NARRATIVE REPORT - 2022 - 2024

BREEDING
RESOURCES
INITIATIVE
NARRATIVE REPORT

2022 - 2024

CGIAR

INITIATIVE ON
Breeding Resources

1.1 BREEDING AND RESEARCH SERVICES

Vision:

Support CGIAR's crop breeding modernisation by institutionalizing state-of-the-art services for breeding research and operations.

Mission:

Ensure that CGIAR-NARES breeding networks have access to modern breeding practices, advanced technologies, and robust analytics through institutionalized services.

4 UNITS
LEVERAGING CGIAR GLOBAL PRESENCE

GSS
Global Shared Services

BPM
Business Process Management

DS
Digital Solutions

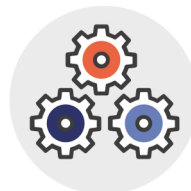### BA
Breeding Analytics

IN A NUTSHELL

16
Crops with specific services

6
Orhan crops supported through the Vision for Adapted Crops and Soils (VACS) Initiative

800+
people trained

1.2 EDITORIAL

CGIAR Senior Director, Breeding Resources Initiative

Dear readers,

At Breeding Resources, our vision is clear. We support CGIAR breeding modernization by providing high-quality services and cutting-edge tools and technologies to crop breeding programs. Without these, breeding remains a very expensive, time-consuming, and complex science.

Operating in silos - where CGIAR Centers and national research institutes independently seek support, negotiate prices, and face expertise gaps—leads to inefficiencies and delays. The solution lies in collaboration, with shared services offering the most effective path forward.

Breeding and Research Services (BRS) has been institutionalizing shared services for breeders and researchers over the past three years. This report highlights the key outcomes and impacts of this work, as CGIAR transitions into its 2025–2030 portfolio. These achievements are a testament to what can be accomplished when breeding programs are supported by streamlined, professional services designed to accelerate innovation and impact.

A heartfelt thanks goes to all team members whose dedication has made this progress possible. I express my hope for the continuation of the work that has begun and for the even deeper integration of shared breeding and research services into the DNA of CGIAR.

SHARIFAH SYED AWEE

BREEDING RESOURCES INITIATIVE
SENIOR DIRECTOR, CGIAR

CONTENT

2.1 GLOBAL SHARED SERVICES
LAB SERVICES AND TRIALLING & NURSERY

Initial challenges: barriers to access high-quality genotyping & phenotyping services

Genomic selection helps breeders select the best plants to cross for a targeted breeding result. It requires genotyping to understand the genetic code and phenotyping to measure the observable plant characteristics. The data is then used in prediction models to select the best plants. Genomic selection significantly accelerates crop breeding and is essential for any modern breeding program.

Unfortunately, the availability of genotyping and phenotyping services varies considerably across regions. While some CGIAR Centers have dedicated labs, others—and many national partners—lack such facilities entirely. Breeders must individually negotiate prices and service standards before procuring services to analyze samples. These time and cost barriers to genomic selection hinders breeders' ability to make informed, data-driven decisions, cause delays and hampers crop development. The variation in data and services limits collaboration across locations and organizations.

Transformative changes implemented

BRS has expanded and institutionalized a suite of shared breeding and research services through its GSS

Global Shared Services unit, including:

- Low and mid-density genotyping;
- Phenotyping of biochemical quality and nutritional testing for biofortification strategies;
- Fast and low-cost genome sequencing to identify desirable genes;
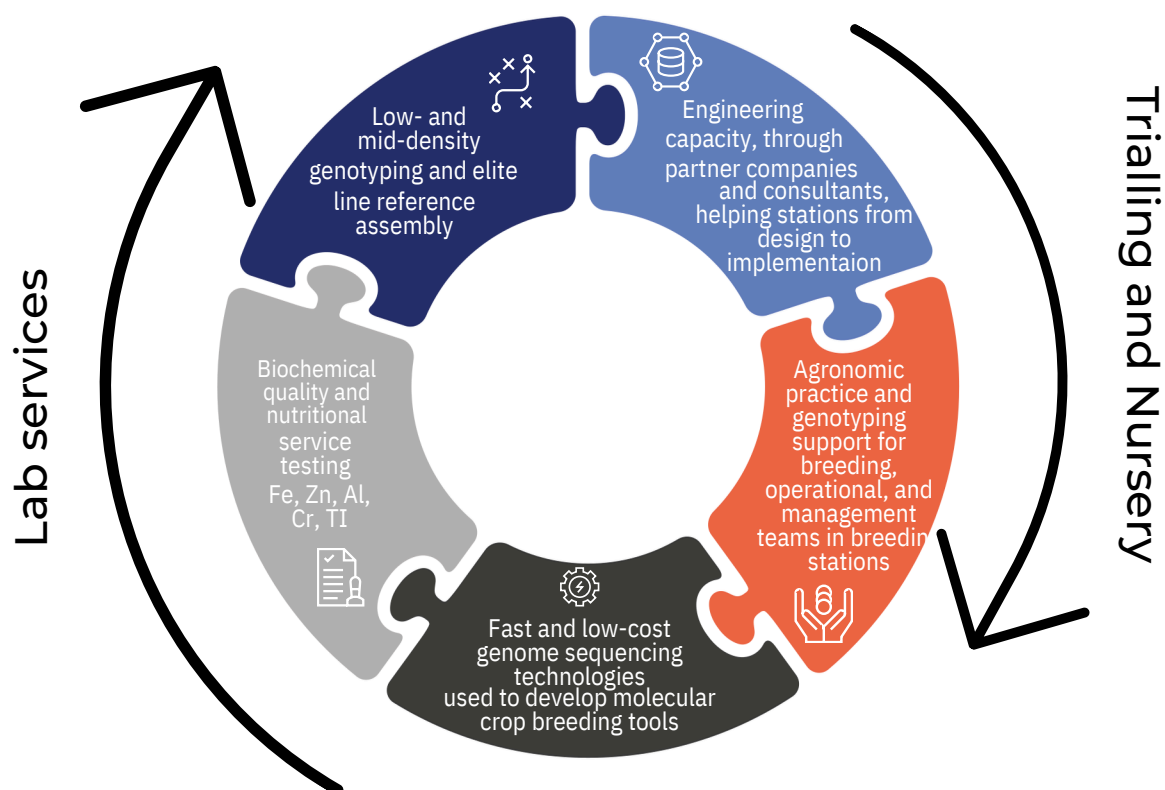- Agronomic and engineering support to improve nursery and trialling activities.

Today, 26 organizations—including teams from all CGIAR Centers and over half of NARES—rely on these services to bridge national and regional gaps.

Key takeaways

1. The seamless integration of services provides a smooth experience for breeding programs, making essential research services available. BRS Service Request Portal facilitates access to services and reduces administrative complexity.
2. GSS negotiates with suppliers using economies of scale to secure the best possible quality-to-price ratio for CGIAR and NARES partners.
3. GSS helps find operational expense and transactional cost savings—while continuously improving service quality and accuracy.
4. The use of shared services is enabling CGIAR and partners to come together with consistent data that can be powerfully combined.

2.2 Figure: GLOBAL SHARED SERVICES OFFERING

Lab services

Trialling and Nursery

Low- and mid-density genotyping and elite line reference assembly

Engineering capacity, through partner companies and consultants, helping stations from design to implementaion

Biochemical quality and nutritional service testing Fe, Zn, Al, Cr, TI

Agronomic practice and genotyping support for breeding, operational, and management teams in breedin stations

Fast and low-cost genome sequencing technologies used to develop molecular crop breeding tools

2.3 Figure: GLOBAL SHARED SERVICES KEY FIGURES

444
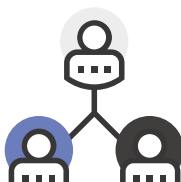*Genotyping requests submitted since launch*

72
Unique requestors of genotyping services, including CGIAR Centers and partners

26
Institutions using GSS, including 50% of NARES

43
T&N requests addressed since launch

13
Unique requestors of T&N services, including CGIAR Centers and partners

1
T&N support request submitted per month, on average

3.1 BUSINESS PROCESS MANAGEMENT
QUALITY SYSTEM & PROCESS MANAGEMENT

Initial challenges: discrepancies in data management and breeding operations

Successful crop breeding relies on high-quality data, robust operational processes, and enhanced know-how. Differences in data quality, operational processes and expertise available across programs, Centers and partners can prevent teams from coming together.

Streamlining data and processes enhances efficiency, reduces duplication, and accelerates variety development—saving time, effort, and resources. Ultimately, this leads to better varieties delivered to farmers faster.

Transformative changes implemented

Recognizing these barriers and potential for improvement, BRS developed a quality framework to define standards across breeding operations. BRS brought together subject matter experts and Continuous Improvement consultants in Process Teams, and established the Business Process Management (BPM) unit for process improvement.

Detailed process maps and Standard Operating Procedures (SOPs) for lab services, trialling and nursery, and breeding data and analytics, were developed to harmonize processes and enable consistency and interoperability. They include performance metrics and implementation instructions, ensuring sustained quality and operational excellence while promoting collaboration and adoption in daily operations. The overarching goal is to address immediate gaps, but also sustained practice and culture change - to lay the foundation for continuous improvement.

Key takeaways

1. BPM supports breeders to produce high-quality outputs, with confidence and well-defined standards and protocols, and ensures that entire teams adhere to these guidelines. Regular operational assessments of the established SOPs guides ongoing improvements.
2. The BRS Service Request Portal provides an accessible centralized repository for SOPs across crops to CGIAR Centers and NARES. Practical capacity development sessions promote adoption.
3. Working with BRS Digital Solutions, an app is under development to automate data collection, provide actionable dashboard insights, and facilitate monitoring and quality management.
4. Partners are engaged, with many already contributing to assessments that shape adoption and further process improvements based on lessons learned and feedback.

3.2 LEAN LEADERSHIP

Over five years, CGIAR has fostered a culture of continuous improvement, recognizing that lasting transformation takes at least seven years. Top leadership plays a key role in embedding these changes. To support Lean leaders, BRS developed targeted resources, including short videos on Lean leadership and tailored support, all accessible via the LMS for individual or team learning. These efforts strengthen leadership capacity, ensuring the sustainability of CGIAR's quality management and improvement culture.

3.3 CAPACITY DEVELOPMENT

Strategy of BRS' capacity development

BRS capacity building combines empowering services and tools with adjunctive training to embed modernized breeding practices and create lasting culture change. Partnerships with leading agricultural universities ensure training content remains cutting-edge, while industry collaborations add practical, real-world insights.
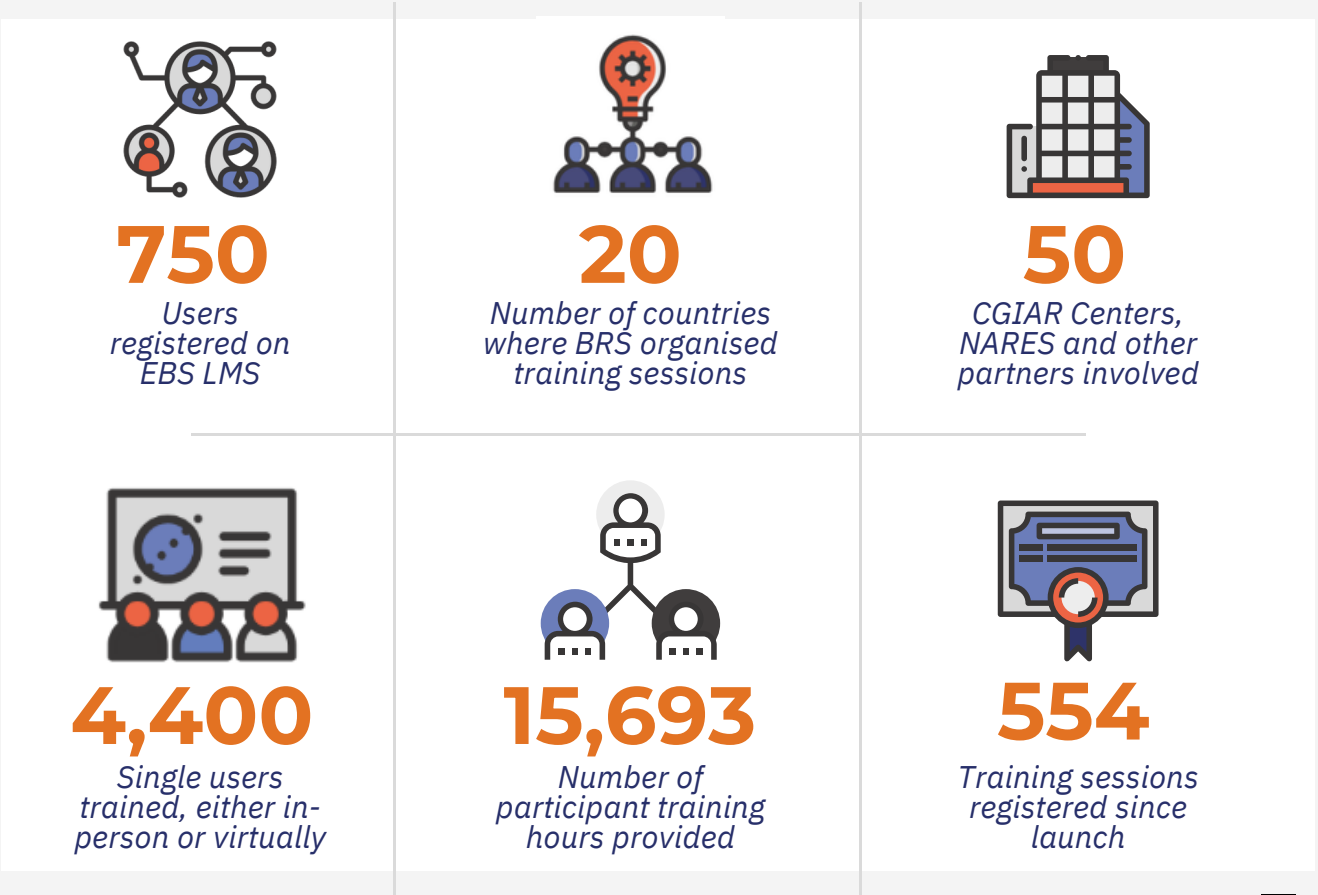
BRS's capacity building ultimately improves performance and productivity for CGIAR and NARES while fostering a culture of continuous improvement and learning for innovative problem-solving. Training programs are designed to improve individual and organizational performance, leading to increased productivity, enhanced job satisfaction, and a more skilled and competent workforce.

BRS Learning Management Systems

A modern Learning Management System (LMS) has been introduced to make training scalable and efficient, and is accessible anytime, from anywhere. LMS serves as a centralized platform for training delivery. It supports multiple learning formats, tracks progress and provides analytics to continually enhance the learning experience. LMS offers a flexible and engaging experience, catering to the diverse needs of learners.

BRS offers a wide range of learning opportunities, including online courses, in-person training (workshops, seminars, hands-on learning sessions) and virtual programs.

3.4 Figure: CAPACITY BUILDING KEY FIGURES

750
Users registered on EBS LMS

20
Number of countries where BRS organised training sessions

50
CGIAR Centers, NARES and other partners involved

4,400
Single users trained, either in-person or virtually

15,693
Number of participant training hours provided

554
Training sessions registered since launch

4.1 DIGITAL SOLUTIONS
THE ENTERPRISE BREEDING SYSTEM

Initiatial challenge: centralizing breeding data for CGIAR and NARES

Breeding programs generate and use large amounts of data. Previously, data was scattered across multiple platforms, stored locally, or even on paper. There was no single, centralized breeding data management system. Data fragmentation impeded integrated streamlined workflows and prevented cohesive collaborative CGIAR-NARES crop breeding networks.
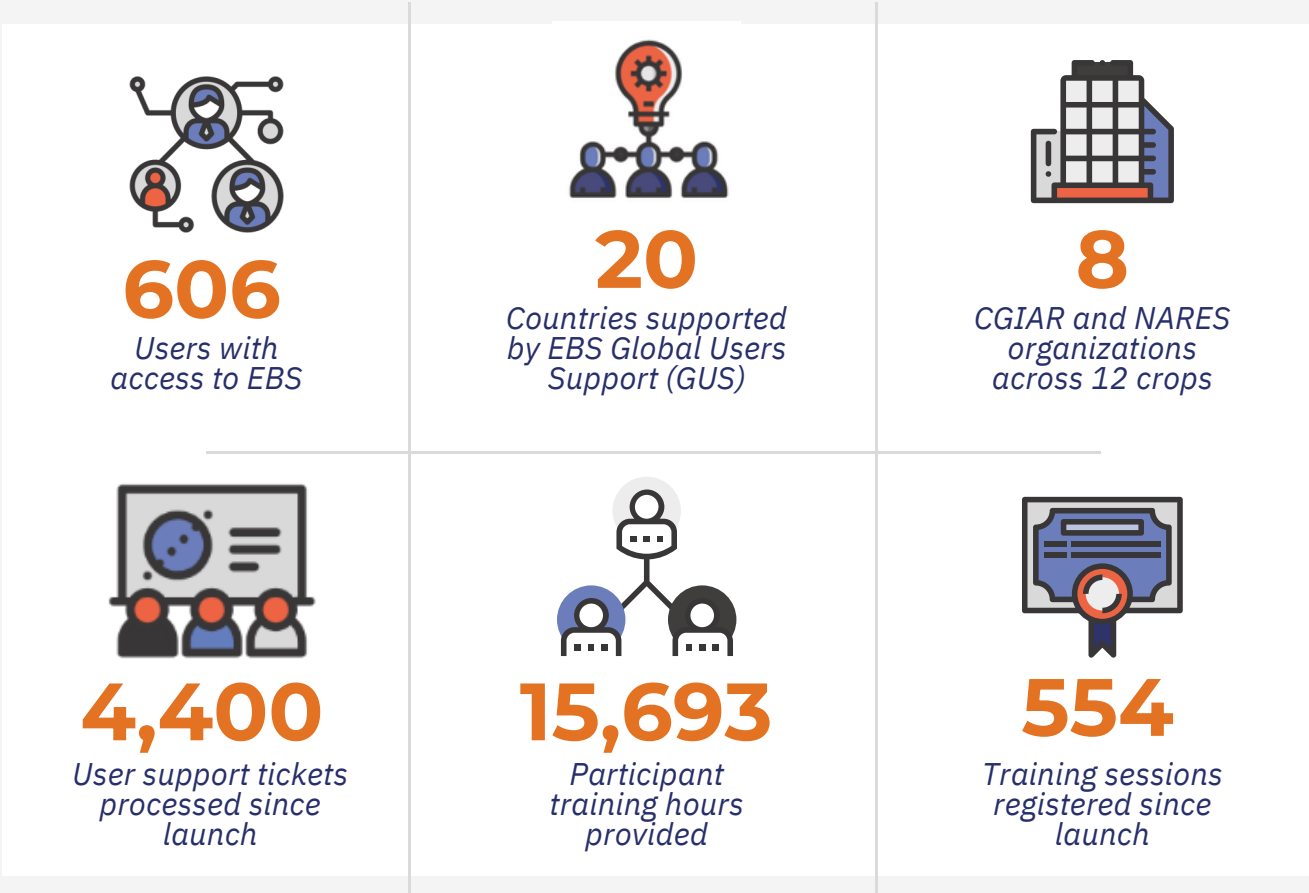
Pre-existing tools only addressed elements of data management without end-to-end workflows. Breeders struggled to make data-driven decisions due to system limitations and often had to rely on manual processes for data exchange or collection. Licenses or funding to access systems led to inconsistent or partial use across programs and regions without full deployment to research stations.

Transformative changes implemented

The Gates Foundation supported BRS's Digital Solutions unit to develop the Enterprise Breeding System (EBS). Informaticians used design-thinking techniques in collaboration with CGIAR and NARES crop breeders to ensure EBS was fit for purpose. EBS launched in 2023 to support core breeding activities, including germplasm inventory management, trial design, field operations, phenotyping, sample tracking, genotyping, data analysis, and decision support.
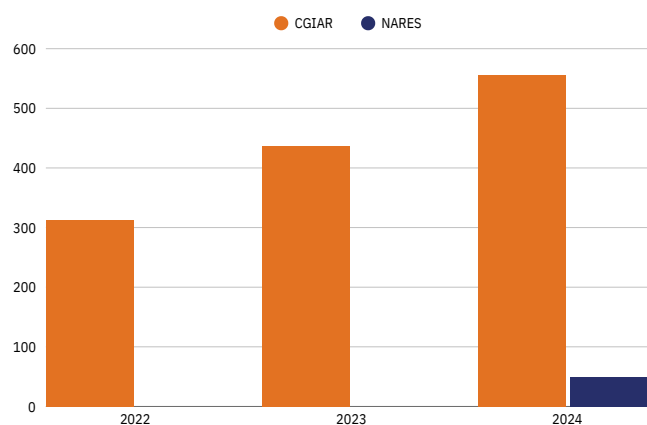
Designed to serve on a global scale, EBS is a robust open-source breeding data management system and available worldwide. It adheres to the principles of Free, Accessible, Interoperable and Reusable (FAIR) data, making it compatible with all future CGIAR digital ecosystem projects.

4.2 Figure: EBS KEY FIGURES

606
Users with access to EBS

20
Countries supported by EBS Global Users Support (GUS)

8
CGIAR and NARES organizations across 12 crops

4,400
User support tickets processed since launch

15,693
Participant training hours provided

554
Training sessions registered since launch

4.3 Figure:
NUMBER OF EBS USERS OVER TIME, 2022 - 2024

Legend: CGIAR (orange), NARES (dark blue)

Chart axis values: 0, 100, 200, 300, 400, 500, 600
X-axis: 2022, 2023, 2024

Key takeaways

1. Through a comprehensive training program, backed by a support team that quickly resolves issues with high user satisfaction rates, adoption has expanded globally.

2. EBS is CGIAR's preferred crop breeding data management platform, offering a high-level of data integrity to breeding workflows, as it collects high-quality curated data with established protocols to prevent missing or broken information.

3. EBS has a clear blueprint for growth and enhancement guided by user feedback and crop-specific insights integrated into a maintenance and development roadmap.

4. EBS is highly stable and connects with other BRS services for seamless integration of tools, technology and services.

5. Structured as a "Platform-as-a-Service" (PaaS) system, EBS offers enhanced manageability at lower costs. EBS can function offline, enabling regional and field adoption.

6. As more data is loaded into EBS, its utility increases, creating a virtuous cycle where improved data access fosters enhanced collaboration and productivity, ultimately supporting the development of better crop varieties, faster.

5.1 BREEDING ANALYTICS

COMPLEX ANALYSES FOR BREEDERS

Initial challenge: leveraging analytics to race against time

In the fast-paced world of crop breeding, timing is everything. Breeders face immense time pressure, particularly during the critical crossing period, where multiple tasks must be handled simultaneously, from controlled pollination, environmental management, seed development, harvesting to analysis.

In many cases, with only three to four days to make crucial decisions before moving on to the next cross, breeders find themselves bogged down by manual calculations. This leaves little time to thoroughly evaluate all the factors that could impact their breeding process.

Transformative changes implemented

BRS's Breeding Analytics team, in collaboration with Accelerated Breeding Initiative and funding from GIZ through Crops to End Hunger, developed an advanced breeding analytics pipeline. Launched in 2024 Biometrical Genetics Workflow, Bioflow, supports CGIAR-NARES crop breeders, especially those without coding and access to statistical quantitative genetics.

Bioflow automates complex calculations, freeing up time and helping breeders make informed breeding decisions on the evolutionary forces driving varietal improvement. Bioflow virtually implements selection to achieve effects on phenotypes, predicting outcomes and making fieldwork more efficient, and eliminates environmental noise to identify genetic effects.

Key takeaways

1. Bioflow automates analytics workflows. Tasks that once took hours or days to complete manually can now be done in just five to ten minutes. Most users can run analyses after a few hours of training, saving weeks of work in the long run.
2. The tool offers an intuitive interface designed for CGIAR and NARES teams, particularly those who lack coding skills but need to calculate breeding values and develop predictive models.
3. Database-agnostic, Bioflow can retrieve data from phenotypic-pedigree databases (EBS, BreedBase), genotypic (GIGWA), and environmental databases (NASAPOWER).
4. For breeders, especially NARES with limited statistics/quantitative genetics support, Bioflow alleviates long standing data analysis challenges. It also helps standardize key performance indicators across CGIAR-NARES breeding networks, ensuring consistent reporting metrics.
5. Members of CGIAR-NARES networks can access CGIAR Breeding Analytics Pipeline through BRS Service Request Portal, with free access to cloud computing.
6. Training and demos are available via the Service Request Portal. For further guidance, a video series is available.
7. Soon, use of the Breeding Analytics Pipeline will become a requirement for CGIAR breeding programs, so that methods are standardized for quality control and collaboration.

5.2 Figure: BIOFLOW KEY FIGURES

541
Users with access to Bioflow production server

303
Users from CGIAR Centers

238
Users from NARES organisations

9
CGIAR Centers represented by Bioflow users

73
Different NARES programs using the tool

6
Continents represented with most users in Africa

37
In-person and online training sessions

13
Countries represented across the training sessions

1,025
People trained on the use of Bioflow

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 BRS, visit please: https://www.cgiar.org/initiative/breeding-resources/

To learn more about CGIAR Research Portfolio, please visit: www.cgiar.org/cgiar-portfolio

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