CGIAR | INITIATIVE ON Breeding Resources

Progress Report 2023

Celebrating a year of collaborative achievements advancing shared breeding services for CGIAR and its partners

January 2024

Contents

Editorial

Sharifah Syed Alwee

Senior Director, Breeding and Research Services

Dear readers,

As we step into 2024, we wanted to take a moment to reflect on the remarkable strides achieved by Breeding Resources Initiative (BRI) in 2023. The year has been pivotal in advancing our mission to provide CGIAR-NARES networks with first-class breeding services, practices, and technologies.

One of our standout successes has been our meticulous process management work and its crucial role in supporting our day-to-day operations. Other noteworthy developments include the decision to adopt the *Canvas Business Model*, a breeding data management and informatics strategy serving the whole organization, and advancements in the analytical pipeline. The *Crops to End Hunger* projects continue, and we proudly launched our Service Request Portal, as a one stop center for all global shared services and support provided by Breeding Resources Services (BRS).

In this end-of-year progress report, we encapsulate key achievements and unveil the roadmap for the coming year. 2024 is intended to be the *year of integration* for Breeding Resources Initiative—a time when all services seamlessly integrate into a business-model framework and within breeding programs.

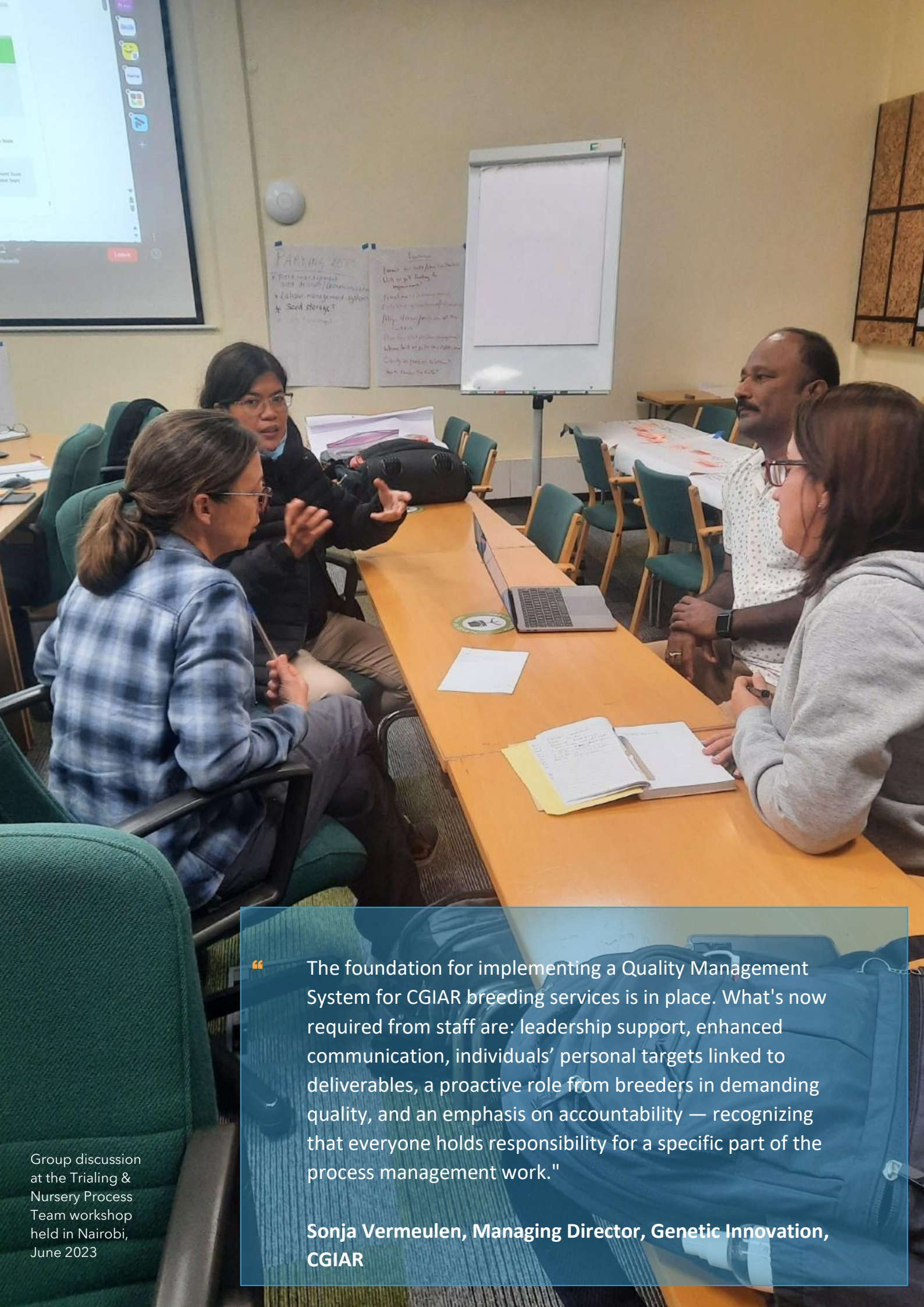
We will focus on developing and promoting Breeding Resources shared services, and amplifying our delivery efforts to underscore the benefits Centers and partners can derive from the Initiative and Breeding Resources Services.

But before we plunge into this transformative year, let's celebrate our accomplishments in 2023, laying the foundation for the new year but also for the upcoming 2025-2027 portfolio.

We extend our sincere gratitude for your collaboration and hard work throughout 2023. Your insights and efforts are crucial to our shared success. Please feel free to reach out with any comments or suggestions.

Wishing you a prosperous and collaborative year ahead!

Sharifah Syed Alwee



> “ The foundation for implementing a Quality Management System for CGIAR breeding services is in place. What's now required from staff are: leadership support, enhanced communication, individuals’ personal targets linked to deliverables, a proactive role from breeders in demanding quality, and an emphasis on accountability — recognizing that everyone holds responsibility for a specific part of the process management work."
>
> **Sonja Vermeulen, Managing Director, Genetic Innovation, CGIAR**

Group discussion at the Trialing & Nursery Process Team workshop held in Nairobi, June 2023

Process Management

To deliver high-quality germplasm and data, CGIAR-NARES networks need to establish common and streamlined processes at Genetic Innovation level, ensuring compatibility in their ways-of-working.

Where are we?

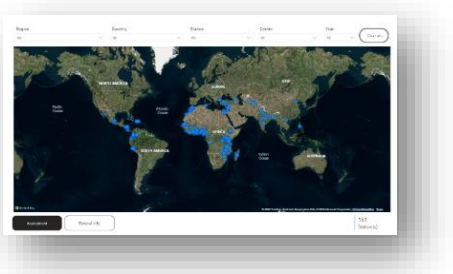
In 2023, BRS launched three Process Teams – Trialing & Nursery, Lab Services, and Breeding Analytics and a fourth team, Product Development, was established in collaboration with Accelerated Breeding Initiative. As laid out in the GI Process Teams launch webinar, these Process Teams are made up of representatives from various crops and Centers, which identify, validate and set the course for Continuous Improvement. They discover, develop and share best practices, document them, and identify capacity development needs.

Process Management Team (PMT, the team of Process Owners) finalized the peer-review of the four Process Teams' SIPOCs (Six Sigma term for "Supplier, Input, Process, Output, Customer"). The SIPOCs are high-level descriptions of the processes owned by each Process Team. Besides a consistency check, the review is a scope negotiation exercise between the teams to clarify boundaries and hand-over points between processes and people or teams operating it. Afterwards, the teams completed process mapping, the description of all processes in more details. Learn more by watching ABI-BRI Process Management Mini-Symposium recording.

What's next?

- Development: The process management work will extend into 2024 to enhance the capabilities of the Process Teams and involve additional breeding teams in the workflow. Process documentation will be improved and enhanced for easy referencing by all. It will be shared with end-users through communication tools and acculturation training.
- Standardization: Aligned with the three SIPOCs of BRI, the team has started the establishment of Standard Operating Procedures (SOPs) for breeding operation processes. This involves describing and formalizing procedures and methods of operation to standardize them across the organization, crops, and Centers.
- Deployment: Will consists of capacity development for Process Teams and providing training on new SOPs and work procedures to staff, as many working methods will undergo changes. Continuous improvement and change management training will also be provided.
- Validation: In late 2023 commenced the development of a framework with the goal of ensuring the relevance, quality, and coherence of metrics and Key Performance Indicators (KPIs) within GI.

Breeding stations assessment and improvement



As part of the Process Management work, to establish a robust quality management system in key CGIAR-NARES breeding stations, Breeding Resources Initiative evaluates them to identify areas for improvement, adoption of state-of-the-art equipment for their breeding activity (through projects like Crops to End Hunger) and refines processes to align with those established by the Process Management Team. A dynamic dashboard disseminates the findings of this work and offers users visibility into the capacity of these stations, highlighting their strengths and weaknesses, while also providing funders and Center managers with visibility into areas requiring improvement. Ultimately, this guarantees the application of top industry standards within the breeding stations, delivering high-quality data and results.


OPTIKA
OPTIKA
IITA

Business Model for Centralized Services

Breeding Resources Initiative is actively engaged in clearly defining its service offerings by adopting a business-model approach, aligning with standard practices observed in other businesses.

What does a business model look like for Breeding Resources Services?

Whether emerging or established, any business activity needs to clearly define how it will create, deliver, and capture value, within its competitive environment. BRI is no exception. Thus, it initiated the process of defining its business model in 2023, extending the work into 2024. A business model is indispensable for informed decision-making and streamlined business operations; it is a core strategy for profitability. It identifies the sources of revenue, target customers, products and financing details, which BRI is in the process of defining.

Formalizing the services offered by each of BRI components serves a dual purpose: enhancing clarity for staff and clearly communicating the expected services to clients. BRI business model aims to foster transparency and efficiency universally, ensuring a shared understanding of services among staff, leadership, and clients.

At the organizational level, the objective is to align and decide on services, streamlining them based on collaboratively identified challenges. The business model will formalize service offerings and address strategic questions such as the geographical scope—whether services should be global or regional, etc.

This exercise will not only define the format of the services but also align internal workflows and set client expectations for service delivery. Through consensus-building, the business model will enable BRI to distinguish between non-critical and critical services, allowing for a strategic focus on critical, albeit more labour-intensive, services. This, in turn, will aid in prioritization, resource allocation, and managing client expectations. Ultimately, the business model is positioned to be a guiding framework for the Initiative, facilitating informed decision-making and strategic resource management.

The Canvas Business Model

Breeding Resources has adopted the *Canvas Business Model* as its management template. This model offers a visual framework for developing, describing, and refining business strategies. Its concise format is designed to generate a comprehensive, one-page overview that highlights key activities, value propositions, customer segments, channels, and more.

Upon completion, teams can efficiently define their priorities by gaining a quick overview of their needs, the necessary steps to take, and areas for progress.

What's next?

Breeding Resources is now actively seeking staff participation:

- Each member of the BRSLT team will populate the *Canvas Business Model* for the specific services or group of services they are responsible for, prioritizing the ones that are already available. This collaborative effort will provide a comprehensive and detailed overview of Breeding Resources' service portfolio, capturing the unique aspects and value propositions of each offering.
- Wider stakeholder consultation will also take place, to get insights from all staff and collectively consolidate Breeding Resources Initiative's business model.

Shared Services

To expedite the development of superior crop varieties, breeding programs must embrace cutting-edge services and technologies.

Why do we set up shared services?

Historically, CGIAR faced challenges in accessing breeding services, leading to inefficiencies. With the One-CGIAR system and the Breeding Resources Initiative moving forward, a transformation is underway. Breeding programs can anticipate an array of new and improved services across the global CGIAR-NARES network.

Shared services provide CGIAR with much greater bargaining power in purchasing or contracting equipment, services, and tools. This enables the generation of cost-efficient and high-quality data, consistent across the breeding network. Shared services are already established for genotyping and sequencing and select biochemical (nutritional trait) testing. New additions will include high throughput phenotyping, soil analysis, biometrics, expansion of existing biochemical testing services, equipment purchases and more.

Lab Services

In 2023, significant strides were made in improving genotyping lab services, including:

- Improved genotyping services: Shared services for genotyping and sequencing are being expanded and updated. These include new service offerings to support partners with: Low density SNP genotyping (KASP platform, suitable for applications requiring less than 50 markers) and mid-density targeted sequencing (1-4K markers, suitable for genomic selection and fingerprinting). These services are now accessible via the Service Request Portal, described below. Reference genome service providing "one-stop" fully assembled platinum reference genomes with competitive pricing and turnaround time, and a whole genome resequencing service, will also be available in the portal in 2024.
- Biochemical- quality and nutritional services: Partners are now able to access expanded biochemical testing for nutritional traits and quality, such as Fe and Zn testing for breeding selection objectives. Initially, the team aims to collaborate with organizations such as Harvest Plus and external vendors to establish a network of service labs with competitive pricing and standardized services to cater to CGIAR and NARES breeding needs. Services now operational include XRF (X-Ray Fluorescence) services and ICP (Inductively Coupled Plasma) services. Non-destructive NIR (Near Infrared) will be available in 2024.

Lab services in the Service Request Portal so far:

16 institutions – CGIAR & NARES
submitting through the portal

10 species markers resources
which can be ordered via the portal

172 orders submitted
since June, in process or completed

Trialing and Nursery

Centers and national programs encounter challenges in accessing specialized engineering capacity, so the establishment of Trialing and Nursery (T&N) Support Services by BRI in 2023 is a pivotal advancement for CGIAR breeding networks. Through the Service Request Portal, breeding teams now have access to the following support:

- Agronomic Practice support: Breeding teams, operational teams, and management teams can utilize this service to enhance agronomic practices, phenotyping protocols, and overall management practices in their stations. Some Centers, including cassava, rice, and beans programs at the Alliance of Biodiversity and CIAT, have already benefited from the expertise of an experienced agronomic practice consultant.

- Engineering capacity: Programs like the rice programs at AfricaRice have received support from engineering companies in various projects. Partner companies and consultants are available to assist breeding programs in designing new seed processing areas, irrigation infrastructure, and more. Support can begin at the early stages, including inception phases and vendor validation. It can extend beyond breeding programs. For example, a BRI partner engineering company aided CIMMYT gene bank in enhancing existing infrastructure. IITA also utilized the service for designing a new lab for KEPHIS in Kenya.
- Process Improvement: Our team of consultants, engineering companies and staff, offers tailored solutions to enhance operational processes. This support ranges from selecting appropriate equipment to analyzing process efficiencies through structured methodologies. For example, prior to engaging an engineering company, CIMMYT received support from a BRI consultant expert in LEAN who, in collaboration with the team, identified numerous process improvement opportunities, forming the foundation for the subsequent engineering design.

T&N in the Service Portal Request so far:

25 registered projects

supporting CIMMYT, CIAT, KARLO, IITA, AfricaRice, SARI, and CRI

Numerous types of project:

Irrigation systems development, agronomic practices improvement, greenhouses design...

Service Request Portal

A new Breeding Resources Service Request Portal is available to make it easier for both CGIAR users and external partners such as NARES to request and track a large range of CGIAR breeding support services.

What are the benefits of the Service Request Portal?

- Expanded services: the Service Portal is accessible to both CGIAR and public users. It covers:
    - Genotyping services
    - Elemental laboratory analyses: quantifying key elements such as zinc, iron, aluminum, chromium, and titanium.
    - Trialing and Nursery support: Trough the service request portal, breeding programs can request engineering services, agronomic practice support for process improvement and so on. By accessing these customized services, breeding teams will be supported by consultants and companies specialized in multiple disciplines, such as seed processing, irrigation, soil management, pest and disease management, and others.
- Proven efficiency: in collaboration with Scriptoria Sustainable Development Solutions' Data Team, the portal provides users with access to a digital system that expedites submissions and minimizes errors.
- Improved service request workflow: by digitizing service requests, this platform significantly reduces the daily administrative burden and makes it possible to monitor and improve the quality of services provided.

What's next?

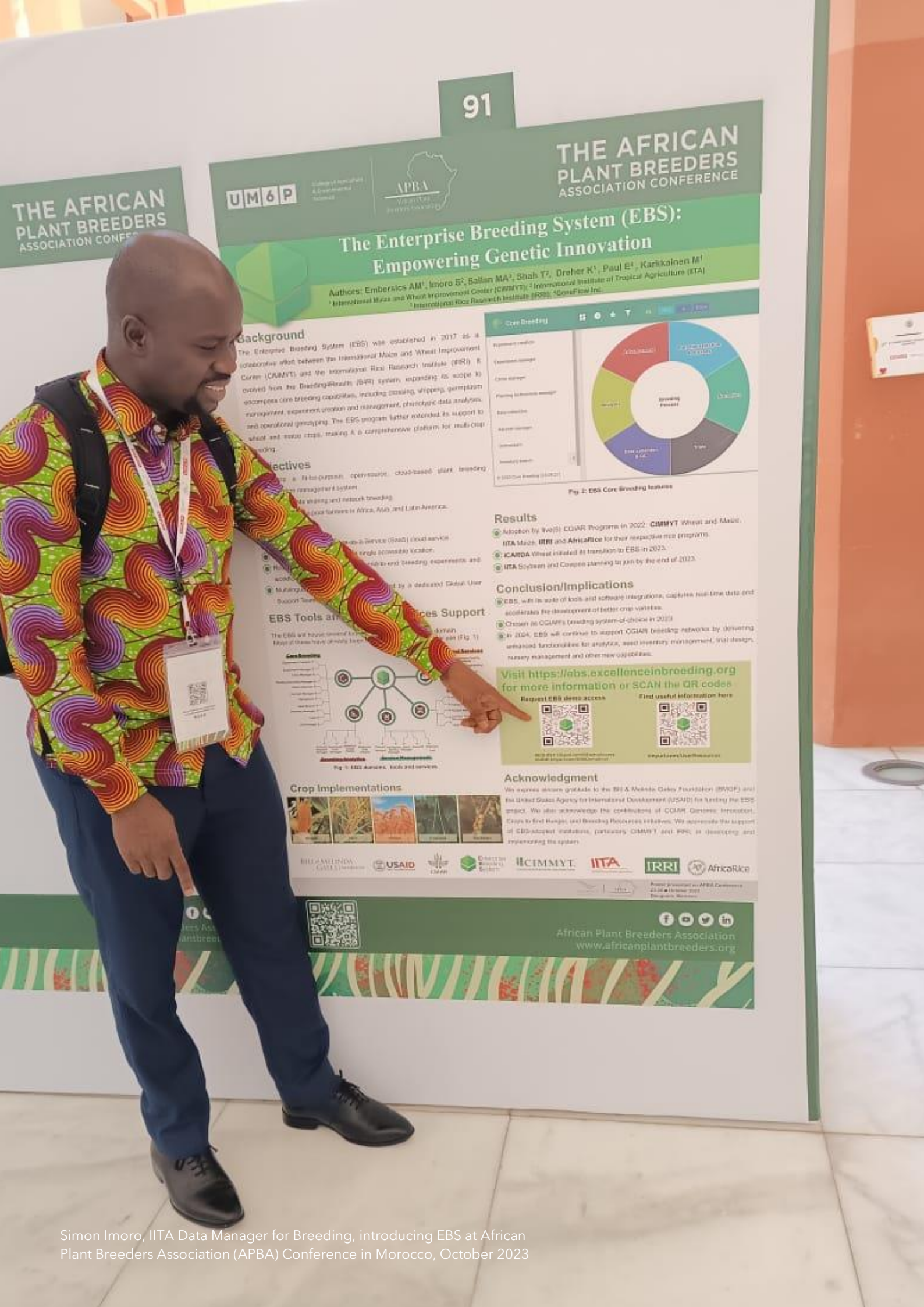
The Service Portal is a dynamic platform, that will evolve with user engagement. Centers pool resources, ensuring instant accessibility for all upon each portal update. When a Center contributes molecular markers for example, this resource becomes readily available to the entire network, including Centers and NARES.

Within the trialing and nursery domain, user requests manifest as public inquiries, fostering transparency. The dedicated team systematically addresses these queries, guaranteeing that responses remain publicly accessible on the platform, contributing to the establishment of a community of practice.

Looking forward, the Service Portal Request will evolve with user engagement and contribution and introduce noteworthy additions, such as data analysis support and capacity-building resources.

Resources:

- Users can access Breeding Resources' Service Request Portal here.
- To watch a video tutorial of the Service Request Portal please visit this page.
- For any questions on the lab services and Service Request portal, you can reach out to Breeding Resources Initiative Lab Service Team.



Simon Imoro, IITA Data Manager for Breeding, introducing EBS at African Plant Breeders Association (APBA) Conference in Morocco, October 2023

Breeding Informatics Strategy

Originally anticipated for release in 2024, BRI team surpassed expectations by developing a breeding informatics strategy for CGIAR ahead of schedule, marking it as a cornerstone achievement in 2023.

What does the strategy encompass?

The strategy delineates CGIAR-wide approach for the effective management of breeding databases, pieces of software, and tools. It outlines the establishment of a centralized breeding data management system serving CGIAR-NARES networks. Key components of this system include:

- The creation of a Breeding Information Management and Technology (BIMT) Unit: tasked with the management, development, and maintenance of breeding data management tools, with the Enterprise Breeding System (EBS) as its foundational platform.

- The establishment of a Global User Support (GUS): designed to facilitate the adoption and utilization of software tools supported by CGIAR's Breeding Information Management and Technology (BIMT) team. GUS comprises a 24/7 support desk that handles user inquiries, connects them with specialists, register issues and can set up demos. Users also have access to a wealth of resources, including user guides, release notes, e-learning materials, and video tutorials available in multiple languages.

- A roadmap to 2027: establishing a timeline for the successful implementation of the strategy. It encompasses the transition of CGIAR Centers and NARES from their existing breeding information systems to the Enterprise Breeding System (EBS). It also provides a comprehensive overview of the landscape for both BIMT and EBS. This includes a thorough examination of critical success factors, potential risks, and recommendations for guiding the next steps in the implementation process.

What's the status of the Enterprise Breeding System?

Meeting the expectations of funders, the development team released the full version of the software at the end of 2023. The tool currently manages breeding data for wheat, maize, and rice, and 2023 witnessed the achievement of releases 6, 7, and 8, encompassing patches including functionality improvements.

Looking ahead to 2024, EBS is set to incorporate additional crops and further functionalities. The team embraces an iterative, continuous improvement approach, seeking user feedback to shape the software.

Structured as a "Platform-as-a-Service" (PaaS) system, EBS offers enhanced manageability over time at a reduced cost. The system is designed to bolster core breeding activities, including germplasm inventory management, trial design, field operations, phenotyping, sample tracking, genotyping, data analysis, and decision support.

EBS as a breeding data management system has been deployed as a fully operational application for rice, maize, and wheat breeding programs at IRRI, AfricaRice, CIMMYT, and IITA. ICARDA Wheat, IITA Legumes, other CG Centers, and their NARES partners will follow shortly.

In 2023, BRS started to showcase EBS at significant gatherings, such as the 2023 International Rice Congress and African Plant Breeders Association Conference. This will continue in 2024, starting at PAG31 in San Diego, CA, in January.

Analytical Pipeline

BRI embraces innovative technology by implementing an advanced analytical pipeline – a powerful tool that harnesses big data to enhance decision-making in breeding processes.

What's the analytical pipeline?

The analytical pipeline is a dynamic and modular project designed to extract data from various databases and perform analysis for better decision-making in breeding processes. The tool has successfully delivered a proof of concept, showcasing its technical capabilities. It is set to undergo testing within Breeding Resources and Accelerated Breeding Initiatives in Q1 2024. The official release, anticipated for Q2 2024, will incorporate feedback from users on technical relevance and usability. The project is jointly funded by Breeding Resources and Crops to End Hunger funds and it was endorsed by senior management in late 2023.

Technical insights

There are many different algorithms and software to analyse breeding data, so the analytical pipeline project is dedicated to standardizing and automating these methods across CGIAR-NARES breeding programs. The tool will be made up of a comprehensive suite of modules, each corresponding to a specific type of analysis integral to breeding work, such as estimating genetic gains, utilizing indices for selection, genomic selection…

The analytical pipeline is deliberately developed as a stand-alone web-based tool, making it database agnostic and able to extract data from all breeding database management systems that are currently used in the CGIAR-NARES breeding programs. The analytical pipeline integrates with all relevant data sources and aims to set standards for breeding analysis across CGIAR and partners by using the best algorithms currently available; it's a dynamic space where users can pick and perform the analyses they require.

In late 2023, Breeding Resources tasked a team of biometricians to develop the analytics pipeline, developed as a web tool with a user-friendly interface, while the actual code performing the analyses runs behind the scenes, mostly in the R statistical software. Users can select data, analytics modules, and parameters, and the tool delivers results directly on the webpage. The entire analytical pipeline is hosted on Amazon Web Services (AWS), as is EBS. The developed framework is open source, so anyone can copy the source code and run it on their own servers, including external partners such as research institutes and universities.

Among the benefits of the tool, a noteworthy aspect is its ability to empower breeding staff to independently conduct high-quality analyses, with the BRI team readily available for support. This simplifies breeding analysis, providing a central hub for all practitioners. The tool signifies a shift towards a more straightforward, efficient, and standardized approach. Moreover, it operates as a dynamic, living system that evolves and will be improved over time.

The analytical pipeline's development approach aligns with Breeding Resources Initiative's vision for robust data quality and analytics, ensuring the active involvement of all Centers in crucial decision-making processes.

What's next?

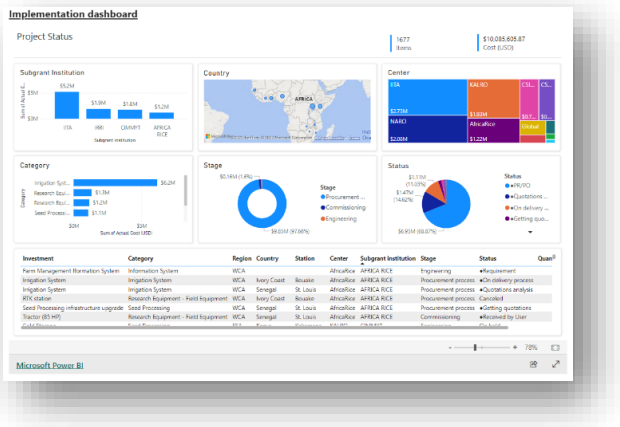
- Next phase: In February, a hackathon with breeding analytics teams and biometricians will aim at identifying missing modules and collectively contributing new ones. Testing, both internal and user-based, will refine the tool's functionality but also its usability and the overall user experience.
- Testing and follow-up: The testing phase will start in 2024, ensuring a comprehensive rollout of the analytical pipeline across breeding programs. Presentations have begun, with plans for more extensive communication, training, and workshops to ensure widespread adoption.

Crops to end Hunger Investment

Crops to End Hunger (CtEH) is a CGIAR initiative designed to accelerate and modernize the development, delivery, and widespread adoption of a continuous flow of new crop varieties.

CtEH investment handled by Breeding Resources Initiative…

CtEH projects serve as additional investments, complementing Genetic Innovation's funding. As part of the 15 projects funded by the Initiative, Breeding Resources is implementing two extensive projects: the analytical pipeline (as mentioned above) and *Facilities Upgrade and Mechanization Improvement* a $15 million project focused on enhancing the infrastructure and mechanization capacity of key CGIAR-NARES breeding stations in Africa, thereby fostering benefits for numerous breeding programs and supporting over 100 breeding pipelines.



The project is now set to deploy equipment and provide training to key breeding stations globally. To report on this work, a project dashboard is publicly accessible for users to stay abreast of the project's real-time implementation and gain insights into funding allocation. In a nutshell, the project will:

- Install approximately 400 hectares of irrigation systems across ten stations
- Purchase various equipment: threshers, combines, planters, dryers, corn shellers, tractors, sprayers…
- Refurbish the seed processing area across seven stations
- Install cold storage facilities across seven stations
- Deliver digitalization equipment such as printers, handhelds, etc.
- Provide training for over 100 operational staff on agronomic practices: soil and irrigation management, crop maintenance, etc.

Most items are scheduled for 2024, but some have already been delivered, such the conceptual layout for AfricaRice station's seed processing area, as well as tractors, in Senegal:

… Building on lasting collaborations

Facilities Upgrade… builds upon previous initiatives, including a *2020 Digitalization project* focused on phenotyping tools and a *Mechanization project* dedicated to introducing advanced field equipment. A dynamic dashboard combines the outcomes of the three projects to enhance communication with stakeholders and provide a transparent view of equipment and investments made at each Center and station.

Breeding Resources Initiative
Key 2023 Figures

initiative training

410

people trained, including:

305

people trained on digitization, including EBS

105

trained on process management, change management, etc.

Lab services in the Service Request Portal

16
INSTITUTIONS -CGIAR AND NARES-
submitting through the portal

18
SPECIES' MARKERS RESOURCES
which can be ordered via the portal

172
ORDERS SUBMITTED ONLINE
since June 2023, in process or completed

Trialing & Nursery in the Service Request Portal

Various types of project requests:

Irrigation systems development, agronomicc practices improvement, greenhouses design…

25
registered projects
supporting CIMMYT, CIAT, KARLO, NARO, IITA, AfricaRice, SARI and CRI

The Enterprise Breeding System (EBS)

443,400
rice germplasm entries created
a 131%
increase in 2023

223,400
maize germplasm entries created
a 1,467%
increase in 2023

51,000
wheat germplasm entries created
a 1,981%
increase in 2023

6,000 participant training hours
for rice, wheat, and maize breeding teams

News, Events, and Resources

Initiative-level

- Brochure: Breeding Resources Initiative 4 page Overview (PDF) / Investment Brief (PDF)
- News: How CGIAR harnesses genetic innovations for resilient African food systems: Highlights from APBA 2023
- News: Price adjustment for genotyping shared services from August 2023

Process management work

- Event/video: Genetic Innovation 1st All Process Teams Webinar
- Event/video: Mini Symposium: Process Management – What's been achieved & what's coming?
- Blog: Inside Genetic Innovation's process management: mapping processes to enhance breeding research services
- Blog: How we are professionalizing breeding research management processes

Crops to End Hunger investment

- News: Generous contribution by GIZ-BMZ empowers smallholder farmers through crop breeding modernization grants
- Blog: CtEH's Facilities Upgrade and Mechanization Improvement project: Modernizing breeding research stations in Africa for higher genetic gains
- Event/video: Crops to End Hunger Project Update: Facilities Upgrade and Mechanization Improvement
- Event/video: CtEH Project Update: Roots, Tuber and Banana Breeding - Phenotyping, and Germplasm Exchange Hub Upgrade
- Webinar series: Crops to End Hunger Case Studies in Africa and Beyond: Supporting CGIAR Partners through Genotyping Services

Breeding informatics

- News: Introducing CGIAR Breeding Resources Service Request Portal for Streamlined Services.
- Tutorial: Service Request Portal video tutorial
- News: Breeding Resources Initiative launches Global User Support (GUS) for breeding information management systems within CGIAR

CGIAR is a global research partnership for a food-secure future. CGIAR science is dedicated to transforming food, land, and water systems in a climate crisis. Its research is carried out by 13 CGIAR Centers/Alliances in close collaboration with hundreds of partners, including national and regional research institutes, civil society organizations, academia, development organizations and the private sector. www.cgiar.org

We would like to thank all funders who support this research through their contributions to the CGIAR Trust Fund: www.cgiar.org/funders.

To learn more about this Initiative, please visit this webpage.

To learn more about this and other Initiatives in the CGIAR Research Portfolio, please visit www.cgiar.org/cgiar-portfolio

CGIAR

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Breeding Resources