Excellence in Breeding
PLATFORM

Plan of Work and Budget

2021

CGIAR Excellence in Breeding Platform (EiB)

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Breeding
Platform

CGIAR

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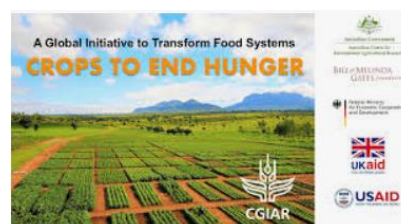
Plan of Work and Budget 2021

The **CGIAR Excellence in Breeding (EiB) Platform** is accelerating the modernization of crop breeding programs that serve farmers in low- and middle-income countries. To combat hunger, poverty and climate change, farmers need diverse and continually improving crop varieties. Drawing on public and private sector innovations, EiB partners with breeding programs to deliver system-level coordination, shared services, expert guidance, resources, and access to cutting-edge technologies and practices.

EiB is hosted by the International Maize and Wheat Improvement Center (CIMMYT).

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Funding:

Funding for the Excellence in Breeding EiB) Platform comes from CGIAR Trust Fund and generous donors including national governments, foundations, development banks and other public and private agencies, as well as the Crops to End Hunger initiative.

Participating Centers and other key partners:

AfricaRice

CROP TRUST

John Innes Centre
Unlocking Nature's Diversity

BAYER

FAO
FIAT PANIS

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA.

Bioversity International

ICARDA
Science for Better Livelihoods in Dry Areas

OSU
Oregon State University

CIAT

INRA
SCIENCE & IMPACT

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

CIMMYT
International Maize and Wheat Improvement C

ICRISAT
INTERNATIONAL CROPS RESEARCH
INSTITUTE FOR THE SEMI-ARID TROPICS

SLU

CIP
INTERNATIONAL POTATO CENTER
A CGIAR RESEARCH CENTER

IITA
Research to Nourish Africa

syngenta

Cornell University

ILRI
INTERNATIONAL
LIVESTOCK RESEARCH
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CSIRO

Integrated Breeding Platform
Today's tools for tomorrow's crops

WAGENINGEN
UNIVERSITY & RESEARCH

Diversity Arrays Technology
IT'S A BULLSEYE WITH DArT

IRRI
International Rice Research Institute

World Agroforestry Centre

CORTEVA
agriscience
Agriculture Division of DowDuPont

The James Hutton Institute

WorldFish

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Contents:

Narrative section

1. Adjustments/ Changes to Your Theories of Change (ToC), if relevant

There are no expected adjustments/changes to the CGIAR EiB Platform's Theories of Change (ToC).

2. Plans and Expected Progress Towards Outcomes

EiB continues to accelerate genetic gains through modernization of CGIAR and National Agricultural Research Systems (NARS) breeding programs, by:
- Supporting breeding programs to advance their improvement plans and adopt best practices and technologies
- Providing coordination and direction to breeding programs across One CGIAR

Progress will be measured against the six requests made by Crops to End Hunger (CtEH) funders:
- Aligning breeding pipelines with market segments, development of pipeline investment cases, product profiles, etc.
- Incentivization of breeding teams and individuals aligned with genetic gain and variety turnover
- Effective delivery mechanism of varieties from breeding program to farmers.
- Increased rate of genetic gain
- Commitment to shared services
- NARS breeding networks and NARS capacity

EiB is structured around five interlinked Modules, along with a National Agricultural Research System (NARS) coordinator, a new Adoption and Outreach coordinator, a new Breeding Improvement Implementation coordinator and the EiB Toolbox coordinator.

With the technical assistance of the module leads and cross-functioning coordinators, EiB is well-positioned to drive technical change. This implementation requires change and that can be very difficult. To successfully drive this modernization, change initiatives need the following:
- Clear lines of accountability
- Sponsorship; particularly from senior leadership
- Technical support
- Financial support
- Standards and a unified platform
- Strategies that consider emotional responses to change

EiB has contracted expert consultants to help our partners develop successful change management strategies. Planned activities in 2021 towards the objectives outlined above include:

Product design and management (Module 1)

Module 1 aims to work closely with CGIAR breeding teams to deliver a complete set of market segments by CGIAR crop, a description of each market segment, and a robust product profile for each market segment.

Current CGIAR breeding pipelines will be aligned to the newly defined market segments. Pipeline investment cases will be developed using information from the market segment description and the information on the current pipeline investment per market segment. The pipeline investment case data will be compiled to allow:

- Comparisons to be made across crops

- Identification of market segments that currently have no or little investment
- Identification of market segments that appear to have over-investment, relative to the opportunity to make an "impact"

Market segment data will be reviewed for accuracy, with sources documented where possible. Approaches will be explored to visually display market segments and the relevant data used to describe the market segment.

Module 1 will partner with five NARS to define local market segments and create related product profiles, aligned to the CGIAR effort. A significant effort will be made to align the EiB approach and terminology with Breeding Program Assessment Tool (BPAT) assessments, and USAID and Syngenta Foundation efforts. This will reduce redundancy and improve consistency through common terminology and consistent approaches.

Module 1 and Module 4 will develop a process to determine pipeline investments, separated by fixed (infrastructure) and variable (executing the workload associated with the pipeline) costs. Module 1 will work across modules to understand the impact of efficiency and pipeline optimization on the investment required for each pipeline.

EiB will review product profiles to ensure traits and the scale of measurement are appropriate, and the minimum threshold score required is documented. Traits will be cross checked with those in Enterprise Breeding System (EBS) and other databases. A pilot study will examine options to automate the creation and management of product profiles.

Annual product advancement meetings will be held by all crops and organized around market segments and product profiles. EiB will train product managers to ensure consistent approaches and to identify and implement best practices.

Module 1 will improve understanding of key drivers of varietal turnover, including through a newly hired market researcher. A small cross-functional working team will be created and co-led by Module 1 to drive this work. This team will ensure gender relevant traits are considered in understanding key drivers of varietal turnover.

A pipeline stage gate system will be finalized, and teams will be assigned to develop the substages. The system will be used in the annual advancement meetings.

A stage gate process will be developed to manage trait discovery efforts. A team of gatekeepers will be established to manage the decision-making process and advancement of traits.

Optimizing breeding schemes (Module 2)

Module 2 aims to ensure breeding teams across the CGIAR better understand the basic concepts of quantitative genetics, leading to an across-system improvement of breeding strategies and terms related to the breeders' equation. For example, breeders will understand how to make better crossing, evaluation and selection decisions.

EiB will continue to achieve major improvements to breeding schemes through simulations, 1:1 interactions, and workshops with breeding teams. For example, the eight crop by region priorities (Cassava, Yam, Banana, Wheat, Maize, Rice, Sorghum, Sweetpotato) have recurrent meetings on improving program size, speed, use of selection indices and good Biometrics practices to increase rates of genetic gain, demonstrating potential improvement based on simulating their breeding programs. Connection with other modules is made on request. All crop by region priorities have made at least one change in the ways they breed.

EiB will increase investment in capacity building. For example, following up six sigma trainings to improve breeding design, EiB will conduct a certification program on designing breeding programs using Quantitative Genetics principles. Two new module members and other consultants will increase impact.

Genotyping / sequencing (Module 3)

Module 3 aims to improve automation of the logistics process to expedite genotyping, by streamlining paperwork and increasing expected results. A new digital sample submission tool will be developed in collaboration with the EBS team with expected roll out by Q2.

New partnerships with NARS are expected as more partners are aware of EiB and Module 3.

With the support of CtEH funding, a genotyping charge account will be created to support the transition of genotyping activities across all breeding networks into a more centrally coordinated manner, aligned with One CGIAR. 2020 marked the end of the High throughput Genotyping Project (HTPG) led by ICRISAT.

Module 3 will roll out a transition plan to ensure continuous support for all genotyping users This includes: merging of the Low density service contract (formerly HTPG) with the EiB-led Mid density contract, and transition of 'HTPG Coordinator' to EiB as 'South Asia Genotyping Coordinator'. The merger of the two genotyping platforms is expected to further enhance ease of access and allow aggregation of business volumes across platforms to maintain low pricing for all users. Expected usage for both low and mid density genotyping is expected to surpass $1.5M USD.

There is a deviation on milestone '$1.50 SNP genotyped sample" as the genotyping work is being integrated in the breeding plan cost of the breeding teams.

Breeding operations and phenotyping (Module 4)

Module 4 expects to see improvement in data quality and heritability in some breeding programs that were engaged, and on those where improvement actions were taken.

Infrastructure and equipment acquisition will continue, with the impact of these in late 2021 to early 2022.

EiB will strengthen its support for breeding programs with:

- Technical training for key CGIAR operational staff
- Access to service for quality and nutritional analysis
- Access to phenotyping service (field phenotyping), supporting the connection between breeding programs and validated service providers.

EiB also plans to provide more support to determine breeding pipeline investment cases, working closely with module 1, streamlining the process to define the investment by fixed and variable costs.

Module 4 will work closely with NARS to define required improvements.

EiB aims to provide more guidance, recommendations and supporting implementation of health and safety improvements defined by breeding programs at operational levels.

We will start the organization of quality assurance management systems (for breeding operations) to share protocols and SOPs, across CGIAR and NARS breeding programs.

Breeding Informatics (Module 5)

Module 5 expects three major outcomes:

- **Delivery of a minimum viable version of the EBS** that can support data management and decisions through a full breeding cycle for CIMMYT wheat and corn, IITA corn, IRRI rice. We expect EBS will be used in production activities by at least one pipeline within each program by end 2021.
- **Establishment of the Breeding Informatics Network** to formalize cross-center collaborations between biometricians and bioinformaticians. The network will produce best practice recommendations and work with EBS developers on software best practices.
- **Determination of alternative strategies for the long-term maintenance of Breeding Management System (BMS) and Breedbase**. While CGIAR non-clonal crops are all targeted to adopt EBS, BMS will remain for NARS non-clonal crop. BMS' maintenance strategy will be tailored to support these programs and their interactions with partner EBS users in the CGIAR. CGIAR's non-clonal crops will continue to use Breedbase, with the goal of reaching consensus on EBS transition by Q1 2022.
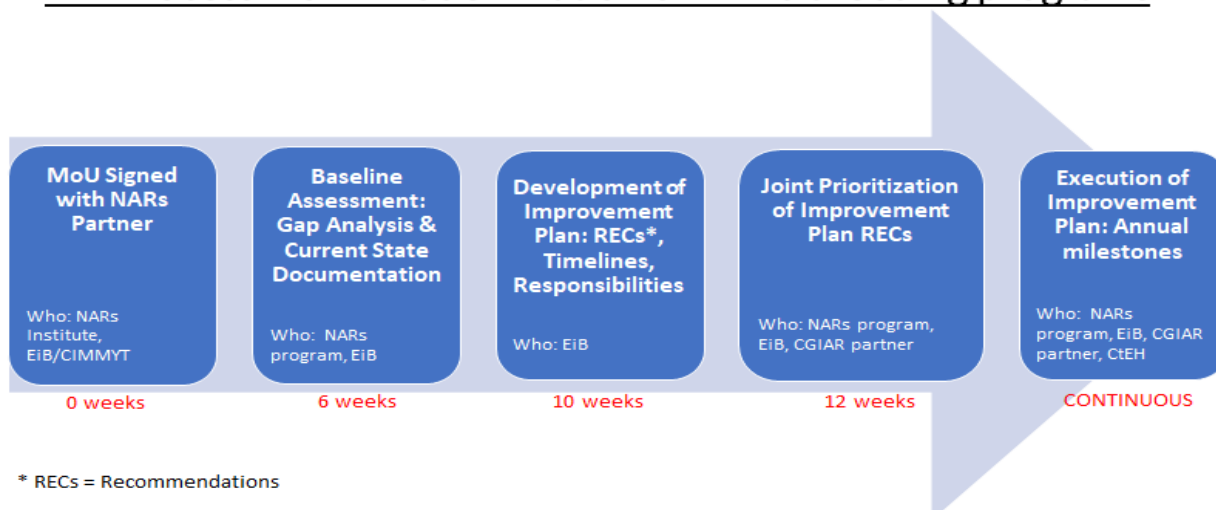
NARS breeding networks and capacity development

Focus is on three priority areas:

1. Technical support to modernize priority NARs breeding programs in focal countries
2. Institutional support to drive change and monitor breeding program performance
3. Promoting a model for more functional CGIAR-NARs breeding networks

EiB continues to provide technical support to priority NARS to develop and implement customized Improvement Plans (IPs). IPs will be based on Baseline Gap Assessments and will be customized to the current state, available resources (financial and human), market demand and program ambition. EiB is working directly with 10 NARS programs focusing on rice and maize in Senegal, Ghana, Kenya, India, Uganda, Tanzania, Zimbabwe. EiB will extend focus to sorghum and priority RTB crops (cassava and musas).

EiB Process Flow: Modernization of NARs breeding programs

MoU Signed with NARs Partner	Baseline Assessment: Gap Analysis & Current State Documentation	Development of Improvement Plan: RECs*, Timelines, Responsibilities	Joint Prioritization of Improvement Plan RECs	Execution of Improvement Plan: Annual milestones
Who: NARs Institute, EiB/CIMMYT	Who: NARs program, EiB	Who: EiB	Who: NARs program, EiB, CGIAR partner	Who: NARs program, EiB, CGIAR partner, CtEH
0 weeks	6 weeks	10 weeks	12 weeks	CONTINUOUS

* RECs = Recommendations

The unit will support one pilot NARS to implement institutional changes to drive optimization of breeding programs across the organization. This will focus on organizational structure, development of performance metrics, and change management support. External organizational assessment and change management consultants, and a senior program administration mentor will assist.

CGIAR-NARS collaborative breeding networks remain a key focus. A model for effective partnership that outlines clear CGIAR/NARS roles and responsibilities was developed in 2020, and customization based on crop and country requirements will be undertaken in 2021 with an initial focus on maize, matoke and rice through the AGG (Accelerated Genetic Gains), ABBB (Accelerated Breeding of Better Bananas) and AGGRi (Accelerated Genetic Gain in Rice). CGIAR centers will lead upstream, centralized components of the breeding pipeline while NARS will lead downstream, localized delivery of products to smallholder farmers.

Adoption

This new module improves program impact by promoting, monitoring and improving usage of module 1-5 outputs (software, tools, processes). This will also allow funders to better understand return on investments at the module level.

The module will promote, monitor and adjust outputs for:
1. **Digitization equipment purchased through module 4.** These will be promoted through standardized documentation that can be applied across any crop and system, as well as trainings to breeders and technicians as part of breeding program crop cycles. The goal is for breeding programs to use digitization devices to capture and load data to a breeding management systems in real-time. Adoption progress and barriers will be monitored via surveys and KPIs. A newly established training and adoption network operating across systems, regions and CGIAR will promote, monitor and make recommendations. This network will focus on operationalizing digitization within a variety of crop programs and systems and report on blockers (training, software, consumables, tools, internet etc.) to end-to-end data management.
2. **EBS adoption for IITA maize.** Promotion, monitoring and feedback (to EBS development team) will be achieved through formal project management and KPIs. The goal is to have breeders and technicians trained and all 2021 experiments harnessed within EBS and historical data to be curated.
3. **EBS adoption for ICARDA wheat.** The system will be promoted through live demonstrations and a demo system that can be used to determine readiness for migration from BMS to EBS. Data curation will be facilitated by sponsoring a curator at ICARDA.
4. **BMS adoption for prioritized NARS.** Promotion, monitoring and feedback will be achieved through formal project management and KPIs managed by IBP. The goal is to have breeders and technicians trained and all 2021 experiments harnessed within BMS and historical data to be curated.

3. Financial Plan for the coming year, including use of W1/2

COVID-19 related travel restrictions led to cancellation of travel and workshops. Expected hires were also delayed. Hence, there will be a W1/W2 2020 carry-over budget of USD $3,400,000 in addition to the expected USD $3,375,000 W1/W2 Funds. In 2020, the Bill & Melinda Gates Foundation (BMGF) approved an EBS supplemental grant of USD $6,500,000.00 (period November 2020-October 2022) for:

> 1. *Completion and implementation of EBS at CIMMYT and IRRI, with full integration of the GOBii genomics database.*

The EBS will be developed for, tested in, and fully adopted by the three largest and most advanced CGIAR breeding programs (maize, wheat, and rice) by the end of this project phase. It is being

designed through a modular Software as Service (SaaS) model which will greatly simplify provision and operation and will achieve greater economies of scale as the user base grows. EBS includes modules for:

- breeding program knowledge management, planning, and optimization
- core breeding cycle capabilities such as breeding trial or nursery experiment creation, field planting and phenotyping, and seed inventory management
- analytical lab sampling
- full integration of the GOBii database system, allowing routine application of genomic data in breeding
- breeding analytics and decision support
- system services such as user authentication, data migration, APIs, etc.
- monitoring key performance indicators (KPIs) such as genetic trend, selection intensity, heritability, and cycle length

EBS is being piloted at CIMMYT and IRRI. In 2021-2022, full implementation of the analytical tools will be completed, and the system will be fully deployed in all CIMMYT and IRRI breeding programs, and piloted by ICARDA (wheat) and IITA (maize). In 2022, ICRISAT will pilot it in crops supported by the AVISA project (grain legumes, sorghum, and millet). Maintenance and upgrading of the core system will be a One CGIAR support function and must be built into its new budget in addition to operating costs.

2. Enable migration of BMS users in the CGIAR to the EBS

BMS, developed by the Integrated Breeding Platform (IBP), was adopted by several CGIAR and NARS breeding programs, and will continue to be maintained for current users However, the CGIAR cannot afford to maintain two full systems for grain crops indefinitely. The EBS will be the main breeding informatics system for CGIAR grain crop breeding programs and it is expected that users of BMS will migrate to EBS after implementation at CIMMYT and IRRI. The supplement will fund development of purpose-built tools needed to support this migration, initiated in the ICRISAT breeding programs by the end of the project.

3. Support adoption of breeding information management systems by CGIAR breeding networks, including NARS partners

The IBP team's extensive skills and experience in supporting deployment of breeding information management systems will support adoption of the EBS by national partners of CGIAR breeding networks, and by NARS breeding institutes that decide to implement a common breeding information management system for either the entire institute or the programs participating in CGIAR-coordinated breeding networks.

4. Crops to End Hunger (CteH) [additional section requested by funders]

The following CtEH projects will be delivered:
- Irrigation and drying capacity for CIMMYT in Kenya, Zimbabwe and Ethiopia
- Seed processing capacity in AfricaRice
- Delivery of digitization equipment
- Revamping irrigation infrastructure for IITA sites in Nigeria

- Upgrading IITA stations to enable centralized operations and development of a regional hub for One CGIAR and NARS
- Dry-ground direct seeded system for rice network
- Establishment of regional biometric and bioinformatics support network

These projects, in conjunction with other initiatives led by EiB, such as Breeding Operation Exchange Program, intend to:
- Bring the current CGIAR station infrastructure to a more advanced level: Currently most of these infrastructures were ranked by the EiB team as 'marginal' to 'basic'. Through these investments EiB aims to improve their capacity, moving the status to 'good'.
- Strengthen regional hubs: By investing in building capacity at regional stations to support cross crop operations and services.
- Improve data collection capacity

Other CtEH initiatives aim to:
- Increase adoption of mechanization
- Reduce health and safety hazards at CGIAR breeding operations by implementing health, safety and environmental standards

EiB-NARS engagement through CtEH projects includes implementing deliverables for two CtEH funded projects led by EiB:
- **HiRice:** the team has completed baseline assessments (gap analysis) for six of eight HiRice partner countries in 2020 and is currently finalizing customized Improvement Plans for each program. These plans will define priorities for operational and infrastructural investment in HiRice partners to enable them to transform their breeding operations. Investments are likely to include improved seed storage, better trial management, and crop processing, irrigation and process development. It is estimated that 50% of the HiRice budget ($220k) will be spent in 2021 on station upgrade investments.
- **CtEH implementation initiative:** the EiB NARS team will be responsible for mapping CGIAR-NARS breeding networks to identify priority NARS stations for investment. Particular emphasis will be on supporting key stations in Uganda's National Agricultural Research Organisation (NARO) and Kenya Agricultural and Livestock Research Organization (KALRO) to modernize their seed systems capacity for roots, tubers and bananas. Further investments will likely be directed towards developing effective seed storage systems and seed storage processes.

Tables

Table 2A: Planned Milestones

Module	Mapped to Sub-IDO	2022 Module outcomes	Milestone	Indication (dropdown)	Means of verification	CGIAR Cross-Cutting Markers 0=not targeted; 1=significant; 2=principal; N/A = not applicable			
						for gender	for youth	for CapDev	for CC
1		1 Outcome: Member breeding programs have gender and (seed, product) market-informed market segments and product profiles in place that are aligned with drivers of variety adoption.	2019 extended to 2021 - (i) Best practices agreed and documented for market/value chain/gender analysis for the purpose of defining product profiles. (ii) Provisional product profiles are in place for all member programs.	Reworded/ rephrased from proposal	The means of verification for the milestone are: 1. EiB seeks to co-support (50% or matching funds) 2 projects x 3 year study on economic traits assessment projects, for the purpose of creating a use case to drive behavioral changes and ensure selection index breeding activities. The partner for this project is AbacusBio Ltd. 2. Written strategy/plan incorporates best practices of Gender Breeding Initiative project into EiB Product	1	1	0	N/A

					Profile Contract Process. Same for Bio-fortification targets. 3. Complete 2-3 High Priority Product Profile Contracts/Market Facing Breeders + Key NARS Breeding Programs 4.Complete Crop Based Breeding Strategy (includes Gender/Bio fortification Strategy) and Tool Gaps 5. Toolbox Release: Product Replacement and Pre-Breeding (Discovery Tool) Strategy Tool. 6. Release of Gender/Bio fortification Tool & Tool GAP Analysis Tool.			
		1 Outcome: Member breeding programs have gender and (seed, product) market informed market segments and product profiles in place that are	2020 extended to 2021 - "(i) Member programs mentored in defining improved targeted product profiles aligned with existing information on environmental, market and gender preferences. Product profiles are developed by a	New/ changed	(i) Toolbox Citation: targeted product profiles information captured in the targeted product profile data based. b) a prioritization of breeding program targets by market segments, target population of environments (TPE)s. c) a	1	0	N/A	N/A

		aligned with drivers of variety adoption.	cross functional group including NARS partners. (ii) Collection of improved gender disaggregated market information which considers variety replacement decisions of seed producers, farmers, processors and consumers; scope depends on funding availability."		formal identification of the product design team (ii) Not Applicable. Gender dis-aggregated market information is not available to EiB Module 1 nor was EiB Module 1 resourced to collect this data. Gender dis-aggregated data may be available from the gender specialist involved in the product design team, as part of a data driven justification of a product design featuring gender responsive features. This data would be found within the product design minute notes or upon request.				
		1 Outcome: Member breeding programs have gender and (seed, product) market informed market segments and product profiles in place that are aligned with drivers of variety adoption.	2020 extended to 2021 - "(i) 1st round of peer review of formal advancement program; recommendation for improved approaches. (ii) Collect feedback from member programs on stage-gate systems and further optimize and incorporate idiosyncrasies of specific crops. (iii) Collect feedback from member breeding	New/ changed	(i) EiB tool box progress positing (ii) written program notes - shared upon request (iii) Not applicable - CGIAR center management have responsibility for employee incentives and performance.	0	0	N/A	N/A

			management teams on implementation of breeding team member incentivization and performance evaluation processes."						
		1 Outcome: Member breeding programs have gender and (seed, product) market informed market segments and product profiles in place that are aligned with drivers of variety adoption.	2020 extended to 2021 - 1. Breeding programs access advice or visit to best-practices sites on a self-funded basis. 2. Portfolio strategy and gap analysis drives support for program improvements including by informing the Platform agenda and priorities	Reworded/ rephrased from proposal	1) NA 2) This will be part of the Advancement Meeting process being implemented in 2020. The results of the advancement meeting of 2-3 mega-projects will be captured in the breeding program advancement notes, which will be included in the toolbox	N/A	N/A	N/A	N/A
		1 Outcome: Member breeding programs have gender and (seed, product) market informed market segments and product profiles in place that are aligned with drivers of variety adoption.	2020 extended to 2021 - (i) In collaboration with BMGF, ensure all CGIAR breeding programs have completed Breeding Program Assessment Tool (BPAT) assessments; (ii) continuously update common and commodity-specific areas of improvements (GAP analysis); (iii) use insights to update priority setting of various modules; and (iv) agree	New/ changed	(i) Not Applicable - BMGF has disconnected EiB from BPAT early in the development of EiB. However, GAP analysis could be extracted from the center improvement plan notes found in Teamwork. Notes (GAPS Analysis) were synthesized from BPAT reports, center improvement plans, center interviews and meetings.	N/A	N/A	N/A	N/A

			with breeding programs on specific improvement strategies to be supported by the Platform (all Modules).						
		1 Outcome: Member breeding programs have gender and (seed, product) market informed market segments and product profiles in place that are aligned with drivers of variety adoption.	2021 - Data analysis of improved gender disaggregated market information which considers variety replacement decisions of seed producers, farmers, processors and consumers.	New/ changed	Data for all market segments compiled in a single file and stored in a central electronic location to be determined. All product profiles stored in a central electronic location, to be determined.	1	1	NA	NA
		1 Outcome: Member breeding programs have gender and (seed, product) market informed market segments and product profiles in place that are aligned with drivers of variety adoption.	2021 - (i) Accumulate published genetic gains assessments in Toolbox. (ii) Peer-feedback to published genetic gains assessments in Toolbox.		All genetic gain information stored in the Toolbox.	NA	NA	NA	NA
	Adoption of CGIAR materials with	1 Outcome: A standard template and stage gate advancement system for monitoring breeding program performance and	2021 - 2nd round of peer review of breeding program assessments, metrics and strategic plans;		2nd round of reviews stored in Toolbox	NA	NA	NA	NA

	enhanced genetic gains	implementation of best practices in breeding programs.	recommendation for improved approaches.						
2	{primary} Adoption of CGIAR materials with enhanced genetic gains	2 Outcome: Increased rates of genetic gain through use of best practices, optimization of breeding strategy and more effective use of resources (time, finances).	2018 extended to 2021 - Members begin to document trait and core breeding pipelines in Toolbox. Broad recommendations for breeders to consider when making key breeding decisions to be developed and posted to the toolbox and be presented to breeding teams and discussed during regional visits.	Reworded/ rephrased from proposal	Breeding schemes documented and available in the toolbox	N/A	N/A	2	N/A
		2 Outcome: Increased rates of genetic gain through use of best practices, optimization of breeding strategy and more effective use of resources (time, finances).	2018 extended to 2021 - In collaboration with Modules 3 & 4, use cases of successful/failed implementation of predictive tools providing value towards breeding for product profiles documented.	Reworded/ rephrased from proposal	Improvement plans detailing the adoption of predictive tools	N/A	N/A	2	N/A
	{primary} Increased household	2 Outcome: Identification of high value predictive tools	2021 - Members update predictive tools used in their breeding programs, grouped	Identical to proposal	1) Memories from the QG training addressing the optimal use of genomic	N/A	N/A	1	N/A

capacity to cope with shocks	for use in member breeding programs	into discovery, validation and in-use stage		technologies. 2) Videos and minutes from the one-to-one support to crop by region priorities in the implementation of genomic technologies 3) Minutes from meetings with the community to define key questions and parameters for use in a series of prioritized simulations in the trait deployment space.				
	2 Outcome: Identification of high value predictive tools for use in member breeding programs	2021 - Trait discovery and deployment activities conducted in key breeding programs are clearly defined and mapped to a conceptual, segmented breeding framework.	New/ changed	Introgression schemes documented and available in the toolbox.	N/A	N/A	2	N/A
{primary} CC Increase capacity of beneficiaries to adopt research outputs	2 Outcome: Documentation and implementation of best practices for trait breeding, aligned with core breeding strategies.	2020 extended to 2021 - (i) Members document trait and core breeding pipelines in Toolbox. (ii) A framework of guidelines for integrating trait breeding with core breeding developed, documented and uploaded to the toolbox.	Identical to proposal	A diagramatic breeding scheme for each breeding pipeline posted to the toolbox.	1	N/A	1	N/A

						N/A	N/A	2	N/A
		2 Outcome: Documentation and implementation of best practices for trait breeding, aligned with core breeding strategies.	2021 - Members optimize trait pipelines aligned to core breeding strategies.	Identical to proposal	Files with breeding scheme for trait discovery and trait deployment efforts.	N/A	N/A	2	N/A
{primary} CC Enhanced institutional capacity of partner research organizations	2 Outcome: Breeding strategy optimization.	2021 - (i) Provide mentorship / consultation to Members needing assistance to implement changes. (ii) Readdress breeding schemes with the implementation of new breeding tools (i.e. MAS, better field designs, mechanized field testing, genomic selection)	Identical to proposal	(1) Documentation from CoP addressing an efficient use of molecular tools in breeding programs, (2) Documentation of a QG training addressing the optimal use of genomic technologies (3) Minutes and videos from meetings where EiB provided one-to-one support to crop by region priorities in the implementation of genomic technologies		N/A	N/A	2	N/A
{primary} CC Increase capacity of beneficiaries to adopt	2 Outcome: Source innovative ideas through an incubator	2021 - Physical and virtual blue sky discussions associated with scientific meetings, to raise and discuss ideas for high-payoff approaches, and discuss and design the incubation of project ideas. Allocation of	Identical to proposal	Documentation from meeting at PAG or other forum to discuss the direction of the project.		N/A	N/A	N/A	N/A

research outputs			modest resources to validate technologies in the incubator while jointly seeking additional funding to test more substantive "game changers."						
		2 Outcome: Source innovative ideas through an incubator	2021 - (i) Optimized breeding schemes will be in place by allocating resources in a way to optimize the trade-off of accuracy and speed while keeping variance and intensity in proper levels for both population improvement and parent development/trait development/pre-breeding pipelines. (ii) Breeding cycles will be driven down to, or close to the biological limit by reducing line derivation, multiplication stages, incorporating parental phenotypic data prior to testing new progeny and use of prediction methods.	Identical to proposal	(i) Each breeding pipeline will be quantitatively described and documented in a standardized way (ii) Simulations will be run to identify options for optimized breeding schemes to allocate plots properly, reduce cycle time and increase accuracy. (iii) Each center will develop, in consultation with EiB, a plan for how to quantitatively optimize each of their pipelines (iv) Changes to breeding schemes will be monitored. (v) Software tools to describe the breeding schemes, understand the principles of breeding scheme design and simulation will be developed and employed.	N/A	N/A	2	N/A

		2 Outcome: Source innovative ideas through an incubator	2021 - (i) Strictly, only elite by elite crosses will be made by population improvement breeders. (ii) All breeding programs will use predictive approaches to increase accuracy of selections, optimize the intensity (size) of programs, reduce cycle time and manage diversity properly. (iii) Breeders conceptualize their variety development pipelines as a (mostly) closed genepool that they improve through a process of rapid cycle recurrent selection, and from which improved varieties (or hybrid parents) are extracted and tested for their suitability to satisfy the market and meet the criteria for variety replacement (as outlined in the product profile).	Identical to proposal	(i) Simulations will be run to show the importance of elite by elite crossing and the use of a relatively small crossing block to properly allocate the plots, reduce cycle time and increase accuracy. (ii) Each center will develop, in consultation with EiB, a plan for how to implement the recommendations drawn from the simulations. (iii) Changes to breeding schemes will be monitored. (iv) Feedback gathered from training on breeding program design for encouraging the coupling of population improvement from product development will be conducted.	N/A	N/A	2	N/A
		2 Outcome: Source innovative ideas through an incubator	2021 - (i) Examples of optimized breeding schemes, incorporating current best practice principals of quantitative genetics and biometrics developed for each	Identical to proposal	Examples / SOP's developed for: 1. selection of parents 2. calculating genetic gain/trend 3.predicting genetic gain by	N/A	N/A	2	N/A

			of hybrid, clonal and fixed line crops will be available and communicated across CGIAR programs. Will include sufficient detail to be used as an SOP.		calculating each component of the breeders' equation 4. shortening the breeding cycle time, including earlier selection of parents and accelerating generation advance 5. calculating heritability 6. calculating genetic correlation between target population of environments (TPE) and trial/test environment				
		2 Outcome: Best practices and tools documented and made accessible to the applied breeding and trait discovery communities through the web based toolbox.	2021 - (i) A 50% increase from 2020 in the number of tools and best practices documented and made available through the EiB platform; use cases developed around missing features and work prioritized with relevant Modules; incorporate new components, upgrade workflows, remove obsolete components in collaboration with members; engage students in developing such information. (ii) A 20% increase in the number of active platform users.	Identical to proposal	1) Document with a roadmap and a series of guidelines for Trait Discovery and Deployment activities upstream of core breeding. 2) Statistics of the downloads	N/A	N/A	2	N/A

		(iii) Members downloading resources from the web platform and reporting implementation in their breeding programs; (iv) Existing projects: Tools developed by Seeds of Discovery, GenomeHarvest, GS-RUSE and other projects submitted with documentation to the toolbox and, as applicable, integrated in Galaxy/Taverna.							
{primary} CC Increased capacity of partner organizations, as evidenced by rate of investments in agricultural research	2 Outcome: Foster toolbox adoption and its dynamic use.	2021 - (i) CoPs document "missing" features in trait discovery, mobilization and precision breeding applications, including prioritization of needs across AFS and CoPs, develop use cases around missing features and work with the Bioinformatics Module to support the formation of technical user requirements for new bioinformatics and/or biometrics tools and approaches. (ii) CoPs provide user-based feedback on tools, workflows, suppliers and		1) TBD		N/A	N/A	1	N/A

		pipelines. (iii) Training and documentation of end user tools and pipelines through webinars, video modules, and implementation guides. (In 2018 & 2019 co-funded with Genomic Open-source Breeding informatics initiative - GOBii). (iv) In-depth training courses / workshops linked to large meetings.						
	{primary} CC Increase capacity of beneficiaries to adopt research outputs	2 Outcome: Review mechanisms for tools and practices implemented in web based toolbox to provide electronic community based feedback to EiB recommendations.	2021 - Review of user feedback conducted; specific needs communicated to respective modules/AFS/partners, selection of any tools/practices receiving poor review for removal from EiB web platform.	Identical to proposal	1) beta version of review functionality in toolbox available	N/A	N/A	1	N/A
		2 Outcome: Capacity development resources developed by EiB and reviewed by EiB made available to the community through the web based platform.	2021 - (i) Development of best practice documentation for e-learning based on materials used at regional workshops (ii) Identification of, and links to relevant external e-modules and courses (iii) Collection of member	Identical to proposal	1) TBD 2) TBD 3) TBD 4) TBD	N/A	N/A	1	N/A

			feedback to material provided (iv) Use of materials by AFS own training programs, BecA and other networks						
{primary} CC Increased capacity for innovations in partner research organizations	2 Outcome: Key performance indicators (KPIs) for improvement of breeding populations and also for development of elite parents with novel haplotypes, based on quantitative genetics principles, calculated and regularly presented by each program for every breeding pipeline	2021 - (i) Different types of breeding (trait discovery, trait deployment, population improvement, product development) will be modularized in the program. (ii) The relative investments in and connectivity of the trait discovery and deployment activities are clearly defined and documented	Identical to proposal	(ii) Current activities, the level of investment in these activities and the defined to integration with population improvement activities will be mapped onto the segmented discovery and deployment framework to identify bottlenecks and opportunities for optimization.	N/A	N/A	2	N/A
		2 Outcome: KPIs for improvement of breeding populations and also for development of elite parents with novel haplotypes, based on quantitative genetics principles, calculated and regularly presented by each program for every breeding pipeline	2021 - (i) Each breeding program calculates their genetic trend annually and their predicted genetic gain annually and in response to each modification to their breeding scheme.	Identical to proposal	(i) Training for how to calculate the rate of response to selection or genetic gain will be conducted and link to Module 5 for support on the actual calculation and documentation validating its application.	N/A	N/A	2	N/A

{primary} CC Enhanced institutional capacity of partner research organizations	2 Outcome: target population of environments (TPE) definition and testing strategy in a market segment framework	2021 - (i) Each breeding program will have their TPE defined	Identical to proposal	(i) Currently available data will be compiled for appropriately considering the Genotype by environment (GxE) of each crop as part of development of the across crop One CGIAR strategic plan for investment into upgrade of CGIAR trialing capacity. (ii) A plan will be developed describing additional data required to properly address remaining questions about GxE of each crop in the context of development of the across crop One CGIAR strategic plan for investment, into upgrading of CGIAR trialing capacity and how to generate such data.	N/A	N/A	2	N/A
	2 Outcome: target population of environments (TPE) definition and testing strategy in a market segment framework	2021 - (i) Early testing across the TPE will be done, to enable parental selection from first year of field trialing.	New/ changed	(i) Simulations reports. (ii) Consultation plan in dropbox (iii) Documented changes in breeding schemes through improvement plans	N/A	N/A	2	N/A

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3	{primary} Adoption of CGIAR materials with enhanced genetic gains Reduce pre- and post-harvest losses, including those caused by climate change	3 Outcome: Efficient and effective application of genomic technology in breeding is mainstreamed within AFS networks, accelerating the rate of genetic gain delivered in farmers' fields.	2020 extended to 2021 - (i) Comprehensive workshop on MAS/GS implementation conducted and planning for various crops applications. (ii) Genotyping application plans integrated into breeding team improvement plan documents	Identical to proposal	EiB member program engagement visits.	1	1	2	N/A
		3 Outcome: Efficient and effective application of genomic technology in breeding is mainstreamed within AFS networks, accelerating the rate of genetic gain delivered in farmers' fields.	2020 extended to 2021 - (i) Discussion of successes and challenges during annual meetings; refine and increase use cases. (ii) A 25% increase from previous year in use of best practices and tools.	Identical to proposal	Documents available on EiB toolbox	N/A	N/A	1	N/A

		3 Outcome: Efficient and effective application of genomic technology in breeding is mainstreamed within AFS networks, accelerating the rate of genetic gain delivered in farmers' fields.	2021 - (i) Discussion of successes and challenges during annual meetings; refine and increase use cases (ii) A 25% increase from previous year in use of best practices and tools.	New/ changed	Documents available on EiB toolbox as well presentations of Module successes and challenges during the EiB Annual meeting	1	1	2	N/A
	{primary} Improved access to financial and other services	3 Outcome: Cost/benefit analysis of MAS and GS workflows are conducted for all EiB supported breeding teams and documented.	2021 - (i) Breeders and managers provide evidence for successful use of cost-benefit analyses. (ii) Optimization tools are finalized.	New/ changed	Matrix report from breeders and managers	N/A	N/A	1	N/A
	{primary} CC Increased capacity of partner organizations,	3 Outcome: Implementation plans developed and executed for all green-light	2021 - Forward MAS and GS plans implemented for all Module 1 approved applications within all EiB supported breeding programs.	Identical to proposal	Capacity development and refined documentation	1	1	2	N/A

as evidenced by rate of investments in agricultural research Increased household capacity to cope with shocks	QC, MAS and GS applications.	(i) Develop use cases and develop/contribute to implementation guidelines for genotyping application in discovery and breeding. (ii) Update and refine existing documents, remove those no longer appropriate/applicable or when reviews are negative. (iii) Contribute to courses and workshops.							
{primary} Improved access to financial and other services	3 Outcome: Contracts that provide access to cost-effective genotyping/sequencing services and tissue/seed sampling systems.	2021 - $1.50 SNP genotyped sample; $8 genome profile.	New/ changed	The means of verification is as follows: 1. Vendor negotiation and meetings; 2. Establish new service contracts 3. Center visits and meetings to secure commitments.	N/A	N/A	1	N/A	

Reduced market barriers

{primary} CC Increased capacity for innovation in partner development organizations and in poor and vulnerable communities | 3 Outcome: Logistics support to effectively utilize genotyping/sequencing services provided to AFS breeding teams so they are able to avail low cost genotyping/sequencing options. | 2021 - 700K SNP genotyped samples; 160K genome profiles. (i) Obtain and aggregate AFS demand for supplies and services. Determine cross-AFS; Genotyping platform preferences, Minimum genotyping quality criteria, Maximum permissible turnaround time for genotyping applications, Minimum number/volume of samples/supplies required (defined unit costs), Minimum number marker conversion rate (ii) Use collated demand information to broker potential arrangements with service providers and solicit pricing feedback from AFS (iii) Finalize brokering of supplies and services, obtain minimum order commitments from AFS. (iv) obtain service providers feedback, AFS clients and document issues collating to form a review for the Trait | New/ changed | AFS report and documentation at dropbox | N/A | N/A | 1 | N/A |

			Discovery and Breeding Toolbox.			N/A	N/A		N/A
{primary} CC Increase capacity of beneficiaries to adopt research outputs	3 Outcome: Capacity enhancement.	2021 - Enlist expertise in marker conversion from SSRs/INDELS to SNP-based platforms	Identical to proposal	Users have a friendly-user toll for SSR/INDEL conversion into SNP		N/A	N/A	1	N/A
{primary} Increased household capacity to cope with shocks	3 Outcome: Technology prospecting.	2021 - Prospect newer methods/approaches for sampling/genotyping; use inputs from participating AFS, ARIs, private sector partners and technology developers/providers; evaluate costs and constraints for application in discovery and breeding. Prepare annual review paper for posting in the Trait Discovery and Breeding Toolbox.	New/ changed	The means of verification is in the form of a survey done through more personal questioner inquiring users about their BP needs and converge these needs with existing platforms and tools		N/A	N/A	1	N/A

4	{primary} Adoption of CGIAR materials with enhanced genetic gains	4 Outcome: Increased phenotyping throughput and accuracy accelerate genetic gains, achieving a stage 1 MET heritability > 0.6.	2018 extended to 2021 - Take stock of current use of laboratories, their capabilities and costs; prioritize needs	Identical to proposal	Agreement with service providers will be available, following CIMMYT procedures. Related protocols will be posted in EiB toolbox.	N/A	N/A	2	1
		4 Outcome: Increased phenotyping throughput and accuracy accelerate genetic gains, achieving a stage 1 MET heritability > 0.6.	2020 extended to 2021 - Based on available funding, (i) providers of priority equipment identified and user group defined (ii) service agreements for key phenotyping/mechanization approaches developed (iii) related training of key technicians/scientists at sites (iv) implementation of automation/ mechanization plans initiated (v) AFS reorient use of secondary traits (including HTP capabilities) to those with greatest added value viz primary traits	Identical to proposal	Reports, materials posted in EIB toolbox	N/A	N/A	2	1

1		4 Outcome: Increased phenotyping throughput and accuracy accelerate genetic gains, achieving a stage 1 MET heritability > 0.6.	2020 extended to 2021 - (i) Negotiate contracts with prioritized laboratories. (ii) Establish logistical support in Toolbox. (iii) AFS use a wider range of NIRS analyses capabilities.	New/ changed	Reports, materials posted in EiB toolbox	N/A	N/A	2	1
		4 Outcome: Increased phenotyping throughput and accuracy accelerate genetic gains, achieving a stage 1 MET heritability > 0.6.	2020 extended to 2021 - (i) Workshop to exchange best practices and challenges. (ii) Test and adapt alternative approaches in members? breeding programs; user feedback (Phenotyping). (iii) Discuss the development of ISO 9000 standards (Phenotyping).	New/ changed	Reports, materials posted in EiB toolbox	N/A	N/A	2	1
	Reduce pre- and post-harvest losses, including those caused by climate change • CC Technologies	4 Outcome: Best-practice information in Toolbox and engineering support permits appropriate automation and mechanization of field trial and nursery management.	2021 - Based on available funding, (i) service agreements for key phenotyping/mechanization approaches developed; (ii) contracting of improved (more cost-effective, more robust) mechanization & automation options (iii) related training of key	Identical to proposal	Templates, SOPs and training materials posted in EiB toolbox. Reports available in Dropbox.	N/A	N/A	2	0

that reduce women`s labor and energy expenditure adopted		technicians/scientists at sites; and (iv) implementation of automation/ mechanization plans completed.						
{primary} Increased availability of diverse nutrient-rich foods	4 Outcome: Contracts for cost-effective laboratory services for physico-chemical composition and nutritional properties; effective use of these services documented in the Toolbox.	2021 - AFS send samples for physico-chemical and nutritional analyses (NIRS and others) to the most cost-effective internal and external labs.	Identical to proposal	Reports in dropbox. templates in EIB toolbox. Contract with vendors following CIMMYT procedures	N/A	N/A	2	N/A
{primary} CC Increase capacity of beneficiaries to adopt research outputs	4 Outcome: Establishment of best practices for phenotyping and environmental analysis through a community of practice.	2021 - (i) Prioritization and investment in Platform interventions including online learning tools and videos. (ii) Liaise with private sector and ARIs to access current state-of-the-art technology (Genotype by environment by management) and gene-to-phenotype methods). (iii) Develop information in support of ISO 9000 standards (Phenotyping)	Identical to proposal	Tools / SOPs / training materials published in EIB toolbox	N/A	N/A	2	N/A

		4 Outcome: Support services from ARIs for experimental design and analysis of precision and high- throughput phenotype data.	2021 - (i) Testing and adaptation of best generic tools in interaction with distinct members' Trait set II. (ii) User survey and troubleshooting.	Identical to proposal	After cloud based image analysis project is delivered, a survey will be run to determine lessons learned - the results will be available in EiB toolbox	N/A	N/A	2	N/A
5	{primary} CC Enhanced individual capacity in partner research organizations through training and exchange	5 Outcome: User and technical requirements related to prioritized breeding case studies documented and improvement strategy for tools established. Analyze pipelines and tools to clarify user and technical requirements related to selected breeding case studies.	2020 extended to 2021 - (i) Develop advancement tools to support key breeding use cases. (ii) Train breeding teams in use of optimization tools and apply them to pipeline redesign.	New/ changed	Software and training material for advancement meetings. EBS analytical framework is able to produce inputs for AlphaSimR	N/A	N/A	2	N/A
		5 Outcome: User and technical requirements related to prioritized breeding case studies documented and improvement strategy for tools established. Analyze pipelines and tools to clarify	2020 extended to 2021 - (i) Strategy to manage and integrate meta-data reviewed and updated. (ii) Crop agronomy ontology defined.	New/ changed	Annual Project Report	N/A	N/A	1	N/A

		user and technical requirements related to selected breeding case studies.							
		5 Outcome: User and technical requirements related to prioritized breeding case studies documented and improvement strategy for tools established. Analyze pipelines and tools to clarify user and technical requirements related to selected breeding case studies.	2020 extended to 2021 - Prioritize analysis pipeline development to support key breeding use cases.	New/ changed	EBS analytical features for experimental design and phenotypic analysis, as well as genotype data management	N/A	N/A	2	N/A
		5 Outcome: User and technical requirements related to prioritized breeding case studies documented and improvement strategy for tools established. Analyze pipelines and tools to clarify user and technical requirements related to	2021 - Predicted genetic gain enabled in Enterprise Breeding System (EBS) for reporting out. Strategy for scaling realized genetic gain estimates in EBS.	New/ changed	Software - EBS analytical pipeline Strategy consensus for scaling summarized in Annual Report	N/A	N/A	2	N/A

		selected breeding case studies.							
		5 Outcome: User and technical requirements related to prioritized breeding case studies documented and improvement strategy for tools established. Analyze pipelines and tools to clarify user and technical requirements related to selected breeding case studies.	2021 - Partially replicated testing enabled in Enterprise Breeding System (EBS). MAS and QTL profiling enabled in EBS. GS enabled in EBS. Advancement and parental selection enabled in EBS.	New/ changed	Software - EBS analytical framework	N/A	N/A	2	N/A
	{primary} CC Increased capacity for innovations in partner research organizations	5 Outcome: A common breeding application programming interface (API) to integrate bioinformatics/biometrics tools and databases. Develop tools to facilitate modular and adaptable breeding pipelines and coordinate the development and implementation of a common BrAPI (Breeding API).	2021 - (i) Core Systems are certified BrAPI v2 compliant. (ii) Workflow implemented for the case studies identified in Year 3. (iii) Implementation of connectivity across the different tools/systems.	New/ changed	Online Documentation in COnfluence KSU Fieldbook integrated into EBS	N/A	N/A	1	N/A

		5 Outcome: A common breeding application programming interface (API) to integrate bioinformatics/biometrics tools and databases. Develop tools to facilitate modular and adaptable breeding pipelines and coordinate the development and implementation of a common BrAPI (Breeding API).	2021 - Data model mapping completed between BrAPI and Enterprise Breeding System (EBS).	New/ changed	Online documentation	N/A	N/A	1	N/A
	{primary} CC Enhanced individual capacity in partner research organizations through training and exchange CC Increased capacity for innovations in	5 Outcome: Breeding Management System (BMS), Cassava/Sweet potato/Musa/YamBase are fully functional in AFS breeding networks not using Enterprise Breeding System (EBS). Long term strategy within the CGIAR for BMS and Breedbase use determined.	2021 - For Breedbase users, conditions for EBS transition identified and alignment reached that they will converge if conditions are met. With IBP, alignment reached on shape of future partnership in contracting services and supporting BMS maintenance.	New/ changed	Annual Report	N/A	N/A	1	N/A

	partner research organizations								
	{primary} CC Increase capacity of beneficiaries to adopt research outputs	5 Outcome: New databases and tools to complement and expand the usefulness of existing bioinformatics initiatives aligned with prioritized breeding use cases. Standardization of marker Platforms for all crops.	2021 - All crops have in hand, or have initiated development of standardized marker panels for QA/QC, FP, GS through Module 3.	New/ changed	Annual Report	N/A	N/A	2	N/A
	{primary} CC Increased capacity of partner organizations, as evidenced by rate of investments in agricultural research	5 Outcome: A community of practice that provides access to bioinformatics and biometrics advice, services and resources.	2021 - Establish the Breeding Informatics Network as a source for analytical services coordinated across CGIAR Centers and as a quality control gatekeeper for analyses implemented through software.	New/ changed	Active community established, working groups established, recommendations from working groups documented and accepted, recommendations from working groups implemented in software	N/A	N/A	2	N/A
	{primary} CC Increased capacity for	5 Outcome: Development and deployment of	2021 - Successful development and deployment of features projected for versions 3 and 4	New/ changed	Software - EBS	N/A	N/A	2	N/A

	innovations in partner research organizations	Enterprise Breeding System (EBS) to target crops	into CIMMYT on premises, and IRRI on cloud						
	{primary} CC Increased capacity for innovation in partner development organizations and in poor and vulnerable communities	5 Outcome: Data management strategy for CGIAR-NARS breeding networks determined	2021 - Technical recommendations for various permutations of CG-NARS interactions worked out, with one or two use cases/partners identified.	New/ changed	Annual Report	N/A	N/A	1	N/A
6	{primary} Increased conservation and use of genetic resources	6 Outcome: Baseline Assessment and Tier Ratings Completed for priority CtEH NARS programs in Africa focusing on maize, sorghum, cassava	2021 - Support AGG to conduct assessment on 2 maize programs in SA, EA, WA (6 in total)	New/ changed	Assessment Reports and Improvement Plans	N/A	N/A	N/A	N/A

		6 Outcome: Baseline Assessment and Tier Ratings Completed for priority CtEH NARS programs in Africa focusing on maize, sorghum, cassava	2021 - Conduct assessments on 4 Sorghum programs in collaboration with AVISA	New/ changed	Assessment Reports and Improvement Plans	N/A	N/A	N/A	N/A
		6 Outcome: Baseline Assessment and Tier Ratings Completed for priority CtEH NARS programs in Africa focusing on maize, sorghum, cassava	2021 - Conduct assessments on 2 Cassava or Musa programs in collaboration with NextGEN or BBB	New/ changed	Assessment Reports and Improvement Plans	N/A	N/A	N/A	N/A
		6 Outcome: Baseline Assessment and Tier Ratings Completed for priority CtEH NARS programs in Africa focusing on maize, sorghum, cassava	2021 - MoU's signed with new NARS partners	New/ changed	Membership Agreements Signed between EiB and NARs	N/A	N/A	N/A	N/A

		6 Outcome: 2021 Improvement Plans Developed, priorities identified, Execution of Improvement plans initiated	2021 - 12 NARS improvement plans developed based on baseline assessments	New/ changed	Improvement Plans developed and Finalized with NARS partners	N/A	N/A	2	N/A
		6 Outcome: 2021 Improvement Plans Developed, priorities identified, Execution of Improvement plans initiated	2021 - 2021/22 modernization priorities identified in conjunction with NARS leadership, CG center (CIMMYT, IITA, ICRISAT).	New/ changed	Priorities identified in Improvement Plan	N/A	N/A	2	N/A
		6 Outcome: 2021 Improvement Plans Developed, priorities identified, Execution of Improvement plans initiated	2021 - Workplans developed to implement priorities - responsibilities and timelines determined	New/ changed	Workplans Developed with clear KPIs and time frames for each improvement priority	N/A	N/A	2	N/A
		6 Outcome: 2021 Improvement Plans Developed, priorities	2021 - Execution of top 5 priorities per NARS improvement Plan: EiB NARS team support NARS hands-on	New/ changed	5 priority areas for improvement addressed	N/A	N/A	2	N/A

		identified, Execution of Improvement plans initiated	in coordination with respective EiB Modules		according to KPIs developed in workplan				
		6 Outcome: HiRice Execution: 8 NARS partners supported to Execute 2020 Improvement Plan	2021 - Market segments and product profiles formalized in collaboration with EiB Mod1, IRRI, AR	New/ changed	Market segments defined and product profiles developed - at least 1 for each of the 8 HiRice NARS partners	N/A	N/A	2	N/A
		6 Outcome: HiRice Execution: 8 NARS partners supported to Execute 2020 Improvement Plan	2021 - Genotyping demand for QA/QC and QTL profiling defined and implemented at Intertek through Mod3.	New/ changed	8 programs submit their genotyping demand to Intertek (either QA/QC or QTL profiling)	N/A	N/A	2	N/A
		6 Outcome: HiRice Execution: 8 NARS partners supported to Execute 2020 Improvement Plan	2021 - Breeding Pipelines re-structured	New/ changed	Breeding pipeline restructuring plans finalized and documented	N/A	N/A	2	N/A

		6 Outcome: HiRice Execution: 8 NARS partners supported to Execute 2020 Improvement Plan	2021 - 3 NARS breeding schemes optimized with Mod2 support	New/ changed	3 optimized breeding schemes presented and documented for 3 HiRice NARS partners	N/A	N/A	2	N/A
		6 Outcome: HiRice Execution: 8 NARS partners supported to Execute 2020 Improvement Plan	2021 - Business Case for HiRice Investments made and implemented with Mod4 following principles of continuous improvement	New/ changed	8 Business plans and project charters developed for Infrastructural Investment at HiRice partners	N/A	N/A	2	N/A
		6 Outcome: HiRice Execution: 8 NARS partners supported to Execute 2020 Improvement Plan	2021 - Appropriate Seed Storage, processing and storage protocols Adopted	New/ changed	2 NARS HiRice partners adopt and implement a seed storage protocol and their seed storage facilities are upgraded	N/A	N/A	2	N/A
		6 Outcome: HiRice Execution: 8 NARS partners supported to Execute 2020 Improvement Plan	2021 - 6 NARS rice programs costed	New/ changed	Costing reports available for 6 HiRice partners	N/A	N/A	2	N/A

		6 Outcome: HiRice Execution: 8 NARS partners supported to Execute 2020 Improvement Plan	2021 - Historical Data and Current seasons digitized for 3 programs on either BMS or EBS coordinated with Mod5	New/ changed	Historical Data from 3 HiRice partners curated, digitized and stored in BMS. 2021 crop cycles generated on BMS.	N/A	N/A	2	N/A
		6 Outcome: AGG Execution: 6 NARS partners supported to Execute 2020 Improvement Plan	2021 - Market segments and product profiles formalized in collaboration with EiB-Mod1, CIMMYT, IITA	New/ changed	6 AGG partners finalize market segments and product profiles.	N/A	N/A	2	N/A
		6 Outcome: AGG Execution: 6 NARS partners supported to Execute 2020 Improvement Plan	2021 - Genotyping demand for QA/QC and QTL profiling defined and fed to Intertek through EiB Mod3	New/ changed	6 programs have their genotyping demand defined and begin using Intertek services	N/A	N/A	2	N/A
		6 Outcome: AGG Execution: 6 NARS partners supported	2021 - Breeding Pipelines re-structured	New/ changed	6 Breeding pipelines restructured: proposals documented	N/A	N/A	2	N/A

		to Execute 2020 Improvement Plan							
		6 Outcome: AGG Execution: 6 NARS partners supported to Execute 2020 Improvement Plan	2021 - 3 NARS breeding schemes optimized with Mod2 support	New/ changed	3 AGG NARS breeding schemes optimized with Mod2 support. Document of breeding scheme optimization.	N/A	N/A	2	N/A
		6 Outcome: AGG Execution: 6 NARS partners supported to Execute 2020 Improvement Plan	2021 - Business Case for Crops to End Hunger Implementation Investments in KALRO, NARO and TARI made and implemented with Mod4	New/ changed	6 NARS programs develop business cases and project charters for Infrastructural upgrades in collaboration with Mod4	N/A	N/A	2	N/A
		6 Outcome: AGG Execution: 6 NARS partners supported to Execute 2020 Improvement Plan	2021 - Appropriate Seed Storage, processing and storage protocols Adopted at NARO, KALRO, TARI	New/ changed	Seed storage protocols adopted at 3 EA NARS partners	N/A	N/A	2	N/A

		6 Outcome: AGG Execution: 6 NARS partners supported to Execute 2020 Improvement Plan	2021 - 4 NARS maize programs costed	New/ changed	Costing reports available for 4 NARS programs	N/A	N/A	2	N/A
		6 Outcome: AGG Execution: 6 NARS partners supported to Execute 2020 Improvement Plan	2021 - Historical Data and Current seasons digitized for 3 programs on BMS coordinated with Mod5	New/ changed	Historical databases available on BMS archive and 2021 crop cycles generated on BMS	N/A	N/A	2	N/A
		6 Outcome: Strategic and Core hubs, particularly for RTB upgraded in East Africa	2021 - No Regret investments identified, business cases developed for upgrades to Strategic and Core NARS breeding stations in East Africa	New/ changed	Strategic and Core CG-NARS testing hubs identified in Tanzania, Kenya and Uganda. No regret investments in station infrastructure identified and implemented.	N/A	N/A	2	N/A
			2021 - Stage Gates for late stage breeding handover to		Stage Gates defined for sweet potato, cassava and matoke	N/A	N/A	2	N/A

		6 Outcome: Strategic and Core hubs, particularly for RTB upgraded in East Africa	early stage seed systems defined for NARO RTB crops	New/ changed	late stage breeding to early stage seed systems			
		6 Outcome: Strategic and Core hubs, particularly for RTB upgraded in East Africa	2021 - Gap assessment and specific investments to strengthen NARS early stage seed systems identified and business cases built to address them.	New/ changed	Business Cases developed to address critical gaps in sweet potato, cassava and matoke seed systems at NARO	N/A	N/A	2	N/A
		6 Outcome: IGGP (Indian Genetic Gains Project)	2021 - Formal Advancement Meetings instituted at 3 ICAR breeding programs	New/ changed	3 advancement meetings conducted at ICAR partners programs in IGPP	N/A	N/A	2	N/A
		6 Outcome: IGGP (Indian Genetic Gains Project)	2021 - Breeding Schemes optimized based on trait values	New/ changed	3 Breeding Schemes optimized at ICAR with Mod2 support.	N/A	N/A	2	N/A

		6 Outcome: IGGP (Indian Genetic Gains Project)	2021 - Strategy defined to implement MAS (GS, QA-QC) in 3 ICAR programs	New/ changed	Strategy defined to implement MAS in 3 ICAR breeding programs	N/A	N/A	2	N/A
		6 Outcome: IGGP (Indian Genetic Gains Project)	2021 - Monthly Calls, Quarterly Technical Meetings organized and Executed	New/ changed	12 Monthly meetings conducted and minutes written	N/A	N/A	N/A	N/A
		6 Outcome: Webinars and Training	2021 - 4 Webinars conducted in 2021 on a) market segments and product profiles b) closing elite germplasm pools c) Change Management d) Managing and Leading Research Teams	New/ changed	4 Webinars conducted and available on Youtube or other repository	N/A	N/A	1	N/A
		6 Outcome: Webinars and Training	2021 - 4 national NARs coordinators identified to promote EiB vision and provide technical support through Train the Trainers approach	New/ changed	4 national consultants onboarded to disseminate and provide intra institutional backstopping	1	N/A	2	N/A

		6 Outcome: Linkage with Parallel Initiatives	2021 - Formalized agreements concluded with WACCI, ACCI, MaRCCI to join the EiB platform, host EiB training and join regional centralized service networks	New/ changed	Signed Membership Agreements	N/A	N/A	1	N/A
		6 Outcome: Linkage with Parallel Initiatives	2021 - Formalized agreements concluded with CORAF to ensure ensure alignment, open communication and avoid redundancy in West Africa	New/ changed	Signed membership agreement with CORAF	N/A	N/A	N/A	N/A
		6 Outcome: Linkage with Parallel Initiatives	2021 - Develop strategy with EiSS to ensure alignment, open communication and avoid redundancy	New/ changed	Internal strategy to ensure alignment and communication with EiSS	N/A	N/A	N/A	N/A

		6 Outcome: Linkage with Parallel Initiatives	2021 - Develop internal strategy to ensure alignment with ILCI	New/ changed	Internal Strategy on ILCI alignment	N/A	N/A	N/A	N/A
	{primary} Adoption of CGIAR materials with enhanced genetic gains	6 Outcome: White Papers	2021 - Publication on Effective CG-NARS networks under 1CGIAR	New/ changed	Publication on effective CG-NARS breeding networks	N/A	N/A	1	N/A
		6 Outcome: White Papers	2021 - Publication on Breeding Investment cases for NARs: where and how does it make sense?	New/ changed	Publication on pipeline investment cases for NARS breeding	N/A	N/A	2	N/A
7	{primary} CC Enhanced institutional capacity of partner	7 Outcome: Adoption of software, tools, and services promoted by having the documentation, teams and training needed for CGIAR	2021 - Work to ensure digitization devices purchased through Module 4 are adopted – develop standardized	New/ changed	Documentation- Toolbox/EiB website	N/A	N/A	N/A	N/A

	research organizations	and NARS to utilise these services	documentation that can be used across crops and systems						
		7 Outcome: Adoption of software, tools, and services promoted by having the documentation, teams and training needed for CGIAR and NARS to utilize these services	2021 - Work to ensure digitization devices purchased through Module 4 are adopted. Train key scientists and technicians in digital devices	New/ changed	Training schedule and check-off when complete- Teamwork	1	1	N/A	N/A
		7 Outcome: Adoption of software, tools, and services promoted by having the documentation, teams and training needed for CGIAR and NARS to utilize these services	2021 - Establish and manage EBS adoption projects for IITA maize EBS adoption	New/ changed	Documentation- Teamwork	N/A	N/A	N/A	N/A
		7 Outcome: Adoption of software, tools, and services			Documentation- Teamwork	N/A	N/A	N/A	N/A

		promoted by having the documentation, teams and training needed for CGIAR and NARS to utilize these services	2021 - Establish and manage EBS adoption projects for ICARDA wheat EBS adoption	New/ changed					
		7 Outcome: Adoption of software, tools, and services promoted by having the documentation, teams and training needed for CGIAR and NARS to utilize these services	2021 - Provide digitization and software support needed for CGIAR-NARS networks through contracting IBP to support prioritized NARS	New/ changed	Documentation/contract and review of deliverables- Teamwork	N/A	N/A	N/A	N/A
		7 Outcome: Adoption of software, tools, and services promoted by having the documentation, teams and training needed for CGIAR and NARS to utilize these services	2021 - Explore opportunities for combined trainings with African Plant Breeding Academy	New/ changed	report- teamwork	N/A	N/A	N/A	N/A

{primary} CC Increased capacity for innovations in partner research organizations	7 Outcome: Adoption of software, tools, services monitored to understand whether EiB investments are having an impact	2021 - Contract services - Identify contractor to assist in developing and collecting adoption metrics	New/ changed	contract with deliverables	N/A	N/A	N/A	N/A
		7 Outcome: Adoption of software, tools, services monitored to understand whether EiB investments are having an impact	2021 - Define and report on adoption of Module 4 digital devices - Develop surveys and distribute. Collect baseline data, monitor over time, assemble results and report on findings including gender and youth disaggregations.	New/ changed	survey and report in teamwork	1	1	N/A	N/A
		7 Outcome: Adoption of software, tools, services monitored to understand	2021 - Define and report on adoption of Module 4 digital devices - Define KPIs with	New/ changed	documentation and report in Teamwork	N/A	N/A	N/A	N/A

		whether EiB investments are having an impact	module 4 and adoption network, monitor and report						
		7 Outcome: Adoption of software, tools, services monitored to understand whether EiB investments are having an impact	2021 - Define and report on adoption of IITA EBS - Develop surveys and distribute. Collect baseline data, monitor over time, assemble results and report on findings including gender and youth disaggregations.	New/ changed	survey and report	1	1	N/A	N/A
		7 Outcome: Adoption of software, tools, services monitored to understand whether EiB investments are having an impact	2021 - Define and report on adoption of IITA EBS through KPIs - Define KPIs, monitor and report	New/ changed	documentation and report	N/A	N/A	N/A	N/A
	{primary} CC Enhanced institutional	7 Outcome: Provide ongoing feedback to continuously improve adoption processes	2021 - Communicate CI project findings to EiB community and work across modules to define	New/ changed	report with recommendations-teamwork	N/A	N/A	N/A	N/A

capacity of partner research organizations	and ensure EiB software and services provide value to CGIAR and NARS partners	ways to improve adoption processes - Report on NARS (KALRO/NARO) BMS adoption and document ways to improve success							
		7 Outcome: Provide ongoing feedback to continuously improve adoption processes and ensure EiB software and services provide value to CGIAR and NARS partners	2021 - Communicate CI project findings to EiB community and work across modules to define ways to improve adoption processes - Report on IITA maize EBS adoption and document ways to improve success	New/ changed	report with recommendations-teamwork	N/A	N/A	N/A	N/A
		7 Outcome: Provide ongoing feedback to continuously improve adoption processes and ensure EiB software and services provide value to CGIAR and NARS partners	2021 - Establish communities of practice that can provide adoption support around software, tools services and recommended processes - (i) Establish Adoption and Training community of practice that will provide feedback from system, equipment and tool trainings	New/ changed	report on teams and activities-teamwork	1	1	N/A	N/A

			and support (ii) Establish Working Groups that will operate short-term to address and provide feedback to immediate challenges (iii) Establish a Breeding Assessment Team that can provide early feedback on EBS features (via a demo instance)						
		7 Outcome: Provide ongoing feedback to continuously improve adoption processes and ensure EiB software and services provide value to CGIAR and NARS partners	2021 - Provide requirements to EBS to improve adoption across CGIAR and NARS crops - Work with EiB EBS steering team to define, prioritize and schedule improvements in breeding system operation and/or to identify broader IT bottlenecks and possible interventions	New/ changed	Jira requests with prioritization- EiB internal repositories	N/A	N/A	N/A	N/A

Table 2B: Planned Evaluations/Reviews, Impact Assessments and Learning Exercises

Platform	Module	Status	Planned studies/learning exercises in the coming year for gender	Geographic scope	Who is commissioning this study

Not applicable

Table 2C: Planned major new collaborations (CGIAR internal, or with non-CGIAR collaborators)

Name of Platform/CRP or non-CGIAR collaborator	Brief description of collaboration (give and take among CRPs/Platforms/non-CGIAR collaborator) and value added (e.g. scientific or efficiency benefits)
IRRI	Deployment of Enterprise Breeding System V3 for capacity development enabling breeding modernization.
IITA	Deployment of Enterprise Breeding System V2.1 and V3 for capacity development enabling breeding modernization.
Cornell University	Software development of Enterprise Breeding System V2.1 and V3, for capacity development enabling breeding modernization.
CIMMYT	Deployment of Enterprise Breeding System V2.1 and V3 for capacity development enabling breeding modernization.

EiB Platform Plan of Work and Budget (POWB)

Table 3: Planned Budget

Module	W1/W2	W1/W2 - CtEH	Total W1/2	W3	W3 - CtEH	Total W3	Center Own fund	Total	Comments on major changes
M1 Breeding Program Excellence	286,390.72		286,390.72	1,129,916.68		1,129,916.68		**1,416,307.40**	
M2 Breeding Scheme Optimization	153,064.63		153,064.63	1,319,242.67		1,319,242.67		**1,472,307.30**	
M3 Genotyping Sequencing Tools and Services	63,982.94		63,982.94	587,637.55		587,637.55		**651,620.49**	
M4 Phenotyping Tools and Services	35,084.35		35,084.35	1,103,847.72		1,103,847.72		**1,138,932.06**	
M5 Bioinformatics Tools and Services	1,872,335.70		1,872,335.70	5,593,050.77		5,593,050.77		**7,465,386.46**	
NARs	23,000.00		23,000.00	180,912.49	491,380.12	672,292.61		**695,292.61**	

Adoption and Outreach	465,150.26		465,150.26	611,800.00		611,800.00		**1,076,950.26**	
Management	475,991.90		1,216,591.90	245,185.03		2,483,609.03		**3,700,200.92**	
*Cross- CGIAR Center		740,600.00			2,238,424.00				
* Projects To be Defined		2,762,900.00	2,762,900.00		4,185,497.00	4,185,497.00		**6,948,397.00**	
Platform Total	**3,375,000.48**	**3,503,500.00**	**6,878,500.48**	**10,771,592.91**	**6,915,301.12**	**17,686,894.02**		**24,565,394.50**	

*Note this budget does not include use of the expected W1&W2 carry-over funds. They will be allocated to Module 1 ($480,000), Module 2 ($480,000),

Module 3 ($480,000) 4 ($490,000), 5 ($495,000), Adoption and Outreach ($ 495,000), and NARS ($480,000).