



Enabling Tools, Technology, and Services for Genetic Gains

| Initiative Lead and Co-Lead | Primary CGIAR Action Area | Estimated 2022 - 2024 Budget |
|--|---------------------------|------------------------------|
| Young Wha Lee Augusto Becerra Lopez-Lavalle | Genetic Innovation | \$90 - \$125 M |

Challenge

There is an acute demand for more productive and nutritious crops in the developing world, as agri-food systems are strained by climate change, rapidly increasing demographic pressure, and soil and natural resource degradation. Crop improvement can play a key role in addressing these challenges as breeding cycles can be drastically shortened (2-3 years for some commodity crops such as rice and wheat) with genetic gains markedly increased through deployment of new technologies and breeding schemes. We must transform our operational capabilities and organizational culture to take advantage of these modern advances.

Operational excellence is defined as the agile and cost-efficient deployment of effective technologies and practices into the breeding process. A proven path to operational excellence is the centralized coordination and specialization of functions, especially those that are crop agnostic and driven by key performance indicators (KPIs), enabling both cultural change in the organization as well as increased effectiveness and cost-efficiency.

Operational excellence in CGIAR and partner breeding programs is not uniformly adopted; some programs and components of programs lag behind current best practices. The result is poor penetrance, uneven uptake, and inefficient deployment of enabling technologies and methods into a fragmented landscape of independently operating programs and Centers, hindering breeding optimization and stifling genetic gains. Farmers then lack access to the best adapted, most nutritious varieties and crop productivity is reduced in farmer fields.

Objective

This objective of this initiative is to define and provide access to best practices, enabling resources, and implementation support to increase the operational return on investment of breeding programs for their stakeholders. Through the supported and scaled implementation of tried and tested innovations breeding programs will deliver enhanced rates of genetic gains and varietal turnover per unit investment. The initiative will operate across commodities, enabling structured and formalized capacity exchange among scientists across CGIAR and partners, regardless of affiliation, to support the rapid validation and translation of innovations. The removal of siloes will promote and enhance cross-disciplinary exchange while securing critical mass within disciplines across the CGIAR-partner network. Dynamic and robust disciplinary groups will better enable innovation and implementation while enabling the recruitment and retention of excellence and fostering the next generation of leaders in crop improvement science and operations within OneCGIAR. The new working model emphasizes the coordination and deployment of quality core services, from global to local level, enabling more effective and efficient incorporation of new technologies and methods simultaneously in multiple crops and pipelines in the CGIAR-partner breeding network. Finally, the new operational model builds new connections between crop and Center based staff to create a sense of shared ownership among all participants of the data, decisions, and germplasm produced in the crop improvement process, fostering a culture of operational excellence and continuous improvement in the CGIAR-partner breeding programs.

Theory of Change

This initiative aims to address barriers to modernization in CGIAR and NARS breeding programs due to uneven acquisition and inefficient deployment of tools, technologies and harmonized best practices and protocols. It will do so by (1) providing transparently costed core services to breeding programs under a new business model (2) establishing a research and innovation brokerage system for capacity exchange between programs and centers, aiming to connect CGIAR and NARS breeding programs with specialists regardless of crop or center affiliation to evaluate innovations and develop best practices (3) providing a sustainable operational infrastructure to institutionalize existing CtEH facility investments into germplasm delivery hubs that will minimize variation in germplasm development (4) establishing a trialing support service for CGIAR-NARS breeding networks that is centrally coordinated for harmonizing SOPs in trialing, facility management, and germplasm evaluation and operational performance monitoring. Enabling core services for quantitative genetics, genotyping, phenotyping, chemotyping, envirotyping, data management, data analysis and data mining are integral elements of this initiative. Building on the advances made by the Excellence in Breeding Platform (EiB) and CtEH facility investments, this initiative will create a new culture of equitable co-ownership of the crop improvement processes. The services provided in this initiative will act as a force multiplier in increasing the operational efficiency of breeding pipelines for both NARS and CGIAR programs and support all genetic innovation action area initiatives, particularly "Accelerated Breeding: Meeting Farmers' Needs with Nutritious, Climate-Resilient Crops".

Enabling Tools, Technology, and Services for Genetic Gains

Highlights

CGIAR-NARS breeding networks benefit from new centralized core services that provide access to high-quality data, analytics, and data management, helping to close the gap in adopting best practices in crop improvement.

CGIAR-NARS breeding networks benefit from a new capacity exchange system that connects researchers with specialized expertise into transient multi-disciplinary teams to support the breeding program's science and innovation needs. Programs can access the best technical support available regardless of crop, center, or partner affiliation, accelerating the translation and scaling of new technologies and discoveries into CGIAR-NARS breeding networks.

A new culture of operational excellence, enabled by co-ownership and engagement of all participants in the breeding process, results in bold, attainable, and effective breeding pipeline optimization, following a baseline established by Excellence in Breeding (EiB) for breeding modernization and Crop for Ending Hunger (CtEH) facility investments in regional germplasm hubs.

Harmonization of protocols, standardization of data, and integration of data types in the Enterprise Breeding System will speed the pace of insights and accelerate the translation and scaling of new technologies and discoveries into CGIAR-NARS breeding networks.

Democratizing access and capacity to take advantage of the core support services by NARS, who become core services customers as well as equal peers in jointly creating a CGIAR-NARS breeding network.

Work Packages

| | Scope of Work | 3-year Outcomes |
|---|---|--|
| Core Data Services | Services will be provided under a new business model to support breeding programs with data generation (genotype and phenotype), operations costing, analyses and simulations, and integrated data management with the Enterprise Breeding System as a core connecting database. The services will support CGIAR-NARS breeding networks and NARS breeding programs. Early NARS adopters of services includes KALRO, NARO, and DRS. | Breeding programs routinely and rapidly capture data, perform high quality streamlined analyses, and deploy appropriate visualization tools to make effective, data-driven breeding decisions. Data use is extended to routinely generate metrics of program effectiveness and health, guiding investment decisions and the planning and execution of continuous improvement plans. |
| Research and Innovation Exchange System | A brokerage system will enable exchange of scientists across CGIAR and NARS regardless of affiliation to support the rapid validation and translation of innovations. The service enables interaction and synergies between specialties to create transient multidisciplinary teams as needed and establishes critical mass to attract the leaders in crop improvement science and operations to OneCGIAR. | Breeders leverage scientific innovation to enhance the efficiency and effectiveness of germplasm development. The continued definition and business case-based refinement of best practices together with access to enabling tools, services, and technical backstopping accelerates and scales the development, identification and implementation of high value innovations across CGIAR-NARS networks. |
| Germplasm Hubs | Hubs dedicated to the application of plant reproductive technologies are established. Breeders will be provided with ready-to-use seed, removing conversion quality, seed quality, or seed identity as a source of variation in field testing. This work package institutionalizes facility investments to create germplasm hubs at select CGIAR and NARS stations via CtEH funding, and will support "Accelerated Breeding: Meeting Farmers' Needs with Nutritious, Climate-Resilient Crops" | Breeding pipelines have increased efficiency and effectiveness of product delivery achieved through access to and use of germplasm hubs securing the generation of high quality, true to type source germplasm. |
| Trialing Support Services | A global trialing support service will enable CGIAR-NARS breeding networks in creating and managing TPE-aligned trials to global standards. The service will harmonize SOPs for trial management, facility management, and germplasm evaluation across regional trialing networks and monitor network performance in data generation and return, supporting "Accelerated Breeding: Meeting Farmers' Needs with Nutritious, Climate-Resilient Crops" and building on CtEH investments into NARS station improvements . | Breeders improve the efficiency and effectiveness of germplasm evaluation within their segmented pipelines through access to and use of harmonized, standardized, TPE-appropriate trialing support services. |

Enabling Tools, Technology, and Services for Genetic Gains

Impact Area Contributions

| | |
|--|--|
| Nutrition, health & food security | This initiative will increase the efficiency of genetic gains by breeding programs to deliver more productive and nutrient-dense crops, thus contributing to improved regional nutritional and health status, especially for women and children, and resulting in a region wide reduction in the loss of disability-adjusted life years. |
| Poverty reduction, livelihoods & jobs | Facilitating more efficient generation of highly productive, more resilient crop varieties will ensure that poor smallholders can increase production under the adversity of pest and disease pressure and climate change, thus mitigating the risk of crop losses and securing their investment. |
| Gender equality, youth & social inclusion | Efficient generation of gender aware varieties will increase wealth and nutrition of disadvantaged communities. Capacity reorganization and career specialization in the CG-NARS network creates new work opportunities in the technology sector for more people, including women, youth and disadvantaged minorities. |
| Climate adaptation & greenhouse gas reduction | Accelerated genetic gains will enable breeding programs to efficiently respond to climate change pressures, including resistance to pests and diseases exacerbated by changing conditions. Increased productivity under adverse conditions will ultimately contribute to feeding more people while reducing per capita resource utilization, including water and fuel consumption. |
| Environmental health & biodiversity | Enabling higher productivity and crop resilience from improved genetics will limit the expansion of agricultural land in regions with high demographic pressure and dwindling natural resources. Higher responsiveness to nutrient applications will lead to healthier soils in the agricultural context and regarding waterway contamination. |

Impact on SDGs



Regions

Global

Countries



Enabling Tools, Technology, and Services for Genetic Gains

Innovations

A corporate and scientific program to develop fee for service models that enable global business units for the delivery of effective and cost-efficient crop improvement services.

Formal benchmarking of the services and operations in CGIAR against public and private peer organization for Genetic Innovations, to harmonize cost structures across the CGIAR and create a disciplined approach to spending.

A KPI tracking and reporting dashboard for Core Services and hub operations to enable these units to monitor themselves to achieve continuous improvement and operational excellence.

A KPI tracking and reporting dashboard for breeding programs to monitor adoption and use of new technologies and protocols for breeding scheme optimization.

A scientific exchange system that connects specialized experts across the CGIAR and partners in dynamically formed teams to support research and innovation efforts, providing breeding programs with the best technical expertise regardless of affiliation.

Key Partners

| | | |
|-------------------|---------------------------------|---|
| Demand | Government | KALRO in Kenya, NARO in Uganda, DRS in Zimbabwe, EIAR in Ethiopia, ISRA in Senegal, CSIR in Ghana, ICAR in India, Embrapa in Brazil |
| | Multilateral | Genetic Innovations action area initiatives: Accelerated Breeding: Meeting Farmers' Needs with Nutritious, Climate-Resilient Crops, Accelerating crop improvement through precision genetic technologies, Genetic Resources (Genebanks), Market Intelligence for More Equitable and Impactful Genetic Innovation, SeEdQUAL: delivering genetic gains in farmers' fields |
| | Other Public Sector | Regional Agricultural Research Organizations including World Bank supported Centers of Excellence (eg AGRA, CORAF, ASARECA, APPSA) |
| | Private Sector | Small and Medium Size Enterprise (SME) and Multinational Seed Companies in Target Regions (eg Kenya Seed Company, Zamseed, Ethiopian Seed Enterprise, East-West Seed, Bayer, Corteva, Syngenta, SeedCo). |
| Innovation | Academic, Training and Research | Sequencing: Arizona University Bioinformatics: Cornell, Cirad, Cambridge Biostatistics: University of Nebraska, Cornell, NCSU, University of Queensland Metabolomics: Royal Holloway Phenotyping: Vermont University, Cirad, CSIRO Data systems: Minnesota University (GEMS); BTI (Breedbase) |
| | Government | KALRO in Kenya, NARO in Uganda, DRS in Zimbabwe, EIAR in Ethiopia, ISRA in Senegal, CSIR in Ghana, ICAR in India, Embrapa in Brazil |
| | Multilateral | CGIAR action areas: Excellence in Agronomy, Meeting Farmers' Needs with Nutritious, Climate-Resilient Crops, Corporate Services, Digital Services USAID supported Innovation Labs |
| | Private Sector | Multinational crop science companies: Corteva Agriscience, BayerCrop Science, Syngenta Vendors and contracting services: Intertek, DaRT, Corteva Agriscience Research as a Service, Amazon Web Services, VSNI, IBP, Hyphen, Keygene |
| Scaling | Government | KALRO in Kenya, NARO in Uganda, DRS in Zimbabwe, EIAR in Ethiopia, ISRA in Senegal, CSIR in Ghana, ICAR in India, Embrapa in Brazil |
| | Other Public Sector | Regional Agricultural Research Organizations including World Bank supported Centers of Excellence (eg AGRA, CORAF, ASARECA, APPSA) |
| | Private Sector | Small and Medium Size Enterprise (SME) and Multinational Seed Companies in Target Regions (eg Kenya Seed Company, Zamseed, Ethiopian Seed Enterprise, East-West Seed, Bayer, Corteva, Syngenta, SeedCo). |

Theory of change for the initiative

Enabling Tools, Technology, and Services for Genetic Gains

This initiative will work synergistically with other initiatives in the Genetic Innovation action area, particularly *Accelerated Breeding: Meeting Farmers' Needs with Nutritious, Climate-Resilient Crops*

