop a performance monitoring system that will include tracking indicators on the Impact Areas applied to internal breeding operations.</p>
<p>EOI-O 6 Increased capacity of NARS breeding programs</p>	<p>60% of samples run through the genotyping service came from National Agricultural Research and Extension Systems (NARES) or NARIS. We also ran extensive capacity building workshops for regional leaders in Sub-Saharan Africa NARES in breeding operations, focusing on farm management, equipment mechanization, and improved phenotyping. Further expansion of services to NARES is expected in future years, but will be subject to constraints from funding limitations</p>
<p>EOI-O 7 Ongoing improvement of CGIAR-NARS breeding programs according to their modernization plans</p>	<p>We coordinated extensively with Accelerated Breeding Initiative (ABI) Work Package leads in the design and prioritization of services, to enable the modernization plans laid out in ABI ACCELERATE.</p>



Section 3 Work Package-specific progress

Work Package 1: Strategic modernization



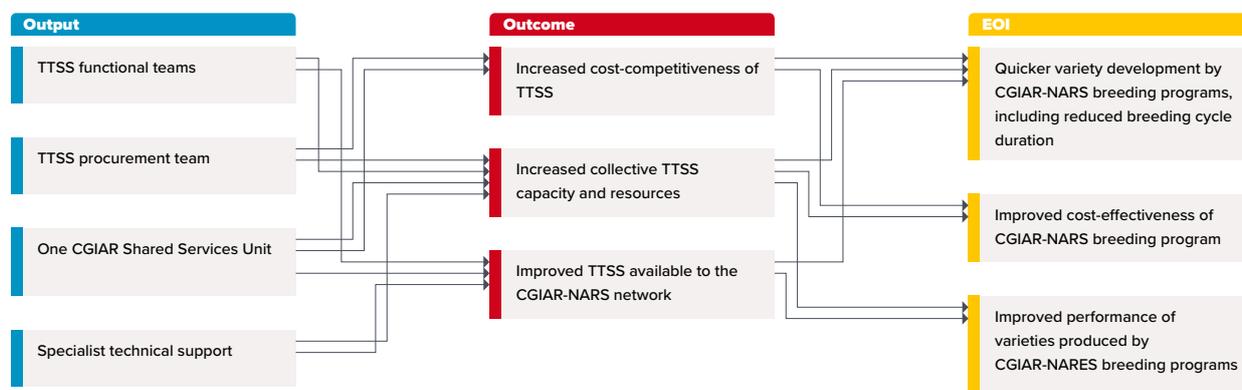
Work Package 1 progress against the theory of change

The Work Package originally aimed to guide modernization investment decisions by optimization of breeding programs according to quantitative genetic principles and the development of financial forecasting capability for breeding operations and services. The Work Package underwent changes in 2022 that resulted in a significant narrowing of scope, driven by organizational changes that occurred as the Genetic Innovations departments formed and initiative roles became fleshed out. The changes were also needed as it became clear that pooled funding would not accommodate significant investments in new technologies but must be directed to the day-to-day operational costs of breeding programs.

Major changes: Breeding program costing and quantitative genetic modelling capacity moved to the **Accelerated Breeding Initiative**.

Breeding Resources focused on costing of services (also see Work Package 2), with the goal of establishing these services in sustainable cost recovery mode in collaboration with key funders. We determined a general model for such services wherein one or two Centers would “host” the service and vendor relationships on behalf of the CGIAR, and this was piloted with support from IFPRI and International Center for Agricultural Research in the Dry Areas (ICARDA). We also coordinated investment in new technologies and tools through Crops to End Hunger and will continue to provide portfolio management of those investments through 2025.

Work Package 2: Cost-effective shared services



Work Package 2 progress against the theory of change

The Work Package establishes centrally coordinated, crop-agnostic breeding services that are both cost-competitive and effective, cutting duplication of infrastructural and personnel investments across CGIAR. This is achieved by organizing existing capacity from Excellence in Breeding (EiB) in these areas into functional teams within Genetic Innovations, as well as leveraging the combined market strength of the CGIAR-NARS networks to facilitate cheaper access to external suppliers. There are six priority shared services.

1. Genotyping

C. 90,000 samples run for low-density panels, with 60% of customers from NARES and NARIS. C. 18,000 samples for mid-density panels. Eighteen crops served. Two new panels validated in cassava and sorghum. Completed development of a sample submission portal to scale the service in 2023. Robust training program in sampling logistics: 28 1:1 sessions, four online workshops (50–150 participants each), and 11 small group trainings (65 men and 56 women).

2. Sequencing

17 new reference genomes developed as community resources to support better marker development in musa, yam, cassava, cowpea, and groundnut.

3. Nutrition testing

Collaboration established with IFPRI-HarvestPlus to launch nutritional services for Zn and Fe using ICP platform with a third-party vendor.

4. High throughput phenotyping

Engaged consultant and developed strategy to mainstream high throughput phenotyping with select vendors.

5. Breeding Analytics

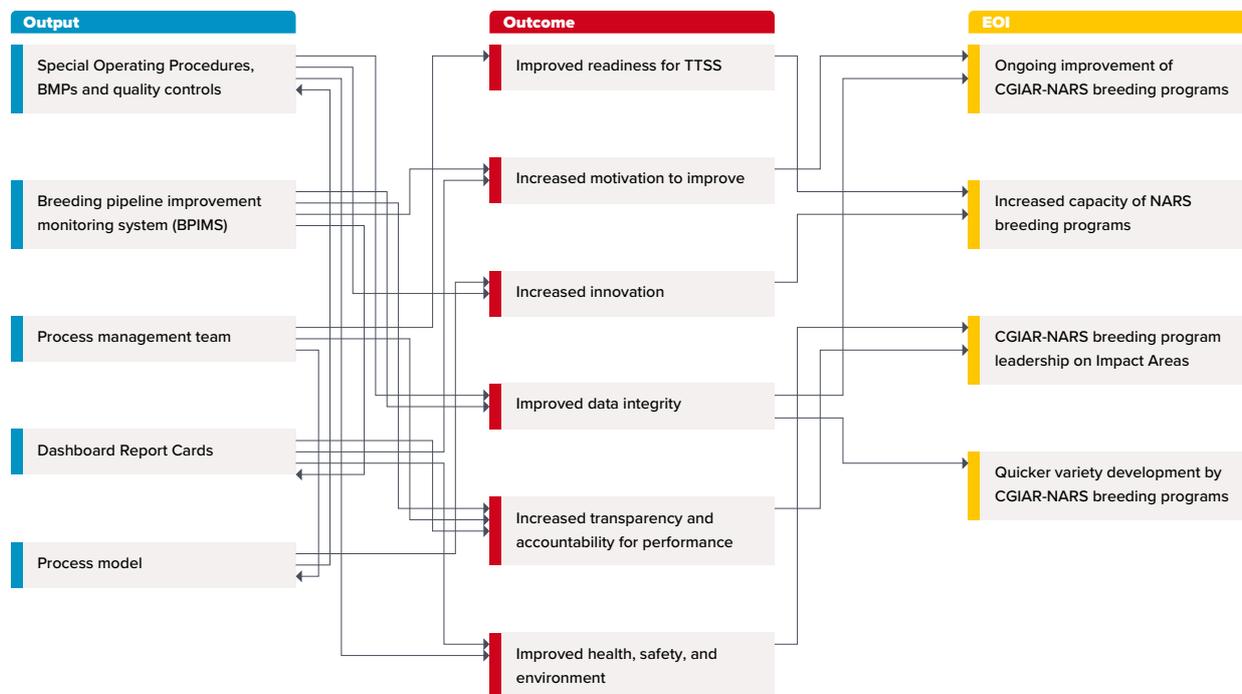
Need to confirm mandate for a central service as CGIAR evolves, as unlike the other services the focus is on organizing existing capacity at Centers.

6. Bioinformatics

Deprioritized due to funding limitations.

Work Package 3:

Performance management of consistent, connected operations



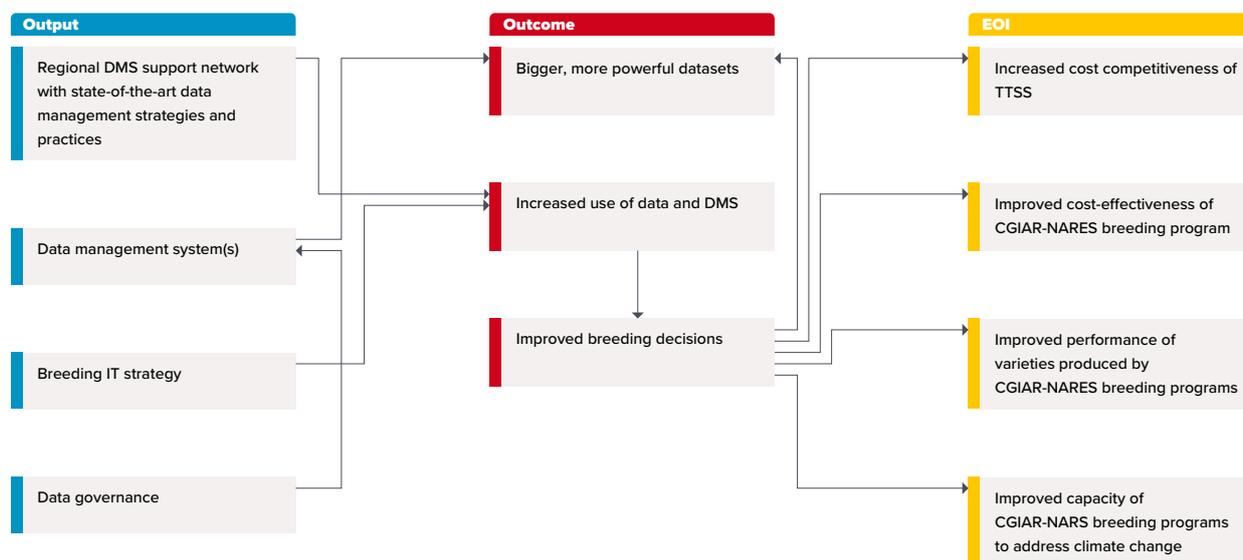
Work Package 3 progress against the theory of change

For new technologies to be adopted, people must also be trained, and new processes and workflows implemented — all in the face of a constantly turning breeding cycle. This Work Package delivers services to help multiple institutions implement change together, through establishing a resilient framework for coordinated and rigorous process management — a prerequisite for consistent and high-quality data generation and decision support in a collaborative breeding network.

We led the development of the Breeding Process Model, which provides a joint decision-making structure for collaboration, deployment, and improvement of Genetic Innovations

processes. Four process improvement teams were launched in the areas of lab, trialing, and nursery support, and breeding analytics, and product development, each with a core group of representatives across Centers and expertise areas. Process teams were equipped with tools and documentation standards for cross-Center harmonization and decision-making. We also launched the breeding data governance network to support process optimization with requirements for data quality and availability. A comprehensive capacity development program was implemented for continuous improvement principles and their application to breeding operations and mechanization, including the publication of a gender inclusion checklist tool for farm management operations.

Work Package 4: Smarter user of more data



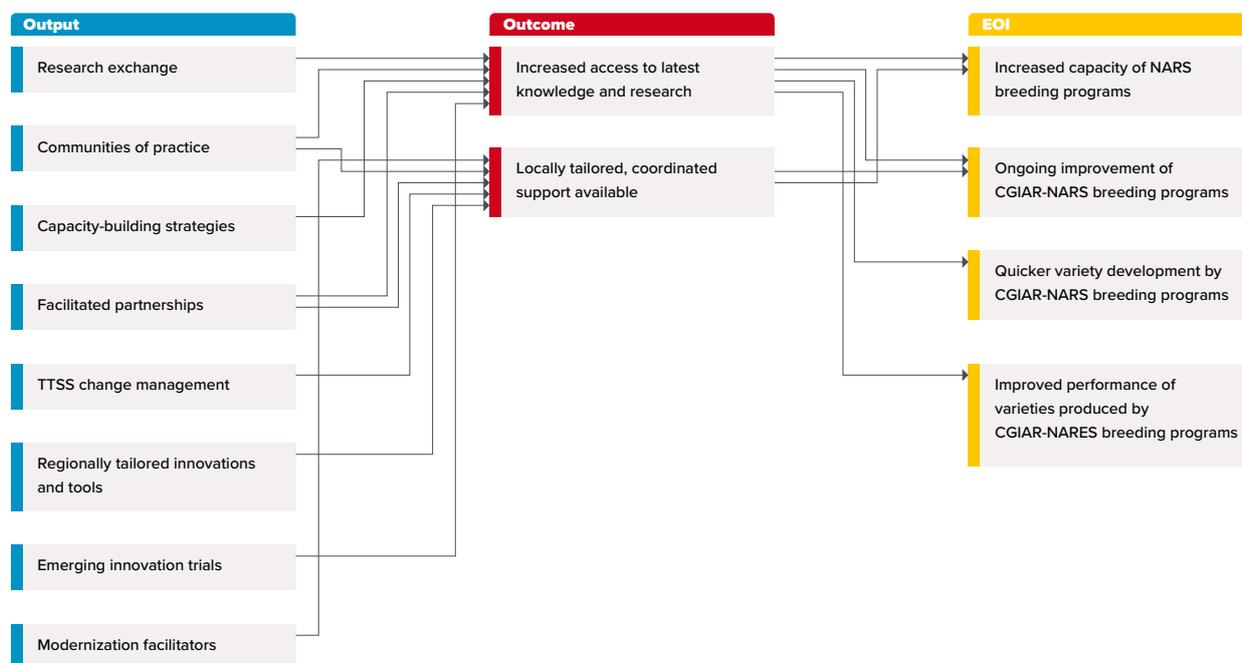
Work Package 4 progress against the theory of change

This Work Package aims to equip breeding programs with data management capabilities for large data volumes and fast turnarounds. Major goals include the development of the Enterprise Breeding System (EBS), ongoing support of legacy data management systems (DMS), support for adoption and implementation of DMS, and implementation of a sustainable and future forward strategy for breeding data management in OneCGIAR.

We developed and released two major versions of EBS in 2022, and successfully deployed EBS as a fully operational system at four Centers for three crops — IRRI, CIMMYT, AfricaRice, and IITA for rice, wheat, and maize — working closely with IT teams

at CIMMYT and IRRI. The EBS Support Desk was established for effective day-to-day support in usage, resolving more than 1,000 tickets with a 95% satisfaction rating. A comprehensive training program was also implemented that comprised 118 separate trainings of various sizes, with 263 women and 365 men trained to use EBS. For the first time in CGIAR, we took a systematic KPI-driven approach to adoption, tracking a common set of adoption indicators monthly, and used the metrics to adaptively respond when usage stalled. We also supported use of a legacy system (Breeding Management System, or BMS), formalized a data migration strategy for future users of EBS from BMS, and developed a data lake strategy to be implemented in 2023, to facilitate advanced breeding analytics and data interoperability.

Work Package 5: Innovation development and research exchange (Idare)



Work Package 5 progress against the theory of change

The Work Package originally aimed to increase adoption of modern breeding innovations by developing a group of regional “Change Leaders” with training in change management. These Change Leaders would work with breeding programs to assess demand and capacity for new technologies and develop suitable capacity building and change management plans for adoption. In 2022, we piloted the role of Change Leaders. We assembled a team of representatives from every CGIAR region, defined their terms of reference, provided change management coaching to the team, and conducted a joint project where we mapped demand and capacity for nutritional testing across geographic regions to help the design of services in Work Package 2.

The Work Package underwent a large reduction in scope at the end of 2022, as it is a significant

personnel investment that could not be prioritized at current funding levels. The regional Change Leader role was eliminated; instead, we consolidated the role into network coordinators from **Accelerated Breeding TRANSFORM**, who could theoretically perform the same function to some degree. While the cultural elements of change management were deprioritized, we still address institutional innovations for change delivery through Breeding Resources Work Package 3.

Going forward, we will prioritize technology adoption support with a narrower scope on the services offered in Work Package 2. Each of these services require significant capacity development to integrate the new technologies and methods into existing operations, and a dedicated coordinator will work across services to support their design, accessibility, and implementation.

Work Package progress rating

WORK PACKAGE	TRAFFIC LIGHT / RATIONALE
1	 <p>If we had retained the original scope and outputs of the work package, we would rate as red. However, the reduced scope is within our resources and is already well integrated into the development of services in Work Package 2.</p>
2	 <p>Services 1–4 are well on track to be established formally as a part of the Breeding Research Services Department in the Genetic Innovation Science Group. While some uncertainty exists for services 5 and 6, we will take advantage of complementary work in two bilateral grants (see Section 7) and the process teams (see Work Package 3) to establish standardization of best practices.</p>
3	 <p>Process teams are solidly established to pursue improvement projects in SOPS and workflows and the development of a KPI framework for breeding operations and services in 2023, with a clear mandate from the GI Management team.</p>
4	 <p>EBS established as a fully operational system at multiple Centers for rice, corn, and wheat. This foundation enables a long-term, sustainable future for data management in Genetic Innovations through increased consolidation into one enterprise system.</p>
5	 <p>If we had retained the original scope and outputs of the work package, we would rate as red. However, the reduced scope is within our resources and is already well integrated into the development of services in Work Package 2, as well as process teams in Work Package 3.</p>

KEY

On track	 <ul style="list-style-type: none"> • Annual 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 jeopardise success of Work Package
Delayed	 <ul style="list-style-type: none"> • Annual progress slightly falls behind Plan of Results and Budget and Work Package theory of change in key areas • Deviations/issues/delays/risks could jeopardise success of Work Package if not managed appropriately
Off track	 <ul style="list-style-type: none"> • Annual progress clearly falls behind Plan of Results and Budget and Work Package theory of change in most/all areas • Deviations/issues/delays/risks do jeopardise success of Work Package

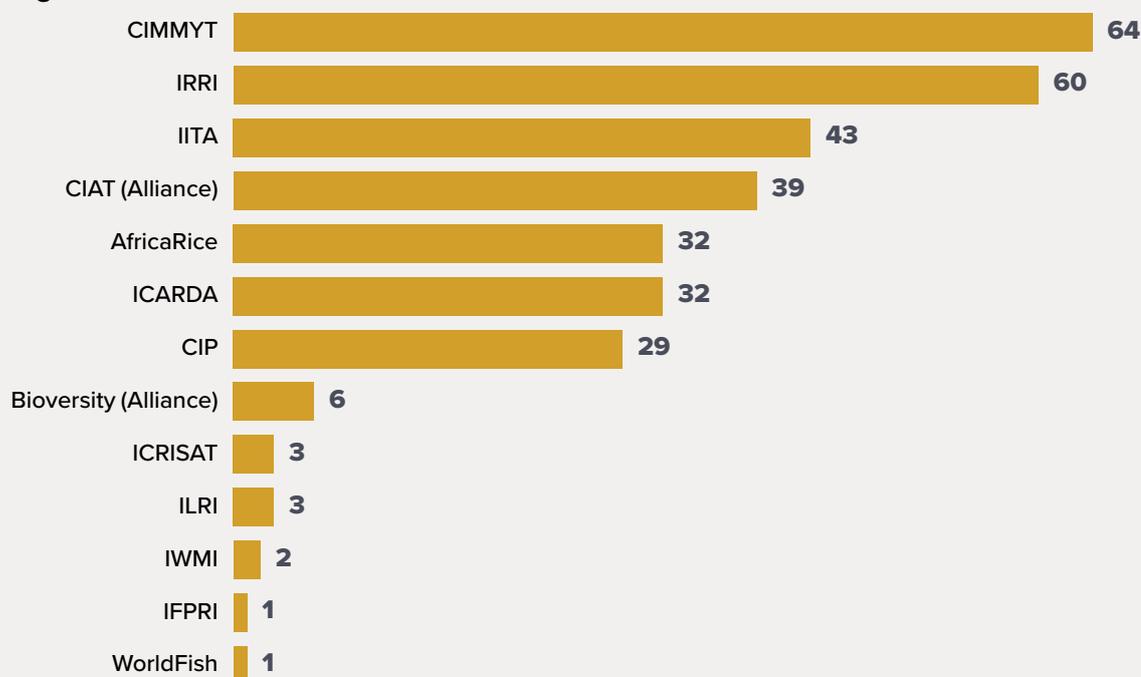
Section 4 Initiative key results

This section provides an overview of 2022 results reported by Breeding Resources. These results align with the CGIAR Results Framework and Breeding Resources' theory of change. Further information on these results is available through the [CGIAR Results Dashboard](#).

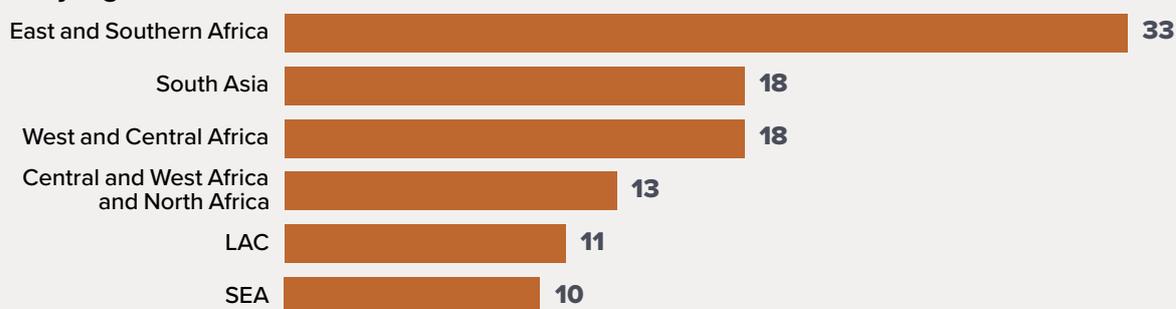
Overview



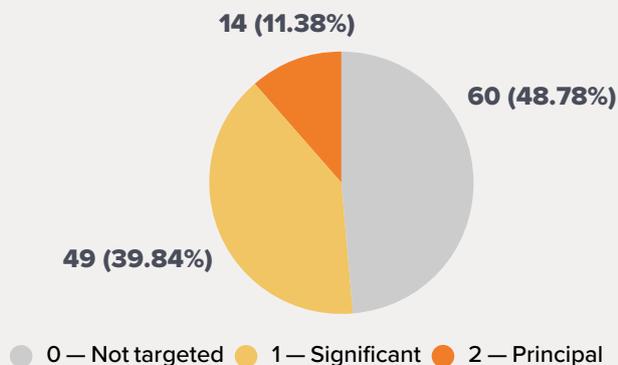
Contributing CGIAR Centers



Results by region



Results by gender tag

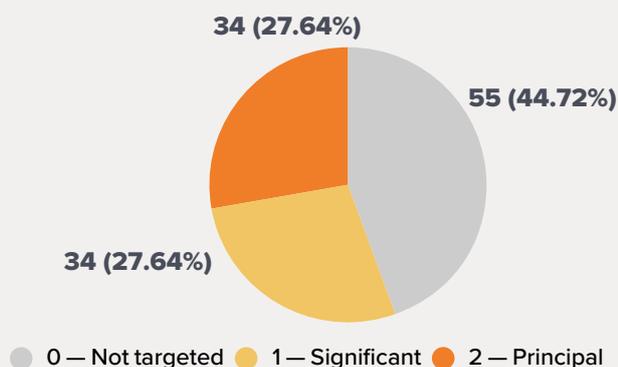


0 = Not targeted: The activity/result does not target gender equality.

1 = Significant: The activity/result contributes in significant ways to gender equality, even though it is not the principal focus of the activity.

2 = Principal: Gender equality is the main objective of the activity/result and is fundamental in its design and expected results.

Results by climate change tag

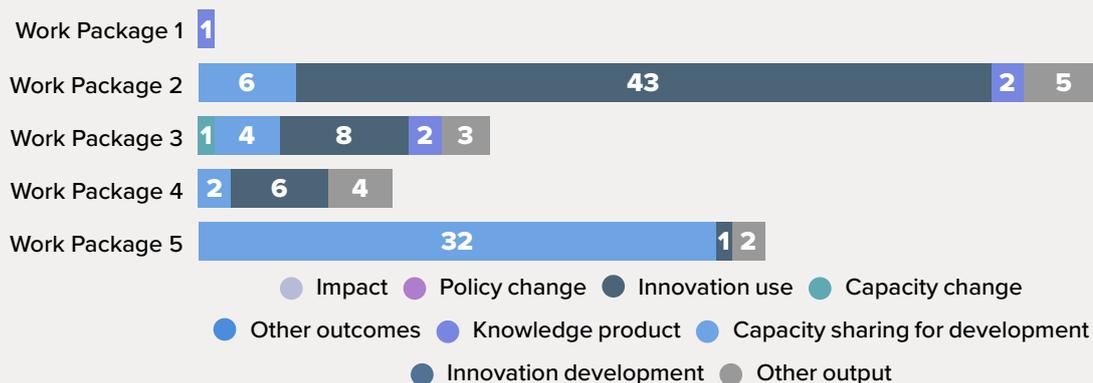


0 = Not targeted: The activity does not target climate mitigation, adaptation, and climate policy goals of the CGIAR as put forward in its strategy.

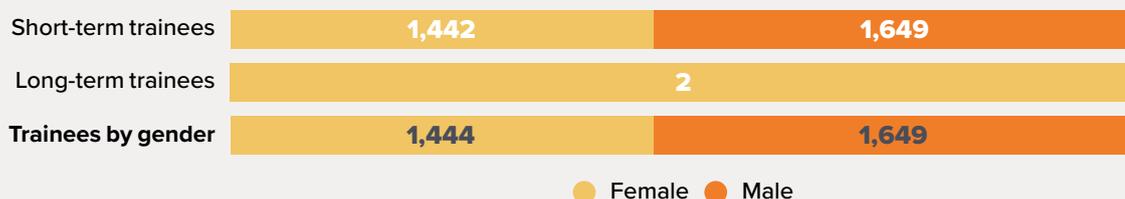
1 = Significant: The activity contributes in significant ways to either one of the three CGIAR climate-related strategy objectives — namely, climate mitigation, climate adaptation, and climate policy, even though it is not the principal focus of the activity.

2 = Principal: The activity is principally about meeting either one of the three CGIAR climate-related strategy objectives — namely, climate mitigation, climate adaptation, and climate policy, and would not have been undertaken without these objectives.

Results by Work Package



Capacity development trainees by term



Innovations by readiness level

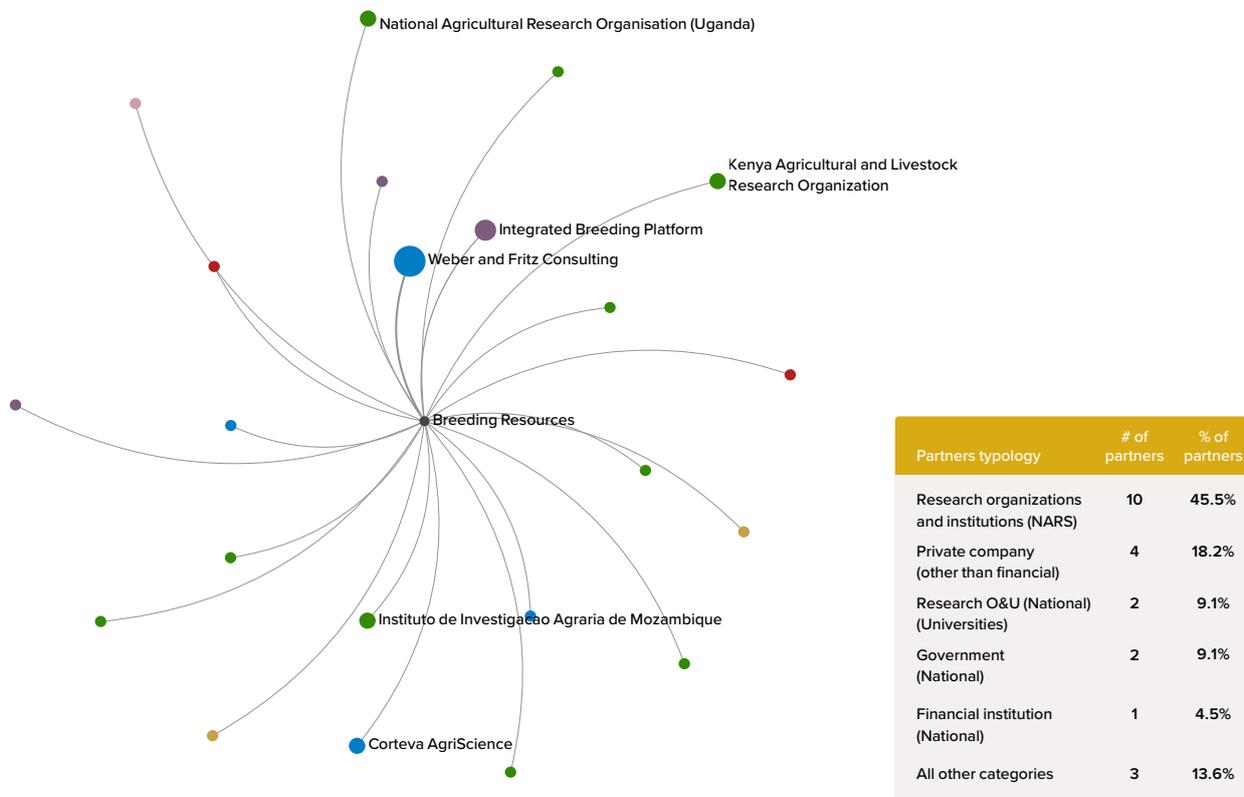
Pipeline overview
Number of innovations

9	PROVEN INNOVATION – The innovation is validated for its ability to achieve a specific impact under uncontrolled conditions	28
8	UNCONTROLLED TESTING – The innovation is being tested for its ability to achieve a specific impact under uncontrolled conditions	6
7	PROTOTYPE – The innovation is validated for its ability to achieve a specific impact under semi-controlled conditions	6
6	SEMI-CONTROLLED TESTING – The innovation is being tested for its ability to achieve a specific impact under semi-controlled conditions	2
5	MODEL/EARLY PROTOTYPE – The innovation is validated for its ability to achieve a specific impact under fully-controlled conditions	3
4	CONTROLLED TESTING – The innovation is being tested for its ability to achieve a specific impact under fully-controlled conditions	5
3	PROOF OF CONCEPT – The innovation’s key concepts have been validated for their ability to achieve a specific impact	3
2	FORMULATION – The innovation’s key concepts are being formulated or designed	5
1	BASIC RESEARCH – The innovation’s basic principles are being researched for their ability to achieve a specific impact	0
0	IDEA – The innovation is at idea stage	0

Results by country



Section 5 Impact pathway integration – External partners



Top five institution types

- All other categories
- Financial Institution (National)
- Government (National)
- Not applicable
- Private company (other than financial)
- Research O&U (NARS)
- Research O&U (National) (Universities)

Note: CGIAR Centres are excluded from the analysis. Partners and edges are sized by the number of results. Labels are shown for the partners involved in 13 or more results.

Partnerships and Breeding Resources, impact pathways

Breeding Resources is aimed at increasing the operational effectiveness of breeding networks led by Genetic Innovations, by consolidating the provision of crop- and Center-agnostic technologies into shared services that benefit NARES and CGIAR breeding operations. It is also an initiative with significant potential to change CGIAR ways of working. Thus, we focus on a small number of partners who can engage deeply with the initiative to demonstrate that consolidating selected functions in breeding operations as shared services brings real value.

Breeding Resources partnerships fall into two major categories: NARES and private industry:

- NARES are customers of the services, offering valuable feedback as we establish them to be fit-for-purpose. These NARES are breeding programs with strong interest and existing capacity to adopt new technologies. Partnership with these NARES involves not only provision of cost-effective services, but also includes a capacity development element, connecting local researchers to subject matter experts, building relationships and professional capabilities.
- Private industry are partners in provision of the services. They may be externally sourced vendors that we contract, consultants providing specific subject matter expertise in areas such as change management, or private breeding companies that advise the Initiative based on their experience with consolidating breeding operations.

Section 6 Adaptive management

RECOMMENDATION	SUPPORTING RATIONALE
<p>Reduce scope of Work Package 1.</p>	<p>Due to organizational changes that occurred as the Genetic Innovations departments formed and initiative roles became fleshed out, breeding program costing and quantitative genetic modeling capacity moved to the Accelerated Breeding Initiative (ABI).</p> <p>Strategic modeling of investment scenarios for tools and technologies was cut, as pooled funding must be directed to the day-to-day operational costs of breeding programs and will not accommodate significant investments in new technologies.</p> <p>We retained costing and forecasting support for services already planned in Work Package 2.</p>
<p>Reduce scope of Work Package 5.</p>	<p>The regional Change Leader role was eliminated, and with it, most of the outputs of the work package, as it is a significant personnel investment that could not be prioritized at current funding levels.</p> <p>Network coordinators from ABI TRANSFORM will instead perform some of the same activities in service demand and capacity assessment.</p> <p>While the cultural elements of change management were deprioritized, we still address institutional innovations for change delivery through Breeding Resources Work Package 3.</p> <p>We retained capacity building support for the services offered in Work Package 2. Each of these services require significant capacity development to integrate the new technologies and methods into existing operations, and a dedicated coordinator will work across services to support their design, accessibility, and implementation.</p>
<p>Alter scope of Breeding Analytics in Work Package 2.</p>	<p>We de-prioritized the hiring of a global breeding analytics lead and altered the scope of the Breeding Analytics service unit to a Breeding Analytics network. The process owner of the breeding analytics process team (Work Package 3) will lead the network and administrate a Crops to End Hunger grant in Breeding Analytics as a joint output of the network. A clear mandate is requested from GI Management team on whether this area remains a network or becomes a service. More details here: Breeding Analytics STP</p>

RECOMMENDATION	SUPPORTING RATIONALE
<p>Reduce scope of Bioinformatics in Work Package 2.</p>	<p>This area was de-prioritized due to funding restrictions. We will do some opportunistic work with funding from the IMAGE project to establish data governance standards for genotype data and develop a QA/QC analytics pipeline for varietal identification that could be further modified for purity testing.</p>
<p>Remove Breeding Resources from the pooled funding for the 2023 year with a return in 2024.</p>	<p>This decision was taken by the GI Managing Director, not at Initiative level. The agenda of work under Breeding Resources will be supported by a W3 grant from the Bill and Melinda Gates Foundation for the 2023 year, thanks to both financial and technical support from the Foundation. The full rationale is available from the GI MD and has been shared with System Council members.</p>
<p>Continue with implementation of the Management Response to the independent EiB review mediated by the Independent Advisory and Evaluation Service of CGIAR.</p>	<p>Along with Accelerated Breeding, Breeding Resources is taking CGIAR forward on the mainstreaming of the Excellence in Breeding agenda across CGIAR's Genetic Innovation portfolio, which includes implementing the Management Response to the EiB review.</p>

Section 7 Key result story



Three crops in four Centers adopt a new breeding data management system to accelerate variety development for smallholder farmers.

Breeding today for smallholder farmers in Africa, Asia, and Latin America requires database infrastructure that can handle large amounts of data with quick turnarounds to enable optimal decisions that produce better varieties that fit market demand. Rice, maize, and wheat breeding programs at IRRI, AfricaRice, CIMMYT, and IITA successfully deployed the Enterprise Breeding System, a new data management system that directly digitizes data from planting to harvest for faster and more accurate crop improvement.

Economic growth in the agricultural sector is more than twice as effective at reducing poverty as growth in other sectors¹, and agriculture is already impacted by climate change faster than we expected². In this straitened setting, breeding today for smallholder farmers in Africa, Asia, and Latin

Noemí Valencia, Seed Health Laboratory Supervisor, stands in the greenhouse where her team makes sure that seeds are healthy for travel.
Photo credit: Alfonso Cortés/CIMMYT

America requires database infrastructure that can handle large amounts of data with fast turnarounds to quickly produce varieties to fit new market demands.

In 2022, rice, maize, and wheat breeding programs at IRRI, AfricaRice, CIMMYT, and IITA successfully deployed the Enterprise Breeding System (EBS), a data management system fit for collaborative network breeding. As part of its commitment to accessibility, EBS is a license-free, cloud-based system which offers end-to-end support for breeding workflows. All operational data is stored in one single place with no need for access to other systems to execute breeding experiments, therefore enabling both data sharing and collaboration. Using state-of-the-art technology, EBS offers a multi-crop platform that is easy to implement and maintain.

A detailed change management plan supported the adoption of the system at each Center.

¹ <https://blogs.worldbank.org/jobs/five-new-insights-how-agriculture-can-help-reduce-poverty>

² <https://www.bloomberg.com/news/articles/2021-11-01/climate-change-to-cut-quarter-off-corn-yields-by-2030-nasa-says?sref=q8selhDd>
<https://www.nature.com/articles/s43016-021-00400-y>

A Service Desk under one centralized platform offered the same level of services whenever needed across all regions of the globe to resolve blockers in daily use of the system. This Service Desk processed more than 1,000 tickets with a 95% satisfaction rating in 2022. For the first time in CGIAR, we also took a systematic KPI-driven approach to adoption, tracking a common set of adoption indicators monthly and used the metrics to adaptively respond when usage stalled. A comprehensive training program was also implemented that comprised 118 separate trainings of various sizes hosted by all four Centers, with 263 women and 365 men trained to use the system.

Adoption progress at the four Centers has been impressive, with more and more breeding teams using the system in their daily routines. Since April 2022, c. 2.5 million plot data points have been recorded in the system with c. 350,000 new germplasm records. This is current data, digitized in real-time for direct use by breeders and their staff,

unleashing breeder time and putting predictive breeding within reach.

With the foundation provided by working software and a comprehensive adoption support process, we are ready to expand to CGIAR legumes at IITA and begin outreach to potential NARES who may be interested to adopt the system in 2023. The system is becoming a cornerstone of the long-term strategy for sustainable data management in Genetic Innovations and has been recognized as a flagship product by CGIAR Digital and Data. As a system that was born within CGIAR in response to breeding program needs, the EBS team practices an iterative user-driven design process guiding its development. As CGIAR's breeding strategy evolves, the EBS software, its supporting team, and its ways of working will ensure that Breeding Resources can adaptively respond in the coming years to support the breeding networks taking shape under Genetic Innovation in their information management needs.

“...we have one primary objective which focuses on implementing improved data management, experimental designs, and breeding methods to accelerate genetic gain and improved breeding efficiency. Therefore, implementing EBS is one of the top priorities for [the] AGG project [Accelerating Genetic Gains in Maize and Wheat for Improved Livelihoods]”

Yoseph Beyene, Regional Maize Breeding Coordinator — Africa, and Maize Breeder — Eastern Africa

References

- 1 <https://ebs.excellenceinbreeding.org/ebs-release/ebs-5-0/>
- 2 <https://ebs.excellenceinbreeding.org/ebs-release/ebs-4-0/>
- 3 PRMS Result 3613
- 4 PRMS Result 3626
- 5 PRMS Result 3632

LINKS TO IMPACT AREAS

Primary Impact Area:



Other relevant Impact Area(s):



Which collective global targets for the relevant Impact Area(s) from the CGIAR 2030 Research and Innovation Strategy does the key result contribute to?

- End hunger for all and enable affordable healthy diets for the 3 billion people who do not currently have access to safe and nutritious food.
- Lift at least 500 million people living in rural areas above the extreme poverty line of US\$1.90 per day (2011 PPP).
- Equip 500 million small-scale producers to be more resilient to climate shocks, with climate adaptation solutions available through national innovation systems.



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GEOGRAPHIC SCOPE

Region: Southeast Asia and the Pacific, South Asia, Eastern and Southern Africa, Western and Central Africa, and Central and South America

KEY CONTRIBUTORS

Contributing Initiative(s): Accelerated Breeding Initiative

CGIAR Center(s): CIMMYT, IRRI, AfricaRice, IITA

Contributing external partner(s) (full names) : Cornell University, Integrated Breeding Platform, Weber and Fritz Consulting, Diversity Arrays Technology, the Breeding API project

Does this key result build on work or previous results from one or more CRPs? Yes, Excellence in Breeding

LINK TO CGIAR RESEARCH PROGRAMS

Excellence in Breeding

COVER PHOTO: Pratima Baral, researcher at the International Maize and Wheat Improvement Center (CIMMYT), using the Plantex app. Photo credit: C. de Bode/CGIAR