Breeding for Tomorrow Science Program

Inception Report

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Acronyms

AI - Artificial Intelligence
AGG – Accelerated Genetic Gains
AoW – Area of Work
CA – Comparative Advantage
CWANA - Central and West Asia and North Africa
ESA – East and Southern Africa
FAIR principles - Findability, Accessibility, Interoperability, and Reuse of digital assets
Genetic Innovation – Genetic Innovation Science Group of the 2022-2024 CGIAR Portfolio
GHG – Greenhouse Gas
GloMIP – Global Market Intelligence Platform
HLO – High Level Outputs
IO – Intermediate Outcome
LAC – Latin America and Caribbean
MELIA – Monitoring, Learning, Evaluation, and Impact Assessment
NARES – National Agricultural Research and Extension Systems
PDT – Product Design Teams
SMEs – Small and Medium Enterprises
ToC – Theory of Change
TPP – Target Product Profile
SA – South Asia
SEA – Southeast Asia
WCA – West and Central Africa

Executive summary

Breeding for Tomorrow contributes to transforming global food systems for greater productivity, inclusiveness, and sustainability by developing climate-resilient, market-preferred, and nutritious crop varieties. Using a gender-intentional and systems-based approach, the Program focuses on improving the resilience of agriculture, equitable growth, and food security for small-scale farmers and consumers in low- and middle-income countries by developing improved cultivars using advanced breeding technologies and accessible seed systems via strong partnerships.

Breeding for Tomorrow builds on key achievements from the Genetic Innovation Science Group, extensive stakeholder engagement, and co-design. Global and regional consultations led to the co-development of seven partnership priorities which were formalized through an Aide Memoire and operationalized in the newly created 'Enable' Area of Work (AoW). Broadly, Breeding for Tomorrow's work is structured along the product development process which stage gates breeding, moving from the identification of needs to germplasm improvement and variety development, through to varietal release. Innovations like genomic selection, speed breeding, and digital seed platforms ensure accelerated and targeted genetic gains. The Program is well positioned for having a comparative advantage in the breeding space because of its public-good mandate, global reach, technical expertise, and longstanding NARES partnerships. It fills critical gaps where private or national actors have limited reach, especially in unserved market segments.

The AoWs that support Breeding for Tomorrow's path to impact have been prioritized to ensure they are working where there is the highest opportunity for impact. Food and nutrition security, poverty alleviation, and climate resilience are the major areas where the Program can most strongly contribute to impact. Moreover, breeding pipelines are undergoing prioritization to ensure resources are targeting those pipelines that have the largest opportunity to deliver breakthrough products in the market segments with the highest needs and likelihood for success. Breeding for Tomorrow's AoWs include *Market Intelligence* (gathers market intelligence and foresight to define market segments and for informing product conceptualization.); *Accelerated Breeding* (prioritizes breeding pipelines, aligns them with relevant market segments, develops germplasm with CGIAR-NARES breeding networks, and optimizes breeding processes while supporting breeding through trait discovery.); *Inclusive Delivery* (co-designs strategies to facilitate increased seed production, delivery, and positioning of improved varieties in inclusive seed systems, plus co-delivers analysis on varietal adoption and turnover, seed replacement and use, and information uptake.); *Breeding Resources* (modernizes breeding infrastructure with shared digital tools and data management, delivers high throughput phenotyping capacity and improvements to breeding operations, and aligns CGIAR-NARES breeding networks under FAIR data principles.); and *Enable* (ensures cross-cutting support for partnerships and capacity development in line with codesigned priorities; Develops crosscutting frameworks and processes for MELIA).

Across these AoWs, causal pathways iteratively link activities, meaning all High-Level Outputs (HLOs) and their associated activities work together to achieve impact. This is reflected in Breeding for Tomorrow's Theory of Change, which underwent adjustments during the Inception Phase to more logically elucidate how the product development process leads to impact. Nonetheless, the Program works in conjunction with other Programs and Accelerators to transform food systems. For example, the Scaling for Impact Program links tightly with our seed systems research to better bundle innovations and more efficiently and effectively scale released cultivars. Through Technologies for African Agricultural Transformation (TAAT) program for example, Climate smart maize technologies have been disseminated jointly in Nigeria and other

countries. Better Diets and Nutrition Program works to define required nutritious traits in market segments to ensure product design includes those nutrition traits needed by target populations.

1. Program/ Accelerator overview

1.1 High-level Vision

Breeding Tomorrow envisions a world where climate-resilient, nutritious, and market-preferred crop germplasm, developed and delivered by the Program, enables food systems to become more productive, resilient, inclusive, sustainable, and equitable. Market failures in segments featuring private sector underinvestment are addressed through a systemic and gender-intentional approach fostering market competition, innovation, and efficiency gains. Small-scale farmers in low- and middle-income countries prosper from the adoption of breakthrough products resulting from advanced breeding methods such as high-throughput phenotyping, speed breeding, genome sequencing, and machine learning-based trait selection to accelerate genetic gain and reduce breeding cycle times thanks to collaboration with public, private, and civil society partners. Products are widely adopted by farming communities and integrated into consumers' diets thanks to refined market segmentation and product targeting, aided by geospatial and foresight modelling techniques. Digital seed platforms track uptake, ensuring impact monitoring and refinement. Ultimately, Breeding for Tomorrow's genetic innovations support sustainable agriculture, regenerative soils, and diversified nutrition sources, leading to a future where smallholders, women, and youth are empowered through thriving, inclusive agricultural economies—unlocking opportunity, reducing inequality, and building resilient communities. Food systems are transformed through accelerated innovation and sustainable practices, paving enduring pathways to peace, prosperity, and environmental stewardship.

1.2 Achievements from 2022—2024

Breeding for Tomorrow builds on the work conducted under the Initiatives in the Genetic Innovation Science Group (Genetic Innovation) and the Excellence in Breeding Platform. Genetic Innovation developed an integrated set of Initiatives that move along the stages of problem identification, targeting, and product conceptualization through to germplasm improvement, product development, varietal release, and delivery of genetic gain to farmers' fields, structured around a clear, stage-gated pathway for generating impact. This structure—articulated through a comprehensive Theory of Change (ToC)—allowed objectives to be targeted to result in the most impactful, end-user aligned product development and delivery programs. Genetic Innovation effectively aligned CGIAR's breeding and delivery goals with national and regional priorities by engaging key stakeholders at multiple levels. Established co-design mechanisms, such as the annual NARES-SRO Leadership Meetings (Nairobi 2022, Istanbul 2022, Marrakech 2023 and Dubai 2024), ensured continual input from national partners, co-design and ownership of partnership strengthening strategies, and joint prioritization and decision making. Outputs of this co-design, such as the execution of over a hundred crop-by-country, multidisciplinary, product design team (PDT) meetings, led to partner-led market segmentation, defining essential trait requirements, and the identification of product concepts. These consultations provided the basis to co-develop Target Product Profiles (TPPs) for targeted national and regional market segments, as well as novel delivery/scaling strategies and models that are adaptable across multiple countries and crops.

Significant progress was made in breeding program effectiveness by leveraging the Excellence in Breeding platform and best practices. This effectiveness was improved in CGIAR and NARES' programs, through strategic capacity-building efforts (refined through over a hundred and twenty peer- and self-assessments), enhanced collaboration, and financial planning. The activities of Genetic Innovation were highly coherent, with consistent breeding approaches across crops. Market Intelligence feedback supported product design teams in refining breeding strategies. The

research was widely recognized for its high scientific quality and strong stakeholder engagement. The inclusion of diverse perspectives, gender and social inclusion efforts, and open science practices enhanced credibility and impact and the integration of GloMIP and the Breeding Portal demonstrated Genetic Innovation's adherence to FAIR data principles, open science, and equitable partnerships.

At the same time, production and delivery of quality seed for improved varieties was enhanced through several innovative partnerships. Novel strategies and business models were codeveloped, most notably with traders (such as for beans in Tanzania), with women-led farmer-producer companies (such as for rice in India), through decentralized seed producer networks (such as for cassava and sweet potato in eastern and southern Africa), and with commercial and state-owned seed companies (such as for major cereals in Asia, Africa, and Latin America). These partners and networks played a critical role in multiplying, delivering, and popularizing quality seed of improved varieties, and reported significant gains in their production and distribution capacity because of their CGIAR engagement. Partnerships also contributed to seed policy changes related to varietal registration procedures, plant variety protection rules, seed quality assurance regulations, seed market liberalization, and trade agreements for improved varieties and seed (e.g. in Uganda where the National Agricultural Research Organisation (NARO) and seed companies were supported in scaling innovative anti-counterfeiting measures, expanding quality assurance standards, and promoting varietal turnover and quality seed use; and in Nigeria where new plant variety protection laws were developed to motivate the private sector to more actively engage in the development of new and relevant seed varieties for the market. These achievements are captured in the 2024 final technical reports and the 2024 IAES Evaluation Report for the CGIAR 2022–2024 Portfolio.

1.3 Description of intended research

Value proposition: Breeding for Tomorrow delivers climate-resilient, market-preferred, and nutritious crop varieties, contributing to food system's future productivity, inclusivity, sustainability, and preparedness for facing the challenges of tomorrow. By leveraging cutting-edge breeding technologies, forward-looking market intelligence and insights and gender-intentional approaches, and innovative delivery models and partnerships, it accelerates genetic gains in farmers' fields while addressing major global challenges such as climate change and food insecurity. Unlike traditional breeding programs, it integrates advanced digital seed platforms, machine learning, and rapid breeding techniques including high throughput phenotyping and genomic selection to optimize product development, drive product uptake and maximize product impact. Moreover, it targets those market segments considered as market failures by the private sector, working with NARES partners to ensure their breeding programs are still able to serve end users. Through partnerships with public, private, and civil society actors, Breeding for Tomorrow benefits small-scale farmers in low- and mid-income countries, empowering them with improved germplasm tailored to their needs and market conditions. Ultimately, it provides a strategic and science-driven pathway to resilient agriculture, equitable growth, and long-term food security.

The **Breeding for Tomorrow 2025 Strategic Priorities** evolved since 2024. They better identify and overcome the key bottlenecks in breeding and seed systems to improve the Program's processes and impact and to align available resources with the largest contributions to progress.

Market Intelligence will conduct foresight analysis using crop modelling and economic methods to forecast crop demand and end-use characteristics beyond 2035. It will closely interact with *Better Diets and Nutrition* to ensure (1) nutrition challenges in market segments are considered in

product design and (2) strategies are developed to foster the uptake of biofortified and health-enhancing staples. It will link with *Climate Action* and *Sustainable Farming* and expand GloMIP with relevant foresight indicators and identify up to two product concepts per crop with high potential for impact. Additionally, it will assess essential trait improvements that incentivize adoption. A standardized product design process, coordinated with Accelerated Breeding, will ensure a systematic approach to defining and developing improved germplasm.

Accelerated Breeding's Center crop leads will prioritize breeding pipelines, market segments, and countries using impact indicators from Market Intelligence, the viability of market segments' seed systems, and considering the role of alternative suppliers of improved germplasm. Minimum viable investments will be determined to develop the TPPs, each of which must be impactful, in-demand by farmers, gender-intentional, and feasible to develop. Prioritization of breeding pipelines will enable priority pipelines to optimize their breeding schemes and to include on-farm verification of elite products as required. Trait discovery and development will be aligned with the essential trait needs of prioritized breeding pipelines.

Inclusive Delivery will focus on assembling and analyzing data and information from seed systems and markets that are necessary to support strategic decision-making on pipeline prioritization, product concept design, and TPP refinement. This includes assessing seed systems' capacity to deliver improved varieties to smallholder farmers, especially women and disadvantaged groups who are particularly vulnerable to climate-related challenges. The AoW will identify traits preferred by producers, traders, processors, and men, women, and youth consumers in incumbent varieties that increase adoption probabilities of replacement varieties; analyze demand patterns and trends in selected market segments and prioritized countries; work with seed producers on seed multiplication and delivery strategies and models that respond to appropriate market signals and increase access to quality seeds for women and last-mile hard-to-reach farmers, with an emphasis on maximizing synergies between the formal and informal sectors; and harmonizing product tracking protocols to measure varietal success post-release to gauge whether new products scale successfully and estimate their reach over a 5–10-year period. This work will be conducted in close coordination with other AoWs, Product Design Teams (PDT), and the Scaling for Impact Program, with the ultimate aim of demonstrating the value propositions for new varieties to accelerate adoption, varietal turnover, and quality seed use.

Breeding Resources aims to modernize and increase the returns on investment of CGIAR crop breeding networks through adoption of cost-effective shared services, state-of-the-art digital solutions, and advanced research operational support. Leveraging the strong network foundation and solutions from Genetic Innovation e.g. Enterprise Breeding System and Bioflow analytic, Breeding Resources will continue strengthening operational integration with existing network partners with innovations tailored to local and regional contexts, ensuring equitable access, business sustainability, and organizational capacity development. The AoW will also partner with *Digital Transformation* to develop CGIAR-wide core data infrastructure and operational framework to enable interdisciplinary data interoperability and AI readiness, underpinned by FAIR principles.

Enable is a new AoW, conceived in response to internal and external partner feedback during the last Portfolio, which sought a coherent stakeholder engagement strategy that functions across the Program to streamline communication, avoid redundancy, and present consistent communication regarding the Program's vision and mission. Enable will document and scale best partnership practices across AoWs, breeding networks, and centers; with the Capacity Sharing Accelerator, coordinate capacity development across AoWs and Centers by establishing a virtual capacity development coordination unit; mainstream use of the portfolio management system to incorporate Breeding for Tomorrow level KPIs in harmonized crop reports; and work closely with the Genebank Accelerator to define policies and processes for germplasm use and exchange.

Enable will also house the Program's MELIA, change management, and Impact assessment unit which aims to assess the impact of Breeding for Tomorrow innovations, across AoWs, at scale.

2. Codesign and partnerships

Breeding for Tomorrow's codesign and partnership mechanisms
Breeding for Tomorrow's design and its focus on strengthening partnerships is anchored in extensive consultation and input received from partners at international, regional, and national levels. This anchoring was initiated during the Genetic Innovation Science Group (2022-2024) with a particular focus on sub-Saharan Africa, North Africa and West Asia, and South Asia. At the international level, four leadership consultation meetings (Nairobi 2022, Istanbul 2022, Marrakech 2023 and Dubai 2024), involving CGIAR, NARES, GFAiR and SRO senior management (representing over 35 countries), led to the co-identification of partnership priorities and bottlenecks within the Genetic Innovation Science Group that ultimately formed the foundation of Breeding for Tomorrow's partnership strategy.

During the Dubai meeting in October 2024, partnership areas of improvement were distilled into seven core priorities that were jointly identified by CGIAR, NARES and SRO leadership with support from GFAiR to ensure alignment with global partnership standards (GFAiR Partnership Principles). All parties in Dubai agreed that these seven core partnership priorities should be actively pursued in the Breeding for Tomorrow Program and this resolution was captured in a formal Aide Memoire signed by representatives from CGIAR, NARES, and SROs. The document and commitment of Breeding for Tomorrow to adhere to these priorities is publicly available to ensure transparency, commitment to co-design, and accountability.

The seven partnership priorities that were jointly identified to be actively pursued in Breeding for Tomorrow are:

1. Co-design and joint priority setting
2. Joint decision making
3. Increased transparency
4. Augmented role of national partners including universities and small and medium enterprises (SMEs)
5. Fair attribution
6. Systematic and objective assessment of the evolution of partnership quality
7. Renewed focus on human and institutional capacity development.

Regional and national stakeholder consultations in 2024 and 2025 further influenced the development of the Breeding for Tomorrow proposal and changes during the Inception Phase. Regional crop network steering committees, established in 2024 as part of Genetic Innovation, emphasized several of the above partnership priorities and stressed the need to clearly assign roles and responsibilities in regional crop improvement networks aligned to the comparative advantage of network members (see Section 4 – Comparative Advantage). The need for a standard and objective method to assess network member capacity and formulate customized, needs-based, and actionable capacity development plans has been repeatedly and heavily emphasized. National consultation meetings (feedback sessions to CGIAR in country-level discussions and technical product design team (PDT) meetings) highlighted the need for CGIAR to engage with partners in a more coordinated and holistic fashion across the crop improvement continuum. A strong need for greater and clearer communication from the CGIAR in the portfolio (2025 onwards) has been repeatedly reiterated.

Response of the Program to codesign outcomes – what changed?
In response to the codesign and partner engagement mechanisms, Breeding for Tomorrow established Enable as a new Area of Work. Enable is dedicated to providing a consistent approach across Breeding for Tomorrow's AoWs to strengthen and assess partnership quality; coordinate

provision of jointly defined, targeted, needs based capacity development in close collaboration with the CapSha Accelerator; and coordinate cross cutting stakeholder engagement and communication. Enable is supporting Breeding for Tomorrow to establish an improved CGIAR model of operating with clear and visible processes for continued co-design and input int Breeding for Tomorrow's decisions while providing frameworks to strengthen inclusivity and engagement with national and regional organizations, including the private sector (SMEs) and universities. Specific, scalable innovations that Enable is currently piloting within Breeding for Tomorrow (Q1 and Q2 of 2025) include the introduction of regional and national product advancement meetings where variety advancement and deployment decisions are jointly taken with demand, scaling, and innovation partners, and execution of network membership agreements co-developed with partners that define how regional crop improvement networks operate. These innovations build on the product design team (PDT) process that was introduced during Genetic Innovation. The 2022-24 PDT meetings saw multi-stakeholder country teams (including farmer groups) take the lead in defining national breeding priorities that were then aggregated to a regional level that can be addressed by CGIAR-NARES breeding networks.

3. Theory of change and MELIA

3.1 Theory of change (ToC)

The Inception Phase provided a valuable opportunity to revise the ToC (see link) and associated MELIA. ISDC's feedback has been addressed with clear alignment between the HLOs and ToC diagram and improved clarity on causal pathways (see an extensive overview of how feedback was addressed). An internal working layer of AoW level outcomes was used to more clearly define causal pathways between HLOs and Intermediate Outcomes (IO). AoW level thinking provided improved assumptions between HLOs and IOs. As a result, the Intermediate and 2030 Outcomes were refined, with one 2030 Outcome shifting to an Intermediate Outcome (IO4). Based on feedback from partners, the Interim Leadership Team prioritized retaining the names of HLOs and AoWs with the previous Portfolio to facilitate smoother communication (too many changes led to confusion among partners, nonetheless, the HLO names were slightly expanded to improve clarity). The ToC narrative reads as follows.

Market Intelligence (AoW1) develops knowledge and foresight on demand-led opportunities for impact. The knowledge will be packaged into decision-support tools (HLO1 Steer to impact). Market segments are being defined, including future market segment development (HLO2 Target to market) and used to develop product concepts (HLO3 Design concepts). Combined, these HLOs will develop and package knowledge for breeding networks to apply, informing the design of foresight- and demand-oriented products.

Accelerated Breeding (AoW2) interprets and applies market intelligence and develops TPPs and pipelines (HLO6 Refocus to markets). CGIAR-NARES breeding networks can then prioritize the transdisciplinary designed, high impact products (HLO7 Accelerating genetic gain). Joint prioritization encourages more targeted breeding by networks (IO1).

The cost-effectiveness of the breeding network (IO3) will be achieved through:

- A culture of continuous improvement, led by Enable (AoW5), as it works to address common challenges across breeding networks. Breeding performance will be monitored annually, with rectifying improvements to organizational structures and processes (HLO21 Improve management), overcoming bottlenecks such as policy barriers to the exchange of genetic resources (HLO22 Exchange genetic resources genetics).
- Market Intelligence (AoW1) will develop investment cases that forecast potential benefits of breeding investments, and the results will be used as a check on the level of impact that is emerging or has been achieved. Analysis of forecasts, compared with actual results gained, from, for example, in-depth impact assessments by AoW 5 Enable (HLO20 Assess performance), will test scaling assumptions, providing additional confidence in the projection models. Combined these activities will ensure Breeding for Tomorrow remains focused on delivering maximum impact.
- Breeding Resources (AoW4) will provide shared services, with economies of scale used to increase the cost-effectiveness of breeding tools and services, to make modernized breeding more available and feasible through CGIAR-NARES breeding networks.

The culture of continuous improvement, enabled through active improvements, maintained impact-orientation and shared services, will come together in CGIAR-NARES breeding networks that efficiently develop products in the shortest possible time (IO3). The improved processes and modernized approaches will further enhance the success of breeding activities (IO2). Active collaboration to successfully develop products (IO2) will occur as a result of HLOs across three AoWs:

- Accelerated Breeding (AoW2) will discover and develop foundational genetic resources such as traits, high-value haplotypes, and elite lines (HLO8. Discover genetic potential), resulting in traits and genetic resources with significant potential for genetic gain.
- Enable (AoW5) will develop new approaches to partnerships with strategic planning of crop x region breeding networks, enabling collaboration on common challenges and opportunities (HLO18 Partnered networks), and coordinate capacity-sharing that enables a dynamic future workforce with appropriate infrastructure and resources (HLO19 Share capacity). Combined, multi-scaled and multi-disciplinary partnered networks with appropriate capacity will be enabled to implement modernized breeding.
- Accelerated Breeding (AoW 2) will build on the networked partnerships established by AoW5: Enable (HLO18 Partnered networks) and embed partners into decision-making on breeding schemes and pipelines (HLO9 Transform collaboration).
- Breeding Resources (AoW4) will develop a package of interoperable tools and services that are scaled to align with the varied capacity within breeding networks. More resourced and higher-capacity partners will be enabled to act as central hubs, providing support to less resourced partners. This approach will build collaborative interdependence and more resilient networks.

The development of genetic resources with significant potential for genetic gain, combined with partnered networks capable of modernized breeding, resourced with interoperable scaled tools, will come together in CGIAR-NARES breeding for targeted products (HLO10 Create products), in accordance with the product prioritization from IO1. This will result in CGIAR Centers, AoW s, and NARES actively collaborating on successful product development (IO2).

Successful product development that delivers the targeted levels of genetic gain and traits required for impact-led and demand-led products will encourage farmers to adopt new varieties. Inclusive delivery (AoW 3) will work on both the supply and demand side of variety adoption. Collaboration with S4I will be sought to ensure sufficient documentation, description, and analysis of experiences in seed supply models and scaling experiences so we can adapt, replicate, improve, communicate them with various audiences. Insights into the motivations of scaling partners and smallholder farmers (HLO4 Foster motivations) will provide feedback to Market Intelligence and inform replacement strategies that along with on-farm trials that demonstrate performance, will increase demand for new varieties by scaling partners (HLO11 Position for demand). Increased demand for improved varieties will further increase uptake by smallholder farmers (2030-OC1)

On the supply side, technologies and strategies to encourage scaling partners to increase production and equitably distribute seed (HLO12 Deploy seed), technologies, and strategies to accelerate delivery (HLO13 Power seed scaling) will address both volume and speed limitations to improve smallholder access to improved varieties. Collaboration with S4I here will involve co-creation and assessment of innovation bundles, analysis of the enabling environment for innovation bundling as well as holistic impact assessments on scaling/delivery mechanisms . Combined with policies on the exchange of genetic resources (HLO22 Exchange genetic resources genetics), increased supply capacities will lead to NARES and SMEs promoting equitable access to varieties for marginalized groups (IO5). S4I grassroots networks and partnerships will be critical in providing feedback on whether we are making sufficient use of CGIAR's country or regional policy engagements. Use of improved varieties by marginalized groups can positively impact these groups (2030-OC2). Significantly improved products with widespread use by smallholder farmers and marginalized groups, will multiply individual benefits to create a transformative, societal scale benefits for farmers, communities, and society.

In this updated ToC there are many pathways to impact. Adoption is maximized through a combination of partnered networks and collaboration for greater NARES empowerment, enhancement of supply and demand by scaling partners, and network-wide resource allocation in accordance with rigorously prioritized impact- and demand-oriented products. Prioritized products will be successfully delivered using modernized and efficient breeding practices. In this comprehensive strategy the breeding pipeline is encompassed within a holistic innovation ecosystem that uses market intelligence and inclusive delivery to achieve societal scale impacts.

3.2 Monitoring, Evaluation, Learning, and Impact Assessment (MELIA)

The vision for Breeding for Tomorrow's MELIA is to connect evaluation science with the social and biological sciences required for implementing the Program. Tools that have been previously developed by Genetic Innovation for tracking and determining various aspects of breeding system performance are being refined to ensure the data collected directly aligns and contributes to MELIA. This is not only efficient but helps each AoW develop an experiential understanding of how MELIA applies to the work undertaken, encouraging greater transdisciplinary appreciation.

Breeding for Tomorrow's MELIA objectives include:

- Assessing the Program's various contributions to impact, to inform future investment decisions.
- Providing accountability by demonstrating how effective the Program was at achieving its intermediate outcomes
- Actively learning for continuous improvement in program design, coordination, and implementation (AoW result level).

This means there is a utilitarian approach to MELIA, as opposed to simply validating results or generating new scientific knowledge. MELIA is focused on guiding Breeding for Tomorrow to maximize impact.

Data collection design, with a strong purpose and clearly applicable findings, is contingent on a ToC and program logic that is clearly linked to the evaluation purpose and relevant evaluation criteria. The strategic design work presented in the refined ToC and program logic provides high confidence in the quality and need for each Research Question. Breeding for Tomorrow is still finalizing the CGIAR MELIA Plan template, noting that the Program's current MELIA foundations are robust, meaning this finalization is informative, constructive, and efficient.

Work has commenced on identifying appropriate breeding system applied indicators and the existing measurement tools to gather data. This will supplement the CGIAR-wide indicators, such as *number of publications* as these indicators have limited relevance to breeding systems. In part, this is due to varietal development offering a direct intervention, meaning that outcomes are gained from innovation uptake as driven by market forces, as opposed to innovations, strategies, or policies that are designed to influence a series of attitudinal or behavior changes. The uptake of a new variety is a replacement strategy, with limited behavior change required. While agronomic practice change is advantageous and can act as a multiplier effect[1], benefits do not require farmers to change their agronomic practices. The direct intervention of variety replacement means additional work is required to develop applied indicators for breeding system contexts. Several HLOs have already developed breeding specific indicators and these have been included in the high-level MELIA plan. There is further work required to identify indicators for remaining HLOs.

Once the full set of indicators is finalized, it will be possible to check available monitoring tools (e.g. Breeding Program Assessment Tool), for completeness and alignment as well as developing specific targets in the Results Framework. Refinements to existing tools, and design of any additional tools to fill specific gaps can then be done in a targeted and efficient manner that

embeds MELIA in operations, limiting additional data gathering costs. Each tool will require a data collection strategy, relevant to the type of tool and appropriate time scale for the indicators included. At this stage, the resourcing already assigned to existing tools is being checked for sufficiency and needs for any gap filling tools determined. Monitoring opportunities such as the upcoming Gates Foundation funded Breeding Program Assessment Tool will be leveraged to ensure alignment with the Program's MELIA data needs. Regular results publication from each monitoring tool can be used to inform reflections on progress.

Finally, evaluation studies, including Impact Assessments that address the stated purpose of the Program's evaluation and subsequent Research Questions, will be further developed. All MELIA activities will need to deliver on the evaluation objectives. At this time, Impact Assessments using Randomized Control Trials (RCTs) need to be refined to better contribute to the evaluation of the Program. An in-depth review is required to determine alignment of in-progress and progressed Impact Assessments, along with additionality of data gathered (what additional insights will be generated, how will this knowledge contribute beyond existing knowledge) before details on these assessments become solidified as part of the MELIA plan.

The detailed planning at the strategic high-level, using the ToC to connect from evaluation objectives and questions, through to indicators and monitoring tools, will mean that evaluation tasks are unlikely to require any costly additional data gathering. Instead, evaluation tasks are expected to involve reviewing existing data, with application of judgement on the merit or worth of results. Participatory approaches may be used as part of existing breeding network events, to engage breeding partners and stakeholders in active and shared learning. While data gathering will be embedded into activities across AoWs, Enable will coordinate collation in their HLO20 *Assess performance*. The Program director will be responsible for oversight of any evaluation tasks.

A proposed plan of action for completing the operational level of MELIA planning by 31 October 2025 is provided in the high-level strategic MELIA plan. The plan allows time to review existing monitoring tools with the AoW leads, before developing data collection strategies and other remaining sections of the CGIAR MELIA template. At this point in time, it is expected that the evaluability assessment for domains A and B will only be partially possible, but that the quality of what is provided and the rigorous basis it provides will be recognized.

See the partially completed Breeding for Tomorrow Results Framework in the attachments.

[1] Markedly improved varieties can motivate and make agronomic changes such as fertilizer application more affordable

4. Comparative advantage analysis

Building on the conscious partnership development fostered in the Genetic Innovation Science Group (GI), Breeding for Tomorrow continues its activities and engagement in spaces where the Program is either well positioned to have the comparative advantage (CA) – or where a partnership yields the likely positioning for having the CA, compared to other parties. Across the Program, the CA positioning principally stems from its broad reach and knowledge sharing (across regions, continents, and crops) coupled with its strong history, partnership, and operations with national breeding programs, as well as the Program's mandate to work in segments deemed as market failures by the private sector. Moreover, building on work undertaken in GI the Program has been consciously partnering with national programs based on co-identified comparative advantage. The CA analysis results reflected this positioning (see the CA attachment) – as most scores yielded *well* or *moderately well positioned*. Broadly, analysis shows the strength of the Program, either in undertaking work that is important though will not be (efficiently or effectively) undertaken by other parties, or in partnering with other parties to ensure the work is efficient and effective. Within Market Intelligence, Accelerated Breeding, and Enable, most analyzed parties were unlikely to undertake the HLOs, meaning the CA positioning is more evident. However, in Inclusive Delivery and Breeding Resources, analyzed parties were more likely to undertake similar activities, leading the AoWs either to partnership and co-implement arrangements, or to undertake the work because of the spillover benefits of coordination, knowledge sharing, and economies of scale.

Across Market Intelligence's HLOs, external parties exist that can potentially undertake the work associated with the HLOs. NARES, international organizations (e.g. FAO), or private sector parties collect relevant data, develop tools, and provide analysis to support data-driven decision making. Market Intelligence links with public sector actors who collect this data by integrating their data into our systems while private sector actors are less likely to collect the specific data relevant to our Impact Areas and desired outcomes. Despite these public sector actors working in a similar space, the AoW is well positioned for having CA because these parties are *unlikely* to collect data and develop analysis at the required spatial resolution, with a multi-crop focus and wide geographic coverage, with the required specificity, and with the same frequency of data collection. For example, FAO provides publicly accessible data aggregated at various levels, though, critically not at the market segment level – which is required for CGIAR-NARES breeding pipelines to target varietal development at the appropriate scale. Within the *Invest* HLO (investment portfolios for breeding pipelines to support investment prioritization), the Gates Foundation has the resources and capacity to do this work. However, their geographical and crop scope is more limited than the Program and its breeding partners require.

Except for the *Create products* HLO (germplasm development), all Accelerated Breeding's HLOs are internally focused, aiming to improve CGIAR-NARES breeding processes and methods (e.g., making better decisions about which pipelines, market segments, and countries to resource or making changes to the way the Program partners). This restricts the number of active parties present that are likely to undertake the work, resulting in Breeding for Tomorrow being well positioned to hold the CA for these HLOs. Conversely, other parties do undertake the work associated with *Create products*. Nonetheless, the Program is well positioned to have the CA because 1) it is unlikely that these parties will work across the same scope; 2) Breeding for Tomorrow's germplasm is developed as an international public good, primarily for market segments deemed 'market failures' (where the private sector is unlikely to work); and 3) those existing willing parties (especially NARES (such as NARO or KALRO) or Advanced Research Institutes) may lack the resources, capacity, or mandate to do this work in isolation. This positions

Breeding for Tomorrow to hold the CA in partnership with willing parties. Partnerships are formed on the basis of roles and responsibilities co-assigned according to comparative advantage and co-defined through extensive consultation and agreement with partners over a number of years (including major funders such as the Gates Foundation) – see Figure 1 below.

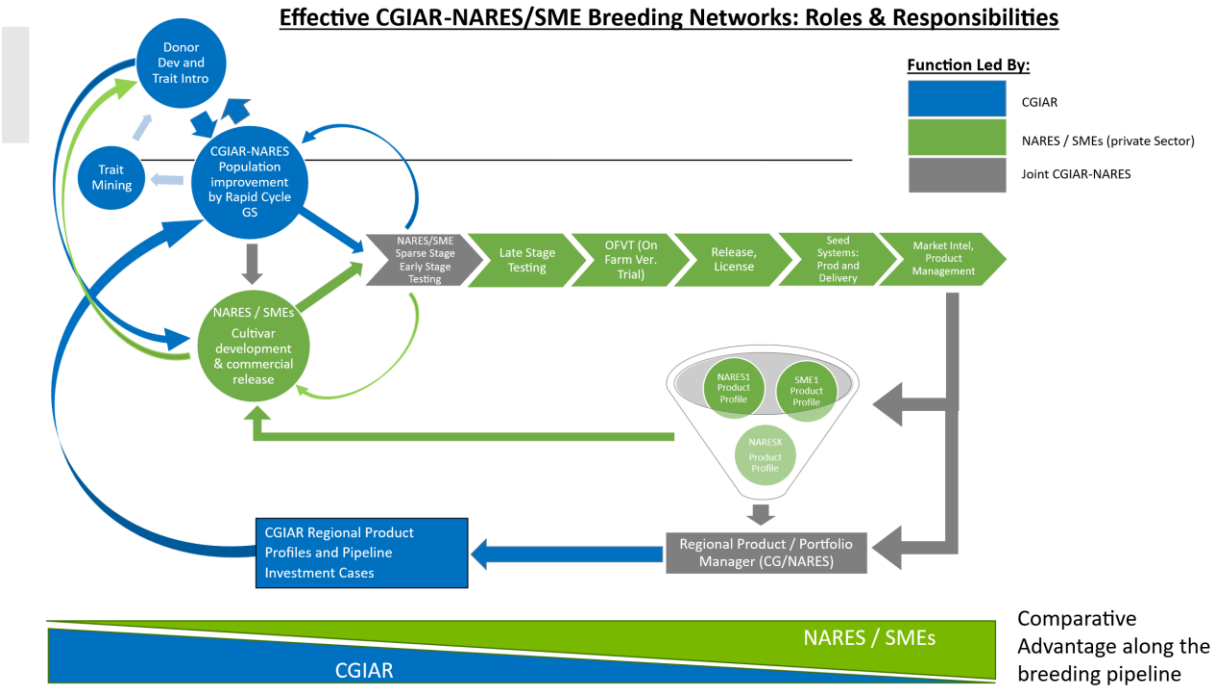

Figure 1. Definition of CGIAR and NARES comparative advantage across breeding pipeline and AoWs.

Across most of the HLOs within Inclusive Delivery, the Program is moderately positioned to hold the comparative advantage. Most parties within the research and development space could undertake work associated with Inclusive Delivery's HLOs. However, the AoW is uniquely positioned to undertake this research and support alongside partners because of its international mandate and positioning. That is, the AoW undertakes research on a global scale providing solutions and knowledge at a meta scale, galvanizing research outputs and solutions across market segments and regions to share knowledge and support policy, delivering economies of scale in findings.

Across Breeding Resources, the CA positioning is variable due to heterogeneous local and regional needs, internal technical capacities, and accessibility challenges to tools and services. Various CGIAR Centers can deliver shared services to support breeding (*Global Shared Services*) or external parties can develop Hub-and Spoke partnerships (*Scale*) (e.g. APAARI, ASARECA). However, if Centers or regional research organizations undertake this work in isolation, critical opportunities for knowledge sharing, efficiency gains through economies of scale, and high-level oversight are missed. Consequently, the AoW undertakes these HLOs in partnership with those parties having the resources and capabilities, ensuring that all CGIAR-NARES breeding networks reap the benefits.

Across Enable's HLOs, positioning for holding CA varies; there are many parties that can undertake work associated with improving partnerships, coordinating capacity sharing, and providing principles and practices relating to breeding products (*Partnered networks*, *Share capacity*, and *Exchange genetic resources*). However, many of these parties do not either cover the full spectrum of technical and partnership issues that CGIAR covers (e.g. FAO), do not have the technical capacity and on-ground presence to undertake the work alone, or lack data or

knowledge at the required level of specificity or geographic scale. In some cases, this leads to partnerships between Enable and these parties (for example, with GFAiR which is currently hosted at CGIAR (see Section 2 on Codesign)). In other cases, Enable's CA positioning emerges because of its extensive and specific knowledge of regional breeding networks' needs and maturity levels, across geographies.

Across all of Breeding for Tomorrow's workstreams, co-implementation and partnerships underpin the work being done and provide the solid positioning for holding the CA. This collaboration means the work being done relies on the most capable parts of both the CGIAR and the relevant partner and that this collaboration changes over time. A part of the Program's objectives is to strengthen the capacities of those parties, particularly national breeding programs and national seed systems, to progressively shift the work being done into their domains and have CGIAR play more of a coordinating, knowledge sharing, and support role.

5. Prioritization

5.1 Knowledge-driven priorities

Expert teams, spanning disciplinary and geographical expertise, conducted strategic prioritization of Breeding for Tomorrow's HLOs. Following the prioritization guidance, initial analysis yielded outputs that provided good insights across regions within each AoW, but did not sufficiently provide nuance across AoWs nor Impact Areas. To address this, the Program team addressed each AoW and Impact Area differently, that is, in a manner that built upon expertise and experience from earlier crop by region and breeding pipeline prioritization efforts (within the Genetic Innovation Science Group Initiatives (the Accelerated Breeding and Market Intelligence Initiatives), the Crops to End Hunger stakeholder group, private sector engagements, and knowledge extracted from published impact assessments). This reframing first had the Breeding for Tomorrow team critically assess, across commodities and geographies, the relative direct contribution of the Program as a whole to the five Impact Areas. In making decisions, the team considered the Program ToC, evidence of contribution from published research, and expert opinion. *Nutrition, Health and Food Security* was considered the most relevant and directly associated Impact Area for the Program, with an aggregate "weight' out of 100 of 40. This was followed by *Poverty Reduction, Livelihoods and Jobs* (25), closely tailed by *Climate Adaptation and Mitigation* (20), *Environmental Health and Biodiversity* (10) and finally *Gender, Equality, Youth and Social Inclusion* (5). The relative weighting of each Impact Area was used to define the maximum prioritization score per Impact Area. These scores were then considered through the lens of the six CGIAR regions. Using average indicator values, per Impact Area, per region, the maximum scores per Impact Areas were scaled to derive a maximum score per region (with the region showing the most challenging Impact Area 'indicator averages' being allocated the maximum available scores). Finally, across the AoWs, a third weighting was applied based on expert opinion and an understanding of the "average" CGIAR-NARES breeding pipeline and the relative needed contribution of AoWs' outputs, as defined in the theory of change. These weights and the score processing can be viewed in the accompanying prioritization file in the worksheet entitled *Max Scores Per AoW*.

Following the updated inputs to the prioritization process, the exercise of allocating the maximum scores per HLO for each AoW, region, and Impact Area was conducted by the AoW leads and co-leads in consultation with expert stakeholders from Centers engaged in activities. This consultation considered previous engagements with NARES in as streamlined a manner as possible. Clear documentation of current state, ideal state, assumptions, within program and portfolio level requirements for success, were all documented. Iterative review of scores was conducted across teams to derive a harmonized prioritization product delivering an output up to Step C of the process.

Building on feedback from the Breeding for Tomorrow AoW teams and other Program teams, the Interim Leadership Team reviewed the Step C outcomes and identified five areas that required intervention to address shortcomings in the harmonized process. The identified challenges, specific interventions, and outcomes are described below, in a stepwise manner and detailed in the worksheet "Phase 2 final adjustments" of the prioritization workbook.

Challenge	Mitigation	Result
Scores' weighting based on indicator values in Step B for food security was considered to over index on absolute population numbers rather than	Review of available data in GloMIP indicated a correlation between the percentage of a population undernourished and measures of extent of hunger (chronic hunger	Rebalancing scores across WCA, ESA and SA resulted in prioritization across HLOs which was more in line with the data from previous and current breeding work (e.g., from crop by

consider in addition the absolute levels of food insecurity or undernourishment. The issue was most acute considering WCA, ESA, and SA regions specifically.	measured as (DALYs/capita) from GloMIP). To rebalance the relative weighting across WCA, ESA, and SA, the total score for the three regions was redistributed based on a recalculated weighting which featured both absolute number undernourished and percentage of the population undernourished but double featured the percentage of the population undernourished, enabling stronger reflection indirectly of absolute levels of hunger.	region prioritization results conducted across Crops to End Hunger and the Accelerated Breeding and Market Intelligence Initiatives for globally grown commodities). This result is more closely aligned with expert opinion from within the CGIAR and beyond.
The Step B weighting used in the Climate Adaptation and Mitigation area focused exclusively on greenhouse gas emissions. Breeding, while playing some role in mitigation and documenting the impacts of cultivation under elevated CO2 (lower nutritive value for example), is much more closely associated with climate adaptation.	Reflecting the need to more significantly emphasize climate adaptation, an additional index derived from the climate vulnerability index and the climate risk index was developed and applied across all scores from Step C for the Climate Adaptation and Mitigation impact area.	The adjusted figures better reflected the contribution of breeding to both climate adaptation (drought, heat, flooding tolerance) and climate mitigation (e.g. improved direct seeded rice germplasm). The relative distribution of scores across regions more closely aligned with the Crops to End Hunger and the Accelerated Breeding and Market Intelligence Initiatives efforts described above.
For *Environmental Health and Biodiversity* the weights relied on indicators from the Projection of Benefits work which did not, at the time of writing, have complete forecast data for relevant indicators. As a result, the same climate mitigation indicator was used as a relative proxy. Given the challenge of this weight the team wanted to define and use a more relevant indicator for the weighting in this Impact Area.	The weights for climate and enabling environment applied in Steps B and C of the harmonized prioritization were reversed and a newly derived weight comprised from Consumptive blue and green water used in food production (m3/ha), Soil erosion rate (/Ha), Forest area lost (%) - the percentage of forested area (%) lost between 2010 and 2020, Global Biodiversity Index and Sustainable agriculture score was determined. The new weight was applied followed by the existing Enabling Environment weight from Step C.	Adjusted scores better reflected known regional challenges and opportunities for breeding in agriculture to respond to biodiversity and environment indicators; from improving fertilizer use efficiency, to enhancing resistance to pests and diseases, to breeding for regenerative agriculture practices.
Re-balancing the relative contribution of breeding to each Impact Area. Despite pre-defining weights to accommodate known and ToC articulated direct contribution of breeding to the five Impact Areas, challenges in score distribution did not clearly	Pre-defined weights for Breeding for Tomorrow opportunity to contribute to each of the five Impact Areas were re-applied.	The adjusted figures better reflected the contribution of breeding across the five Impact Areas as described in the Crops to End Hunger and the Accelerated Breeding and Market Intelligence Initiatives, business-level prioritization efforts, synthesized from documented impact studies, and interrogated by expert opinion.

reflect and emphasize the differences in opportunity.		
Concerns of broad distribution of high and low extremes of indicators within regions masking specific country level priorities were raised.	GloMIP was consulted across indicators per Impact Area interrogating distribution of variables across countries within regions.	The most extreme range between the lowest and highest value across a range of indicators per impact area was seen in LAC. Other regions had far less dispersed values. A recommendation for LAC in particular is at a later juncture to conduct a more detailed country level assessment to define key opportunities for breeding investment.

5.2 Final decisions on the Program/Accelerator's direction and design

Based on the outputs of the process described above the following recommendations can be made for prioritization within Breeding for Tomorrow. HLOs' scores (potential contribution to impact) in the *Nutrition, Health and Food Security, Poverty Reduction, Livelihoods and Jobs*, and *Climate Adaptation and Mitigation* were higher over *Environmental Health and Biodiversity* and *Gender, Equality, Youth and Social Inclusion* Impact Areas, across regions. Nine HLOs were consistently prioritized (to differing degrees) across all Impact Areas and regions. One was in Market Intelligence (1.1), four of were in Accelerated Breeding (2.1, 2.2, 2.4 and 2.5), one in Inclusive Delivery (3.4), three in Breeding Resources (4.1, 4.2, 4.3) and one in Enable (5.1). This output re-enforces the cross-regional importance of these HLOs and their integral part in the Breeding for Tomorrow ToC.

Two Market Intelligence HLOs (1.3 and 1.4), were consistently de-emphasized across all Impact Areas and regions in favor of HLO 1.1, reflecting GloMIP's potential value across the CGIAR Portfolio. Once more foresight data is available in GloMIP (a 2025 priority for Market Intelligence), the priority of this HLO will require rebalancing as translation of market intelligence data into product concepts (HLO 1.3) and developing clear understanding of drivers of varietal turnover (HLO 3.3) become more important for achieving impact in breeding process.

Beyond the prioritization work using the common framework across programs and accelerators, a "business" level prioritization was piloted within the initiatives (Accelerated Breeding Initiative) to identify the crop by region combinations which had the greatest potential investment impact (see methodology). Building on efforts initiated in conversations with the Crops to End Hunger work a team cutting across initiatives (now represented as AoWs in Breeding for Tomorrow), worked to define investment priorities of whole pipelines (all the way to variety) in the then defined CGIAR market segments. A series of impact opportunity indicators represented in GloMIP were chosen across the CGIAR impact Areas. Eight separate indices were formulated leveraging different weighting of factors and covering different resolution of data. These indices were evaluated, demonstrating little overall variation considering relative impact opportunity for regions or crop types. Adjustments were made to extend the value of legumes from nutrition and farming system perspectives and the model was then applied to recommend investment across market segments and regions. The output was critiqued by breeding leads and opportunities for improvement were identified (e.g. opportunity/need in some intersects for a trait pipeline versus a whole breeding pipeline, consideration of comparative advantage etc.). The foundation of this work is now extended into Breeding for Tomorrow with ongoing efforts to prioritize and focus on breeding pipelines (and therein target product profiles) of the highest impact.

Together the two streams of prioritization enable us to identify opportunities across a product development by methods matrix, facilitating visualization of dependencies and data driven investment needs and best bets.

Considering each Impact Area separately, the following specific recommendations can be detailed, per region:

IA + AoW	LAC	CWANA	WCA	ESA	SA	SEA
Food Security: Overall the impact area with highest prioritized activities. Broad prioritization of AoW2>AoW3>AoW 4~AoW1 (where HLO prioritized)>AoW5	Relative moderate prioritization with additional de-prioritization of HLO 1.5, 5.2 and 5.5	Relative moderate prioritization with de-prioritization of HLO 1.5	Relative to other regions, falls in second highest place for prioritization. Even and highest prioritization of all AoW2's HLOs	Consistently high relative prioritization across all AoW where ratings are given. Even and highest prioritization of all AoW2 HLOs	Relative to other regions, falls in third highest place overall prioritization. Even and highest prioritization of all AoW2 HLOs	Relative moderate prioritization with additional de-prioritization of HLO 1.5, 5.2 and 5.5
Poverty: Overall the impact area with second highest prioritized activities. Broad prioritization of AoW2>AoW3>AoW 4~AoW1 (where HlO prioritized)>AoW5	Relative moderate-low prioritization with additional de-prioritization of HLO 1.5, 5.4 and 5.5	Relative moderate-low prioritization with de-prioritization of HLO 1.5, 2.3, 3.3, 5.3, 5.4 and 55	Relative to other regions, falls in second highest place for prioritization. Even and highest prioritization of all AoW2 HLOs	Consistently high relative prioritization across all AoW where ratings are given. Even and highest prioritization of all AoW2 HLOs	Relative to other regions, falls in third highest place overall prioritization. Even and highest prioritization of all AoW2 HLOs	Relative low prioritization with de-prioritization of HLO 1.5, 2.3, 5.3, 5.4 and 55
Social inclusion: Overall, the impact area with lowest number and ratings of prioritized activities.	Very low Priority. No priority for HLO 1.2, 1.5, 2.3, 3.1, 3.3, 5.2, 5.3, 5.4 or 5.5.	Very low priority. No priority for HLO 1.2, , 1.5, 2.3, 3.35.3, 5.4 or 5.5.	Low priority Slightly higher rating than other regions. Similar to ESA and SA. No priority for HLO 1.2, 1.5, 2.3, 3.2, 3.3, 5.2, 5.3, 5.4 or 5.5.	Low priority Similar to WCA and SA. No priority for HLO 1.2, 1.5, 2.3, 3.2, 3.3, 5.2, 5.3, 5.4 or 5.5.	Low priority Similar to WCA and ESA. No priority for HLO 1.2, 1.5, 2.3, 3.2, 3.3, 5.2, 5.3, 5.4 or 5.5.	Very low priority. No priority for HLO 1.2, 1.5, 2.3, 3.1, 3.3, 5.2, 5.3, 5.4 or 5.5.
Climate adaptation Overall the impact area with third highest prioritized activities. Broad prioritization of AoW2>AoW4>AoW 3>AoW 1>AoW5	Relatively moderate priority. No priority for HLO 1.2, 1.5, 5.1, 5.4 or 5.5.	Relatively moderate priority. No priority for HLO 1.5, 5.4 or 5.5. Second Highest ABI priority for IA	Relatively moderate priority. No priority for HLO 1.5, 5.1, 5.4 or 5.5. Highest ABI priority for IA	Relatively moderate priority. No priority for HLO 1.5, 5.4 or 5.5. Third Highest ABI priority for IA	Relatively moderate priority.	Relatively moderate priority.
Environmental Health	Moderate-low prioritization. Third highest prioritization of regions. De-prioritization of HLO 1.2, 1.5, 5.1 and 5.5	Relative low prioritization. Lowest across regions. De-prioritization of HLO 1.2, 1.5, 3.3, 5.1, 5.3 and 5.5	Moderate-low prioritization with additional de-prioritization of HLO 1.5, 5.4 and 5.5	Moderate-low prioritization . De-prioritization of HLO 1.5, 5.1 and 5.5	Moderate-low prioritization. Second highest prioritization of regions. De-prioritization of HLO 1.5, 5.1 and 5.5	Moderate-low prioritization. Highest prioritization of regions. De-prioritization of HLO 1.5, 5.1 and 5.5

6. Alignment of W3 and bilaterally funded work

Across the 70+ bilateral and W3 project mapped to Breeding for Tomorrow, the vast majority target the Accelerated Breeding and Inclusive Delivery AoWs. Within the Accelerated Breeding aligned projects, all HLOs are covered, with greatest alignment across the Strategize, Optimize, and Create products HLOs. Inclusive Delivery aligned projects largely support the Position for demand and Deploy seed HLOs. There are evident gaps in projects' alignment with the Market Intelligence, Breeding Resources, and Enable AoWs. This spread of projects aligns with the prioritization of AoWs within the Program, though nonetheless, greater W3/bilateral support for the three aforementioned AoWs will be sought going forward, noting their important contribution to the overall breeding process and the ToC success. Where there is alignment, W3/bilateral projects focus on innovations that address the objectives outlined in the Program ToC and during the Inception Phase, Accelerated Breeding made great progress working with funders of the largest bilateral projects to align project ToCs and indicators (used for reporting) with those of Breeding for Tomorrow. For example, the Accelerated Genetic Gains (AGG) for maize, wheat, and rice projects accelerate the development of higher-yielding, climate-resilient maize, wheat and rice varieties, addressing specific pipelines, for smallholder farmers in low- and middle-income countries, aligning with the prioritization approach of Accelerated Breeding's Refocus to markets and Create products HLOs. The partnership model and breeding methods targeted in AGG are completely aligned with the Transform collaboration, Discover genetic potential and Accelerating genetic gain HLOs and the Partnered networks HLO in Enable. Bilateral funds also support the development of specific tools and services in support of modern breeding approaches. For example, the 'Mining useful alleles for climate change adaptation' Project supports faster and more cost-effective discovery and deployment of climate-adaptive alleles from the world's germplasm collections. This contributes to the Accelerated Breeding's *Discover* HLO. In Inclusive Delivery, the Pan-African Bean Research Alliance's Demand-Led Seed Systems work with stakeholders involved in seed production, distribution, and utilization, to better generate, articulate, and sustain demand for seeds, directly contributing to Inclusive Delivery's IO3.1 (see the Results Framework attachement).

7. Plan of Results and Budget

Breeding for Tomorrow 's 2025 budget reduced significantly since the 2022-24 Portfolio and reduced since budget estimations were provided at the beginning of this year. In February 2025, the Program was projected to receive ~$51M USD while the current, revised budget is $35,948,803 for the 2025 fiscal year. Of the total proposed budget, $6M USD is anticipated from the Gates Foundation through the W2 funding mechanism. This funding is intended to be directed towards the Accelerated Breeding AoW, specifically for the development of defined breakthrough products in key African crops and for specific Centres. Discussions with the Foundation on which specific crops and market segments will be targeted are ongoing but will follow the crop-level prioritization process outlined in Section 5. Because these breakthrough products are not yet defined, this investment will be allocated to Centres at a later stage. Because of this continuing discussion, the PORB for the Breeding for Tomorrow Program does not have all line items with all detail. What is available, is the breakdown of the budget by Centre. Detailed breakdowns of Centre x AoW x HLO/Outcome will be available by 4th July, 2025 (see attached Breeding for Tomorrow PORB).

After putting the Gates Foundation funding aside, the remaining budget amounts to $29,948,803. From this $29.9M USD, management costs ($1.7M USD or 5% of the *total* 2025 budget) were allocated to Centres, aligning with the Global Science Team's *minimum viable management arrangements*. Subsequently, $630k USD of W2 resources earmarked to the Breeding Resources AoW were allocated to Centres to support the delivery of priority strategic outputs within the AoW. Finally, $1.4M USD (or 4% of the *total* 2025 budget) was allocated to Centres to support strategic cross-cutting activities aimed at enhancing the effectiveness, efficiency, and transparency of the Program. This cross-cutting work is essential for cross-Centre learning, support, and data and knowledge sharing across the Program. For example, the cross-cutting work housed under the previous Accelerated Breeding Initiative (now, AoW) spurred important changes to breeding schemes, including large reductions to breeding cycle time. This cross-cutting funding, which all Centres benefit from, will further go towards the Breeding goals, shared by all Centres.

The remaining resources, considered as the operating budget ($26,172,142 USD), were allocated Across Centres and AoWs in accordance with the results of the prioritization exercise (see Section 5). Considering the reduced budget envelope, prioritization was extremely important. Prioritization results highlighted that varietal development (sitting within the Accelerated Breeding AoW) has the highest potential to contribute to impact across all regions and Impact Areas. Resultingly, all Centres received most funding to go towards this AoW (roughly 55% of the operating budget). Moreover, following the crop-level prioritization, majority of this funding is being directed towards breeding pipelines for market segments on the African continent. Potential to contribute to impact, as revealed through the prioritization exercise also meant funding was split across the other four Breeding for Tomorrow AoWs in the approximate percentages Market Intelligence – 9%; Inclusive Delivery – 17%; Breeding Resources – 8%; and Enable – 11%.

Generally, those Centres receiving the largest funding allocations aligns with the number of active breeding pipelines and crops focussed on within those Centres. Moreover, some Centres got relatively higher allocations because they 'house and help facilitate the management the cross-cutting budgets' on behalf of all Centres.

8. Cross-Portfolio linkages and geographic coordination

8.1 Cross-portfolio linkages

Breeding for Tomorrow contributes to and benefits from linkages to the majority of the other Science Programs in the Portfolio. However, some of Breeding for Tomorrow's most important links are with the Scaling for Impact and Better Diets and Nutrition Science Programs.

Breeding for Tomorrow and Scaling for Impact
A key link between Breeding for Tomorrow and Scaling for Impact centers on expanding partnership strategies employed to more rapidly deliver new products to end-users. This means developing product packages and bundles, requiring specialized services that complement seeds and traits, e.g. credit, insurance, and other financial services that reduce adoption and production risks; commercial services that reduce market and price risks; and digital services that address asymmetric information in markets for seeds, traits, and crops. This also means working with S4I to develop product packages/bundles that are uniquely gender-intentional in design or designed in a manner that addresses youth, marginalized or vulnerable social groups, or other socially excluded populations. This will be achieved by leveraging both Breeding for Tomorrow's long-standing CGIAR-NARS-SME networks and Scaling for Impact's network of private-sector entities, including the farmer-based associations, financial service providers, and agribusinesses. An important practical linkage between Breeding for Tomorrow and Scaling for Impact is the space to promote the scaling of Breeding for Tomorrow innovations and innovation bundles available through the E-Catalog of the TAAT website. A recently published 'Cassava Seed System Toolkit' provides an example of how practical approaches to implementing a sustainable pipeline for delivering genetic gain from breeders to seed producers and finally to farmers can be achieved.

Another key link focuses on advancing the science of scaling through joint analysis and validation of scaling approaches that are replicable and adaptable across multiple contexts. Breeding for Tomorrow and its predecessor programs has developed many scaling strategies to develop and deliver genetic gain to farmers' fields, e.g. regional research and product delivery networks like PABRA, hybrid parent line consortia like IMIC, HRDC, and other models that are essential to Breeding for Tomorrow's success. Scaling for Impact has assembled the capabilities and assets needed to (a) identify generalizable principles and practices within these models that can be replicated and adapted across multiple crops, market segments, and countries; (b) systematically explore the scaling readiness of these models, including their strengths and weaknesses; and (c) refine and facilitate their application to new contexts.

The primary mechanism will be joint work planning and operational coordination, with an emphasis on linking Breeding for Tomorrow's scaling-focused Inclusive Delivery AoW with S4I AoWs. The content for this planning and coordination will be based on an ongoing exercise with S4I to identify and assess the scalability of Breeding for Tomorrow's top 10 innovations under development or in use.[1]

[1] Examples include: product design standards for newly bred cultivars, including high-impact "breakthrough" products that target future market opportunities; a digital market intelligence platform for guiding CGIAR and partner investment decisions; a digital exchange platform for elite materials and products under development; advance market commitments for the development and delivery of newly cultivars; practical toolkits for designing seed system interventions across humanitarian and development contexts; and digital seed traceability systems.

Breeding for Tomorrow and Better Diets and Nutrition

Breeding for Tomorrow's links with Better Diets and Nutrition will focus on jointly developing and delivering nutrient-dense and healthy crops. Breeding for Tomorrow and Better Diets and Nutrition will work closely to mainstream nutrition traits in Breeding for Tomorrow's pipelines wherever feasible and to advance nutrition-oriented product concepts, target product profiles with the required nutrition traits for the relevant market segment, efficacy trials and farmer/consumer acceptability studies, and seed system development specific for biofortified crops. The ultimate goal here is improving diets and nutritional outcomes in CGIAR's target populations. Coordination mechanisms are currently being built at both the Program and AoW levels. Breeding for Tomorrow will collaborate via all of its AoWs with Better Diets and Nutrition, while Better Diets and Nutrition will concentrate its engagement via its AoW4 on nutritious and healthy crops.

8.2 Geographic coordination

For purposes of geographic coordination, Breeding for Tomorrow is exploring an opportunity to map its regional, country, and crop-specific CGIAR-NARS-SME networks in a manner that allows other Programs and Accelerators to directly engage traditional CGIAR partners more effectively around the topics of developing and delivering genetic gains are relevant. The idea is to provide Programs and Accelerators, such as Scaling for Impact, with a ready-made entry point to partners, a platform that can be expanded to bring in new partners, and a set of rules, norms, and conventions that encourage open and efficient exchanges between partners on, e.g. new products and pipelines, early generation seed availability, capacity development opportunities, or funding opportunities. Breeding for Tomorrow has already advanced this opportunity internally by adding a Seed Systems Priorities module to the NARS Breeding Program Baseline Assessment (specifically, its gap analysis and documentation of the NARS current state). The ultimate goal of this Assessment is to develop and implement an improvement plan for the breeding program based on SMART recommendations and objectives that are jointly prioritized by the NARES partners and CGIAR. Extending this process to include Scaling for Impact, CapSha, and other Programs and Accelerators where it makes sense, is a relatively straightforward exercise for Breeding for Tomorrow.

9. Risk management

#	Category	Title	Description	Current Risk Level	Target Risk Level	Actions /Controls to manage risks
1	**Partners and Partnerships**	Prioritization and loss of country partner capacity	Prioritization of Breeding for Tomorrow resources to a narrower range of crops, geographies or market segments puts at risk support to corresponding national capacities resulting in damage to partners ability to fulfil their mandates	16	9	(1) Conduct annual network partnership review to ensure aligned prioritization and resourcing; (2) Wholistic mapping of priorities and resources (W1/2/3) towards common and agreed indicators
2	**Research innovation**	Operational culture: Resistance to change	Resistance to operational and culture changes impedes the effective implementation of modernization and aligned, outcome-oriented breeding.	12	4	(1) Co-creation of network level performance indicators to ensure ownership across all stakeholders (2) Develop incentive/ prioritization model that is transparent, and outcome oriented for Breeding for Tomorrow resources
3	**Partners and Partnerships**	Fit for purpose partnerships: Empowered NARES and SMEs	Failure to empower NARES and SMEs to enable them to collaborate in breeding decision making and processes and taking on responsibilities, resulting in a failure to develop and deliver results and significant delays in achieving time-bound objects	12	6	(1) Product advancement meetings with CGIAR, NARES and SMEs to ensure joint ownership; (2) Adoption of common research data system for greater transparency and decision timeliness; (3) Develop RACI structure for greater equity
4	**Data**	Operational: Data Impedance	Delays in generating needed market intelligence data, particularly for new crops, forages and trees, impedes the product profile revision process and results in breeding programs pursuing inadequately targeted priorities.	16	9	(1) Establish data interconnectivity across all SPs and Accelerators to leverage cross domain expertise for improved system wide alignment; (2) Develop decision and accountability matrix within Breeding for Tomorrow for priority setting; (3) Develop criteria for time bound minimally viable product profiles to ensure operational continuity
5	**Funding**	Insufficient MELIA	A lack of proper mechanisms and accountability for tracking progress against outcomes at different levels or a lack of investment in Monitoring, Evaluation, and Learning, and Impact Assessment will 1) prevent proper demonstration of the impact and outcomes of our work, which will ultimately impact funding; and 2) prevent the proper monitoring of breeding teams progress meaning investments may not be contributing to efficient outputs/outcomes.	12	2	Invest in (1) developing SMART MEL+IA plans and investing resources into undertaking monitoring; (2) develop indicators/KPIs for breeding teams and other Breeding for Tomorrow colleagues and work with Centers to ensure they are implemented and have accountability chains; (3) using the results of these to communicate impact and outcomes to funders.

10. Addressing feedback on select topics

Concise summary of feedback	**Details on how Breeding for Tomorrow has addressed or will address this feedback** (in the Inception Phase or beyond)
There is a lack of information on how water systems are covered in the Portfolio.	Breeding for Tomorrow contributes to sustainable and efficient water systems through trait inclusion in TPPs. Crop varieties that are more resilient to drought require less water to grow. Twenty CGIAR crops list drought tolerance as a target trait in their TPPs in the Breeding Portal. Traits that support water use efficiency (for example optimized root and leaf architecture translating to reduced yield loss under drought conditions) reduce the water use requirements across agriculture and reliance on irrigation systems which can negatively affect environmental flows; traits targeting natural pest and disease control reduce the need for fertilizers and pesticides (input use efficiency) resulting in fewer leached chemicals into waterbodies. Twenty-one CGIAR crops list multiple disease and pest resistances as traits in their TPPs in the Breeding Portal.
There is a lack of information on how climate mitigation is covered in the Portfolio.	Breeding mitigates the effects of climate directly through trait selection that preferences reduced greenhouse gas (GHG) production (e.g., reduced methane emissions in dry-seeded rice varieties) and natural pest and disease resistance (reducing chemical inputs). Indirectly, breeding contributes to mitigation via higher yields/area (reducing the need for expanded agricultural land and thus, deforestation/land use change). GloMIP features several geospatial indicators on GHG emissions, which enables the Program to prioritize its portfolio towards market segments, traits, and products that maximize mitigation.
Lack of information on how tradeoffs and synergies in mixed systems are covered.	Breeding and trait selection is constantly dealing with trade-offs. The number of essentially improved traits that can be incorporated into TPPs is capped at three (preferencing one or two), meaning each market segments' needs must be prioritized and contextualized in terms of the tradeoffs between their contribution to impact and how this has potential to contribute to that market-segment and its end users. These choices are made by multi-disciplinary product design teams, including participation from NARES and SMEs.
There is a lack of information on how environmental health and biodiversity is covered in the Portfolio.	Breeding contributes to environmental health and biodiversity by reducing land use change via productivity increases (reducing biodiversity loss, GHG emissions, and land degradation); developing biotic-stress resilient varieties (reducing the need for chemicals, benefiting environmental (and human) health); and aiding the productivity of multi-crop cropping systems, reducing monoculture and fostering biodiversity. Market Intelligence is increasingly identifying traits that can foster productivity at the cropping system level, rather than at the individual monoculture level. GloMIP features 16 indicators in the Impact Area on Environmental Health and Biodiversity and is developing a land use change model driven by yield changes that support product design and investment prioritization, enabling breeding pipelines to contribute to this Impact Area. Market Intelligence collects evidence on the requirements of stakeholders (e.g., farmers, processors, consumers), which further supports prioritization of traits that contribute to environmental health.
There is a lack of information on how orphan and opportunity crops and pulses are covered in the Portfolio.	With pooled funding Breeding for Tomorrow covers 24 crops including six types of pulses (lentils, faba beans, chickpeas, pigeon pea, grass pea, and soybean). Pooled funding also funds orphan crop breeding pipelines including finger millet, groundnut, yam, and cassava. Bilateral and W3 funding also focus heavily on orphan crops and pulses. The VACS project enhances African agrifood systems by improving the productivity of opportunity crops and funds Bambara, Finger Millet, Okra, Sesame, Taro, Amaranth, and Pigeon Pea breeding. The AVISA project enhanced the breeding and seed delivery systems, focusing on climate-resilient, high-yielding dryland crop varieties that improve productivity and adaptability for small-scale farmers. PROSSIVA project catalyzed development, validation and scaling of innovative packages to establish

Concise summary of feedback	**Details on how Breeding for Tomorrow has addressed or will address this feedback** (in the Inception Phase or beyond)
	functional and profitable seed systems of vegetatively propagated crops in target African countries.
There is a lack of information on how youth and social inclusion (that does not relate to gender) is covered in the Portfolio.	Through Market Intelligence, Breeding for Tomorrow contributes to youth and social inclusion through (1) indicators in GloMIP that can help identify market segments with high impact opportunities for youth, marginalized communities and indigenous people, and (2) research on market and behavioral intelligence that can help specific target populations (youth, marginalized communities, indigenous people) access high-value markets requiring products with specific traits (e.g., related to processing in specific value chains in which these target populations are involved). Market Intelligence also focusses on projected benefit models covering labor, which are extremely relevant for young people given high youth unemployment and disengagement in many focus countries. Inclusive Delivery supports equitable seed system development and improvement by prioritizing and developing gender-inclusive and socially inclusive delivery and scaling approaches, and by monitoring and analyzing patterns and trends in the adoption of improved varieties and quality seed as they relate to gender and social inclusion.
There is a lack of information on how capacity sharing (as it relates to internal learning and decolonization of research) is covered in the Portfolio.	Enable's *Share capacity* HLO focuses on developing customized capacity development plans for entire regional breeding networks and individual organizations based on rigorous, objective, and standardized assessments of breeding capacity, infrastructure, and management systems. Assessments are conducted jointly by network members (peer assessments) to share experience, strengthen relationships, and build regional capacity to identify technical and managerial bottlenecks. Peer assessments lead to the development of customized network and institutional improvement plans that form the basis for capacity development investments. A high emphasis is placed on leveraging capacity within individual organizations in regional breeding networks (e.g., phenotyping capacity) to avoid duplication and support existing capacity and teams. A key component of the *Share capacity's* strategy is to promote Visiting Scientist placements within regional breeding networks and across CGIAR crop improvement programs to ensure that best practices which are operational and fit for purpose in the Global South are broadly shared and adopted.

Appendix 1: Addressing specific feedback

Concise summary of feedback	**Details on how Breeding for Tomorrow has or will address this feedback** (in the Inception Phase or beyond)
Breeding Resources and Data Quality Risks: Sharing breeding resources and IT platforms is well-intentioned but raises concerns around data quality and security. With more users outside CGIAR contributing data there is a risk of data degradation, incorrect entries, or even misuse. Furthermore, successful implementation will require significant investment in change management and training. Security risks need to be addressed.	Breeding Resources doesn't generate the research data but instead provides tools and services to manage data. All these IT tools follow industry security best practice, for example, multi- factor authentication. Because tighter security means higher cost levels, for each tool, the appropriate balance is struck depending on risk exposure and severity. All crop x region networks will sign Network Membership Agreements (as of Enable's *Partnered networks* workplan) that clearly indicate that network members that sign up and receive network benefits must adhere to minimum data standards, reporting timelines and data use rules defined by the networks. Regarding data quality, the "responsible" for the data's quality resides with the breeding team or whomever uses the system. These teams have their own methods for ensuring quality data and adherence to standard ontologies which are domain specific. Moreover, Breeding Resources has tools to curate data and implement digital approaches to minimize errors due to manual interventions, though nonetheless, it is up to research units to use these tools.
The overall Theory of Change illustration (Fig 1) lacks alignment with the 22 high-level outputs (Table 1) and needs better synchronization to be credible. Integration with other Programs is missing from Fig. 1.	We agree that more alignment and consideration of the HLOs and their interactions is needed. In the updated version all HLOs are now shown. There has been refinement to the Intermediate Outcomes and 2030 Outcomes. The multiple pathways to impact are less linear. AoW ToCs are now fully nested within the Breeding for Tomorrow ToC, more clearly showing how each AoW contributes to the whole. Research Questions have been identified to assess the contribution of other programs to Breeding for Tomorrow outcomes.
The proposal's focus on standardized crop outputs poses risks of monoculture with all the attendant risks. It should consider how to incorporate more diversified crop varieties tailored to specific environmental and market considerations. Leveraging both generative AI and analytical AI could allow CGIAR to support polyculture leading to greater resilience. Smallholder farmers could then command higher price premiums by offering more specialized as well as diverse crops.	Breeding for Tomorrow focuses on a vast range of crops across the entire portfolio. With pooled funding, 21 crops are focused on and within the bilateral space, orphan crops are also included. For example, in the VACS project, Bambara, Finger Millet, Okra, Sesame, Taro, Amaranth, and Pigeon Pea. The standardized crop outputs can be delivered in any crop, and so this approach does not in any way increase the risk of monoculture. Regarding incorporating more diversified crop varieties tailored to specific environmental and market considerations, through the Market Intelligence AoW (and the MI Initiative), 700 Market Segments across 24 crops have been defined over all CGIAR's regions (see GloMIP). For all of these market segments, multi-disciplinary teams, including NARES partners, have designed product concepts and Target Product Profiles (TPPs) that align with the needed traits for those markets. CGIAR-NARES breeding programs then use these TPPs to breed for the traits that are most needed and demanded in that market segment. Indeed, smallholder farmers can command higher price premiums by offering more specialized as well as diverse crops because of the very broad range of crops Breeding for Tomorrow targets. This can also be achieved across all crops due to farmers growing varieties that better

	meet the needs of consumers and processors (higher quality, improved storage ability and/or improved processing). The needs of consumers and processors are specifically considered in TPP design.
More details could have been given regarding **different funding strategies**, as well as the **"gender-intentional systems approach"** and the **"viable pathways out of conflict and migration."** There is an emphasis on LMIC which is appropriate, including geopolitical instability-related challenges. The alignment with the Strategy could be made more prominent.	Breeding for Tomorrow will appeal to both traditional and non-traditional funders to fund the Program's agenda. With TPPs now in place, it is possible to aggregate TPPs across crops that address similar problems, e.g., nutrition or climate resilience. By aggregating TPPs in this way Breeding for Tomorrow can present funders with several portfolios of TPPs, each of which presents a distinct value proposition. It is expected that both traditional and non-traditional funders will find such an approach highly compelling. Breeding for Tomorrow makes conscious decisions about the traits that are included in product conception and TPP design and how they impact and interact with gender. Building on specific demands and preferences of women and other marginalized groups (gathered through market intelligence), traits are selected that either cater to these needs and preferences or do not negatively impact their associated groups. This is reflected in the validation mechanism for Target Product Profiles, which include gender intentionality as one of the four criteria. Moreover, collaborative CGIAR-NARES breeding networks engage socially disadvantaged groups – which ensures their inclusion and knowledge transmission during product design, contributing to varieties that are developed in a socially equitable manner. In supporting viable pathways out of conflict and migration, firstly, Breeding for Tomorrow delivers new products that support local farmer-led and small-scale food industries, which onflow to supporting livelihoods and reduce the need for migration as a mechanism for improving livelihoods. Moreover, in supporting the development of robust seed systems, the impacts of conflict can be mitigated, through faster rehabilitation of fragmented supply chains and food systems in fragile and conflict settings caused by Geopolitical Instability. Supporting seed producers to produce and deliver high-quality seeds and farmers to access and use quality seeds to produce quality grain, is crucial for increasing agricultural productivity, food, nutrition and income security of internally displaced people, refugees, host communities and returnees under conflict/fragile situations.
More acknowledgement could be given to the crucial role of the NARES and farmers and their local knowledge which should be integrated with modern tools to enhance adoption. While targeting "the highest scale for potential impact," care must be taken to include the most vulnerable and poor. More detail could be given to the methods of the implementation of "co-creation and co-testing."	NARES are involved in Breeding for Tomorrow and product development through all stages of the pipeline. In Market Intelligence, NARES are involved in co-design and co-creation of evidence on market and impact opportunities and stakeholder requirements (see example). Over a hundred product design team (PDT) meetings led by NARES have clearly identified national priorities and enabled the CGIAR to align with national priorities and development plans. Evidence generated from these stakeholder consultations is translated into actionable knowledge, which is then fed into varietal development through product conception and TPP design – both of which also include NARES, reenforcing the absorption of local knowledge into the design of varieties that align with local needs. After targeted varietal development, in the seed system space, the NARES are involved in co-design and co-implementation of demand/

	awareness creation efforts through large N on-farm trials and obtaining feedback from farmers and other stakeholders on new varieties.
The comparative advantage of CGIAR is well articulated…This is a general comparative advantage, however, and may not apply to each individual case. Specific opportunities should be continuously monitored to ensure this comparative advantage is leveraged. More clarity could be given to how the transformational partnerships will be implemented to advance the seed sector's policies and practices.	It is accepted that there are large variations in capacity of regional networks and individual network members and thus comparative advantage varies region to region and within regional crop improvement networks in each region. Breeding for Tomorrow is making an intentional effort, building on extensive efforts from the Genetic Innovation Science Group, to systematically assess the strengths of networks and network members across Breeding for Tomorrow's AoWs in order to accurately and realistically define partner roles and responsibilities based on their capacity and comparative advantage.
The research questions and hypotheses are clearly stated but could be improved by being more quantitative and giving clarity to how they can be tested. For instance, research question in the Program-level Theory of Change as shown in fig. 1 seems to be too general and not clearly actionable… In addition, potential negative outcomes and time frames could be discussed.	Research questions have been redesigned to address the Key Evaluation Questions and evaluation criteria. This has ensured all research questions will contribute to assessing current impact from investments and informing continuous improvement. Research questions have also been mapped to the refined ToC. This structured approach has avoided general questions and focused on producing knowledge that is informative for evaluation and can be applied in the future to continuously improve Breeding for Tomorrow and its impacts. The applied breeding indicators for each HLO will gather quantitative data. Qualitative research will be required to assess relationship changes, such as the effectiveness of new partnership approaches.
The Theory of Change… details are not clear. For instance, the links between outputs, outcomes, and impacts are not clear, with the large arrows…being too unspecific. In addition, integration with other Programs is missing…	The ToC has been refined. All HLOs are now shown. As a result, there has also been refinement to the outcomes. The Intermediate Outcomes are less linear, better representing the interlinked nature of Breeding for Tomorrow's work. The pathway to impact from the HLOs is now clear. AoW ToCs are now fully nested within the Breeding for Tomorrow ToC, more clearly showing how each AoW contributes to the whole.
1. MARKET INTELLIGENCE --- Does a focus on maximum RoI risk reducing the benefits for the poor? 2. ACCELERATED BREEDING is a major strength of this Program. Is there a reason (other than policy restrictions imposed by a group of funders) for not including GMOs? Maybe not now but what about in the future when they might become a necessity? Farmer organizations are not listed as partners in the PARTNER/TRANSFORM high-level output.	1. When referring to maximizing Return on Investment (ROI), Breeding for Tomorrow and the Market Intelligence Initiative do not consider this in strict economic terms. ROI is return on investment in the five CGIAR Impact Areas – and returns must be met across all five of these Impact Areas. 2. Regarding GMOs, genome editing is included as part of Breeding for Tomorrow via bilateral funding mechanisms (e.g., the SGP-Genome Editing Project). The design of the previous Genetic Innovation Science Group included a Genome Editing Initiative which was fully funded through bilateral work. This genome editing work is ongoing in this Program, still via bilateral funding mechanisms. We do actively solicit input from farmer groups during national product design team meetings. They are important partners, although our primary conduit to deliver products to farmers remains NARES and SMEs.

3. INCLUSIVE DELIVERY. Missing is the dimension of linking smallholder farmers to markets. Lack of market access by the most vulnerable farmers can result in constraint for variety adoption. 5. ENABLE. It is not clear why ENABLE is a necessary part of this proposal. The added value and essential contributions of ENABLE should be made more explicit.	3. While Breeding for Tomorrow appreciates the importance of linking smallholders to markets, it falls outside the explicit remit of Inclusive Delivery. However, through links with the Policy Program, Scaling for Impact as well as other non-CGIAR actors in the seed systems space, ID is facilitating easier access to and sale of new varieties, improving market access for smallholders growing improved varieties. We acknowledge the fact that seed demand is derived from grain (produce) demand, and sustainability of seed systems depends on this farmer market linkages with off-takers, traders, processors, consumers etc. 4. Enable is a critical component of the Program as it provides the necessary cross cutting coordination in the critical areas of partnership, capacity development, portfolio management and MELIA across all AoW. Enable thus provides a unified and consistent approach across the Program's AoWs, negating the need for each AoW to develop its own mechanisms (risking duplication and provision of mixed messages to internal and external partners). Enable was established in response to clear feedback during the previous Science Portfolio (Genetic Innovation) and during Breeding for Tomorrow's proposal development. There was a call for a cross-cutting unit to coordinate stakeholder engagement, communication and adopt use of a consistent approach particularly to partnership and capacity development that are core functions of all the Program's AoWs.
However, a more explicitly farmer-centered approach would be desirable, recognizing the value of local knowledge alongside modern tools to effectively target improved crops and varieties. Perhaps a little more experimental details could have been included.	Farmers are the ultimate beneficiary of the Program and do play an active role in co-designing and co-developing innovations. Farmer groups participate in country crop product design team (PDT) meetings where they provide insights into preferred traits and characteristics that are used to define national market segments and target product profiles which in turn guide research prioritization. By design, country-crop PDTs meetings include a gender specialist (typically from CGIAR or NARES) and a minimum of 30% women participants to ensure a broad range of perspectives are captured while establishing breeding priorities. In addition, Breeding for Tomorrow emphasizes the need for scalable, on-farm verification of new varieties as part of the variety development and testing process. Farmer feedback through participatory on-farm verification methods such as TRICOT will play a critical role in ensuring that varieties that advance in the pipeline clearly meet farmer requirements.
There is evidence suggesting that the rise of extreme political movements is partially driven by a perceived loss of power and status among groups who historically held social, economic and political dominance… this proposal to include consideration of how to deal with such situations…	While understanding the sentiment behind this piece of feedback, addressing global politics and the acceptance of changes in hegemony and power dynamics falls outside of the scope of Breeding for Tomorrow's science.
Perhaps too much concentration on building standardized crops for rapid growth and expansion, which could result in certain	Breeding for Tomorrow's varietal development is constantly being improved and supported by trait discovery and deployment. The probability of certain alleles becoming too dominant in a monoculture is mitigated through the Discover genetic potential HLO. The

alleles becoming too dominant…Rather use a more resilient approach using a variety of similar traits but from various sources leading to greater crop diversity. Stronger farmer participation in all stages of crop improvement could strengthen this.	Discovery Area of Work actively explores a wide range of genetic sources for key traits, including resistance to diseases and abiotic stress, to avoid over-reliance on specific alleles. Much of this diversity comes from CGIAR genebanks and other public collections. Through the Discover genetic potential HLO, we integrate this diversity using novel germplasm, advanced phenotyping, and precision genetics to strengthen varietal development. This approach enhances resilience while supporting farmer-relevant traits and long-term sustainability.
Linkages include Better Diets and Nutrition Program, Multifunctional Landscapes and Sustainable Animal and Aquatic Food Programs. The question is, how to assure these linkages? CGIAR could benefit from the introduction of three models of scaling: scaling up, scaling out and scaling deep. It could explore how to foster all three to enhance their impacts.	Extensive linkages have already been formed with the Better Diets and Nutrition Program by designing specific high-level outputs (HLOs) in their Theory of Change that aim to directly engage with breeding pipelines in Breeding for Tomorrow in a process of co-creation between Breeding for Tomorrow and Better Diets and Nutrition. For example, Better Diets and Nutrition's HLO3 entitled "Framework for embedding nutrition into breeding pipelines and processes" in Area of Work 4 on Strengthening the Impact of Biofortified and Health-enhancing Staples" aims to ensure nutrition expertise from Better Diets and Nutrition is available and accessible to inform transdisciplinary product design processes. Secondly, a Biofortification Working Group was set up encompassing all CGIAR Centers, HarvestPlus and HarvestPlus Solutions. This group collaborates on research around 1) identifying the most impactful traits for improving nutrition in different market segments and how those traits serve different consumer groups (including women and youth)… Linkages to non-crop products are planned by extending and adjusting the market segmentation model (and TPPs later on) to animal and aquatic foods.
Re MELIA, one problem is that it is not clear at what stage various people will become involved in the process, and those who are supposed to benefit will be associated. An early assessment should be whether the new varieties are appreciated by the target farmers or not. More information could be given regarding the feedback loops among the various Areas of Work…	A robust framework for MELIA has been developed, with the ToC providing a consistent structure for all MELIA components. This will ensure that MELIA activities undertaken by each AoW will connect to form a comprehensive evaluation of outcomes. The high-level MELIA plan outlines the steps now required to operationalize the framework, embedding it into existing tools such as the Breeding Program Assessment Tool, Breeding Operations Assessment, Breeding Station Staff Survey, On-farm Trial Product Performance Report and Network Performance Review. MELIA activities will be conducted by all AoW s, making use of the most relevant areas of expertise in applied measurement of the holistic variety improvement system. Enable will provide operational oversight and strategic oversight and collation of results across multiple lines of evidence will be the Director's responsibility.