How EBS Is Advancing Improved Crop Breeding Decisions: **The Legumes Case Review**

Enterprise Breeding System

A Focus on Modernizing Cowpea and Soybean Breeding Programs at IITA

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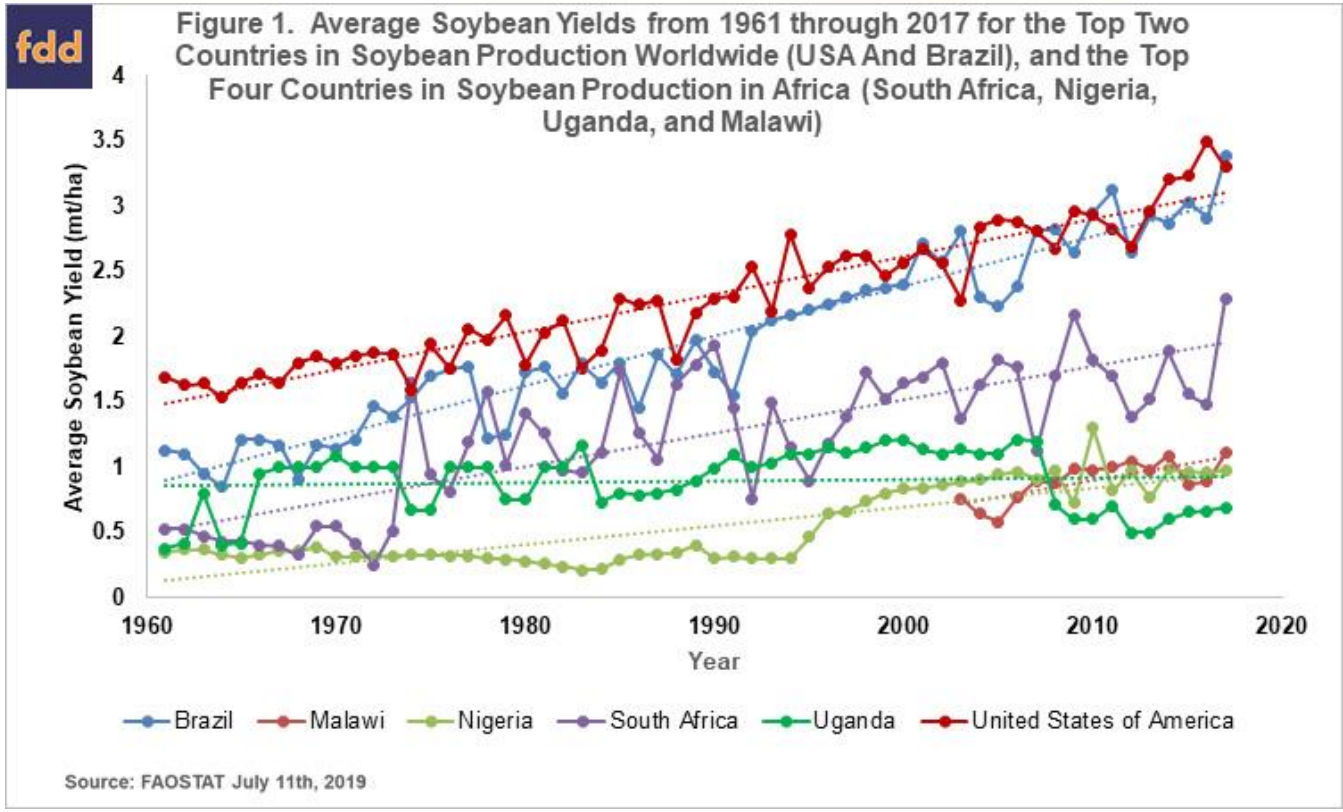
PLANT & ANIMAL GENOME CONFERENCE / PAG 32
The Largest Ag-Genomics Meeting in the World.
January 10 -15, 2025
San Diego, CA
www.intlpag.org

Background and Context

- *IITA's role: a member of the CGIAR* advancing tropical agriculture with a focus on **legumes**, maize, cassava, yam, bananas

- *Importance of legumes*: cowpea and soybean as pillars for nutrition, income, and sustainable farming.

- *Challenge*: Breeding programs face increasing complexity, requiring advanced tools for better data management.
- *Solution*: EBS was adopted to modernize breeding workflows and improve breeding decisions and genetic gains.

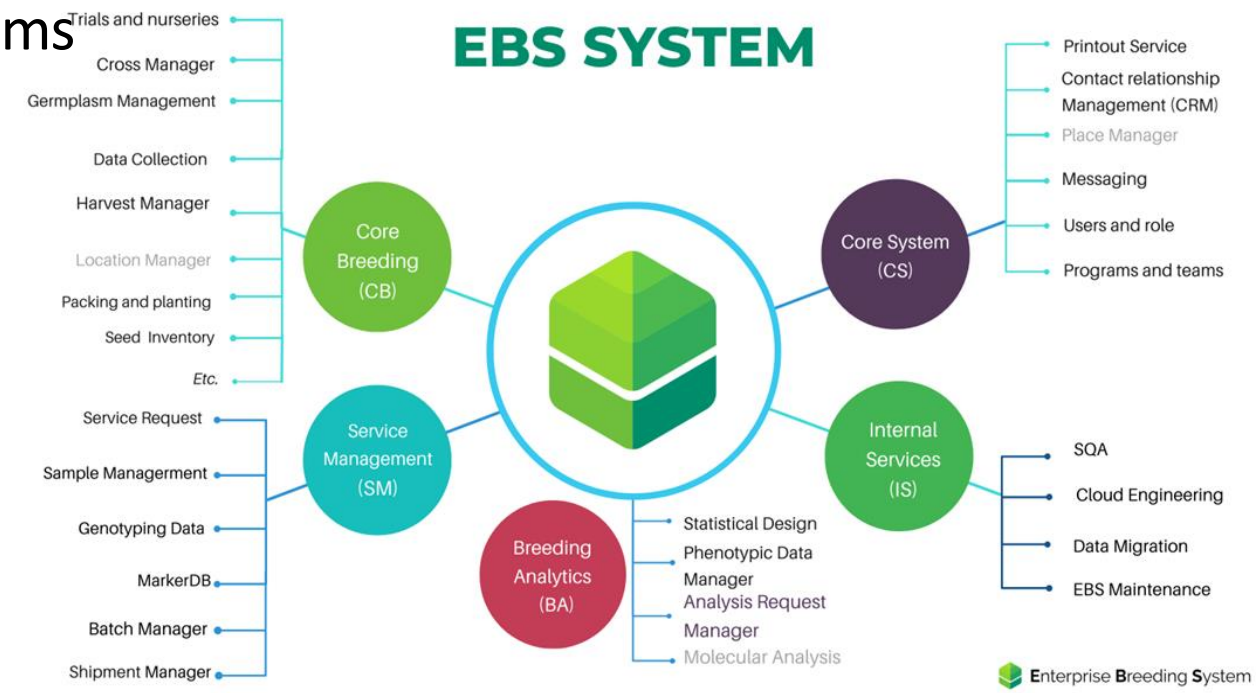


Regional production trends vs. potential gains.

Why EBS?

Drivers for EBS Adoption by legume teams:

- Data complexity and quality issues in breeding pipelines.
- Need for real-time collaboration across teams and locations.
- Robust seed inventory management
- Data privacy, security and control (RBAC)
- Comprehensive built-in printout manager
- Challenges in remote and low-resource environments
- Dedicated 24/7 global user support
- Great system documentation and user resources
- EBS is **CGIAR preferred** breeding system of choice



"EBS is more than a tool—it's a digital transformation platform for smarter breeding decisions."

Objectives

Transform IITA's cowpea and soybean breeding through **enhanced data** management.

Deliver better tools for breeders: increased **accuracy**, **reduced errors**, and **faster decisions**.

Foster **collaboration and accessibility** for real-time data.

Streamline breeding processes through **workflow standardization and modernization**.

"Leveraging EBS to make better data-driven and faster breeding decisions."

Implementation & Methods

- **Deployment**: EBS multi-crop instance rollout for cowpea and soybean breeding teams.

- **Features**: Customizable tools for product profiling, breeding pipelines, stage-gate processes, flexibility.

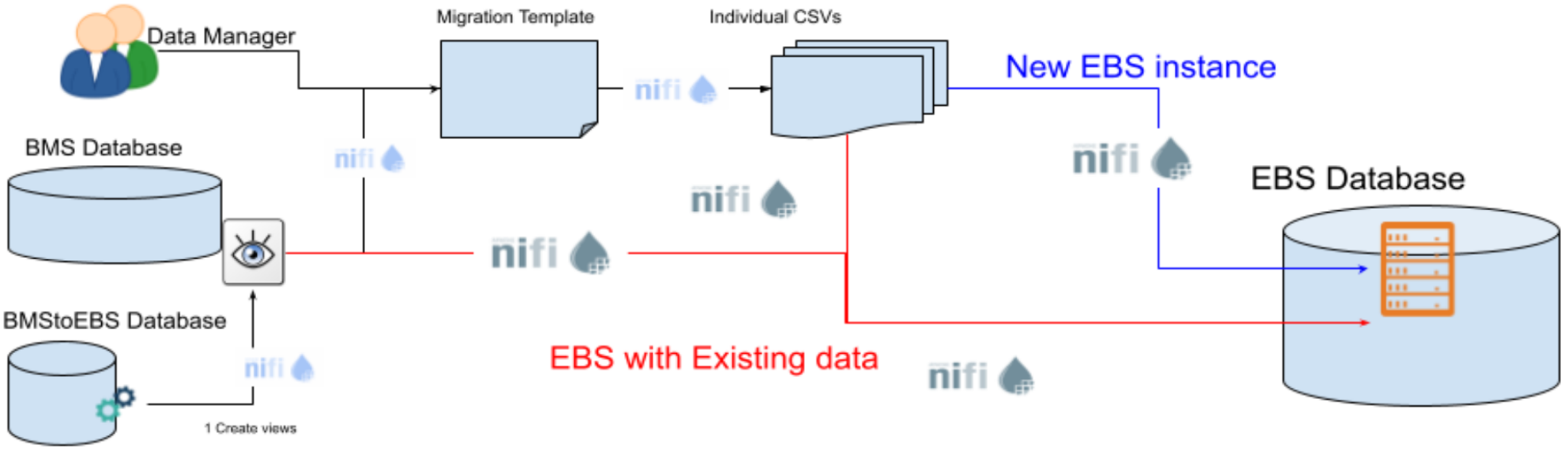
- **Interoperability** : Seamless connection with tools like FieldBook, Bioflow for data capture and analysis.

- **Data Migration**: Standardizing germplasm, trait, sites nomenclature for consistency, duplicate identification and resolutions.

- **User Training:** Empowering end-users to effectively adopt the system.

“The training ensured even first-time users could integrate EBS into their workflows within days.”

Migration Pipeline



Programs
People and Teams
Pipelines
Breeding Stages and Seasons
Germplasm
Traits
Breeding locations
Seed lots and packages

Duplicates and consistency checks

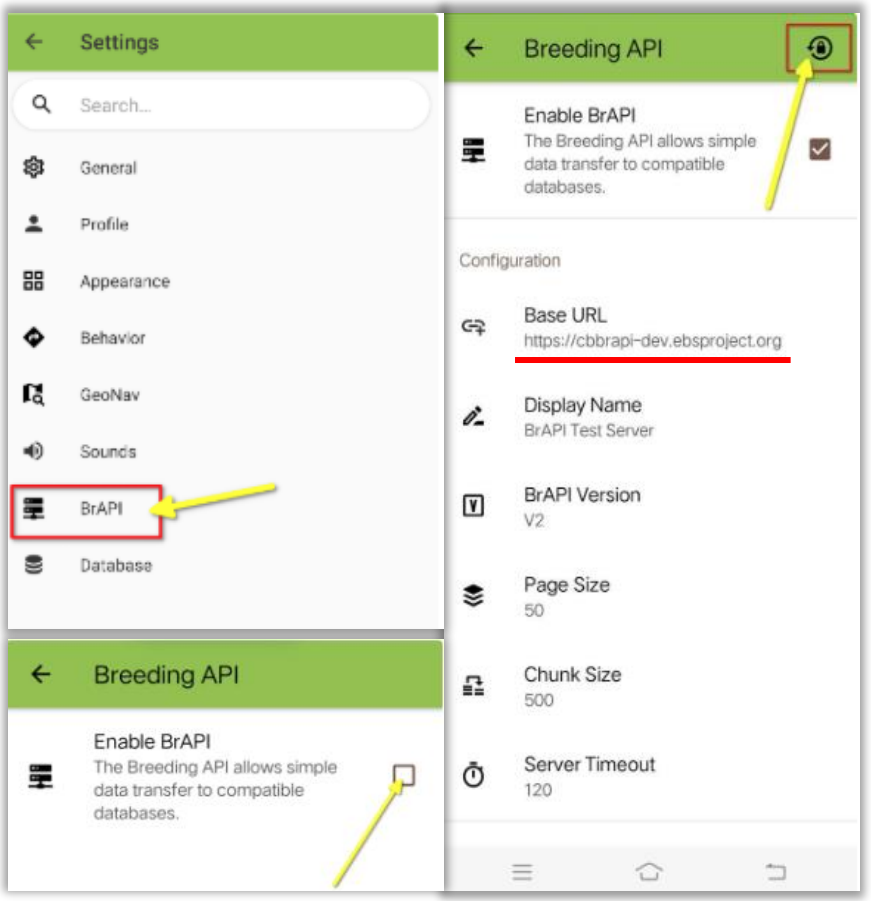
Script checks → Data verification → Stored Proc. checks → Data Issues resolution

Data Collection

Data Collection (DC) allows users to upload collected data, conduct basic validation, compute traits variables, suppress and un-suppress selected plot data, commit validated data to make it available for analysis.

EBS and Field Book Integration

- Seamless login and connect to Field Book v5.6+ via **BrAPI**
- Confidential germplasm info (e.g. pedigree) are excluded
- Import fields, load traits, collect and sync data directly to EBS



Data Capture and QC

1 - KSU/PhenoApps: Field Book

Collecting phenotypic data made easy through the use of data collection software and applications like Field Book app.

2 - Data Collection Tool

Collected data is imported to the Data Collection tool in EBS for review.

3 - Quality Checking

The Phenotypic Data Manager (PDM) in EBS is used for quality-checking the data and reviewing the data visualizations.

4 - Analysis

After quality-checking, the data can be sent for single- and multi-occurrence analysis in the Analysis Request Manager (ARM).

*** - External Analysis Tools**

In addition to PDM and ARM, external analysis tools like Bioflow are available for users.

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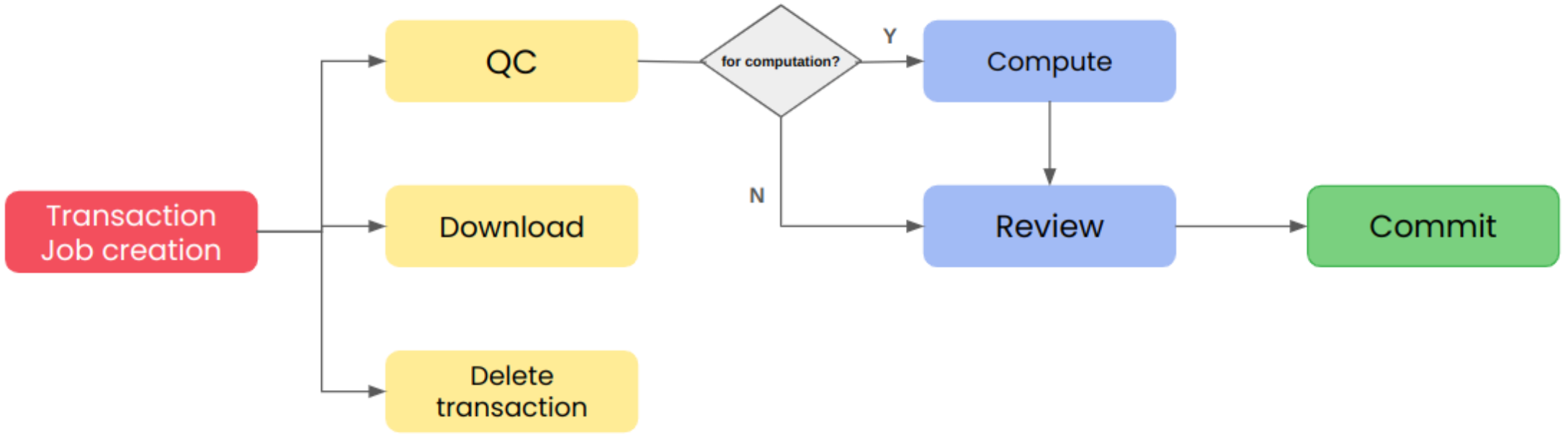
Fieldbook App Export via **BrAPI** feature allows users to seamlessly transfer occurrence

How to Sync Occurrence Data?

1. Go to **Export**.
2. Under the Observation section, check if there are any **New Observations**. Click **Export** button.
3. A message prompts "**BrAPI Export Successful**."



Data Terminal
[Transactions]
[Review-Summary]

CGIAR

Quality Control » NG_MO-2024-A-016

COMPUTE | REVIEW | COMPLETE TRANSACTION

Summary | Plot

This browser lists all uploaded and computed variables in this transaction.

Total **13** items.

				INVALID	MISSING	VOIDED	NEW					UPDATED	SUPPRESSED		
Variable	Data Unit	No. of observations	No. of remarks	Count	Count	Count	Min	Max	Avg	Variance	Count	Count	Rule	Remarks	Count
EH_M_cm	plot	69	0	0	0	0	30	90	65.14	246.30	36	33	*(not set)*		0
PHTslB_M_cm	plot	71	0	0	0	0	85	170	141.00	282.09	36	35	*(not set)*		0
GMoi_M_pct	plot	72	0	0	0	0	6.9	11.2	9.68	0.94	36	36	*(not set)*		0
HskCov_E_1to5	plot	62	0	0	0	0	2	3	2.23	0.08	36	26	*(not set)*		0
EPo_Cmp_ratio COMPUTED	plot	71	0	0	0	0	0.28	0.65	0.46	0.01	36	35	*(not set)*		0
RLodgInc_E_1to9	plot	61	0	0	0	0	1	6	1.69	1.55	36	25	*(not set)*		0
SLodgInc_E_1to9	plot	65	0	0	0	0	1	5	1.88	0.92	36	29	*(not set)*		0
PStandHv_Ct_plntPlot	plot	70	0	0	0	0	12	18	16.36	2.20	36	34	*(not set)*		0
EW_M_kgPlot	plot	69	0	0	0	0	0.55	1.95	1.17	0.08	36	33	*(not set)*		0
GW_CMP_kgPlot COMPUTED	plot	69	0	0	0	0	0.44	1.56	0.94	0.05	36	33	*(not set)*		0
GY_CMP_THA COMPUTED	plot	69	0	0	0	0	1.47	5.2	3.13	0.58	36	33	*(not set)*		0
GY_MOI15_5_CMP_THA COMPUTED	plot	36	0	0	0	0	1.714	5.715	3.57	1.23	0	36	*(not set)*		0
GY_MOI12_5_CMP_THA COMPUTED	plot	36	0	0	0	0	1.655	5.519	3.45	1.15	0	36	*(not set)*		0

Data Terminal
[Review - Plot]

CGIAR

Quality Control » NG_MO-2024-A-016

COMPUTE | REVIEW | COMPLETE TRANSACTION

Summary | Plot

Status NEW UPDATED Legend: EXPERIMENT VALUE

Showing 1-72 of 72 items.

No selected items. SUPPRESS UNSUPPRESS

OCCURRENCE NAME	OCCURRENCE CODE	LOCATION NAME	LOCATION CODE	EH_M_CM	PHTSLB_M_CM	GMOI_M_PCT	HSKCOV_E_1TO5	EPO_CMP_RATIO	RLODGINC_E_1TO9	SLODGINC_E_1TO9	PSTAN
WL-STG3-24A-M2406-002	EXP0015563-002	NG_MO-2024-A-016	NG_MO-2024-A-016	50 65	140 145	9.4 6.8	2 2.5	0.36 0.45	1 4		17
WL-STG3-24A-M2406-002	EXP0015563-002	NG_MO-2024-A-016	NG_MO-2024-A-016	40 50	140 95	9.3 8.5	2.5 3	0.29 0.53	1 3	3 2	18
WL-STG3-24A-M2406-002	EXP0015563-002	NG_MO-2024-A-016	NG_MO-2024-A-016	60 40	137 127	9.9 8.1		0.44 0.31	1 2	2 3	15
WL-STG3-24A-M2406-002	EXP0015563-002	NG_MO-2024-A-016	NG_MO-2024-A-016	65 40	127 100	7.7 8.3	2.5 3	0.51 0.4		3 2	17
WL-STG3-24A-M2406-002	EXP0015563-002	NG_MO-2024-A-016	NG_MO-2024-A-016	40 45		11 8.2	2 2.5	0.31 0.35	1 3	1 2	17
WL-STG3-24A-M2406-002	EXP0015563-002	NG_MO-2024-A-016	NG_MO-2024-A-016		85 105	10 9.1	2 3	0.53 0.43		5 1	15

User training

1.Concepts & Overview

2.Navigating the EBS System & User Resources

3.List Manager

4.Germplasm & Inventory Search

5.Inventory Management (including seed transfers and updating seed quantities)

6.Experiment Creation

7.Planting Instruction Manager

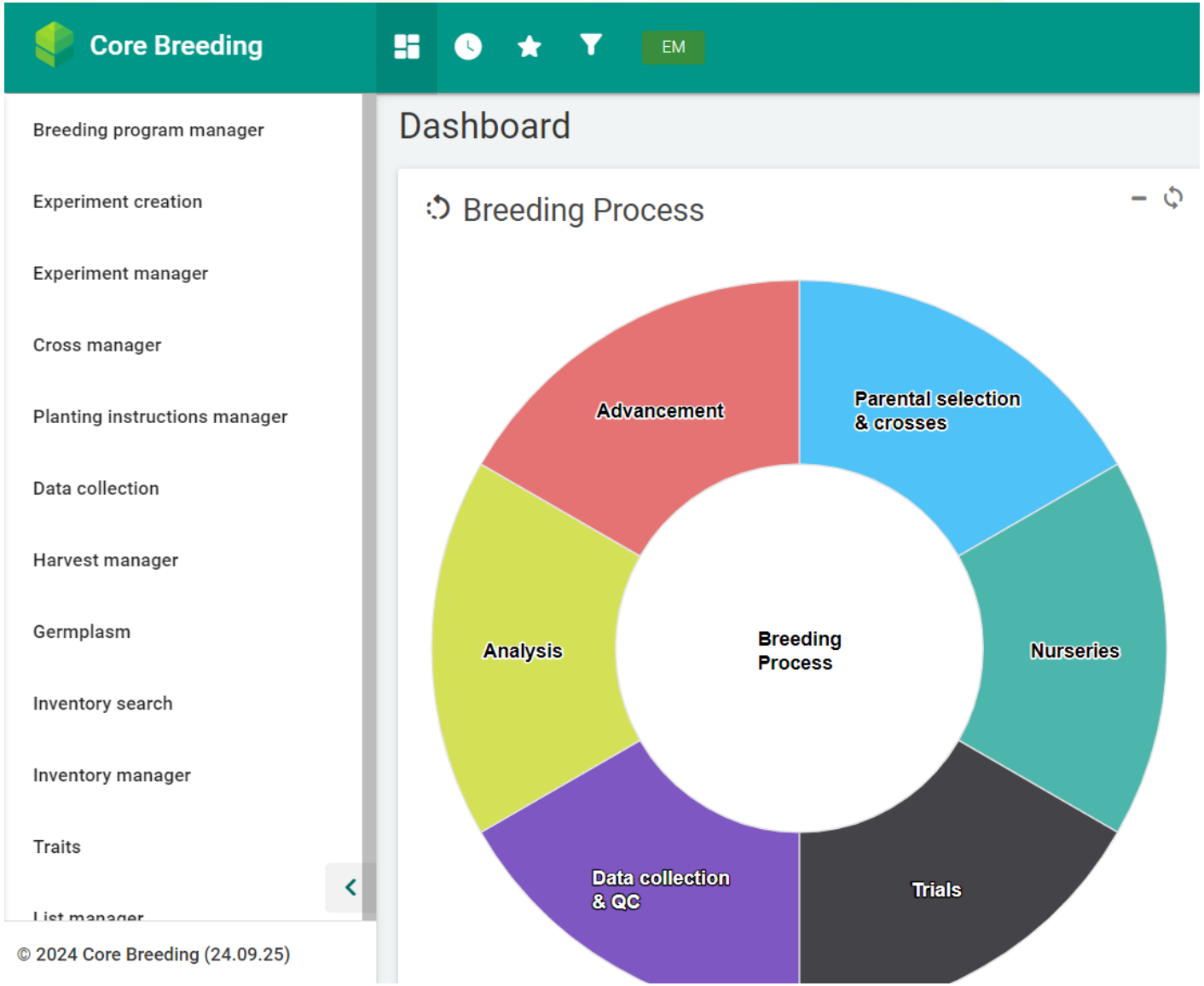
8.Experiment Manager

9.Cross Manager

10.Data Collection & Trait Search

11. Phenotypic Data Manager

12. Harvest Manager



EBS Training for Cowpea Team

EBS Training in Kano,Nigeria, May 7-10, 2024

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EBS Training for Soybean Team

- Core breeding team members trained on:
- All EBS Core Breeding workflows
- Data quality checks and basic data analysis (single and multi-occurrence analyses.

Lusaka, Zambia, Jul 18-23, 2024

EBS-Bioflow Training for Breeding Programs @IITA

Topics covered

- EBS Overview
- Experiment Creation
- Experiment Management
- Digital Data Collection
- Data Quality Checks/Visuals
- Data point suppression and outlier treatment
- Single and Multi-Trial Analysis
- Selection index
- General discussion and feedback for improvement

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BIOMETRICAL GENETICS WORKFLOW

Ibadan, Nigeria, Oct 28-30, 2024

Results

Standardization: Enhanced harmonization of nomenclature, metadata, integration of pedigree, phenotypic, and genotypic data for better breeding decisions.

Data Quality: Improved data consistency and reduced errors due to standardized entries and processes.

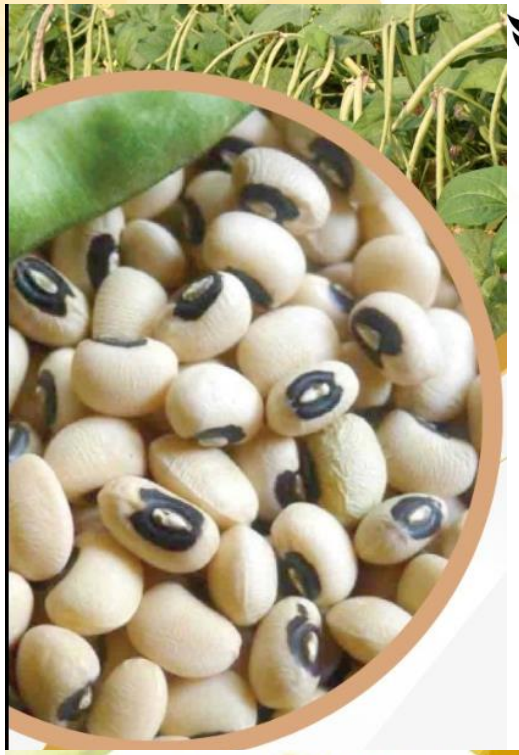
Data Centralization and Accessibility: All historical trials and nurseries migrated, and new experiments loaded to EBS and available to all program members.

Collaboration: Real-time data sharing and control enabled cross-program teamwork.

Resilience: Strong EBS performance even in low-bandwidth environments ensuring usability across remote sites.

"EBS accelerates the process of delivering better legumes to farmers."

Impact and Broader Implications



- EBS's Role in Modernization: Greater efficiency, better data, and better varieties.

- Enhanced Farmer Impact: More resilient cowpea and soybean varieties meeting smallholder needs.

- Contribution to Global Goals: Sustainable agriculture and improved food security in sub-Saharan Africa

- Benefits Beyond Legumes: EBS as a scalable solution for other crop programs. Pipeline developed to migrate from BMS to EBS, positioning it as a template for modernizing breeding in similar contexts.

"The integration of EBS technology isn't just about data—it's about changing lives."

Lessons Learned and Future Directions

- **Reflections**:
  - User feedback was critical for refining workflows and system customizations.
  - Effective training methods enabled team-wide adoption.
  - Dedicated and responsive support desk increased user confidence, satisfaction and continual usage of the system.
  - Available and easily accessible system documentation and user resources are great reference points and aid adoption

Next Steps:

- Refresher training and continuous refinement based on user feedback
- Expand training and partnerships with NARES for global adoption.
- Build more partnerships to strengthen interoperability with other breeding tools.
- Scale EBS to IITA RTB crops (cassava, yam, bananas).

Conclusion

EBS is a scalable, adaptable solution for modern breeding challenges and needs.

Easy to use: Perform all breeding tasks, analysis and decisions from a single modern dashboard.

Powerful: Provide end-to-end workflow support and data analytics empowering breeders to improve crop resilience, yield, and adaptability

Interoperable: Connect key applications and databases with ease.

Configurable: Customize your workflow from the set of tools available and supported

Field-ready/Real-time data access: Data collected offline can be uploaded directly via BrAPI or later with no loss of integrity.

Dedicated Global Support Desk: Provide unparallel support to users to maximize the use of their data.

Network Breeding Support: Collaborate on trials, secured data sharing, and Role Based Access Control (RBAC)

"Join us in transforming crop breeding through this fit-for-purpose technology!"

Visit https://ebs.excellenceinbreeding.org

Find useful information here

User Resources:
tinyurl.com/UserResources

Request EBS demo access

REQUEST: tinyurl.com/RDemoAccess

GUIDE: tinyurl.com/EBSDemoEnvt

Acknowledgements

CGIAR-BRS leadership

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