CGIAR Excellence in Breeding Platform Plan of Work and Budget (POWB) 2020

Contents

Platform Plan of Work and Budget (POWB)

CGIAR Excellence in Breeding Platform (EiB)

The International Maize and Wheat Improvement Center (CIMMYT)

Participating Centers and other key partners:

AfricaRice

Bayer

Bioversity International

International Center for Tropical Agriculture (CIAT)

CIMMYT

International Potato Center (CIP)

Cornell University

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Diversity Arrays Technology

CORTEVA

Global Crop Diversity Trust (GCDT)

Food and Agriculture Organization of the United Nations (FAO)

International Center for Agricultural Research in the Dry Areas (ICARDA)

Institut National de la Recherche Agronomique (INRA)

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Platform Plan of Work and Budget (POWB)

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

International Institute of Tropical Agriculture (IITA)

International Livestock Research Institute (ILRI)

Integrated Breeding Platform (IBP)

International Rice Research Institute (IRRI)

James Hutton Institute

John Innes Centre

Nottingham University

Oregon State University

Queensland University

Swedish University of Agricultural Sciences (SLU)

Syngenta

United States Department of Agriculture (USDA)

Wageningen University

World Agroforestry Centre (ICRAF)

WorldFish

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Narrative section

1. Adjustments/ Changes to Your Theories of Change (ToC), if relevant (max. 500 words)

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

2. Plans and Expected Progress Towards Outcomes (max. 2000 words)

At the end of 2019, all CGIAR centers had submitted improvement plans based on an EiB template and in close collaboration with EiB staff while – in a parallel process with breeding programs, funders and private sector representatives – a vision for breeding program modernization was developed and presented to CGIAR breeding leadership at the EiB Annual Meeting. This vision represents an evolution of EiB in the context of the Crops to End Hunger Initiative (CtEH) beyond the initial scope of providing tools, services and expert advice, and serves as a guide for Center leadership to drive changes with EiB support. In addition, EiB has taken the role of managing and disbursing funding, made available by Funders via CtEH to modernize breeding and enable CGIAR breeding programs to implement the vision provided by EiB.

In 2020, EiB will draw on the improvement plans, existing and planned initiatives to support Centers to progress towards the eight Pillars of modernization outlined in the vision for CGIAR breeding:

1. *Defining breeding targets and objectives:* All breeding is oriented to development of products for maximum impact.
2. *Breeding scheme strategy:* Breeding schemes are optimized for rate of genetic gain and likelihood of developing products for impact.
3. *Breeding operations:* Breeding strategy is executed is such a way as to optimize data accuracy, cost and throughput.
4. *Crossing:* Best parental selection decisions are made and genetic diversity managed according to the breeding strategy.
5. *Evaluation:* Germplasm is tested in a way to maximize accuracy.
6. *Selection:* Parents and products are selected on the basis of accurate data and aligned with the product profile.
7. *Product verification, release and delivery:* There is a pipeline and process for maximum impact of breeding program outputs.
8. *Collaboration and culture*: There is a culture that allows for improvement, sustainability and synergy.

According to the division of work among five Modules, with support from the EiB national agricultural research system (NARS) coordinator and the EiB Toolbox, planned activities in 2020 towards the objectives outlined above are as follows:

Product design & management (Module 1)

Building on progress that includes the development and release of a product profile capture tool across CGIAR and NARS centers (and piloting and adoption activities), best practices and tools will be advanced across CGIAR and NARS breeding programs to ensure continuous improvement in product development (Pillars 1, 7 & 8):

- A second version of the product profile tool will be developed in coordination with a convened group of experts and practitioners.
- A tool to guide pre-breeding (the introgression of genetics into elite materials used for population improvement and product development) will be developed to align upstream breeding activities with downstream customer needs and impact goals.
- A working group will be convened to define a cross-CGIAR stage-gate system that enables better role specialization, collaboration, transparency and data-driven management of breeding pipelines.
- Drawing on the above, product and trait advancement meetings will be established within CGIAR and NARS breeding pipelines in which management collaborates with breeders to ensure pipelines operate and deliver according to breeding program goals.

The goal of Module 1 is for product design and development to become a consumer/market data-driven exercise to ensure variety turnover and impact. To that end, an initiative to integrate Gender in Breeding Initiative (GBI) tools into the product profile process promoted with breeding programs will take off in 2020, and economic trait assessment tools will also be developed and promoted to embed selection indexes in breeding programs.

According to the prioritization of EiB/CtEH target crop-region areas identified in 2019, collaboration with breeding programs in Africa will be prioritized. As Demand Lead Breeding (DLB) is an important practitioner of Module 1 themes with NARS breeding programs in the region, further collaboration will be pursued in 2020 to align methods and objectives with DLB.

EiB has been working directly with NARS programs on the above themes in Kenya, India and Uganda in 2019 and will expand to Ghana and Tanzania in 2020. EiB will work with priority crop programs within these NARs (identified in alignment with CtEH criteria) to formalize product profiles and support NARs programs to align their pipeline metrics to market segments.

In 2020, a major workshop will be convened to discuss a more functional CGIAR-NARs breeding network with defined roles for the various stakeholders. The objective will be to support more inclusive and effective product development, product deployment and variety turnover on farmers' fields.

Trait discovery and breeding tools & services (Module 2)

With a dedicated Module 2 leader now in place, EiB will provide guidelines, tools and consultancy for CGIAR and NARS breeding programs to optimize their breeding schemes to deliver on breeding program goals (Pillar 2).

A vision for a gold standard vision for breeding schemes, with excellent in-practice examples, will be produced as a means to socialize concepts and assess changes to current practices. The different stages, processes and activities involved in CGIAR breeding pipelines will be identified and clearly defined using a common language that can be adopted across the CGIAR and NARS, to facilitate learning, collaboration and improvement of breeding schemes.

Methods, tactics and examples of how an excellent breeding scheme can be achieved will be then be developed and promoted. This will include, for example: guidelines for developing breeding pipelines that are relevant to targeted product profiles and guidelines for how germplasm is utilized from initial trait discovery to variety release. These guidelines will be based on robust quantitative genetics principles, and aimed at standardizing the adoption of rational breeding schemes based on quantitative genetics, clearly-defined processes and consumer/market-driven targeting.

All CGIAR breeding schemes will be captured in a standard template during 2020, and a strategy developed that describes how breeding programs will advance towards the implementation of a gold standard breeding scheme aligned with their goals using methods such as workshops and consultation with individual breeding schemes.

Module 2 will also promote the use of quantitative genetics principles embodied in breeding program simulations to make informed decisions about how breeding schemes can be optimized. A simulation platform will be developed to demonstrate the potential impact of alternative schemes to the current practices captured in the EiB template, based on rates of genetic gain per dollar invested, to reduce the risks and uncertainties involved in setting strategies for investment in different pipelines and product profiles. The outputs of these simulations for different use cases will be published in the EiB toolbox, along with guidelines for the development, validation and implementation of any predictive tool.

Most NARs programs have not been assessed by the BPAT team and only a limited number will be assessed in 2020. As a result, EiB will continue to characterize NARS breeding programs using the EiB Baseline Metrics assessments as a starting point for the development of improvement plans and pipeline optimization recommendations. The EiB Baseline Metrics assessment was applied to 9 programs from Kenya and Uganda in 2019, and one improvement plan was developed for the Uganda National Agricultural Research Organisation (NARO) groundnut breeding program. In 2020, improvement plans will be developed for the eight other programs that we characterized in 2019, and a further 12 programs in Ghana, India and Tanzania will be characterized.

Genotyping / sequencing tools & services (Module 3)

Module 3 will build on training activities, consultations and successful low-price genotyping service offerings in 2019 to focus on the following (Pillars 4-5):

A minimum of four visits will take place with EiB members in 2020 to assist in planning for the integration of genotyping in breeding activities, in the context of the continuous development of

improvement plans. Routine engagement will take place with various crop projects and CRPs to align genotyping activities with better forecasting. Module 3 will also participate in a cost-benefit analysis of the effective use of molecular tools in the context of Module 2 efforts to optimize breeding schemes.

In order to expand the adoption and use of high-quality genotyping services, in 2020 the features a new mid to high-density genotyping platform will be evaluated, and pricing negotiation will be carried out with potential service providers. These services will be supported by continuous improvement of materials on the EiB toolbox, such as marker datasheets, use cases and standard operating practices for logistics and sampling.

Onboarding and training of new logistics managers will take place, and a working group will be established with EiB Module 5 and the Genomic Open-Source Breeding informatics initiative (GOBii) to focus on the deployment of enterprise sample tracking solutions and practical haplotype graphs (PHGs) for key crops.

The Module 3 steering committee will meet on a quarterly basis, while EiB staff will participate in key international forums to represent Module 3 to breeding programs.

Breeding operations and phenotyping tools & services (Module 4)

In 2019, in line with the overall evolution in EiB's role in accordance with CtEH, Module 4 supported breeding programs and Centers in the development of improvement plans and provided detailed current-state assessments of operational capacity in breeding programs. In 2020, these activities will continue, resulting in recommendations and new cross-CGIAR initiatives to improve practices, alongside the initial mandate of providing phenotyping tools & services (Pillars 3, 6 & 8). These activities are aimed at building operational capacities in alignment with breeding program product delivery targets (Module 1) and breeding scheme designs (Module 2).

Current state capacity assessment will be made available to breeding programs and Centers on request, while Module 4 will also assist with the continuous development of improvement plans by providing a gap analysis based on current state assessments and future operational capacity requirements.

A major finding in 2019 was that most NARS programs that were assessed lack basic machinery and equipment (e.g. cold room, WIFI, etc.) to run functional breeding pipelines, and have very limited understanding of where their major cost centers lie. In 2020, focus NARs programs will be supported to cost out their breeding programs using the University of Queensland costing tool, and a template will be developed for NARS to build business cases for investment in mechanization.

A community of practice (CoP) will be convened to focus on quality traits in crop residues and grain, with the goal of aligning the measurement of both quality traits and agronomic traits during the breeding process. Another key cross-CGIAR initiative will be the development of a proposal for a Global Support Network, which will support breeding programs to achieve operational excellence through training, rapid support response and technology sharing.

Key tools and services to be made available in 2020 include: a template to quantify the current cost of breeding operations and identify efficiency gains; a service to access remote (unmanned aerial vehicle-based) imaging and analytics to assist breeding programs wishing to uptake this technology.

Bioinformatics, biometrics & data management tools & services (Module 5)

Development of the Enterprise Breeding System (EBS) started in 2019, and a minimum viable implementation will be launched early in 2020 for validation and development with the International Maize & Wheat Improvement Center (CIMMYT) and International Rice Research Institute (IRRI) breeding programs.

In 2020, Module 5 will focus on three main areas: data management, biometrics and bioinformatics analysis pipelines, and communities of practice in data analytics and data management (Pillars 3, 4 & 6). Major deliverables by each area include:

Data management

The current landscape in terms of data management tools has been documented; this will be updated and published on the EiB Toolbox. A plan for the sustainable maintenance and support of key database systems will be developed, and a supplemental grant proposal will be drafted to fund this support plan. A consultant will be hired to gather requirements from breeding programs currently not covered by existing database projects (CIAT, CIP and IITA).

To support the convergence of data management systems to provide more integrated functionality, Module 5 is incorporating various existing subgrants; to perform this role effectively, a management and oversight process will be developed.

Targeted initiatives to integrate available systems to provide key data management functionalities to breeding programs will continue (including sample tracking, connecting genotype and phenotype data, field data collection). To ensure proper metadata is captured and data can be merged across systems, several activities will take place including Breeding Application Programming Interface (BrAPI) project hackathons, BrAPI validation server development, a joint meeting with the Big Data Platform Metadata CoP and continued implementation of universally unique identities (UUIDs).

Biometrics and bioinformatics

Biometrics and bioinformatics tools are currently accessible through the [EiB Galaxy instance](#); this will continue to be supported and training provided for Galaxy power users, as well as best practice training for users. Targeted development will take place of an analytics module within the EBS.

Communities of practice

Module 5 will continue to fund workshops and hackathons, in addition to a 2020 intake of the popular sabbatical program in which EiB sponsors CoP members to visit host institutions to build capacity and initiate cross-project/institute collaborations.

Digitization of NARS breeding programs

Although most NARs breeding programs have been exposed to one type of breeding management software or another, most have not fully adopted a system and most programs are not yet digitized. In 2020, the Integrated Breeding Platform (IBP) will be brought on as consultants to fully digitize a number

of pilot breeding programs at the Kenya Agricultural and Livestock Research Organization (KALRO) and NARO in preparation for the pilot deployment of EBS at NARs institutes.

3. Financial Plan for the coming year, including use of W1/2 (max. 500 words)

The 2019 initial W1/W2 financial plan for EiB was USD $1,730,000; towards the end of the 2019 Financial Year, EiB was informed that it would receive a total of USD $3,629,000, hence there will be an estimated W1/W2 2019 carry-over budget of USD $2,461,000 in addition to the expected USD $1,700,000 W1/W2 Funds. In 2019, a Module 2 supplemental grant of USD $3,500,000 (period January 2020-October 2022) was approved by the Bill & Melinda Gates Foundation (BMGF), these supplemental funds will be used:

1. To build a comprehensive and user-friendly simulation and modelling platform to support decision making and insight generation in CGIAR and NARS breeding programs, and to assist decision-making for the investors funding these programs;
2. To establish a team at (EiB host institution) CIMMYT headquarters who will use the tool to support the modernization of CGIAR and NARS breeding programs through a strong outreach campaign; and
3. To use the simulation and modelling platform results to generate and promote new and improved breeding schemes at breeding programs.

All new positions and related activities will be covered by the supplementary grant. Costs of previously hired personnel, workshops/training, consultancies and sub-awards will be distributed according to Table 3, below.

TABLES

Table 2A: Planned Milestones

Module	Mapped to Sub-IDO	2022 Module outcomes	Milestone	Indicate of the following	Means of verification	CGIAR Cross-Cutting Markers for the milestone			
						for gender	for youth	for CapDev	for CC
1	• {primary} Adoption of CGIAR materials with enhanced genetic gains • CC Enhanced individual capacity in partner research organizations	CGIAR and NARS breeders develop and identify cultivars more efficiently, with clearer targets for men and women farmers, and optimized breeding pipelines that	2020 - (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 cross functional group including NARS partners. (ii) Collection of improved gender-disaggregated	New/ changed	(i) Toolbox citation: a) targeted product profiles information captured in the targeted product profile data based; b) prioritization of breeding program targets by market segments, target product environments (TPEs); c) a 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-	1	0	N/A	N/A

	through training and exchange	result in accelerated breeding cycles and rates of genetic gain per unit time of at least 1% annually and at least double pre-2018 levels under typical farmers conditions. Outcome should be variety turnover.	market information which considers variety replacement decisions of seed producers, farmers, processors and consumers; scope depends on funding availability (scope can be broadened if additional funding can be secured).		aggregated data may be available from the gender specialist involved in the product design team as part of a data-driven product design process featuring gender-responsive features. This data would be found within the product design minute notes or upon request.				
1		CGIAR and NARS breeders develop and identify cultivars of greater impact and more efficiently, with clearer benefits to men and	2020 - (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	New/ changed	(i) EiB Toolbox progress posting (ii) Written program notes - shared upon request (iii) Not applicable - CGIAR center management have informed that employee incentives and performance are their responsibilities.	0	0	N/A	N/A

		women farmers, and optimized breeding pipelines that result in accelerated breeding cycles and rates of genetic gain per unit time of at least 1% annually and at least double pre-2018 levels under typical farmers conditions. Outcome should be variety turnover.	crops. (iii) Collect feedback from member breeding management teams on implementation of breeding team member incentivization and performance evaluation processes.						
1		CGIAR and NARS breeders develop and identify cultivars more efficiently,	2020 - (i) Accumulate published genetic gains assessments in Toolbox. (ii) Mentor implementation	New/ changed	(i) Not Applicable: CGIAR center R&D leaderships and breeding team leaders have blocked publishing of the breeding program rate of their genetic gains in a public document, so	N/A	N/A	N/A	N/A

		with clearer targets for men and women farmers, and optimized breeding pipelines that result in accelerated breeding cycles and rates of genetic gain per unit time of at least 1% annually and at least double pre-2018 levels under typical farmers conditions. Outcome should be variety turnover.	of genetic gains assessments for more challenging specific cases where broadly applicable documentation describing methods for assessing genetic gains may not be applicable.		verification is not possible. (ii) Not Applicable: This milestone was transferred to Module 2 in 2018/19.				
1		CGIAR and NARS breeders develop and	2020	Reworded/ rephrased	i) NA	N/A	N/A	N/A	N/A

		identify cultivars more efficiently, with clearer targets for men and women farmers, and optimized breeding pipelines that result in accelerated breeding cycles and rates of genetic gain per unit time of at least 1% annually and at least double pre-2018 levels under typical farmers conditions. Outcome should be variety turnover.	(i) Breeding programs access advice or visit to best-practices sites on a self-funded basis. (ii) Portfolio strategy and gap analysis drives support for program improvements including by informing the Platform agenda and priorities	from proposal	ii) 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 published in the Toolbox				

1		CGIAR and NARS breeders develop and identify cultivars more efficiently, with clearer targets for men and women farmers, and optimized breeding pipelines that result in accelerated breeding cycles and rates of genetic gain per unit time of at least 1% annually and at least double pre-2018 levels under typical farmers conditions. Outcome should be	2020 - (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 (iv) Agree with breeding programs on specific improvement strategies that are to be supported by the Platform (all Modules).	New/ changed	(i) Not Applicable - BMGF 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. ii) GAP analyses were synthesized from BPAT reports, center improvement plans, center interviews and meetings. (iii) Verification is through documented modifications to improvement plans (iv) Verification through official feedback provided to CGIAR breeding centers from EiB	N/A	N/A	N/A	N/A

		variety turnover.							
1		CGIAR and NARS breeders develop and identify cultivars more efficiently, with clearer targets for men and women farmers, and optimized breeding pipelines that result in accelerated breeding cycles and rates of genetic gain per unit time of at least 1% annually and at least double pre-2018 levels under typical farmers	2020 - (i) CGIAR breeding programs with BPAT assessments completed finalize improvement/ optimization plans for (a) current resource levels and (b) current resources plus a one-time grant for capital and training. (ii) Members initiate improvement/ optimization plans, in terms of capital and training. Progress is monitored jointly with research leaders."	Reworded/ rephrased from proposal	The EiB team synthesized notes from BPAT, the Center Improvement Plans and interviews to make recommendation of high priority crops as part of the CtEH project initiative. This is an ongoing process that continues to be documented.	N/A	N/A	0	N/A

		conditions. Outcome should be variety turnover.							
1		CGIAR and NARS breeders develop and identify cultivars more efficiently, with clearer targets for men and women farmers, and optimized breeding pipelines that result in accelerated breeding cycles and rates of genetic gain per unit time of at least 1% annually and at least double	2020 - Improvement plans developed with at least 4 NARS in South Asia and sub-Saharan Africa.	New/ changed	Verification of this task has been transferred to the EiB National Program coordinator. Module 1 will continue to support as requested.	N/A	N/A	0	N/A

		pre-2018 levels under typical farmers conditions. Outcome should be variety turnover.							
2	• {primary} CC Enhanced institutional capacity of partner research organizations •Reduced smallholders production risk	Increased rates of genetic gain through use of best practices, optimization of breeding strategy and more effective use of resources (time, finances).	2020 - (i) A 50% increase from previous year in number of tools and best practices documented and 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; engage students in developing such information. (ii) A 20% increase in number of active platform users. (iii) Members downloading resources from the web platform and reporting	Identical to proposal	Google analytics and web site metrics for https://excellenceinbreeding.org/.	N/A	N/A	1	N/A

			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.						
2		Increased rates of genetic gain through use of best practices, optimization of breeding strategy and more effective use of resources (time, finances).	2020 - (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 pipelines. (iii) Training	Identical to proposal	Summary documents of COP feedback, Training materials (documents, videos etc.)	N/A	N/A	2	N/A

			and documentation of end user tools and pipelines through webinars, "YouTube" modules, and implementation guides. (In 2018 & 2019 co-funded with GOBII). (iv) In-depth training courses/ workshops linked to large meetings.						
2			Increased rates of genetic gain through use of best practices, optimization of breeding strategy and more effective use of resources (time, finances).	2020 - 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	Summary document and revisions to website.	N/A	N/A	1	N/A
2			Increased rates of genetic gain through use of best practices, optimization of	2020 - (i) Development of best practice documentation for e-learning based on materials used at regional workshops	New/ changed	Summary documents and training materials available through https://excellenceinbreeding.org/.	N/A	N/A	2	N/A

		breeding strategy and more effective use of resources (time, finances).	(ii) Identification of, and links to relevant external e-modules and courses (iii) Collection of member feedback to material provided (iv) Use of materials by AFS own training programs, BecA and other networks						
2		Increased rates of genetic gain through use of best practices, optimization of breeding strategy and more effective use of resources (time, finances).	2020 - Members use guidelines to document predictive tools used in their breeding programs, grouped into discovery, validation and in-use stage	New/ changed	Survey results of tools in active use, # downloads of tools where verifiable.	N/A	N/A	1	N/A
2		Increased rates of genetic gain through use of best practices, optimization of	2020 - Members document use of trait pipelines within their breeding programs to discuss during annual meetings	New/ changed	Documented pipelines available from EiB/CIMMYT repository.	N/A	N/A	2	N/A

		breeding strategy and more effective use of resources (time, finances).							
2		Increased rates of genetic gain through use of best practices, optimization of breeding strategy and more effective use of resources (time, finances).	2020 - (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)	New/ changed	Documents detailing intended and achieved changes in breeding schemes.	N/A	N/A	2	N/A
2		Increased rates of genetic gain through use of best practices, optimization of breeding strategy and	2020 - 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	Identical to proposal	Meeting summary document in EiB/CIMMYT repository.	N/A	N/A	N/A	N/A

		more effective use of resources (time, finances).	project ideas. Allocation of modest resources to validate technologies in the incubator while jointly seeking additional funding to test more substantive game changers.						
3	• {primary} Adoption of CGIAR materials with enhanced genetic gains •Reduce pre- and post-harvest losses, including those caused by climate change	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 - (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.	N/A	N/A	1	N/A
3		Efficient and effective application of genomic	2020 - Support to member breeding programs implementing cost-benefit	New/ changed	Report (EiB Dropbox).	N/A	N/A	1	0

		technology in breeding is mainstreamed within AFS networks, accelerating the rate of genetic gain delivered in farmers' fields.	analyses of MAS and GS workflows.						
3		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 - Forward MAS and GS plans implemented for applications with greatest chance of success. Cost-effective MAS and GS plans developed for additional traits and crops. (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.	New/ changed	Workshops and reports.	N/A	N/A	2	N/A

			(iii) Contribute to courses and workshops.						
3		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 - $1.50 SNP genotyped sample; $8 genome profile.	New/ changed	Report and service agreement.	N/A	N/A	1	N/A
3		Efficient and effective application of genomic technology in breeding is mainstreamed within AFS networks, accelerating	2020 - 600K SNP genotyped samples; 125K genome profiles. (i) Obtain and aggregate AFS demand for supplies and services. Determine cross-AFS; Genotyping platform preferences, etc. (ii) Use collated demand information to broker	New/ changed	Report and service agreement.	N/A	N/A	1	N/A

		the rate of genetic gain delivered in farmers' fields.	potential arrangements with service providers and solicit pricing feedback from AFS. (iii) Finalize brokering of supplies and services and obtain minimum order commitments from AFS. (iv) Obtain feedback from service providers and AFS clients and document feedback collating to form a review for the Trait Discovery and Breeding Toolbox.						
4	• {primary} Adoption of CGIAR materials with enhanced genetic gains	Increased phenotyping throughput and accuracy accelerate genetic gains, achieving a stage 1 MET heritability > 0.6.	2020 - 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	New/ changed	Reports, materials posted on toolbox.	N/A	N/A	2	N/A

			secondary traits (including HTP capabilities) to those with greatest added value viz primary traits						
4		Increased phenotyping throughput and accuracy accelerate genetic gains, achieving a stage 1 MET heritability > 0.6.	2020 - (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 on toolbox.	N/A	N/A	2	N/A
4		Increased phenotyping throughput and accuracy accelerate genetic gains, achieving a stage 1 MET heritability > 0.6.	2020 - (i) Workshop to exchange best practices and challenges. (ii) Test and adapt alternative approaches in members' breeding programs; user feedback (Phenotyping).	New/ changed	Reports, materials posted on toolbox.	N/A	N/A	2	N/A

4		Increased phenotyping throughput and accuracy accelerate genetic gains, achieving a stage 1 MET heritability > 0.6.	2020 - (i) Testing and adaptation of best generic tools in interaction with distinct members – Trait set I. (ii) Integration in bioinformatics platform – Launch of Trait set I.	New/ changed	Reports, materials posted on toolbox.	N/A	N/A	2	N/A
4		Increased phenotyping throughput and accuracy accelerate genetic gains, achieving a stage 1 MET heritability > 0.6.	2020 - (i) Testing with members. (ii) Integration in bioinformatics platform. (iii) User survey and trouble-shooting.	New/ changed	Reports, materials posted on toolbox.	N/A	N/A	2	N/A
5	• {primary} CC Enhanced institutional capacity of partner	Genotypic, phenotypic, and pedigree data are fully integrated for use in real-	2020 - Breeding use cases reprioritized based on progress.	New/ changed	Annual Project Report.	N/A	N/A	1	N/A

	research organizations	time selection decisions by AFS breeding networks.							
5		Genotypic, phenotypic, and pedigree data are fully integrated for use in real-time selection decisions by AFS breeding networks.	2020 - i) BrAPI v2 defined ii) Workflows implemented for phase 1 use cases. (iii) Strategy to implement the Year 3-4 case studies defined. (iv) Implementation of BrAPI and local APIs for different systems.	New/ changed	Online documentation.	N/A	N/A	1	N/A
5		Genotypic, phenotypic, and pedigree data are fully integrated for use in real-time selection decisions by AFS breeding networks.	2020 - Breeding management system: (i) Implement plan for maintaining the BMS; (ii) implement updated breeding management systems in appropriate member programs and obtain feedback; (iii) develop plan for maintaining GOBII including support for making critical enhancements	New/ changed	Annual Project Report.	N/A	N/A	0	N/A

			needed to support GOBII users.							
5		Genotypic, phenotypic, and pedigree data are fully integrated for use in real-time selection decisions by AFS breeding networks.	2020 - (i) Existing databases and tools assessed and updated (ii) Documented gap analysis for the Year 3-4 case studies. (iii) Development or acquisition of new database and tools	New/ changed	Annual Project Report.	N/A	N/A	1	N/A
5		Genotypic, phenotypic, and pedigree data are fully integrated for use in real-time selection decisions by AFS breeding networks.	2020 - (i) Develop advancement tools to support key breeding uses cases. (ii) Train breeding teams in use of optimization tools and apply them to pipeline redesign.	New/ changed	Software and training material.	N/A	N/A	2	N/A
5		Genotypic, phenotypic,	2020 - (i) Strategy to manage and integrate meta-data	New/ changed	Annual Project Report.	N/A	N/A	0	N/A

		and pedigree data are fully integrated for use in real-time selection decisions by AFS breeding networks.	reviewed and updated. (ii) Crop agronomy ontology defined.						
5		Genotypic, phenotypic, and pedigree data are fully integrated for use in real-time selection decisions by AFS breeding networks.	2020 - (i) Protocols, manuals, and best practices based on recommendations of the CoPs developed and uploaded in Toolbox. (ii) Review of CoP effectiveness and modifications made as necessary. (iii) Software development rules updated as necessary. (iv) Common BrAPI updated as necessary. (v) Capacity development strategy updated. (vi) Support capacity building and the evaluation of new bioinformatics/biometrics tools and approaches in collaboration with distinct user groups and use cases prioritized in Modules 2-4. (vii) Training workshops for	New/ changed	Training material and online documentation of best practices.	N/A	N/A	2	N/A

			biometricians in CGIAR target countries to expand the number of resource persons. (viii) Broker access to proprietary software and computational capacity on a pay-per-use basis.						

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

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)
Cornell University	Software development and consulting.
IRRI - International Rice Research Institute	Software Development
DArT - Diversity Arrays Technology	Software Development.
CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo	n/a
Syngenta Foundation for Sustainable Agriculture	Collaborations with Product Design
IITA - International Institute of Tropical Agriculture	The center is part of the EiB Network of Breeding Program Modernization
AbacusBio - AbacusBio	Financial but also project design and development. EiB is working in partnership with NextGen Cassava
CIP - Centro Internacional de la Papa	The center is part of the EiB Network of Breeding Program Modernization
CIAT - Centro Internacional de Agricultura Tropical	The center is part of the EiB Network of Breeding Program Modernization
IRRI - International Rice Research Institute	The center is part of the EiB Network of Breeding Program Modernization
ICRISAT - International Crops Research Institute for the Semi-Arid Tropics	The center is part of the EiB Network of Breeding Program Modernization
ICARDA - International Center for Agricultural Research in the Dry Areas	The center is part of the EiB Network of Breeding Program Modernization
IFPRI - International Food Policy Research Institute	The center is part of the EiB Network of Breeding Program Modernization

ICAR - Indian Council of Agricultural Research	The center is part of the EiB Network of Breeding Program Modernization (EiB is part of the ICAR-BMGF project).
KALRO - Kenya Agricultural and Livestock Research Organization	The center is part of the EiB Network of Breeding Program Modernization (Requested by BMGF above the CGIAR Focus)
NARO - National Agricultural Research Organisation (Uganda)	The center is part of the EiB Network of Breeding Program Modernization (Requested by BMGF above the CGIAR Focus)
AfricaRice - Africa Rice Center	The center is part of the EiB Network of Breeding Program Modernization
Corteva	Part of a Public/Private Partnership between EiB and Global Seed Companies to support public breeding modernization process.
Bayer Crop Science	Part of a Public/Private Partnership between EiB and Global Seed Companies to support public breeding modernization process.
Syngenta	Part of a Public/Private Partnership between EiB and Global Seed Companies to support public breeding modernization process.
CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo	Breeding program clients bringing their expertise and insights of CG breeding and willingness to adapt and adopt breeding scheme changes
IRRI - International Rice Research Institute	Breeding program clients bringing their expertise and insights of CG breeding and willingness to adapt and adopt breeding scheme changes
IITA - International Institute of Tropical Agriculture	Breeding program clients bringing their expertise and insights of CG breeding and willingness to adapt and adopt breeding scheme changes
ICRISAT - International Crops Research Institute for the Semi-Arid Tropics	Breeding program clients bringing their expertise and insights of CG breeding and willingness to adapt and adopt breeding scheme changes
CIP - Centro Internacional de la Papa	Breeding program clients bringing their expertise and insights of CG breeding and willingness to adapt and adopt breeding scheme changes

CIAT - Centro Internacional de Agricultura Tropical	Breeding program clients bringing their expertise and insights of CG breeding and willingness to adapt and adopt breeding scheme changes
ICARDA - International Center for Agricultural Research in the Dry Areas	Breeding program clients bringing their expertise and insights of CG breeding and willingness to adapt and adopt breeding scheme changes
WorldFish - WorldFish	Breeding program clients bringing their expertise and insights of CG breeding and willingness to adapt and adopt breeding scheme changes
ICAR - Indian Council of Agricultural Research	Breeding program clients bringing their expertise and insights of CG breeding and willingness to adapt and adopt breeding scheme changes
KALRO - Kenya Agricultural and Livestock Research Organization	Breeding program clients bringing their expertise and insights of CG breeding and willingness to adapt and adopt breeding scheme changes
NARO - National Agricultural Research Organisation (Uganda)	Breeding program clients bringing their expertise and insights of CG breeding and willingness to adapt and adopt breeding scheme changes
CSIR - Council for Scientific and Industrial Research	Breeding program clients bringing their expertise and insights of CG breeding and willingness to adapt and adopt breeding scheme changes
CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo	n/a
ICRISAT - International Crops Research Institute for the Semi-Arid Tropics	Coordinating low-density genotyping platfrom
IRRI - International Rice Research Institute	Key genotyping user and contributor for rice markers
CIP - Centro Internacional de la Papa	Key genotyping user and contributor for potato markers
CIAT - Centro Internacional de Agricultura Tropical	Key genotyping user and contributor for common bean markers
IITA - International Institute of Tropical Agriculture	Key genotyping user and contributor for cassava, maize, cowpea & soybean markers
ICARDA - International Center for Agricultural Research in the Dry Areas	Key genotyping user
BRRI - Bangladesh Rice Research Insitute	Key genotyping user

ICAR - Indian Council of Agricultural Research	Key genotyping user
Cal-Riverside - University of California, Riverside	Cowpea marker contributor
University of Wisconsin-Madison	Potato marker contributor
KSU - Kansas State University	Sorghum marker contributor
NARO - National Agricultural Research Organisation (Uganda)	Key genotyping user
KALRO - Kenya Agricultural and Livestock Research Organization	Genotyping user
PhilRice - Philippine Rice Research Institute	Genotyping user
DArT - Diversity Arrays Technology	Shared genotyping service provider
Intertek	Shared genotyping service provider
AfricaRice - Africa Rice Center	Key genotyping user
EMBRAPA - Empresa Brasileira de Pesquisa Agropecuária	Genotyping user
USDA - U.S. Department of Agriculture	Genotyping user
IBP - Integrated Breeding Platform	Key genotyping user (IFAD project)
Cornell University	Bioinformatics support for mid density genotyping service
INRAB - Institut National de Recherche Agricole du Benin	Genotyping user
INERA - Institut de l'Environnement et de Recherches Agricoles (Burkina Faso)	Genotyping user
CNRA - Centre national de recherche agronomique	Genotyping user
CSIR-SARI - Council for Scientific and Industrial Research - Savanna Agricultural Research Institute	Genotyping user
NCRI - National Cereals Research Institute	Genotyping user

IER - Institut d'Economie Rurale (Mali)	Genotyping user
ISRA - Institut Senegalais de Recherche Agricole	Genotyping user
SLARI - Sierra Leone Agricultural Resarch Institute	Genotyping user
ARC - Agricultural Research Corporation, Sudan	Genotyping user
EIAR - Ethiopian Institute of Agricultural Research	Genotyping user
RAB - Rwanda Agriculture and Animal Resources Development Board	Genotyping user
IRAG - Institut de Recherche Agronomique de Guinée	Genotyping user
FOFIFA - Centre National de Recherche Appliqué au Développement Rural	Genotyping user
CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo	n/a
IITA - International Institute of Tropical Agriculture	We will work close to improve the rate of genetic gain of IITA breeding programs
IRRI - International Rice Research Institute	We will support them to improve the rate of genetic gain of IRRIs breeding programs
ICRISAT - International Crops Research Institute for the Semi-Arid Tropics	We will support them to improve the rate of genetic gain of ICRISAT's breeding programs

Table 3: Planned Budget

	Planned Budget				Comments on major changes
	W1/W2	W3/Bilateral	Center Own fund	Total	
Module 1	$ 283,000	$ 1,075,712	$0.00	$ 1,213,000	
Module 2	$ 283,000	$ 1,945,712	$0.00	$ 2,083,000	
Module 3	$ 218,000	$ 1,045,154	$0.00	$ 1,118,000	
Module 4	$ 283,000	$ 1,095,712	$0.00	$ 1,233,000	
Module 5	$ 283,000	$ 1,045,712	$0.00	$ 1,183,000	
Platform Management & Support Cost	$ 350,000	$ 0.00	$0.00	$ 1,078,558	

Platform Plan of Work and Budget (POWB)

Platform Total				$0.00		
	$	1,700,000	$	6,208,000	$0.00	$ 7,908,000	

*Note this budget does not include use of the expected W1&W2 carry-over funds. They will be allocated to Module 1 ($420,000), Module 2 ($533,600), Module 3 ($543,000) 4 ($514,400), and 5 ($450,000).