Breeding for Tomorrow Program

Full design document

September 2024

Table of Contents

List of acronyms

ABI	Accelerated Breeding Initiative
AFDB	African Development Bank
AGRA	Alliance for a Green Revolution in Africa
AI	Artificial Intelligence
AoW	Area of Work
ARI	Advanced Research Institutes
BRI	Breeding Resources Initiative
CIFOR-ICRAF	Centre for International Forestry Research and World Agroforestry
CIRAD	Centre Cooperation International in Agricultural Research Development
COMESA	Common Market for Eastern and Southern Africa
CWANA	Central and West Asia and North Africa
ECOWAS	Economic Community of West African States
GHG	Greenhouse Gas
GI	Genetic Innovation Science Group
GloMIP	Global Market Intelligence Platform
HLO	High-level output
ISDC	Independent Science for Development Council
IT	Information Technologies
LAC	Latin America and the Caribbean
LMIC	Lower-Middle Income Countries
MII	Market Intelligence Initiative
MoU	Memorandum of Understanding
NARES	National Agricultural Research and Extension Systems
NARS	National Agricultural Research Systems
NGO	Non-Governmental Organisation
R&D	Research and Development
RoI	Return on Investment
SE	Southeast
SEI	Seed Equal Initiative
SME	Small and Medium Enterprise
TOC	Theory of Change
TPP	Target Product Profile
VACS	Vision for Adapted Crops and Soils
WorldVeg	World Vegetable Center

Glossary

Breeding: The full range of activities described in this proposal, including, but not limited, to the design, development, and delivery of new breeding products.

Breeding community: The full set of actors that participate in the activities described in this proposal and their expertise including, but not limited to, plant and animal breeding, pathology, molecular biology, crop modeling, economics, gender science, sociology, anthropology, data science, nutrition, food and seed technology, scaling, and organizational management, and innovation management.

Breeding ecosystem: The full set of actors that participate in the activities described in this proposal; their expertise as described above; the activities they undertake both separately and jointly; and the laws, regulations, and institutions, and practices that shape their actions and relationships.

Breeding networks: Both traditional networks of CGIAR Centers, national agricultural research systems, and small- and medium-scale enterprises engaged in breeding activities, as well as more expansive networks that involve a wider range of organizations involved in the full range of activities described in this proposal.

Breeding products: Products and services resulting from the activities described in this proposal, including, but not limited to, product concepts, target product profiles, market segments, breeding lines, improved varieties, quality seed, seed multiplication technologies, field protocols, data and information management systems and platforms, innovation management systems, multi-stakeholder platforms, sociotechnical bundles, gender assessment tools, impact assessment methods, and policy and regulatory recommendations.

Farmers: A broad range of individuals and households engaged in agricultural activities, including small-scale resource-poor farmers, agricultural laborers, livestock keepers, fisher-people, and people who derive livelihoods from forestry and agroforestry.

Gender: The identities and expectations associated by society to a certain sex, and that are affected by power relations that intersect with other social markers (e.g. age or ethnicity) and that influences access to and control over resources and opportunities.

Gender equity: The equivalence of life outcomes for women and men achieved through strategies that address their different needs, interests, access to resources and power.

Gender-intentional (gender-accommodative) approaches: Policy, program, and organizational approaches that recognize and respond to the specific needs and realities of men and women, based on their existing roles and responsibilities as shaped by existing social and economic structures, but that do not challenge the status quo and do not question systemic barriers.

Gender-transformative approaches: Policy, program, and organizational approaches that recognize aim to catalyze social change by addressing norms that constrict a particular group and leveraging existing norms that are conducive toward gender equality.

Market intelligence: Practice of gathering and analyzing data across food value chains to identify and describe opportunities for breeding and delivery systems to optimize their contribution to CGIAR Impact Areas.

National seed strategy: A statement of national principles that guide government action and explain the roles of relevant stakeholders in the coordination, structure, functioning and development of the seed sector. It also serves as the overall framework for policy and regulatory instruments, such as the seed laws and related regulations.

Opportunity crops: Crops which have been grown and valued continuously in one or more regions but have had limited research and breeding intervention.

Pipeline investment case: Assessment of the projected return on investment (RoI) across CGIAR Impact Areas of a breeding pipeline that is aligned to one or more market segments and guided by TPPs.

Product concept: Description of a hypothetical future product and its projected benefits for farmers, processors, and consumers.

Productivity gains or efficiency gains: Increased yields, lower costs, higher profits, fewer losses, higher micronutrient content, or other desirable outcomes per unit of production.

Public policy: The principled guides to action established by the state through a political process, selected from among alternatives, and chosen in light of given conditions and values, that are meant to determine and guide present and future decisions.

Return on investment (RoI): In this proposal, we define the RoI as the ratio of the projected benefits across the five Impact Areas generated by a breeding pipeline or the Breeding for Tomorrow portfolio to the investment required to realize those benefits (e.g., number of people lifted out of undernourishment, poverty or climate risk exposure or tons of greenhouse gasses mitigated per million of US$ invested). The RoI can also be described as the development outcomes achieved for the US$ spent, with each outcome being measured in their appropriate units.

Seed quality: The quality of material used for propagation related to physical purity, genetic purity, germination rates, moisture content, pest/disease presence, or other desirable attributes.

Seed replacement rate: The rate at which farmers replace or refresh seed stocks due to deterioration in genetic, physical, physiological and health attributes and properties.

Seed sector policy: The set of laws, regulations, guidelines, programs, schemes, conventions, and investment choices that together shape the acquisition, production, conservation, and use of propagation materials for crops, forages, trees, livestock, and fish in relation to the conservation, development, multiplication, distribution and use of genetic resources.

Seed sector: The set of seed systems in which propagation materials for crops, trees, forages, livestock, and fish are produced, conserved, exchanged, and used.

Seed system: Any system in which propagation materials for crops, trees, forages, livestock, fish, and aquatic species are produced, conserved, exchanged, and used.

Seed value chain: The set of entities, activities, and relationships related to the design, development, production, distribution, marketing, and use of propagation materials.

Social inclusion: The process of improving the terms on which individuals and groups take part in society—improving the ability, opportunity, and dignity of those disadvantaged on the basis of their identity.

Target product profile (TPP): The set of essential and nice-to-have traits, the scale used to measure each trait and the threshold score for each trait that is required in a new product to meet or exceed the needs of farmers, processors and consumers in a market segment.

Variety: In the context of this proposal, this term is used in a broad and generic sense and refers to crop varieties, tree and forage species, livestock breeds, fish strains, and aquatic species strains, along with the genotypic and phenotypic characteristics that distinguish them.

Varietal turnover rate: The rate at which farmers replace one variety with another to obtain different or improved genetic traits.

Welfare improvements: Increases in incomes, consumption, nutrition, health, educational attainment, gender equality, gender equity, or other measures of well-being at the individual, household, community, and/or national levels.

Women's empowerment: The ability of women to achieve their desired life goal.

1. Executive Summary

CGIAR is globally by far the largest provider of publicly available breeding materials and in a unique position to draw on the vast genetic diversity held in its germplasm banks. Time and again, CGIAR breeding programs have proven to be mission-critical for providing solutions to the challenges encountered by agrifood systems.

Breeding for Tomorrow's impactful crop varieties offer vast benefits to farmers, consumers, and society in the Global South. Breeding efforts are based on market intelligence that identifies both the most impactful geographies and user needs, focusing on both near-term releases and anticipating future needs, and using a harmonized approach across crops and Centers. Significant contributions are to be made towards climate adaptation and resilience; reduced input needs, losses and waste, higher farmer incomes and better nutritional and end-use quality.

New, cutting-edge approaches accelerate the development of impactful products. Technological advancements like allele-mining, genomic prediction, new statistical techniques and digital phenotyping tools are more precise and powerful in combining the best genetics. Varieties are tested with smallholders, capturing gender-disaggregated feedback and ensuring performance in real-world environments today, and environments that are modeled to those 20 years into the future.

Partnerships are central to CGIAR breeding. Under Breeding for Tomorrow, these collaborations are being strengthened. Partners are expected to play a greater role in germplasm development, breeding decisions, and shaping objectives. By closely working together to implement modern breeding methods, partners' breeding and delivery capacity will be enhanced, and promote equity and sustainability in market analysis, product development, and delivery.

Over the past years, Breeding for Tomorrow has strengthened its capacity to ensure that impactful varieties are taken up more widely by seed system actors, to accelerate availability to smallholders, in particular those with limited access and benefits. By creating a more coordinated approach across crops and Centers, bottlenecks that limit access are being researched and addressed through user-oriented targeted product profiles, public private partnerships and innovation platforms. These partnerships and platforms will involve new actors that will improve seed availability across the wide range of crops, while generating wider awareness among women and men farmers. Data and information from seed system work at the 'end of the pipeline' are funneled into the market intelligence work at the 'beginning of the pipeline' that contributes to product development, meaning a closed loop system from product design to delivery.

The accelerated development of improved varieties tailored to farmers' and consumers' needs, alongside a more effective seed system, results in transformative benefits for the Global South. Agricultural production is currently growing at 1% annually. Increasing this growth by an additional 0.5% per year could, over 10 years, reduce chronic hunger by 29% and hidden hunger by 21% and create an economic surplus of USD 182 billion. When combined with other food system approaches and better policies, these benefits could be further increased. Climate-resilient varieties are crucial, because around 40% of future productivity gains must come from regions impacted by climate change. The push to biofortify varieties of major staple crops must continue to reduce hidden hunger. To the contrary, without CGIAR's contributions, production increases will fall below 1%, hunger and malnutrition will increase, and farmers' livelihoods and entire foods systems will be exposed to newly emerging, virulent pests and diseases.

CGIAR has been developing improved varieties for over 50 years. Drawing on the wealth of genetic diversity, modern technologies, and partnerships, Breeding for Tomorrow ensures the pace of change will accelerate with an innovative, forward-looking approach.

2. High-level vision in response to challenges and megatrends

2.1. Challenges and megatrends

Climate-resilient, market-preferred, healthy, and nutritious products from crop and animal breeding programs are the keystone of global efforts to address the ISDC megatrends. Demographic Trends (MT1) require crops optimized for mechanization, longer shelf-lives, and simpler processing to provide for growing populations, especially in urban centers, with lower cost and more nutritious foods. Changing Consumption Patterns (MT2) requires systems that focus on diverse mixes of crops and animals that provide greater dietary diversity and access to essential micronutrients. Soil Degradation (MT5) requires crops that build healthy soils, increase resource-use efficiency, and improve environmental sustainability. Agrifood Market Concentration (MT3) necessitates new products that support local farmer-led and small-scale food industries, thereby contributing to competitive markets. These same products also contribute to the rehabilitation of fragmented supply chains and food systems in fragile and conflict settings caused by Geopolitical Instability (MT7). The growth in Frontier Technology and Innovation (MT9) further assists these efforts by increasing the precision of breeding, reducing breeding cycle lengths, and increasing genetic gains. Gender intentionality in breeding acts to limit exacerbation of gender inequality, while focus on genetic resilience and productivity gains address elements of vulnerability to rising food prices (MT8). Most importantly, breeding and delivery need to be geared to addressing the profound impacts of Climate Change (MT4) and their compounding effects on disruptions caused by past shocks such as COVID-19 and future unknown shocks.

2.2. High-level vision

Breeding for Tomorrow aims to develop and deliver a portfolio of climate-resilient, market-preferred and nutritious varieties[1] and to make food systems more productive, resilient, inclusive, and sustainable. The Program emphasizes a gender-intentional systems approach in its design and execution, while aiming to foster both market competition and innovation, alongside productivity and efficiency gains. The approach explicitly fosters the delivery of higher genetic gain in farmers' fields, focusing on genetic innovations that have the greatest potential to address CGIAR's five Impact Areas and megatrend challenges. In partnership with public, private, and civil society collaborators, Breeding for Tomorrow will develop and deploy products to improve the quality of life of small-scale, resource-poor women and men farmers in low- and mid-income countries (LMICs) in the Global South.

Breeding for Tomorrow will expand its range of crops[1] to include food-feed crops, tree species, vegetable species, forages, food-feed, and specific "opportunity crops" under the Vision for Adapted Crops and Soils (VACS) initiative in addition to the traditional CGIAR mandated crops and upstream elements of work on animal and aquatic resources. Breeding for Tomorrow will also develop tools for livestock and aquatic animals by facilitating knowledge sharing and scientific efficiencies to reduce breeding cycle length and increase trait selection accuracy (although actual

[1] Throughout this proposal, the term "varieties" refers to crop varieties, food-feed crops, tree and forage species, livestock breeds, fish strains, and aquatic species, along with the characteristics that distinguish them. See Glossary for a definition of other terms used throughout this proposal.

animal and aquatic species breeding will be done in the Sustainable Animal and Aquatic Foods Program). Ultimately, this work will lead to additional sources of nutrition and combined systems resilience through context-relevant diversification.

Improved varieties will be the diverse building blocks of a nutritious, sustainable, and resilient approach to future agriculture, feeding into multifunctional landscapes, nutritious food options, and regenerative soils, while providing opportunities for smallholders and for engaging youth and women in more profitable farming and business, ultimately leading to better livelihoods, reduced inequality, and viable pathways out of conflict and migration. Breeding for Tomorrow will contribute to these outcomes with a strategic program to design, develop, and deliver products that will accelerate genetic gain in farmers' fields.

2.3. What is new in this Program?

Climate change requires Breeding for Tomorrow to continue to produce high-yielding farmer-demanded varieties and deployment of varieties that withstand climate-related stresses (including new and emerging pests and diseases) at a faster pace and with a significant increase in their real-world impacts. Including trees, vegetables, forages food-feed, and opportunity crops in the portfolio alongside CGIAR's mandate crops, and finding synergies with animal and aquatic systems, provides Breeding for Tomorrow with new and innovative options to build productive, resilient, and inclusive production systems.

To better address the social, economic, and behavioral factors that constrain end-users' sustained uptake and adoption of products, the Program will employ new geospatial and impact modelling techniques to both more proactively predict and refine market segments, and to target climate change ready product concepts in these market segments. Using this improved design guidance, the Program will be positioned to raise the efficiency of its breeding networks and enhance Partners' roles and responsibilities across the product design, development and delivery stages. This will be augmented with the use of new breeding methods, such as high-throughput phenotyping, speed breeding, and genome sequencing, coupled with the integration of machine learning and artificial intelligence tools for reduced breeding cycle times and enhanced genetic gain. Novel digital seed platforms will be used to track and trace adoption, and Breeding for Tomorrow will then focus on deploying innovative strategies to accelerate product delivery, track product uptake, enhance gender and social inclusion, and affect policy and regulatory changes that collectively contribute to further refining product concepts, with enhanced co-creation and co-testing to generate transformation impact in farmers' fields.

3. Evidence-based and demand-led prioritization

Evidence-based and data-driven prioritization have already been piloted within the Genetic Innovation Science Group (GI) Initiatives. An example of this emerging space includes efforts to use data and a range of indicators, now available within GloMIP, to assess and rank/prioritize different commodities by 'region investment opportunities'.

Crops, trees, and forages are the basic unit of all plant-based and most animal-based food systems. To identify which of Breeding for Tomorrow's high-level outputs (HLOs) have the highest likelihood and scale for potential impact[2] across geographies, portfolio-level prioritization is employed to provide an overview of opportunities and gaps. This HLO prioritization is broadly commodity-agnostic, is strategic, identifies cross-cutting and methods-oriented approaches, aligns with stakeholder demand, and outlines where HLOs can best address varied Megatrends as viewed through the lens of defined indicators across CGIAR's five Impact Areas. When coupled with business level prioritization (which was started in GI and will continue in Breeding for Tomorrow), including the prioritization of particular breeding pipeline investment cases according to current and future demands, a strong and comprehensive view of evidence and data-based prioritization emerges.

Here, focusing on strategic level prioritization, Breeding for Tomorrow completed the initial phases of a detailed prioritization process. Considering geographic scope, the Program has focused on countries as the geographical unit. While market segments could have been used as a unit of measure, they vary significantly in footprint across and within crops trees and forages. When considering the implementation of work within breeding networks, the efforts of key actors, the NARS, are primarily focused on country level agricultural R&D. This feature coupled with strategic reflection and alignment of Breeding for Tomorrow priorities with countries' breeding priorities resulted in a focus on the country as the commodity-agnostic geographical framing for strategic prioritization. Input from comparative advantage analysis is incorporated into the prioritization process along with elements assessing the enabling environment capacity to translate Breeding for Tomorrow outputs to outcome and impact. The comparative advantage analysis assessment (Section 4) focuses on regional scale, work to translate this to country level will be conducted as part of the next prioritization steps.

Analysis of the current countries with one or more defined Target Product Profiles (TPPs), as documented in the Breeding Portal and GloMIP, coupled with countries involved in WorldVeg and CIFOR-ICRAF's breeding work resulted in 107 countries defined in the Program's scope of work (see Table 1 and Figure 1). The breeding work of ILRI and WorldFish coincides with the 107 countries. Analysis of the distribution of TPPs indicates a number of countries where breeding activities are concentrated, potentially reflecting a strong business case for breeding work, good alignment of breeding goals with national priorities, and/or a strong enabling environment for breeding product use. Further assessment, through the strategic priority setting exercise, will help provide evidence to support or reject some of these possibilities.

Across five AoWs, Breeding for Tomorrow defined 22 high-level outputs (Table 1). Engagement with stakeholders, to validate HLOs and their mapping as part of the priority setting exercise, is ongoing; initial consultation on the Breeding for Tomorrow portfolio has currently spanned stakeholders in all regions with Breeding for Tomorrow aligned activities (Table 1).

Table 1. Prioritization scope and factors

[2] Impact estimated as ability to influence indicators of the five CGIAR Impact Areas reflecting any of the nine megatrend challenges.

Prioritization factor	Key prioritization components
Scope	Breeding for Tomorrow focuses on countries as a geographical unit. The footprint of Breeding for Tomorrow spans 107 countries (Figure 1). Current breeding activities are reflected in the Prioritization Appendix (Step 0). The 107 countries are made up of those countries included in the Breeding Portal and GloMIP (having at least one TPP) as well as countries involved in breeding programs of WorldVeg and CIFOR-ICRAF.
High-level outputs	**STEER:** Innovation package of decision-support tools centered around the Global Market Intelligence Platform (GloMIP) being continuously expanded institutionally (towards non-CGIAR Centers such as WorldVeg, NARES, and SMEs) and across products, updated and innovated through new functionalities for guiding investment, product and technology design decision making in Breeding for Tomorrow and other Science Programs. **TARGET:** Portfolio of current and future producer and consumer market segments with state-of-the-art market intelligence evidence enabling targeted product design, analyzed, and revised regularly. **CONCEPT**: Portfolio of market segment-focused product concepts informing design and revision of TPPs (ACCELERATED BREEDING Output 1.1), following the Product Design Standard. **FOSTER:** Portfolio of social, economic, and behavioral intelligence to inform product design, investment and delivery on opportunities for accelerating product turnover. **INVEST**: Portfolio of investment cases for Breeding for Tomorrow and other Science Programs for impactful investment mobilization and prioritization. **STRATEGIZE / REFOCUS:** CGIAR–NARES–SME breeding pipelines, and underlying investments, are aligned to the local needs of market segments and impact opportunities. Product Design teams review and update Target Product Profiles to ensure they are feasible, in-demand, gender-equity-inclusivity (GEI) intentional, and impactful. **PARTNER:** Breeding networks innovate and implement impact-oriented, sustainable partnership models in which partners (NARES, ARIs, SMEs, CGIAR) systematically contribute to innovation, priority setting, decision-making, and the development and delivery of farmer-valued cultivars. **DISCOVER:** Trait discovery, development, and deployment teams are focused on essential traits for current and future market segments to integrate high-value haplotypes into elite genetic backgrounds. They exchange and use best practice breeding methods, pursue and transform tools for trait integration, upstream science discovery, and delivery to CGIAR–NARES–SME breeding networks **OPTIMIZE / ACCELERATE:** CGIAR–NARES–SME breeding networks design and optimize breeding schemes for population improvement and product evaluation to maximize rates of genetic gain for targeted market segments. They track key performance metrics to drive improvements and identify innovation challenges **CREATE:** CGIAR–NARES–SME breeding networks produce candidate products for major food, food-feed, and forage crops, vegetables, and trees - breeding materials, elite parental lines, impactful varieties, breeds or clones - with the ability to drive transformative impact across the five Impact Areas. **POSITION:** Co-designed, evidence-based strategies to sustainably position quality seed of improved varieties and complementary innovations within inclusive and equitable delivery systems.

	DEPLOY: Co-designed, cost-efficient, inclusive, context-specific technologies and strategies to facilitate increased production and delivery of quality seed of improved varieties. **TRACK:** Co-designed, validated, low-cost, and effective methods and tools to assess and share data and analysis on varietal adoption, varietal turnover, seed replacement, quality seed use, and information uptake at scale. **POWER:** Innovative partnerships, technical and functional capabilities, best-fit policy and regulatory solutions, and gender and social inclusion intervention to accelerate the delivery of quality seed of improved varieties. **SHARED SERVICES:** A portfolio of shared services that meets current and emerging user needs, delivered by an organisational structure that is prepared for beyond 2030. **FAIR DATA:** Clients of shared services are supported to maximize alignment of data with FAIR principles in alignment with governance mechanisms. **HUB AND SPOKE:** Hub and Spoke style partnership developed with regional partners effectively working together as supported by scaled services, to expand the reach of breeding and delivery system. **TRANSFORM:** Systematized coordination and provision of tools and approaches to improve partnership, co-ownership, organization and understanding of roles within and across breeding and delivery activities in Breeding for Tomorrow. **SHARE:** Coordinated capacity-sharing strategies across Breeding for Tomorrow's breeding value chains and impact pathways. **MANAGE:** Impact-aligned strategic and transparent portfolio and innovation management support and resources. **ASSESS:** Rigorous evidence on the impacts resulting from Breeding for Tomorrow's breeding and delivery activities in selected geographies, countries, and market segments. **EXCHANGE**: Evidence-based recommendations and guidance on principles and practices relating to the generation, use and exchange of breeding products.
Stakeholder demand	Stakeholder engagement has occurred with breeding network actors and is ongoing. Stakeholder consultation was conducted during virtual regionally themed meetings in July focusing on Sub-Saharan Africa, Asia (South and Southeast), CWANA, and Latin America and the Caribbean. Continued engagement to verify the anticipated impacts of megatrends on action area indicators, review assumptions of priority setting, and identify alignment with national and regional priorities will be conducted as part of the ongoing priority setting exercise.

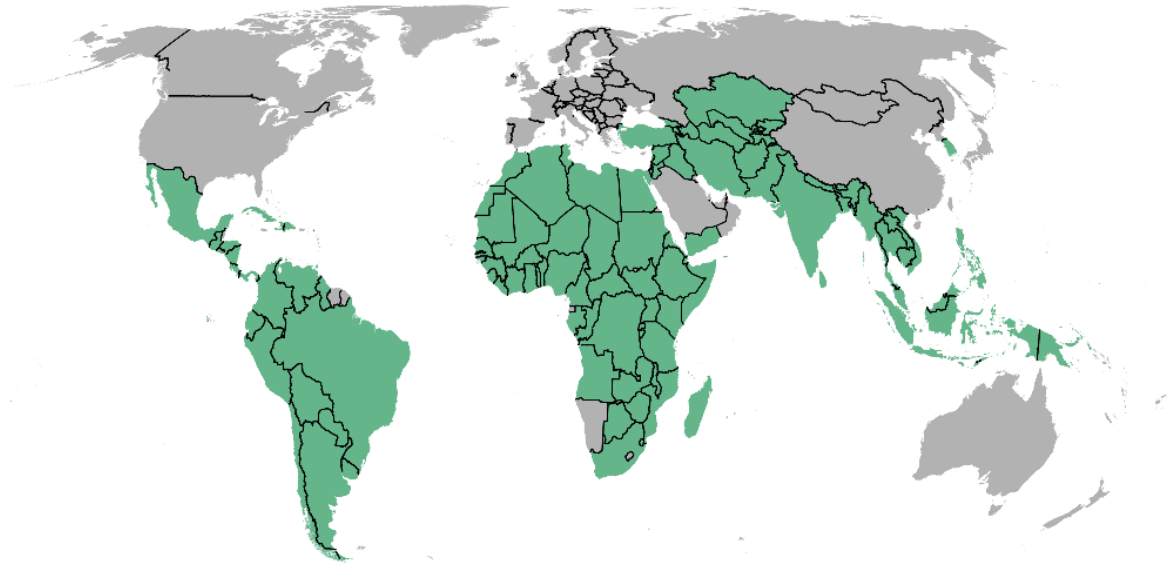

Figure 1. Map of countries in scope for Breeding for Tomorrow's prioritization efforts

Moving forward, investment cases will heavily rely on harmonized prioritization efforts at both strategic and business levels. To facilitate the cross cutting and interdisciplinary nature of prioritization, these activities will be housed in the ENABLE AoW, involving active participation of representatives from MARKET INTELLIGENCE, ACCELERATED BREEDING, INCLUSIVE DELIVERY, and BREEDING RESOURCES. The INVEST HLO within MARKET INTELLIGENCE will inform the prioritization with data on Impact Area indicators, estimated impacts of megatrends, impact opportunities and projected benefits (ex-ante impact); ACCELERATED BREEDING will inform through costing and pipeline feasibility considerations; INCLUSIVE DELIVERY will inform via delivery costing and feasibility; ENABLE will bring to the table broad enabling environment and country priority data together with elements spanning comparative advantage analysis of actors within the breeding network. These data, assembled through transparent, open systems, provides the basis for dynamic and iterative priority setting which will underpin broad and specific prioritization of activities with Breeding for Tomorrow.

Current use of this data to assess broad investment opportunities within current breeding landscape detailed in the Breeding Portal and GloMIP estimates that:

- Changing annual productivity increases from 1.0% to 1.5% could reduce chronic hunger by 29% and hidden hunger by 21% over a ten-year period.
- Changing annual productivity increases from 1.0% to 2.5% could reduce chronic hunger by 78% and hidden hunger by 60% over a ten-year period.
- About 40% of these productivity increases will need to come from climate-affected areas.
- Investments in crop biofortification will have additional beneficial effects on hidden hunger.
- Removing the work of CGIAR breeding, on the other hand, would lower current annual productivity increases to below 1% and likely result in significant growth of chronic hunger and hidden hunger.
- Moving annual productivity increases from 1.0% to 1.5% will result in an economic surplus (to farmers and consumers) of USD 28 billion in year 10 compared with the baseline, and a cumulative surplus of USD 182 billion across ten years.

- Moving annual productivity increases from 1.0% to 2.5% will result in an economic surplus (to farmers and consumers) of US$85 billion in year 10 compared with the baseline, and a cumulative surplus of USD 553 billion across the ten years.
- Indirect effects on the general growth of the agricultural sector and employment creation are not included in this calculation. E.g., Emran and Shilpi 2018 found that a 1 per cent increase in yields in Bangladesh causes rural wages to go up by 0.9 per cent, labor supply to increase by 0.4 per cent, and consumption to increase by 0.5 per cent.

These estimates in productivity are opportunities for the broad CGIAR portfolio, with the work described in this Program comprising a critical component to achieving these outcomes. CGIAR portfolio is delivering impact at scale on an annual resourcing of less than USD 2 billion per year. In contrast, the World Food Programme has a 2024 funding requirement for 2024 of USD $22.7 billion to reach 157 million people with lifesaving and life-changing operations (www.wfp.org) a funding requirement that will stay high unless farmers in the Global South are given the means to improve agricultural productivity.

Data driven, transparent, and inclusive prioritization of efforts within Breeding for Tomorrow, focusing on strategic and business level prioritization, will not only help ensure resources are channeled to the most relevant and impactful work, but that the Program is better equipped to develop and deliver evidence-based investment cases that underpin efforts to seek appropriate resourcing for breeding network modernization, operations and delivery.

4. Comparative Advantage

CGIAR's comparative advantage lies in its global research infrastructure, improved and diverse germplasm, direct access to its Genebanks, established advanced breeding technologies, the capacity to employ globally renown international scientists, and ability to collaborate with diverse partners across regions. This allows Breeding for Tomorrow to optimize breeding programs and deliver impactful, regionally adapted solutions. While breeding capacities vary across partners and regions, CGIAR's combination of global insights and local knowledge gives it a strategic edge in delivering high-level outputs (HLOs) aligned with market and social needs.

The MARKET INTELLIGENCE AoW develops tools to leverage advanced market intelligence, designs product concepts, and with ACCELERATED BREEDING contributes to designing target product profiles (TPPs) and prioritizing investments to create market-driven, impactful, and feasible breeding products. By collaborating with partners including NARES, SMEs, ARIs, SROs, and MNCs, Breeding for Tomorrow ensures these product concepts and TPPs are holistic, data-driven, and strategically aligned with investment needs. Breeding for Tomorrow holds the comparative advantage in developing and refining market segments and TPPs as the Program leads the development of the global models, databases, transboundary and transdisciplinary expertise that can inform these decisions. Moreover, product concepts and TPPs must be informed by partner knowledge and Breeding for Tomorrow has the capacity to manage wide ranging stakeholder engagement with partners that inform decisions on their design.

MARKET INTELLIGENCE has a comparative advantage in generating an enabling environment for transdisciplinary collaboration as it collects market intelligence across the five Impact Areas, requiring a diversified network of experts. Breeding for Tomorrow also holds the comparative advantage for developing and integrating platforms and tools to enhance decision-making as CGIAR's main mandate is research for development (meaning the Program has access to a swath of information, plus models and data and data expertise and key platforms for data management/sharing). Partners' advantage here is contribution of their local knowledge to these tools, while CGIAR's advantage is the consolidation and global sharing of this public good. Finally, CGIAR has a comparative advantage in setting global standards for market intelligence and market-driven design of breeding products because of the economies of scale (expanding across geographies and to NARES and scaling partners) and scope (expanding to other products) it can achieve in this space thanks to its global, multi-product and multi-Impact Area mandate. In comparison, national partners cannot gain similar economies of scale and scope due to their narrower geographical and crop focus.

The ACCELERATED BREEDING AoW optimizes breeding programs across species and regions to consistently deliver higher rates of genetic gains that meet global market demands. The Strategize HLO builds on MARKET INTELLIGENCE to understand TPPs and market segments. In that sense, CGIAR's transdisciplinary expertise that brings together economists, breeders, climate change experts, agronomists and more provides a competitive advantage at the global scale, while partners like NARES and regional institutions offer in depth local insights to anchor the global portfolios. The Discovery HLO aims at generating novelty of germplasm and approaches. It relies on the strong CGIAR's genetic resources collections involving 12 Genebanks, and it takes advantage of the transversal expertise in pathology, physiology, biometrics, and genetics. It builds on the vast network of trialing locations run by partners to evaluate the germplasm, while it exploits the attraction capacity of CGIAR to link with advanced research institutions to access the latest innovations. The Optimize HLO refines breeding schemes to achieve higher genetic gain. CGIAR's biometricians and quantitative geneticists provide a significant advantage to ensure this achievement, and their services are transferable across multiple crops and breeding networks, providing support that smaller institutions and NARES

cannot sustain independently. Also, CGIAR breeders are often recognized as leading examples for the crop they manage, representing a competitive advantage in itself. The Partner HLO strengthens networks to evaluate and promote breeding lines adapted to specific regional contexts. While partners hold the capacity to precisely test at the target population of environment (TPE), CGIAR international scope enhances cross-boundaries coordination and joint outcomes. While other actors may focus on limited geographies, CGIAR's global reach and established breeding networks enable large-scale deployment of breeding lines, technologies, and methods.

The INCLUSIVE DELIVERY AoW aims to deliver genetic gain to farmers' fields in the Global South by accelerating the deployment and scaling of Breeding for Tomorrow products. INCLUSIVE DELIVERY's comparative advantage lies in its decades of collective expertise and experience in delivering CGIAR breeding products to women and men smallholder farmers in the Global South. This comparative advantage is based on several critical capabilities and assets that are unique to CGIAR. First and foremost, INCLUSIVE DELIVERY embodies a global public goods research agenda that is focused on pragmatic, actionable solutions for seed sector development, i.e., context-specific problem-solving to lift constraints to seed systems and markets that serve smallholders. This means that INCLUSIVE DELIVERY (and Breeding for Tomorrow more generally) is motivated by core values and organizational incentives that drive its agenda towards a uniquely cross-country, cross-crop perspective on developing context-specific best-fit solutions. The basis for this comparative advantage is INCLUSIVE DELIVERY's participation in rich and diverse networks of innovation and scaling partners involved in the delivery of breeding products and complementary services, including private seed companies, farmers' organizations, and providers of complementary products and services; government ministries, agencies, and services; and funders who are critical to advancing change in seed sector policy and practice. No other R4D organizations have similar networks across so many countries and partners. This aspect of comparative advantage is augmented by CGIAR's strong reputation in the breeding space that encourages partners to routinely seek independent guidance and advice from CGIAR on complex product delivery solutions. Finally, INCLUSIVE DELIVERY's comparative advantage lies in positioning that allows it to mobilize the full force of CGIAR's scientific and technical expertise in seed multiplication technology development, product delivery and scaling strategies, gender and social inclusion, and public policy and regulation in support of its goal.

The BREEDING RESOURCES and ENABLE AoWs represent the Program's comparative advantage in architectural design to ensure its overall operational efficiency and effectiveness. Key CGIAR assets include a future-ready organizational structure that offers shared scientific and technical services, a fit-for-purpose innovation management system, bespoke data management architectures and platforms, decades of breeding network expertise and a reenforced culture of transparency, accountability and inclusivity across its breeding networks. These strategies, systems, and tools enable the Program to meet both current and future needs, advancing genetic research and driving innovation. In parallel, partners can take advantage of these achievements and services, while effective management solutions developed by partners will also be adopted by CGIAR and further promoted to more partners. Access to the best service providers will be leveraged thanks to the international reach of CGIAR and down priced thanks to the competitive advantage of CGIAR to bring forth large requests spanning vast breeding networks.

By integrating regionally tailored breeding strategies, robust delivery networks, and strategic support, Breeding for Tomorrow demonstrates a clear comparative advantage in developing climate-resilient, market-preferred, healthy, and nutritious varieties across a wide range of crops, livestock, and fish breeds. CGIAR's global reach and adaptability position Breeding for Tomorrow to address diverse regional needs, reduce the impact of climate change, and enhance genetic gains under challenging conditions. Its ability to leverage global market intelligence, cutting-edge seed technologies, and strong partnerships ensures that Breeding for Tomorrow remains at the

forefront of agricultural innovation. The collaboration with NARES and other stakeholders enhances local relevance, while CGIAR's infrastructure and expertise ensure the scalability and impact of its breeding solutions, driving global food security and sustainable development.

Identifying potential partners

Breeding for Tomorrow's comparative advantage resides within its breeding networks, which include not only CGIAR Centers and programs, but also its partners at the global, regional, national and local levels. Partners that are key to the Program's success include the traditional breeding networks comprised of CGIAR breeding programs, national research organizations, and small- and medium-scale enterprises (CGIAR-NARES-SME), but it also goes beyond to include advanced research institutions (research institutes and Universities) and larger enterprises that support the process.

In Breeding for Tomorrow, this network expands to include a wider and more diverse range of partners: private crop science and seed companies, state-owned seed production units, public and private extension services, community-based seed producers, seed entrepreneurs, agro-dealers, women's and men's farmer organizations, cooperatives, agri-processing industry, civil society organizations, and other entities involved or having a stake in the design, development, and delivery of Breeding for Tomorrow products.

In addition, Breeding for Tomorrow is supported by partners that provide the enabling scientific, technical, policy, and institutional environment. These are government ministries and regulators, advanced research institutions, universities, think-tanks, industry and farmer associations, non-governmental organizations, financial service providers, regional development organizations, and funders.

5. Program-level Theory of Change (ToC)

Challenge statement

Breeding for Tomorrow aims to address the challenges of food insecurity, malnutrition, poverty, and social inequalities in LMICs that are fueled by demographic shifts, climate change, environmental degradation, market concentration, and growing inequalities. Breeding for Tomorrow aims to design, develop and deliver climate-resilient, market-preferred, nutritious varieties and to make food production systems more productive, resilient, inclusive, and sustainable. The Program emphasizes gender-intentional system approaches in its design and execution, while aiming to foster both market competition and innovation, as well as productivity and efficiency gains. This approach explicitly fosters higher genetic gain in farmers' fields, efficiency, competition, and innovation, focusing on genetic innovations that have the greatest potential to address CGIAR's Impact Areas and megatrend challenges. In partnership with public, private, and civil society collaborators, Breeding for Tomorrow develops and deploys modern technologies to improve the quality of life of small-scale women and men farmers in LMICs.

Breeding for Tomorrow – Theory of Change

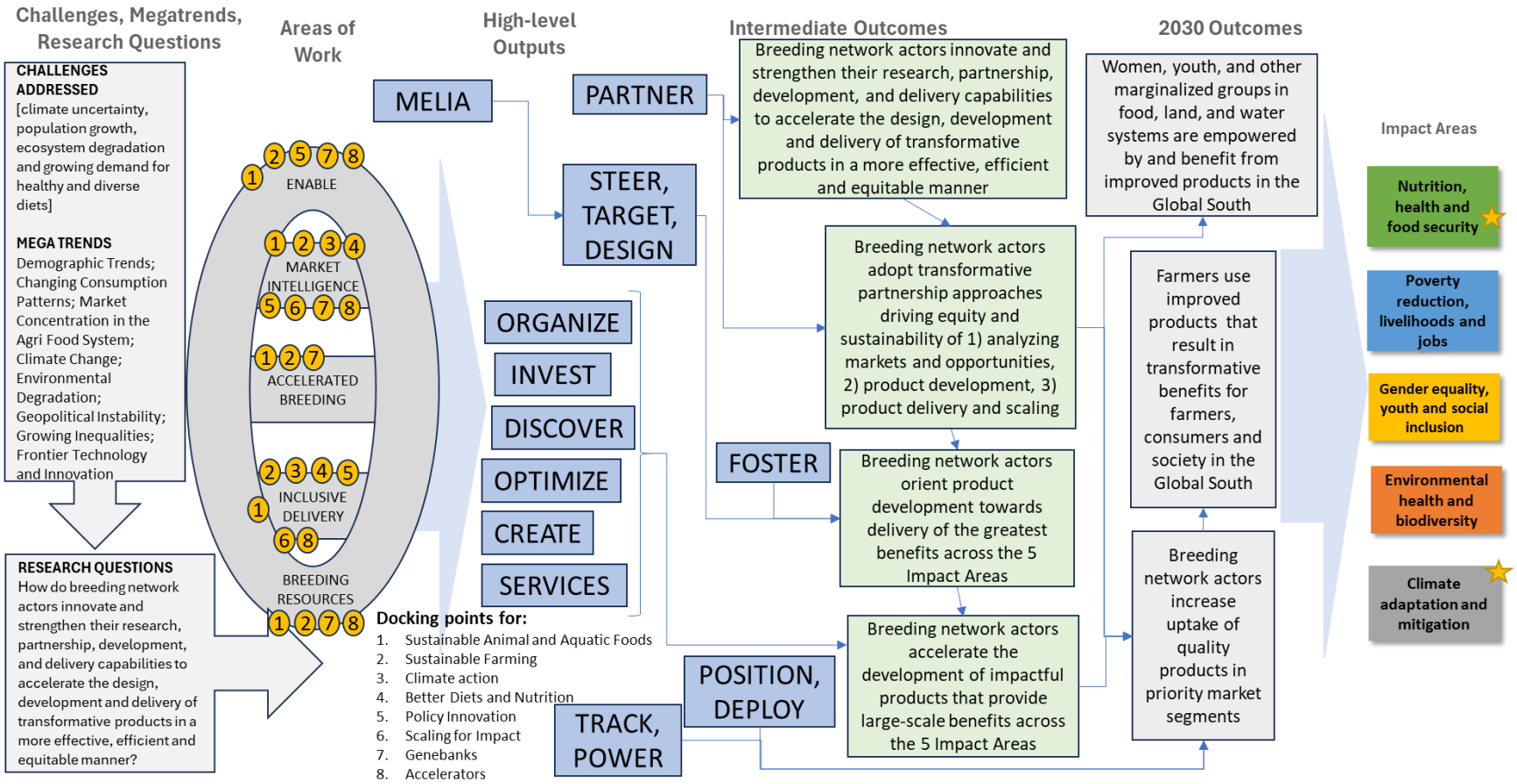

Figure 1. Breeding for Tomorrow's theory of change

Overall ambition

Breeding for Tomorrow will engage with a wide range of change processes already underway in partner countries and among partner organizations and breeding networks. These include efforts to further enhance breeding networks to deliver more impactful and in-demand breeding products; support national partners' breeding improvement plans to amplify the impact of their investments in plant breeding; utilize AGRA's Seed System Assessment Tool (SeedSAT) and its Center of Excellence for Seed Systems in Africa (CESSA); contribute to regional trade and regulatory harmonization efforts being advanced by the Common Market for Eastern and Southern Africa (COMESA), and the Economic Community of West African States (ECOWAS), and other regional economic communities; and support national seed policy and regulatory reforms that are currently under development in many partner countries.

Breeding for Tomorrow's engagement strategy, in further influencing these change processes, relies on the power of its existing NARES-SME breeding networks, an inclusive approach to expanding participation in these networks, the institutionalization of transdisciplinary teams, standardization of target product profiles (TPPs), modernization of breeding programs, and deep engagement in strengthening and integrating seed systems.

The Program supports breeding network actors in innovating and strengthening their research, partnership capacities, and product development and delivery capabilities to accelerate breeding processes in a more effective, efficient, and equitable manner (Table 2). Breeding network actors are motivated to innovate and strengthen their capabilities through transformative partnership approaches because of their national and regional interests in developing products, their facilitated empowerment in undertaking these activities, and because collaboration fosters proper resourcing. Collectively, this drives equity and sustainability across networks. In supporting transformative partnership approaches, Breeding for Tomorrow aims to orient product development towards delivery of the greatest benefits across the five Impact Areas. Raising network strategic and operational capacity enables network actors to produce and deliver varieties that are well-targeted to meet the needs and demands of small-scale farmers.

Breeding for Tomorrow will aim to encourage investors, including funders and implementers, to focus on impact pathways that best address the needs of regions and countries. This will be done through the provision of knowledge and data on what these impact pathways are (projected future impact of market segments and of product concepts), backed by consultation and partner validation. This will improve investments and help refocus breeding resources and breeding efforts towards the greatest need and impact.

Breeding for Tomorrow aims to further support change processes that will allow breeding network actors to increase the uptake of quality products in priority market segments. Here, Breeding for Tomorrow aims to work with partners to not only improve the capacity of seed systems to deliver improved products to small scale farmers, but also to improve the enabling environment that fosters success in seed systems. Breeding for Tomorrow will also work with seed network actors to close the information loop between product conception (at the beginning of the breeding pipeline) and product release (at the end of the pipeline) by facilitating data and information sharing on which products fare well in the market and why. This hopes to facilitate improved impact through better product design that aligns not only with data and partner needs, but also feasibility in the seed system space.

Ultimately, Breeding for Tomorrow's ambition is that end-users use improved products that result in transformative benefits for farmers, consumers, and society in the Global South. This will be realized through improved crop varieties and innovative products and processes that contribute to women, youth, and other marginalized groups' access to these varieties.

Research and supporting activities

Breeding for Tomorrow has organized its AoWs to address the overarching research question *"how do breeding network actors innovate and strengthen their research, partnership, development, and delivery capabilities to accelerate the design, development, and delivery of transformative products in a more effective, efficient and equitable manner?".*

Product development and delivery of varieties will be achieved through a variety of intermediary and complementary actions including:

(1) gathering forward-looking market intelligence for breeding to deliver in-demand, targeted varieties that align with national priorities including the needs of women, men, youth farmers, consumers, and other value chain actors

(2) consistently supporting CGIAR-NARES-SME networks and breeding pipelines through essential breeding services, transformative partnerships, capacity sharing, and operational support to facilitate access to and uptake of enabling tools and technologies

(3) scaling access to cutting-edge breeding methods, organizational frameworks, and monitoring systems to right-size breeding investments based on priorities and opportunities for impact at scale

(4) improving the availability of high-value genetic variation for breeding by leveraging appropriate trait discovery and deployment approaches, novel germplasm from CGIAR genebanks and other public collections/programs, and precision genetics technologies and novel phenotyping methods

(5) improving seed systems through public-private-farmer partnerships to increase and improve delivery of new varieties, in conjunction with monitoring of uptake and impact.

Breeding for Tomorrow's Key AoWs and science scope include:

1. Market analysis to define product concepts and prioritization of breeding pipelines; breeding strategies to translate product concepts into feasible, impactful, and in-demand target product profiles with clear value propositions.
2. Enhanced breeding designs with novel and innovative phenotyping for higher and sustained genetic gain; discovery and deployment of native traits into elite germplasm.
3. Precision genetics deliver desired variations for breeding.
4. Novel technologies to enhance the uniformity, health, propagation efficiency, and scale of seed production.
5. Capacity-sharing and building strategies to strengthen national and regional breeding and scaling capabilities.
6. Data management processes and systems to improve decision-making.
7. Applications of the science of scaling, organizational behavior, gender, and participatory research to co-create new products and services.
8. Policy research with socio economic and regulatory analysis to foster genetic innovation enabling environments and adoption of new varieties/breeds.
9. Causal impact evaluation to concisely attribute CGIAR investments in genetic innovation to outcomes across the five Impact Areas.

There are many opportunities emerging from nascent applications of transdisciplinary approaches within genetic innovation and scientific advances including:

(1) Global crop breeding programs that effectively leverage CGIAR's global science capabilities and capacity for local product development and enhanced approaches to collect and collate market intelligence from stakeholders.

(2) Wider application of current and new genomic selection techniques, novel phenotyping and speed breeding methods, predictive breeding and AI tools to improve and accelerate genetic gain.

(3) More precise and faster trait discovery and deployment opportunities for leveraging climate and genetic foresight along with new tools and capacity for genome editing.

(4) Systemwide application of digital tools in varietal/breed development, adoption and quality management.

(5) New and collaborative strategies to deliver higher genetic gains in farmers' fields integrating context specific scaling models.

Ongoing work will continue including Center and bilateral projects, public-private partnerships and collaboration with non-CGIAR advanced research institutions for upstream discovery. Market Intelligence efforts on market segmentation will be enhanced to continue informing and improving investment decisions. Continued modernization of breeding programs will build on the extensive work of the Accelerated Breeding Initiative in optimizing breeding programs' organization, design, analytics, data quality control, monitoring, and partnerships, further strengthening CGIAR-NARES-SMEs breeding networks' effective and efficient product development and deployment efforts. Access to enabling tools and services, developed as part of Breeding Resources Initiative will be extended to additional crops, trees, forages, livestock, poultry, and aquatic species, improving tool access and leveraging improved efficiencies for all. Access to precision genetic tools and capacities will be leveraged from the Genome Editing Initiative. Variety catalogues, digital variety adoption tracking tools, and policy/regulatory analyses conducted by the CGIAR Seed Equal Initiative will be strengthened and expanded to link product development with delivery, to generate evidence on adoption patterns and trends.

Engagement and Partnership

Breeding for Tomorrow's work will build on partners' regional and national breeding targets and the principles for collaborative work developed in the 2022 and 2023 NARES and subregional bodies consultation meetings. Further it will encompass breeding network actors' feedback and feedback coming from Regions and Partnership's Listening Sessions and other country-level consultations. Breeding network actors will continue working closely with regulatory agencies, seed system partners, and allies in the public, private, and civil society sectors to accelerate the co-development and adoption of market demanded, superior varieties and breeds to improve the quality of life of people in LMICs.

Internally Breeding for Tomorrow will work with the **Climate Action Program** on innovation packaging and local tailoring for climate response; the **Policy Innovations Program** on foresight information on megatrends to inform market intelligence; the **Better Diets and Nutrition Program** and **Sustainable Animal and Aquatic Foods Program** to inform prioritization of breeding pipelines, identify traits of breeding relevance, and further mainstream CGIAR work on genetic biofortification; the **Sustainable Farming Program** to implement a common targeting framework, develop innovation packages of resilient, adapted and productive varieties and breeds co-optimized with integrated farming management practices, and to ensure plant health monitoring and IPM systems are well aligned and inform breeding; the **Food Frontiers and Security Program** to identify quick to scale and deliver innovations and inform breeding pipeline prioritization; the **Scaling for Impact Program** to ensure that a partnership-driven, scientifically grounded approach is pursued in the design and implementation of scaling models to deliver

genetic gain innovation packages to farmers' fields; the **Gender Equality and Inclusion Accelerator** to advance gender-responsive and transformative product design and development; the **Digital Transformation Accelerator** to streamline data architecture and improve access to, and integration of, enabling digital tools and technologies; the **Capacity Sharing Accelerator** for novel approaches to organizational learning, change and continuous improvement; and **Genebanks** as a source of desired novel genetic variability for traits of interest.

Table 2. Breeding for Tomorrow Theory of Change results, assumptions, and indicators

ToC Element #	Statement	Contributing area(s) of work #	Partners (including internal) and roles	Assumption (for outcomes only)	Indicator and target (for 2030 outcomes only)
OP	Refer to outcomes in AoW TOC/ Tables	Refer to outcomes in AoW TOC/Tables	Refer to outcomes in AoW TOC/Tables	Not required	Not required
I-OC-1	Breeding network actors innovate and strengthen their research, partnership, development, and delivery capabilities to accelerate the design, development and delivery of transformative products in a more effective, efficient and equitable manner	ALL	CGIAR Centers NARES SMEs Non-governmental organizations Academia Genebanks CGIAR Science Programs ARIs Seed and food industry NGOs Donors and investors National agricultural research & extension systems Regional/sub-regional economic communities Regional/sub-regional development initiatives Regional/sub-regional agricultural research organizations Industry, trade, and farmer associations State-owned seed production units Knowledge & data management companies National and regional policy think-tanks Capacity sharing/development service providers International development & multilateral finance institutions Government ministries and agencies Private seed companies Multinational corporations Farmers	Breeding network actors operate in an environment that supports and enables efforts to innovate and strengthen their capabilities	1. Proportion of breeding networks that have applied innovations and strengthened their research, partnership, development, and delivery capabilities.
I-OC-2	Breeding network actors adopt transformative partnership approaches driving equity and sustainability of 1) analyzing markets and opportunities, 2) product development, 3) product delivery and scaling	ALL	CGIAR Centers NARES SMEs Non-governmental organizations Academia Genebanks CGIAR Science Programs ARIs Seed and food industry NGOs Donors and investors Regional/sub-regional economic communities Regional/sub-regional development initiatives Regional/sub-regional agricultural research organizations Industry, trade, and farmer associations State-owned seed production units Knowledge & data management companies National and regional policy think-tanks Capacity sharing/development service providers International development & multilateral finance institutions Government ministries and agencies Private seed companies Multinational corporations Farmers	Breeding network actors are interested, empowered, and resourced to engage in a breeding network and willing to pool resources.	2. Proportion of transformative partnerships established between and among breeding networks with documented and augmented roles and responsibilities.

ToC Element #	Statement	Contributing area(s) of work #	Partners (including internal) and roles	Assumption (for outcomes only)	Indicator and target (for 2030 outcomes only)
I-OC 3	Breeding network actors orient product development towards delivery of the greatest benefits across the 5 Impact Areas	MARKET INTELLIGENCE, ENABLE, DEVELOP, BREEDING RESOURCES	CGIAR Centers NARES SMEs Non-governmental organizations Academia Genebanks CGIAR Science Programs ARIs Seed and food industry NGOs Donors and investors Sub-regional organizations International and local development organizations Private sector associations Universities Multinational corporations Farmers	-Breeding network actors recognize the value of a more holistic, inclusive, transdisciplinary research approach needed to orient product development towards impactful delivery of benefits for smallholders and for women, youth and other disadvantaged social groups.	3. Proportion of CGIAR breeding pipelines that have revised their breeding strategy or TPP to improve alignment with impact opportunity indicators. Baseline 0%, target by 2030 is 100%.
I-OC 4	Breeding network actors accelerate the development of impactful products that provide large-scale benefits across the 5 Impact Areas	MARKET INTELLIGENCE, ACCELERATED BREEDING, ENABLE, BREEDING RESOURCES	CGIAR Centers NARES SMEs Non-governmental organizations Academia Genebanks CGIAR Science Programs ARIs Seed and food industry NGOs Donors and investors Sub-regional organizations International and local development organizations Private sector associations Universities Multinational corporations Farmers	Raising the strategic and operational capacity of breeding network actors will enable them to produce and deliver products that are well-targeted to the needs and demands of smallholders	4. Proportion of breeding pipelines that have implemented systems to measure realized genetic gains at last stage of testing and performance indicators for components of the breeder's equation (100%). 5. Realized genetic gains (broadly defined) at last stage of testing.
I-OC 5	Investors, including funders and implementers, focus on impact pathways that best address the needs of regions and countries.	MARKET INTELLIGENCE, ACCELERATED BREEDING	Genebanks CGIAR Science Programs ARIs Seed and food industry NGOs Donors and investors Sub-regional organizations International and local development organizations Private sector associations Universities Multinational corporations Farmers	Breeding leads and funders value impact projection data to refocus breeding resources and breeding efforts. They rely on projected future impact of market segments and of product concepts.	6. Proportion of crops with augmented allocations of investment that better align with impact opportunity indicators.

ToC Element #	Statement	Contributing area(s) of work #	Partners (including internal) and roles	Assumption (for outcomes only)	Indicator and target (for 2030 outcomes only)
I-OC 5	Breeding network actors increase uptake of quality products in priority market segments	ALL	CGIAR Centers NARES SMEs Non-governmental organizations Academia Genebanks CGIAR Science Programs ARIs Seed and food industry NGOs Donors and investors Regional/sub-regional economic communities Regional/sub-regional development initiatives Regional/sub-regional agricultural research organizations Industry, trade, and farmer associations State-owned seed production units Knowledge & data management companies National and regional policy think-tanks Capacity sharing/development service providers International development & multilateral finance institutions Government ministries and agencies Private seed companies Multinational corporations Farmers	Breeding network actors recognize, accommodate, and support pluralistic and integrated seed systems where and when appropriate. Breeding network actors share data and information on their products, activities, and outputs.	7. Change in the quantity of quality seed produced and distributed by partners for a prioritized set of representative crops and countries (50% increase on 2021 reference value) 8. Positive changes in public policies, regulations, and investments that influence breeding network actors, genetic resource management, and/or seed sector development (20% increase on 2021 reference value)
2030-OC-1	Farmers use improved products that result in transformative benefits for farmers, consumers and society in the Global South	ALL	CGIAR Centers NARES SMEs Non-governmental organizations Academia Genebanks CGIAR Science Programs ARIs Seed and food industry NGOs Donors and investors Regional/sub-regional economic communities Regional/sub-regional development initiatives Regional/sub-regional agricultural research organizations Industry, trade, and farmer associations State-owned seed production units Knowledge & data management companies National and regional policy think-tanks Capacity sharing/development service providers International development & multilateral finance institutions Government ministries and agencies Private seed companies Multinational corporations Farmers	Small-scale farmers perceive benefits from proposed new improved crop varieties.	9. Change in weighted average varietal age (WAVA), or alternative measures, for a prioritized set of representative crops and countries (25% decrease on 2021 reference value)

ToC Element #	Statement	Contributing area(s) of work #	Partners (including internal) and roles	Assumption (for outcomes only)	Indicator and target (for 2030 outcomes only)
2030-OC-2	Women, youth, and other marginalized groups in food, land, and water systems are empowered by and benefit from improved products in the Global South	ALL	CGIAR Centers NARES SMEs Non-governmental organizations Academia Genebanks CGIAR Science Programs ARIs Seed and food industry NGOs Donors and investors Regional/sub-regional economic communities Regional/sub-regional development initiatives Regional/sub-regional agricultural research organizations Industry, trade, and farmer associations State-owned seed production units Knowledge & data management companies National and regional policy think-tanks Capacity sharing/development service providers International development & multilateral finance institutions Government ministries and agencies Private seed companies Multinational corporations Farmers	-Smallholders have opportunities to articulate their demands, to gain access to, and to benefit from improved products.	10. Proportion of women, youth, or other marginalized social groups reporting positive changes in access, use, and benefit realization as a result of CGIAR innovations, capacity, or policy outputs (70%) 11. Proportion of breeding network actors having institutionalized processes to innovate and strengthen the role of gender and social inclusion in the structure, organization, and management of their work.

6. Areas of Work

6.1 MARKET INTELLIGENCE

Challenge statement

Investment in CGIAR-related crop technologies has been estimated to generate at least a 10-fold return. By 2020, cumulative investment in CGIAR since 1960 generated $47 billion annual welfare gains across Asia, Africa and Latin America. Breeding can inclusively benefit the livelihoods of producers and the nutrition and health of populations while supporting healthy ecosystems and minimizing greenhouse gas (GHG) emissions. However, despite past successes, product turnover has slowed down as evidenced by the high average age of varieties in farmers' fields, [3] partly due to products failing to adequately meet client requirements owing to supply-focused investment decisions. Investors have stressed the need for **institutional change** in product design and investment prioritization to render breeding more market-driven, but efforts remain fragmented with limited involvement of social scientists, nutritionists, climate experts, NARES and value chain stakeholders, and little attention to behavioral drivers of product replacement. Consequently, breeding still falls short of its full potential in responding to megatrends and addressing impact challenges across multiple CGIAR Impact Areas: (1) nutrition, health and food security; (2) poverty reduction, livelihoods and jobs; (3) gender equality, youth and social inclusion; (4) climate adaptation and mitigation; and (5) environmental health and biodiversity.

Overall ambition

The overall ambition of MARKET INTELLIGENCE is to maximize the Breeding for Tomorrow's Program's return on investment (RoI) across the five Impact Areas under varying budget scenarios. This is done through **institutional innovation** in product design and investment prioritization, enabling the development and delivery of future climate-resilient, nutritious, and market-preferred products that satisfy the requirements of men and women farmers, off-takers, processors and consumers and agilely respond to emerging megatrends and the most pressing impact challenges in the Global South.

MARKET INTELLIGENCE draws on the novel framework co-developed by CGIAR Excellence in Breeding and the CGIAR Initiatives on Market Intelligence and Accelerated Breeding (2022–2024) and institutionalized through the Global Market Intelligence Platform (GloMIP) and the Breeding Portal to (1) identify global impact opportunities across 46 crops in 171 countries through more than 200 indicators across the five Impact Areas; (2) target breeding pipelines for 20 CGIAR mandate crops by identifying and describing more than 600 market segments; (3) guiding breeding pipelines through the design and revision of more than 400 target product profiles (TPPs) based on market intelligence; (4) providing behavioral intelligence on

[3] See: Atlin, G.N., Cairns, J.E. and Das, B., 2017. Rapid breeding and varietal replacement are critical to adaptation of cropping systems in the developing world to climate change. *Global Food Security,* 12, 31-37, https://doi.org/10.1016/j.gfs.2017.01.008; McEwan, M.A., Almekinders, C.J., Andrade-Piedra, J.J., Delaquis, E., Garrett, K.A., Kumar, L., Mayanja, S., Omondi, B.A., Rajendran, S. and Thiele, G., 2021. Breaking through the 40% adoption ceiling: Mind the seed system gaps. A perspective on seed systems research for development in One CGIAR. *Outlook on Agriculture,* 50(1), 5-12, https://doi.org/10.1177/0030727021989346; Thiele, G., Dufour, D., Vernier, P., Mwanga, R.O., Parker, M.L., Schulte Geldermann, E., Teeken, B., Wossen, T., Gotor, E., Kikulwe, E. and Tufan, H., 2021. A review of varietal change in roots, tubers and bananas: consumer preferences and other drivers of adoption and implications for breeding. *International Journal of Food Science & Technology*, *56*(3), 1076-1092, https://doi.org/10.1111/ijfs.14684; and Walker, T., Alene, A., Ndjeunga, J., Labarta, R., Yigezu, Y., Diagne, A., Andrade, R., Muthoni Andriatsitohaina, R., De Groote, H., Mausch, K., Yirga, C., Simtowe, F., Katungi, E., Jogo, W., Jaleta, M. & Pandey, S. 2014. *Measuring the Effectiveness of Crop Improvement Research in Sub-Saharan Africa from the Perspectives of Varietal Output, Adoption, and Change: 20 Crops, 30 Countries, and 1150 Cultivars in Farmers' Fields.* Report of the Standing Panel on Impact Assessment (SPIA), CGIAR Independent Science and Partnership Council (ISPC) Secretariat: Rome, Italy; https://cas.cgiar.org/sites/default/files/pdf/ISPC_DIIVA_synthesis_report_FINAL.pdf.

opportunities for accelerating product turnover and product lifecycle management; and (5) prioritizing breeding investments through pipeline investment cases. The Initiatives catalyzed an institutional change process whereby product design decision making shifted from breeders to transdisciplinary product design teams (PDTs) composed of social and biophysical scientists in CGIAR and NARES, and other stakeholders in seed systems and processing industries.

This institutional change process will now be formalized through a **Product Design Standard** that clearly defines verifiable requirements for (1) product design processes, roles, and responsibilities, driven by transdisciplinary Product Design Teams involving NARES and stakeholders in product design and advancement meetings, and (2) measurable targets, ensuring products are in-demand, gender-intentional, and impactful (MARKET INTELLIGENCE Output 3), and feasible in terms of cost effectiveness (ACCELERATED BREEDING Output 1). The transfer and use of market intelligence in product design (and revision through iterative cycles) will be institutionalized through the Product Design Standard and STEER, an innovation package of digital decision support tools centered around GloMIP (Figure 3) and scaled within CGIAR-NARES-SME networks and to non-CGIAR partners (ENABLE).

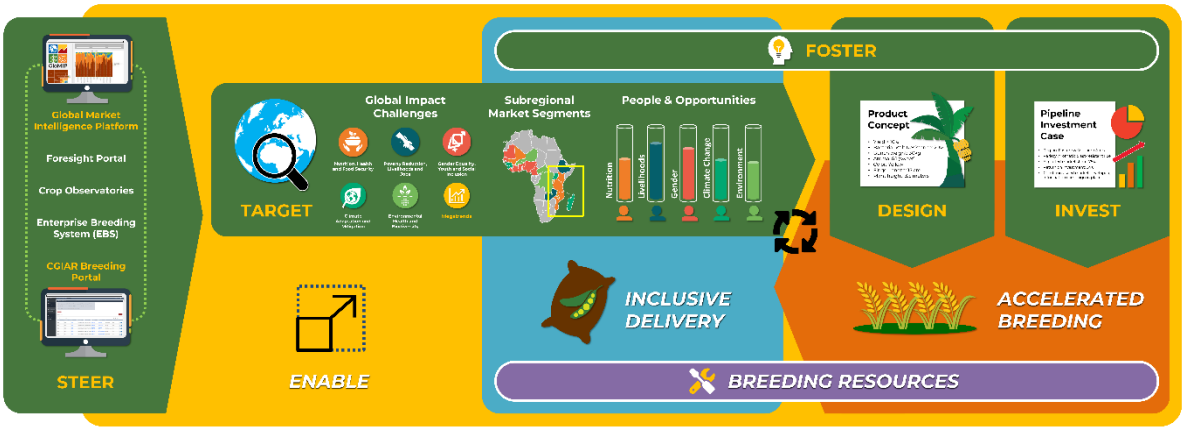

Figure 3. Internal pipeline of MARKET INTELLIGENCE

Note: The green areas illustrate how the global impact challenges and megatrends steer the Breeding for Tomorrow portfolio of pipelines through iterative product design-revision cycles towards maximum return on investment

By 2030, MARKET INTELLIGENCE's ambition is to achieve 50% Product Design Standard compliance by breeding pipeline managers, as they are driven by their professional aspiration, institutional mandate and donor requirements to maximize RoI (Figure 4). MARKET INTELLIGENCE will target a 20% increase in investment in Breeding for Tomorrow as the improved investment prioritization framework (STEER) generates transparency and boosts investors' confidence. To achieve these ambitious outcomes, several intermediate outcomes need to be achieved. First, researchers and managers in CGIAR-NARES-SME networks trust and are encouraged (through their institutional mandate and donor requirements to maximize RoI) to use the innovation package to steer decision making towards impactful targeting, design, investment, and delivery, and effective resource mobilization. Secondly, similar to how academic impact incentivizes publishing, it is assumed that GloMIP will attract market intelligence, driven by researchers' incentives to evidence uptake and impact of their market research. Thanks to judicious quality control and advanced functionality (through AI), GloMIP will become the trusted source of state-of-the-art market intelligence for transdisciplinary teams in CGIAR-NARES-SME networks, who will comply with the Product Design Standard, driven by their professional aspiration, institutional mandate and donor requirements to maximize RoI. This will result in CGIAR-NARES-SME networks consistently deploying market intelligence synthesized in GloMIP to target, design, develop, deliver, evaluate, and foster the adoption of products that are in-demand, gender-intentional, impactful, and feasible. Outside

CGIAR, it is expected that the seed industry, NGOs, and investors will use GloMIP for strategic decision making, driven by trust in this source of information and their mandate to maximize their relevance and RoI.

Area of Work 1: MARKET INTELLIGENCE

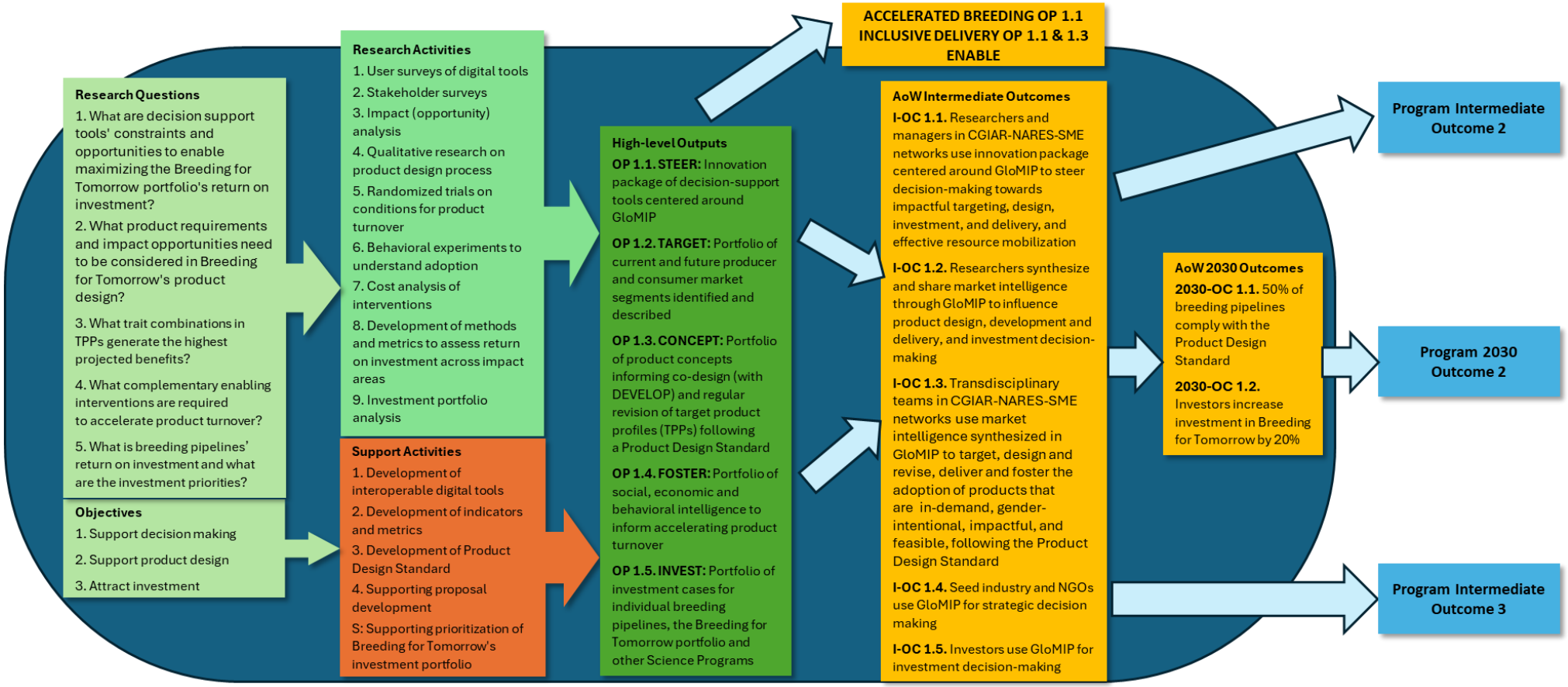

Figure 4. Theory of change of the MARKET INTELLIGENCE Area of Work

Research questions

To steer the Breeding for Tomorrow portfolio towards maximum return on investment, research will be conducted to identify users' key constraints in current decision support tools and improve their integration (Figure 4). Further, to enable product design to maximize impacts across the five Impact Areas, impact opportunities will be identified in current and future market segments, which will enable prioritizing investment in market intelligence research aimed at identifying and predicting the product requirements of producers, processors, and consumers. Research will unravel what trait combinations in TPPs generate the highest projected benefits in each market segment, what the trade-offs are across the five Impact Areas, and what complementary enabling interventions are required to foster and accelerate product turnover. Finally, these insights will enable assessing the projected return on investment of breeding pipelines across the five Impact Areas and identify the investment trade-offs and priorities. Detailed research activities and research sub-questions are outlined in Figure 4 and in the Appendix.

Research and supporting activities

Continuation of established work from Market Intelligence

MARKET INTELLIGENCE will be implemented through five high-level outputs, which are an optimized reconfiguration of the Market Intelligence Initiative's work packages 1–4 (Figure 4):

1. **STEER:** Innovation package of decision-support tools centered around the Global Market Intelligence Platform (GloMIP) being continuously expanded institutionally (towards non-CGIAR Centers such as WorldVeg, NARES, and SMEs) and across products, updated and innovated through new functionalities for guiding investment, product and technology design decision making in Breeding for Tomorrow and other Programs.
2. **TARGET:** Portfolio of current and future producer and consumer market segments with state-of-the-art market intelligence evidence enabling targeted product design, analyzed, and revised regularly.
3. **DESIGN:** Portfolio of market segment-focused product concepts informing design and revision of TPPs (ACCELERATED BREEDING Output 1), following the Product Design Standard.
4. **FOSTER:** Portfolio of social, economic, and behavioral intelligence to inform investment and product design, delivery and lifecycle management on opportunities for accelerating product turnover. Product lifecycle management will be possible thanks to clear feedback loops between Inclusive Delivery and Market Intelligence.
5. **INVEST:** Portfolio of investment cases for Breeding for Tomorrow and other Programs for impactful investment mobilization and prioritization.

To support the institutional change process and implementation of the activities, STEER will provide training on digital tools to familiarize and empower prospective users (researchers. managers, fund raisers, investors, etc.) through online outreach and physical events. TARGET, DESIGN, and FOSTER will collaborate to initiate multi-stakeholder processes and share capacity to form and empower transdisciplinary teams. Finally, INVEST will support evidence-based prioritization of the Breeding for Tomorrow portfolio.

Emerging/new work

MARKET INTELLIGENCE will support its scaling partners by **expanding** its framework to food, feed, and forage crops; trees and other perennial species; and animal and aquatic species. To render the Breeding for Tomorrow portfolio more future-proof and responsive to emerging megatrends and new threats like diseases and pests, MARKET INTELLIGENCE and Policy Innovation will closely collaborate to project the current market segments and indicators to the future (2030–2050) through foresight, climate, crop and pest/disease modeling. MARKET INTELLIGENCE will refine market segmentation through geospatial modeling, improving targeting accuracy. Moreover, to improve breeding pipelines' contribution to nutrition and health while fostering social inclusion, MARKET INTELLIGENCE will identify producer and consumer market segments for nutrition-dense and health-enhancing crops (e.g., low GI foods, high beta carotene potatoes, high flavonoid content foods, etc.) and stakeholder requirements

for the development of inclusive value chains in the Better Diets and Nutrition Program. Further, research on behavioral intelligence to accelerate product turnover will expand to include interventions addressing social and economic barriers to adoption, enabling evidence-based product lifecycle management. Finally, the Digital Transformation Accelerator will support human-centric design and the integration of AI in GloMIP.

Dropped work

MARKET INTELLIGENCE will reallocate its cross-cutting work on MELIA and institutional scaling (formerly work package 5) to the ENABLE AoW.

High-level summary of internal/external partnerships

Innovation, scaling and demand partners

MARKET INTELLIGENCE will closely collaborate with all AoWs in Breeding for Tomorrow to support decision making in the design, development, delivery, support, and enablement of breeding pipelines to maximize their return on investment and attract new investments to target unserved beneficiaries. MARKET INTELLIGENCE's main innovation partner will be French Agricultural Research Centre for International Development (CIRAD), which will support MARKET INTELLIGENCE in collecting and analyzing market intelligence. Scaling partners include NARES in CGIAR-NARES-SME networks, WorldVeg, CIFOR-ICRAF, ILRI, WorldFish, and the Sustainable Animal and Aquatic Foods Program, which will enable scaling MARKET INTELLIGENCE towards vegetables, trees, food-feed crops, forages livestock and aquatic foods. Finally, MARKET INTELLIGENCE will support demand partners such as seed companies, NGOs, and investors in strategic decision making.

Collaboration with other Programs/Accelerators

MARKET INTELLIGENCE will closely interact with the Gender Equality and Inclusion Accelerator to mainstream gender intentionality in product design and investment prioritization. Close interaction with Genebanks will enable linking accessions to market intelligence using artificial intelligence (AI). MARKET INTELLIGENCE will explore synchronized targeting of product-management bundles with Sustainable Farming. Policy Innovation will help building GloMIP's foresight capacity. MARKET INTELLIGENCE will support Scaling for Impact in market-driven scaling, while incorporating countries' priorities in investment prioritization. More details on partnerships can be found in the Appendix.

6.2 ACCELERATED BREEDING

Overall ambition

ACCELERATED BREEDING contributes to transformative change by accelerating the development of a new generation of climate-resilient, nutritious, and market-preferred varieties and steers breeding processes, collaborations among the CGIAR Centers and partnerships to becoming more efficient, sustainable, and fair.

Innovations from Accelerated Breeding, Market Intelligence, and Excellence in Breeding, have defined, for the first time, the full portfolio of CGIAR breeding strategies: the portfolio of breeding pipelines and the market segments and Target Product Profiles (TPPs) they breed for, with a defined level of breeding effort and resources, and for a defined level of impact against CGIAR's five Impact Areas: Climate adaptation & mitigation; environmental health & biodiversity; gender equality, youth & social inclusion; nutrition, health & food security; and poverty reduction, livelihoods & jobs. This represents a powerful example of business analytics enabling strategic optimization. CGIAR now has the data to review and optimize the breeding strategy, which empowers breeding networks to orient product development towards delivery of greater benefits across the five Impact Areas and ensures that breeding teams and funders focus on impact pathways which best address the needs of regions and countries.

Vanguard methods and collaboration with innovative organizations allow teams to discover and use novel traits, accelerate genetic gains, and scale farmer involvement in product development, at a speed that has not been possible before. Interdisciplinary, interinstitutional teams have grown and strengthened to build products with precision in: climate resilience – heat, drought, flood tolerance, resistance to virulent pest and disease, i.e. stresses that emerge with increasingly greater frequency and devastate farmers' livelihoods; nutrition – varieties that are healthier and combat malnutrition; preference – traits that increase the marketability, storability, and reduce the drudgery or time needed for home processing and are highly valued and therefore in demand by end users.

ACCELERATED BREEDING works on the genetic diversity of food crops, with methods acquired, developed, and exchanged with universities and the multinational private sector and that it widely shares resulting methods and materials with local partners via open access channels. Over the past three years, local partners' breeding capacity and ambitions were systematically assessed, and partnerships involving a wider range of species established. ACCELERATED BREEDING's ambition is to utilize this foundation to further define roles and responsibilities, empowering globally and regionally important breeding networks for crops, vegetables, forages, and trees with new methods and approaches. This will allow greater contributions to addressing climate change and chronic and hidden hunger and will create new opportunities for value generation and augmenting the resilience, sustainability, and diversity of food systems.

High-level outputs

To realize this overall ambition, ACCELERATED BREEDING will deliver the following five high-level outputs (Figure 2) through an integrated structure (Figure 3):

1. **STRATEGIZE / ReFOCUS:** CGIAR–NARES–SME breeding pipelines, and underlying investments, are aligned to the local needs of market segments and impact opportunities. Product Design teams develop, review and update Target Product Profiles to ensure they are feasible, in-demand, gender-equity-inclusivity (GEI) intentional, and impactful.
2. **PARTNER / TRANSFORM:** Breeding networks innovate and implement impact-oriented, sustainable partnership models in which partners (NARES, ARIs, SMEs, CGIAR) systematically contribute to innovation, priority setting, decision-making, and the development and delivery of farmer-valued cultivars.
3. **DISCOVER:** Trait discovery, development, and deployment teams are focused on essential traits for current and future market segments to integrate high-value haplotypes into elite genetic backgrounds. They exchange and use best practice breeding methods,

pursue and transform tools for trait integration, upstream science discovery, and delivery to CGIAR–NARES–SME breeding networks.

4. **OPTIMIZE / ACCELERATE:** CGIAR–NARES–SME breeding networks design and optimize breeding schemes for population improvement and product evaluation to maximize rates of genetic gain for targeted market segments. They track key performance metrics to drive improvements and identify innovation challenges.
5. **CREATE:** CGIAR–NARES–SME breeding networks produce candidate products for major food, food-feed, and forage crops, vegetables, and trees - breeding materials, elite parental lines, impactful varieties, breeds or clones - with the ability to drive transformative impact across the five Impact Areas.

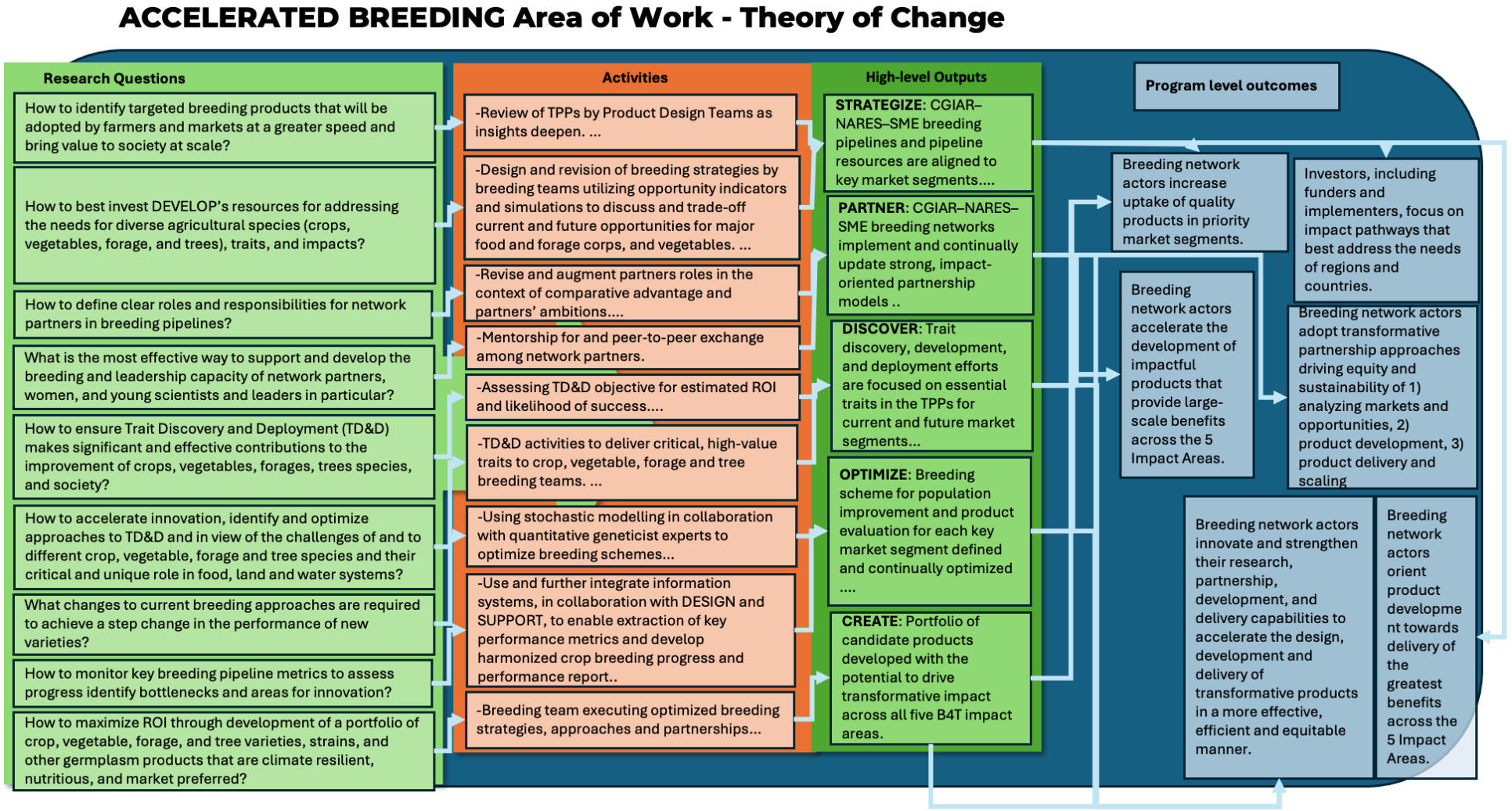

Figure 2. Theory of change of the ACCELERATED BREEDING Area of Work

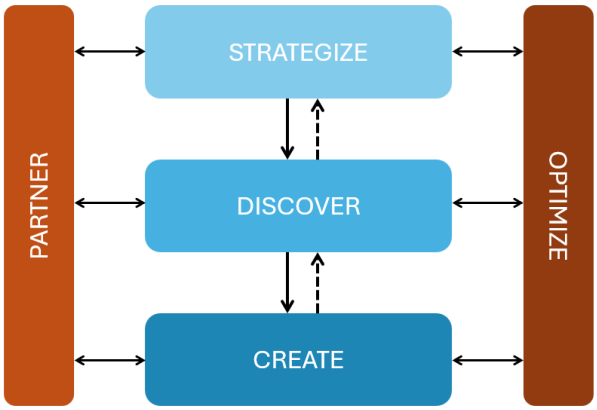

Figure 3. Overview of links among ACCELERATED BREEDING's high-level outputs

Research questions and sub-questions

STRATEGIZE/ReFOCUS (Breeding strategy):

How to identify targeted breeding products that will be adopted by farmers and markets at a greater speed and bring value to society on a scale?

> **Method/approach**: The following hypothesis will be tested: interdisciplinary and interinstitutional teams composed of key informants that have expert insight on what is impactful and gender-intentional (MARKET INTELLIGENCE), in-demand (MARKET INTELLIGENCE surveys and feedback from ACCELERATED BREEDING and INCLUSIVE DELIVERY), and feasible to develop (ACCELERATED BREEDING) are required to penetrate the complexity and agree on most impactful, high value, and realistic Target Product Profiles to be pursued.
>
> **Activity**: Review of TPPs by Product Design Teams as insights deepen. Advancement meetings that track decisions, perspectives, and learnings from stakeholders. Mentorship to augment interdisciplinary skills and actively incorporate lessons in TPP design to increase the ability to address farmers', markets', and society's needs.

How to best invest ACCELERATED BREEDING's resources for addressing the needs for diverse agricultural species (crops, vegetables, forage, and trees), traits, and impacts?

> **Method / approach**: The following hypothesis will be tested: aligning investments with impact opportunity indicators and establishing strategies that most effectively link trait and breeding pipelines to impactful TPPs and market segments can optimize resource allocation and value delivered to farmers and society. Innovative breeding strategies are required to both prioritize and pursue the diversity required in resilient, more productive, nutritious, climate adapted, less wasteful food, land, and water systems.
>
> **Activity**: Design and revision of breeding strategies by breeding teams utilizing opportunity indicators and simulations to discuss and trade-off current and future opportunities for major food and forage crops, and vegetables. Enhancements to the Breeding Portal to track breeding strategies, investments and results, and support decision making.

PARTNER / TRANSFORM:

How to increase partner engagement, create co-ownership, and design effective and equitable breeding networks that leverage and acknowledge the strengths and contributions of each member?

> **Method / approach**: The following hypothesis will be tested: a review of partners' roles and responsibilities, strengths, and change ambitions will reveal opportunities for

greater involvement of partners in developing and delivering mutually prioritized TPPs and market segments, the pooling of resources, joint priority setting, and decision making. This will increase motivation to engage, the visibility of partner contributions, equity, and the effectiveness of each partner's investment and efforts in achieving individual and common goals.

Activity: Revise and augment partners' roles in the context of comparative advantage and their ambitions. Build awareness about alternative partner models that attract support to breeding networks and partners' roles.

What is the most effective way to support and develop the breeding and leadership capacity of network partners, women, and young scientists and leaders in particular?

Method / approach: The following hypothesis will be tested: partners' breeding capacity will improve because of increased active involvement in developing network germplasm; providing virtual and physical capacity sharing opportunities for both applied breeding and innovation; and challenging participants to identify and co-create novel approaches and solutions to current bottlenecks.

Activity: Mentorship for, and peer-to-peer exchange among, network partners. Capacity sharing events and opportunities for women, young scientists, and leaders that exploit synergies with MARKET INTELLIGENCE, BREEDING RESOURCES, and CapSha. Joint identification of innovation challenges and co-creation of novel approaches and solutions through breeding networks.

DISCOVER[4]:

How to ensure Trait Discovery and Deployment (TD&D) makes significant and effective contributions to the improvement of crops, vegetables, forages, trees species, and society?

Method / approach: The following hypothesis will be tested: By considering the estimated return on investment (ROI) of each TD&D objective / targeted trait and the likelihood of success, TD&D investments will have greater impact. By developing a decision tree, TD&D breeding teams will make better decisions regarding TD&D objectives. Developing a detailed strategic plan for how TD&D outputs will be used by variety development breeders - including to what extent, when, and under which scenarios / circumstances - prior to starting trait deployment will lead to an increase in use of TD&D products and a decrease in extraneous TD&D activity.

Activity: Assessing TD&D objective for estimated ROI and likelihood of success. Develop decision trees for TD&D trait prioritization. Create strategic plans for how TD&D outputs will be used between TD&D and breeding teams.

How to accelerate innovation, identify and optimize approaches to TD&D and in view of the challenges of and to different crop, vegetable, forage and tree species and their critical and unique role in food, land and water systems?

Method / approach: The following hypothesis will be tested: novel genetic variation is key and plays a unique role for addressing climate resilience, malnutrition, end user preferences, input efficiency, greenhouse gas emission, and reducing the use of pesticides. Active innovation hunting from ARIs and the private sector, exchanging effective methods, learnings and protocols for the rapid identification and development of deployment-ready markers, high-throughput phenotyping and the sourcing of new traits, will increase speed, innovation and value delivered by TD&D teams to crop breeding teams.

Activity: TD&D activities to deliver critical, high-value traits to crop, vegetable, forage and tree breeding teams. Vanguard projects with ARIs and private sector that capitalize on discoveries and progress in genomics, sensor technology and analytics, artificial intelligence, information systems and others. Systematically augmenting

[4] All work in DEVELOP employing precision genetic technologies shall be resourced from W3/bilaterally operated projects.

TD&D teams' ability to utilize best practice approaches to pursue specific challenges of important crop, vegetable, forage and tree species.

OPTIMIZE / ACCELERATE:

What changes to current breeding approaches are required to achieve a step change in the performance of new varieties?

Method / approach: The following hypothesis will be tested: while pursuing crop specific challenges and therefore priorities and needs, breeding teams will increase the rate of genetic gain by optimizing breeding schemes and pipeline strategies; accelerating breeding cycles; implementing more accurate, relevant and appropriately scaled (genomic and phenotypic data-driven) approaches to identify best materials at earlier breeding stages while following TPP trait priorities; involving farmers and their environments earlier and at scale to identify those that meet their needs; and by increasing throughput and quality control.

Activity: Using stochastic modeling in collaboration with quantitative geneticist experts to optimize breeding schemes. Improving the precision and effectiveness of genomic and phenotypic selection aligned with trait priorities. Enabling larger-scale and earlier trialing under farmer-relevant conditions through new design and analyzes approaches. Innovating speed breeding and increasing throughput and quality control.

How to monitor key breeding pipeline metrics to assess progress and identify bottlenecks and areas for innovation?

Method / approach: The following hypothesis will be tested: by using connected data systems (such as Bioflow, the Breeding Portal, Enterprise Breeding System, Program Management Platform) key performance metrics (including genetic gain, quantitative genetics parameters), harmonized crop breeding progress and performance reports can be automatically generated, providing appropriate trials are designed and conducted including use of a recommended check strategy.

Activity: Use and further integrate information systems, in collaboration with MARKET INTELLIGENCE and BREEDING RESOURCES, to enable extraction of key performance metrics and develop harmonized crop breeding progress and performance report. Progressive harmonization of approaches to reduce transaction costs and extract the power of such systems.

CREATE:

How to maximize ROI through development of a portfolio of crops, vegetables, forage, and tree varieties, strains, and other germplasm products that are climate resilient, nutritious, and market preferred?

Method / approach: The following hypothesis will be tested: by combining the efforts of STRATEGIZE-ReFOCUS; PARTNER-TRANSFORM, DISCOVER, OPTIMIZE-ACCELERATE, global and regionally important breeding networks for crops, vegetable, forages, and trees will be empowered to create new varieties and strains with a step-change in performance that help society to address the challenges of climate change, chronic, and hidden hunger, and provide new opportunities for value generation and augmenting the resilience, sustainability, and diversity of food systems.

Activity: Breeding team executing optimized breeding strategies, approaches and partnerships to create varieties and strains that are valued, impactful and in-demand in distinct regions and countries, and by distinct constituencies and markets.

Emerging/new work and dropped work

Addressing the research questions described above represents emerging / new approaches that are logical "next steps" that build upon work conducted over the past seven years by the Accelerated Breeding Initiative (ABI) and/or Excellence in Breeding (EIB). Revision of the breeding strategy should result in greater alignment of breeding programs with impact opportunity indicators, which raises the possibility of the discontinuation of breeding for 25%-

35% of market segments with the lowest opportunity for impact. These resources will be reallocated to the market segments with the highest opportunity for impact, enabling the application of innovative approaches to develop better varieties faster. Including tree breeding in this portfolio, which was not in the scope of Accelerated Breeding, these innovative approaches will also represent emerging / new work. Most of the work funded by the Accelerated Breeding Initiative, development of improved varieties, will continue under ACCELERATED BREEDING.

High-level summary of internal/external partnerships

ACCELERATED BREEDING will drive collaborations among CGIAR Centers through the Global Crop Breeding Programs utilizing its global science, capacity, footprint and global shared services to develop better varieties faster.

ACCELERATED BREEDING will maintain existing and create new strategic and innovative external partnerships for developing improved, farmer-preferred crop varieties, aligned with comparative advantage and partners' ambitions. A key focus of ABI was developing strong engagement with NARES through CGIAR–NARES–SME partner networks, and these partnerships will continue. ACCELERATED BREEDING will expand these networks to include, where appropriate, other types of external partners, including advanced research organizations and universities. The goal is, for most (if not all) breeding activities, to be conducted collaboratively through these partner networks.

ACCELERATED BREEDING will focus on strengthening partnerships, particularly with NARES, to be more effective, with clearer attribution of contributions and an increased sense of ownership by partners of varieties developed. This will be achieved by assigning roles and resources for variety development according to comparative advantage and partners' ambitions. ACCELERATED BREEDING is also focused on building breeding capacity of partners. This will be achieved by:

- increasing partners' active involvement in modern breeding approaches as part of the breeding network, including ensuring partners' involvement is adequately resourced;
- empowering partners to take a greater leadership and/or decision-making roles in breeding networks;
- joint assessment of partners' research and breeding capacity;
- co-development of partners' breeding improvement plans.

Innovation, scaling and demand partners

ACCELERATED BREEDING will partner with the following organizations and organization types:

- NARES
- Advanced research institutes
- Universities
- Sub-regional organizations
- Small and medium enterprises
- Multi-national breeding companies
- University of Queensland BPAT team

Collaboration with other Programs/Accelerators

Internally, Breeding for Tomorrow operates as an integrated whole, with all AoWs fully interconnected. ACCELERATED BREEDING works with and/or relies upon the following AoWs in the following ways:

BREEDING RESOURCES: ACCELERATED BREEDING relies on tools and services provided by BREEDING RESOURCES to implement modern and/or improved breeding approaches.

ENABLE: ACCELERATED BREEDING's success will be enabled by the management and partnership frameworks and MELIA developed and managed by ENABLE.

MARKET INTELLIGENCE: Market intelligence from MARKET INTELLIGENCE, such as data on future market segments and product concepts (profiling products that are in-demand, impactful, and gender intentional) for future market segments, are required for Product Design Teams to review TPPs and breeding teams to optimize breeding strategies.

INCLUSIVE DELIVERY: ACCELERATED BREEDING relies on INCLUSIVE DELIVERY to support and strengthen seed systems so that improved varieties are delivered to, and adopted by, farmers. ACCELERATED BREEDING also requires market intelligence from INCLUSIVE DELIVERY regarding the current and future strength of seed systems in respective crop-by-regions to more effectively optimize the breeding strategy.

Across CGIAR and Programs, ACCELERATED BREEDING works with and/or relies upon the following Programs and Accelerators:

Sustainable Animal and Aquatic Foods will breed fish and livestock with similarities and overlaps in approaches and skills required, creating opportunities to collaborate and/or share approaches with plant breeding teams in ACCELERATED BREEDING.

Sustainable farming will provide ACCELERATED BREEDING with market intelligence about farming systems that improved varieties must perform in, including how to best test variety performance under farmer relevant conditions in the most important farming systems.

Genebanks will be invaluable sources of genetic variance if there is insufficient variance among elite germplasm.

Digital Capacity Accelerator, together with BREEDING RESOURCES, will provide ACCELERATED BREEDING with IT and data management tools and services.

Capacity Sharing Accelerator will support ACCELERATED BREEDING to develop capacity internally and with partners.

6.3 INCLUSIVE DELIVERY

Overall ambition

The overall ambition of INCLUSIVE DELIVERY is to accelerate the delivery of genetic gain to farmers' fields in the Global South. INCLUSIVE DELIVERY ensures that CGIAR's new generation of climate-resilient, nutritious, and market-preferred varieties will reach smallholder farmers through robust dissemination systems, and that they benefit farmers and other food system actors. Success will depend on the design and implementation of systematic strategies centered on context-specific scaling innovations to deliver CGIAR's co-designed and co-developed products: quality seed of improved varieties and associated innovations.

INCLUSIVE DELIVERY draws on decades of CGIAR expertise in building durable and inclusive partnerships to improve access to affordable improved varieties and quality seed for smallholders. INCLUSIVE DELIVERY's planned outcome is an increase in both the demand for and delivery of quality seed of climate-resilient, nutritious, and market-preferred varieties[5] to women and men smallholders.

To achieve this outcome, INCLUSIVE DELIVERY will focus its research on pluralistic seed systems and value chains, with an emphasis on (a) the interface between seed providers and farmers, and (b) the enabling policy and institutional environment required to facilitate the flow of products co-designed and co-created with partners under Breeding for Tomorrow's MARKET INTELLIGENCE and ACCELERATED BREEDING AoWs for selected geographies, countries, and market segments.

INCLUSIVE DELIVERY will play a facilitative role through in-depth engagement with partners, actionable data-driven research, and capacity sharing to position CGIAR as the go-to partner to move market-intelligent products from global and regional breeding programs to national delivery, extension, and scaling partners at multiple levels of operation. INCLUSIVE DELIVERY will, in effect, accelerate the pace at which CGIAR contributes to a demand-driven, partnership-based agenda to deploy innovative products to smallholders in the Global South.

Research questions and sub-questions

INCLUSIVE DELIVERY's research questions leverage CGIAR's sources of comparative advantage in conducting actionable research on seed sector development, including its (a) transdisciplinary teams deployable to priority research topics; (b) access to networks of innovation and scaling partners at the global, regional, and national levels; (c) strong relationships with government agencies and funders; (d) a credible and independent reputation and brokering position related to seed sector development; (e) scientific and technical expertise in seed technologies and systems, delivery and scaling strategies, gender and social inclusion, and public policy and regulation; and (f) underlying institutional incentives to conduct research-for-development on a cross-country, cross-crop basis that incorporates context-specificity and best-fit solutions.

Research Questions (see Appendix for sub-questions)

- Which strategies are effective in **accelerating the delivery of genetic gain to farmers' fields** given the diversity of end-users and their needs, and given the scarcity of resources for seed sector development?
- How can **linkages between and among seed sector actors** be improved to accelerate the delivery of genetic gain in farmers' fields?
- What strategies, approaches, and models are more likely to address the **gender, youth, and social inclusion** dimensions of seed sector development?
- How can **demand** for quality seed of improved varieties be better articulated, enhanced, and sustained among smallholder farmers and other seed sector actors?

[5] For the sake of brevity, we shorten this term to "quality seed of improved varieties" or simply "products" hereafter.

- Which **seed health, multiplication, and distribution technologies and systems** can increase the quantity and quality of seed of improved varieties delivered to women and men smallholder farmers and other seed sector actors?
- How can **emergency seed assistance and resilience programming in conflict-affected and fragile settings** be made locally relevant, more inclusive of marginalized social groups, less disruptive to local seed systems, and more resilient to shocks?
- How can the **measurement and monitoring** of seed sector development be improved?
- What are the **policy and institutional changes** required to strengthen the reach, inclusivity, and impact of seed sector development?
- What are the **technical and functional capabilities** required by national partners to advance inclusive and sustainable seed sector development?

Area of work's research and/or supporting activities as well as high-level outputs

INCLUSIVE DELIVERY is organized around three high-level outputs, a fourth cross-cutting high-level output, and feedback mechanisms between and among each output, as follows (see both Figure 4 and Figure 5).

- **POSITION:** Co-designed, evidence-based strategies to sustainably position quality seed of improved varieties and complementary innovations within inclusive and equitable seed systems.

POSITION's main research activities will: estimate and forecast demand for seeds and traits; co-design inclusive seed sector development strategies with partners, including seed road maps, value chains, targeting and inclusion strategies, models, and approaches; test, optimize, and validate demand-creation methods; assess product handover and delivery processes and performance; develop alternative varietal release and seed quality assurance systems; and develop solutions that improve emergency seed assistance and resilience programming in conflict-affected and fragile settings. Support activities will include participation in the coordination and alignment of the breeding-to-delivery pipeline with Breeding for Tomorrow AoWs; and establishing/maintaining multistakeholder platforms, networks, and partnerships for seed delivery and scaling.

- **DEPLOY:** Co-designed, cost-efficient, inclusive, context-specific technologies and strategies to facilitate increased production and delivery of quality seed of improved varieties.

DEPLOY's main research activities will: develop efficient and effective seed health, multiplication, and distribution technologies and systems for multiple seed classes; jointly implement viable delivery, scaling, and business strategies, models, and approaches; introduce and institutionalize alternative varietal release and seed quality assurance systems; and implement solutions that improve emergency seed assistance and resilience programming in conflict-affected and fragile settings. Support activities will include efforts to support partners' seed health, multiplication, and distribution technology and system development, and advance and refine handover and delivery processes for and with seed sector actors.

- **TRACK:** Co-designed, validated, low-cost, and effective methods and tools to assess and share data and analysis on varietal adoption, varietal turnover, seed replacement, quality seed use, and information uptake at scale.

TRACK's research activities will: collect, analyze, and share data on varietal testing, registration, and release, early generation and quality seed production and distribution; design and validate methods and tools for varietal identification and seed tracing; and monitor and analyze patterns and trends in the adoption of improved varieties and quality seed, including the gender and social inclusion dimensions of adoption. Support activities include the development and institutionalization of data collection and analysis systems for varietal release, varietal identification/adoption/turnover, seed traceability/replacement, seed

supply/demand, and other key performance indicators, with both internal and external platforms for sharing data and analysis.

- **POWER:** Innovative partnerships, technical and functional capabilities, best-fit policy and regulatory solutions, and gender and social inclusion intervention to accelerate the delivery of quality seed of improved varieties.

POWER's research activities will: clarify, analyze, and assess policies and regulations related to regulatory harmonization and seed trade, varietal release, and seed quality assurance systems; design, analyze, and validate best-fit solutions to increase the participation and benefits for women, youth, and marginalized social groups in seed production, entrepreneurship, and policy consultation; design and test strategies that integrate seed into social protection/inclusion/resilience programs, socio-technical innovation bundles, and gender-transformative mechanisms. Support activities will include: close engagement with INCLUSIVE DELIVERY's teams on cooperation with multistakeholder platforms, partnerships, and networks to advance seed sector development; development of technical and functional capabilities of seed sector actors to participate in, benefit from, and affect change; and collaboration with partners to improve their capacity to monitor and assess the impact of seed sector interventions to better inform evidence-based decision-making.

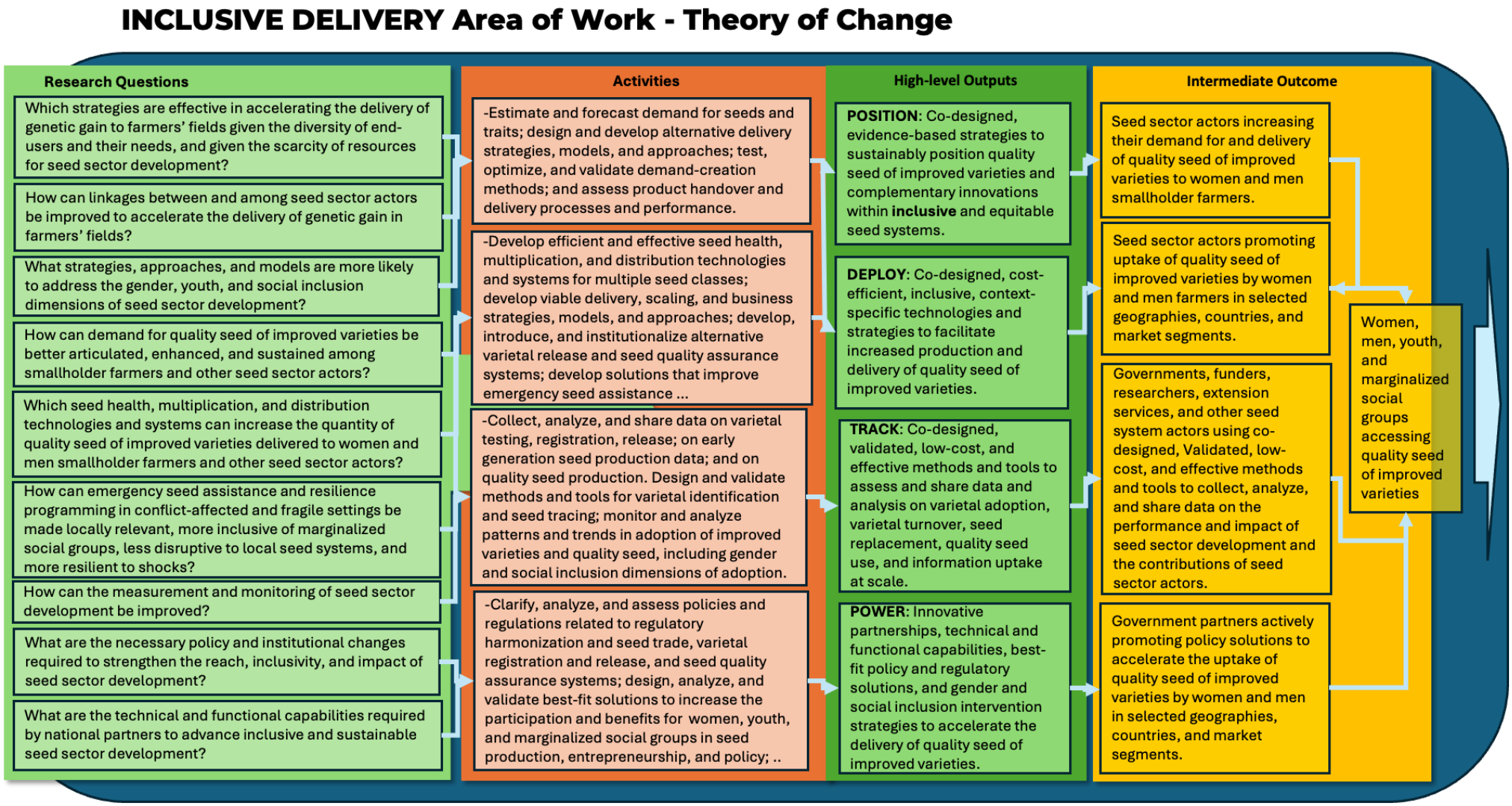

Figure 4. Theory of change of the INCLUSIVE DELIVERY Area of Work

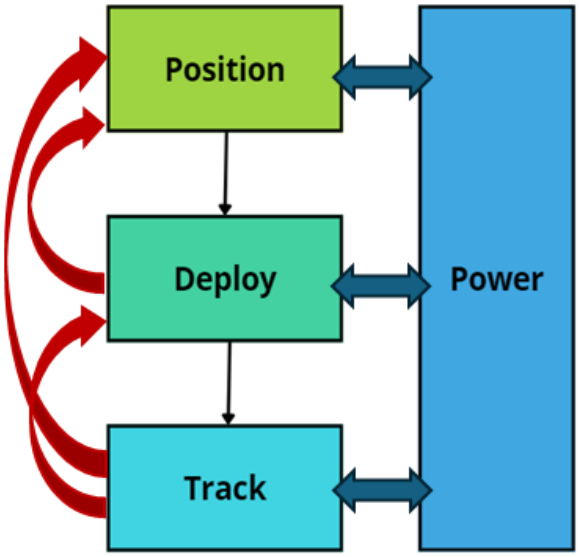

Figure 5. INCLUSIVE DELIVERY's high-level outputs

Note: The figure highlights INCLUSIVE DELIVERY's "pipeline" structure, the cross-cutting role of Power, and feedback loops.

Continuation of established work from Seed Equal (~ 80%)

INCLUSIVE DELIVERY's four high-level outputs are a reconfiguration of Seed Equal's seven work packages. This ensures a clear continuation of Seed Equal's work, including core activities such as co-developing innovative delivery strategies, capacity sharing with national partners, monitoring varietal turnover and quality seed use, catalyzing seed value chain actors to invest in production and delivery, and strengthening resilience and inclusivity in seed systems. The reconfiguration also creates opportunities to improve efficiency with closer integration across Seed Equal's crop archetypes, its cross-cutting policy work, and its work on gender/social inclusion, while maintaining flexibility for each of these communities to develop their own research space.

Emerging/new work (~20%)

INCLUSIVE DELIVERY's new, emerging, and expanded work falls under the following areas: (a) development of a public-facing digital seed systems platform; (b) internal digital integration; (c) expansion to vegetables, trees, agroforestry, forages, food-feed, and opportunity crops; (d) novel seed health, multiplication, and distribution technologies and systems; (e) emergency seed assistance and resilience programming in conflict-affected and fragile settings; (f) expanded work on women, youth, and social inclusion; (g) innovation in capacity sharing; (h) seed trade and regulatory harmonization; and (i) scaling strategies, business models, and innovation bundles.

Dropped work

INCLUSIVE DELIVERY will reorganize the structure of Seed Equal's work packages into the activity clusters described above, effectively integrating crop archetypes with work on policy and regulation, and gender and social inclusion, while also providing an opportunity for each of these research communities to stake out their own space within the AoW. INCLUSIVE DELIVERY will also reallocate its work on genetic resources policy (including technology transfers and licensing) and causal impact evaluation to ENABLE given the cross-cutting nature of these topics for all of Breeding for Tomorrow.

High-level summary of internal/external partnerships

Narrative high-level summary of partnerships

INCLUSIVE DELIVERY will maintain existing partnerships and forge new partnerships to enhance both the demand for and delivery of quality seed of improved varieties. **Scaling partners** that play a direct role in the seed value chain include private seed companies, state-

owned seed production units, public research systems, community-based seed producers, seed entrepreneurs, agro-dealers, women's/men's farmer organizations/cooperatives, traders, and other value chain actors. Scaling partners that play an indirect—but equally important role—include extension and advisory services, non-governmental organizations, financial service providers, and public programs for social protection/inclusion/resilience. **Innovation partners** that contribute to strengthening the enabling scientific, technical, policy, and institutional environment for seed sector development include key ministries, regulatory agencies, public research systems, universities, think-tanks, and farmer and industry associations. **Within CGIAR,** INCLUSIVE DELIVERY will collaborate with key Programs and Accelerators (see Appendix for details).

How to achieve equitable research, scaling, and impact partnerships

Building on CGIAR's Engagement Framework for Partnerships and Advocacy (v2.0), INCLUSIVE DELIVERY will continue Seed Equal's efforts to build equitable and sustainable partnerships that are grounded in mutual trust and understanding. INCLUSIVE DELIVERY will prioritize deep, long-term engagement with its innovation and scaling partners to better understand their priorities, build effective collaborations, and make resources available to support their own objectives.

Gender and social inclusion will also be central to INCLUSIVE DELIVERY's new and established partnerships. The incorporation of gender and social inclusion into all four of INCLUSIVE DELIVERY's HLOs (and their research questions articulated above) will enable INCLUSIVE DELIVERY to better identify and scale strategies that (a) provide equitable access to quality seed of improved varieties for women, youth and marginalized social groups, and (b) promote women and youth entrepreneurship in seed production and marketing, including financial and digital inclusion, and technical and business skill development.

Collaboration with other Programs/Accelerators to deliver on key outputs or outcomes

INCLUSIVE DELIVERY's success will depend significantly on the approaches, tools, expertise, and partnerships of other Programs and Accelerators. INCLUSIVE DELIVERY will collaborate with the Policy Innovations, Better Diets and Nutrition, and Scaling for Impact Programs, and the three Accelerators (see Appendix for details).

6.4 BREEDING RESOURCES

Overall ambition

Breeding for complex and multi-trait products requires modern breeding methods. The potential for predictive modern breeding can be enhanced by shared services based on community data collection, data sharing, and integrated platforms for local and multi-user meta-analysis. BREEDING RESOURCES will centralize the provision of required services defined by ACCELERATED BREEDING across CGIAR-SME-NARES networks to ensure consistency for interoperability and facilitate leveraging across and beyond the breeding network.

Between 2022 and 2024, the Breeding Resources Initiative successfully established innovative shared services and operational support to crop breeding networks operating in Africa, Asia and Latin America (see the List of Shared Services in the Appendix). Development of services serves as a foundation for establishing operational excellence through process and continuous improvement activities in service development and delivery. BREEDING RESOURCES will build on this and expand by capitalizing on synergies and scale for more cost-efficient crop-agnostic services. Benefits from the next generation of shared services will emerge as breeding programs across Centers and NARES seamlessly work together with equitable access to context and purpose tailored technologies.

Building on the successful establishment of the Breeding Resources Initiative, BREEDING RESOURCES will make its portfolio of services available beyond core CGIAR breeding networks for equitable use across food, land, and water systems. BREEDING RESOURCES will create a critical mass of diverse users adopting consistent shared services to facilitate connected yet independent and locally driven efforts that can fully leverage resources across the breeding network and beyond. This will empower new regional and local leadership in breeding, facilitate connections with agronomy, and harness the comparative advantage of the full CGIAR and partners' network.

BREEDING RESOURCES's vision looks beyond 2030, to locally empowered breeding, connected through a portfolio of services, that enables global leveraging of technology, knowledge, and breeding innovations for maximum impact. This long-term vision will require BREEDING RESOURCES to develop an organizational structure that optimizes equity of access, service provision, and financial sustainability.

To achieve this vision, BREEDING RESOURCES will focus on lessons from the Breeding Resources Initiative and address the current financial risks to the long-term provision of services and associated collaborative advantages. Users need to be guided in interpreting and applying results with adjunctive experiential learning to embed capacity. Equal access to services requires technologies to be tailored across scales to create viable options for local contexts, with varying levels of resources and capacity. In addition, a critical mass of widespread service use will need an understanding of the motivations and barriers to technology adoption by breeding programs. There are specific capacity limitations, for example in financial literacy and standardized operational procedures (SOPs) which create barriers to adoption, and longer-term technology adoption motivations can be increased by transparently monitoring user defined service specific targets.

Research objectives

In response to the learnings mentioned above, the following three objectives have been identified (see Appendix for more details):

Objective 1: Leverage shared services and support to accelerate long-term adoption and implementation of modernized breeding.

The Breeding Resources Initiative has established a portfolio of shared services (CGIAR Services Portal). BREEDING RESOURCES will facilitate ongoing maintenance and lead efforts to adapt and

evolve services to meet the current and future needs of users, with adjunctive support that embeds experiential learning and demonstrates the value of services adopted. This will create longer-term demand, laying the foundations for an efficient and effective sustainable portfolio of shared services that is valued by a diverse user base beyond 2030.

Objective 2: Equitable use of shared services to transform food, land, and water systems.

The experience of Breeding Resources in building and delivering shared services and operational support has prepared BREEDING RESOURCES to offer services beyond breeding networks.

Objective 3: Scaling of shared services to empower 'hub' and 'spoke' style connected partnerships.

BREEDING RESOURCES's vision of local empowerment requires services that are appropriately scaled to align with the varying needs and capacities of breeding programs.

Area of work's research and/or supporting activities as well as high-level outputs

BREEDING RESOURCES is organized around three high-level outputs (see Figure 6).

GLOBAL SHARED SERVICES: A portfolio of shared services that meets current and emerging user needs, delivered by an organizational structure that is prepared for beyond 2030.

GLOBAL SHARED SERVICES reflects the need for the established shared services to evolve based on 1) actual end-user input, including feedback on Breeding Resources' shared services and broad consultation with prospective CGIAR and NARES users; and 2) emerging and future technologies (for example in lab analytics and diagnostics, artificial intelligence, and IT system integration). Maintaining currency of the portfolio will require collaboration with innovators and early adopters within breeding programs, non-CGIAR centers, ARIs and NARES to leverage learnings into transferable, scalable and crop-agnostic applications that minimize the technology transfer lag to developing countries. User informed evolution of the portfolio will prevent the Breeding Resources services from becoming obsolete or less relevant over time and mitigate the risk of loss of users limiting the collaborative advantage gained through shared services, interoperability and multi-user meta-analysis.

A portfolio of services that range in costs will support equitable use of shared services across a broadened user base of diverse user-contexts. For example, in the case of bulk access to services by a commercial third party, the costs of negotiation and management of bulk access will be borne by BREEDING RESOURCES. In comparison, where BREEDING RESOURCES can directly provide competitive or unique services, some level of cost-recovery may be appropriate (see attached services list). Individual services will have varying levels of financial sustainability, with the overall portfolio designed for an optimal (not maximized) level of cost recovery. Establishing business-like structures for BREEDING RESOURCES is an important risk management step for longer-term provision of services, beyond 2030.

Achieving this objective will overcome informational barriers to integration and collaboration across teams that go beyond breeding and address financial and other capacity disparities across service users.

DIGITAL SOLUTIONS: Clients of shared services are supported to maximize alignment of data with FAIR principles in alignment with governance mechanisms.

DIGITAL SOLUTIONS will provide a platform facilitating more efficient data collection processes, access to comprehensive analysis tools, and supporting evidence-based practices for data sharing to unlock data driven decision-making spanning transdisciplinary teams. The linkages established with Sustainable Farming, Genebank, and the Digital Accelerator can be leveraged to encourage this collaboration. DIGITAL SOLUTIONS will spearhead a collaboration with the Digital Transformation Accelerator to develop underpinning data infrastructure for data sharing across research platforms. A common data interoperability standard will be developed and used to connect and collaborate.

SCALE: Hub and Spoke style partnerships developed with regional partners, effectively working together as supported by scaled services, to expand the reach of genetic innovations

SCALE will empower CGIAR Centers and NARES that are currently operating as hubs to provide leadership within their respective regions if appropriately scaled services are available to support their extended network (spokes). The services provided to spokes will need to match resources and be delivered with adjunctive support that lifts and embeds capacity, enabling ongoing development of the collective network. The strategy of scaled services with interoperability will encourage collaboration between hubs and spokes, respecting and promoting existing regional relationships. Achieving this objective will promote technology diffusion, broaden the inclusion of less resourced countries, and ultimately extend the benefits of breeding to more beneficiaries. It will require a tailored package of services that enable less resourced countries to effectively engage with breeding efforts, while harnessing strategic opportunities to make valued contributions to global breeding efforts, access improved varieties, and efficiently deliver benefits to small scale farmers. Services will be developed that are adapted to local contexts to align with the shared services capacity and operations available. Activities will include pilot incubators to co-develop more appropriately scaled services with spokes, with participatory research to learn together while testing the model, informing guidance materials for effective hub and spoke partnerships. Hubs and spokes for pilots will be selected following a process of self-nomination, technical assessment, and determination of likely transferability of learnings and outputs to the broader network.

Continuation of established work from the Breeding Resources Initiative (~ 80%)

BREEDING RESOURCES's three high-level outputs are a reconfiguration of Breeding Resources Initiative's five work packages. This ensures a clear continuation of Breeding Resources Initiative's work, including core activities of developing and delivering the shared services including breeding databases, such as the Enterprise Breeding System. The reconfiguration also creates opportunities to improve efficiency and effectiveness of the shared services while contributing towards optimizing the cost of breeding programs across the networks.

Emerging/new work (~20%)

BREEDING RESOURCES's new, emerging, and expanded work fall under the following areas: (a) development of business structures for future sustainability of shared service delivery; (b) collaboration with the Digital Transformation Accelerator to develop underpinning data infrastructure (c) supporting hub-and-spoke style partnership including partnership guidance, needs assessments, and scaled services and (d) establishing hub and spoke pilot incubators to co-develop scaled services in participatory action research.

Dropped work

BREEDING RESOURCES will reorganize the structure of the Breeding Resources Initiative work packages into the activity clusters described above and increase emphasis on adjunctive adoption support to empower service users.

High-level summary of internal/external partnerships

Narrative high-level summary of partnerships

BREEDING RESOURCES will maintain existing partnerships and forge new partnerships to enhance both the demand for and delivery of shared services and breeding IT. The hub-and-spoke style partnerships will play a direct role in the scaling of shared services while empowering the partners to implement operational excellence and continuous improvement in their breeding operations. BREEDING RESOURCES will also continue to work with existing and new innovation partners to strengthen our existing shared services while also introducing new enabling tools and technologies for

the benefit of breeders and researchers. Within CGIAR, BREEDING RESOURCES will collaborate with key Programs and Accelerators (see Appendix for details).

Collaboration with other Programs/Accelerators to deliver on key outputs or outcomes

BREEDING RESOURCES's success will depend significantly on the approaches, tools, expertise, and partnerships of other Programs and Accelerators. BREEDING RESOURCES will collaborate with the Sustainable Farming Program, Digital Transformation Accelerator, and Genebanks.

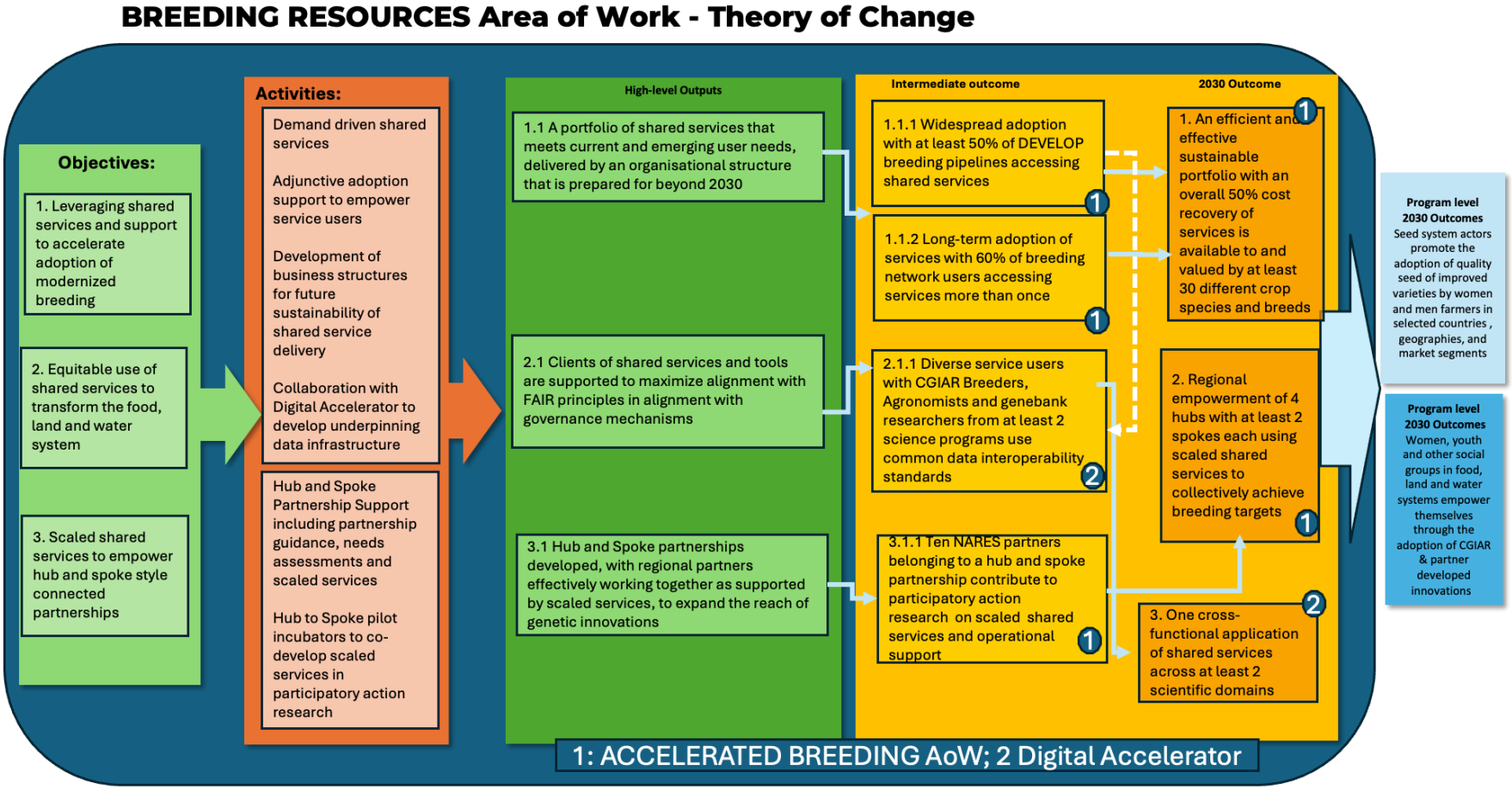

Figure 6. Theory of change diagram for BREEDING RESOURCES Area of Work

6.5 ENABLE

Overall ambition

The overall ambition of ENABLE is to address the complex challenge of designing an effective and efficient coordination and support system across different functions, diverse partners, and dynamic priorities within global, national, and regional breeding and product delivery pipelines. CGIAR and its partners believe it is critically important to increase the efficiency, effectiveness, and inclusivity of their joint efforts along the Breeding for Tomorrow product definition-development-delivery continuum. This requires renewed and enhanced investment in designing coordination mechanisms, leveraging excellence in management, lowering fragmentation and repetition of efforts, remedying stakeholder and funder fatigue, improving internal and external communications on activities, opportunities, challenges, strategies, performance and impact, and encouraging innovation in the design, development, and delivery of new products.

ENABLE's key focus is strategic cross-cutting capability development, making breeding processes and ultimate outcomes more inclusive, equitable, and transparent, synergizing the outcomes from the individual AoW within Breeding for Tomorrow. ENABLE will support the delivery of other AoWs in a manner that lowers individual transaction costs and focuses on delivering impact across the Breeding for Tomorrow continuum rather than maximizing output in one AoW alone. Through its dedicated focus, it will also support the design and deployment of a comprehensive communication strategy to drive Breeding for Tomorrow's effectiveness and showcase the Program's innovations and achievements.

Research questions and sub-questions

ENABLE's research questions leverage CGIAR's sources of comparative advantage as a network of Centers with global and regional breeding mandates, extensive geographical footprint, and broad partnerships within breeding networks reaching through to national partners (see Figure 7). This position gives unique cross-commodity and cross-border scope to deliver the desired high-level outputs of ENABLE and contribute to the outcomes of Breeding for Tomorrow. The research questions of ENABLE reflect upon the ambition to build upon the work of the GI Initiatives, the Excellence in Breeding platform, and bilateral projects to maximize the transparency, accountability and inclusivity of Breeding for Tomorrow activities. The research questions we propose to address are as follows:

- How can breeding and delivery activities be strengthened to improve co-ownership among partners and clarity in partners' roles and responsibilities in a systematic and coordinated manner across the Breeding for Tomorrow ecosystem?
- How can capacity-sharing strategies be designed and executed in a coordinated and effective manner across the Breeding for Tomorrow ecosystem?
- What organizational structures, resource allocations, and incentive mechanisms are required to advance impact-aligned strategic portfolio and innovation management for the Breeding for Tomorrow ecosystem?
- What are the impacts of Breeding for Tomorrow's breeding and delivery activities in selected geographies, countries, and market segments?
- What policies, regulations, rules, procedures, and practices are required to ensure that Breeding for Tomorrow outputs are shared with and utilized by intended end-users in an efficient, effective, and equitable manner aligned with international treaties and national laws?

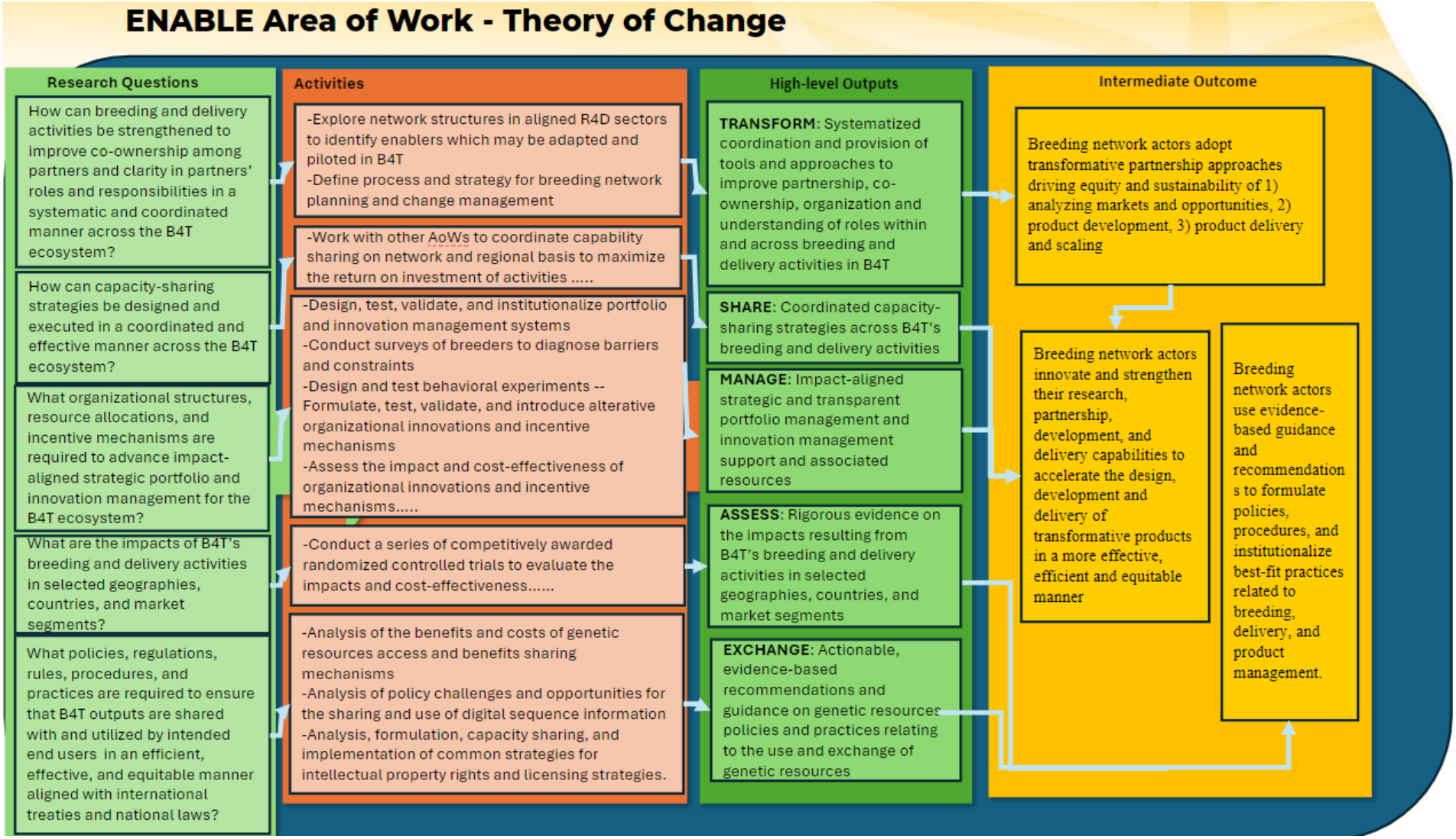

Figure 7. ENABLE's theory of change

ENABLE's high-level outputs

ENABLE is organized around five high-level outputs, each addressing a different facet of the overall research and coordination effort needed to enhance the delivery of Breeding for Tomorrow:

1. **TRANSFORM:** Systematized coordination and provision of tools and approaches to improve partnership, co-ownership, organization and understanding of roles within and across breeding and delivery activities in Breeding for Tomorrow
2. **SHARE:** Coordinated capacity-sharing strategies across Breeding for Tomorrow's breeding value chains and impact pathways
3. **MANAGE:** Impact-aligned strategic and transparent portfolio and innovation management support and resources
4. **ASSESS:** Rigorous evidence on the impacts resulting from Breeding for Tomorrow's breeding and delivery activities in selected geographies, countries, and market segments
5. **2EXCHANGE:** Evidence-based recommendations and guidance on principles and practices relating to the generation, use, and exchange of breeding products.

The above outputs are achieved through deep engagement and clear communication with, and buy-in from, Breeding for Tomorrow partners who are critical to delivering the strategic vision of ENABLE. See Appendix for details on research and supporting activities.

Continuation of established work, emerging work, and areas to be dropped

Opportunities to enhance breeding and delivery through better partnerships, management, and policy support were well recognized during the development of CGIAR Initiatives in the 2022-24 Portfolio. Positive efforts within and across Centers, Initiatives, and projects were undertaken to realize these opportunities, including in the following areas:

Harmonizing organizational terminology and breeding conceptualization to clearly articulate organizational functions and forms, as well as team and individual roles, responsibilities and accountabilities therein. Work on this area is already established within ACCELERATED BREEDING, though continued effort to define and use RACI-aligned[6] stage plans will be required for MARKET INTELLIGENCE and INCLUSIVE DELIVERY.

Coordinating partnerships across the product design, development, and delivery spaces, reflecting a transition to broader and more inclusive network approaches to breeding and delivery in response to feedback from NARES partners. This work was established within all GI Initiatives mapping to Breeding for Tomorrow's AoWs, but not harmonized across. Continuation of coordination efforts is required to support achievement of the desired inclusivity along the value chains of focus.

Portfolio conceptualization and documentation using an Innovation Management lens including collaboration frameworks based on crop archetypes (cereals; legumes; roots, tubers, and bananas; and opportunity crops), coupled with learning strategies to optimize partner experiences and harmonization of breeding and delivery objectives facilitating clear documentation, communication and understanding of goals and activities. Work across the GI Initiatives saw the development of new conceptual frameworks and associated tools within this space. The mainstreaming and refinement of these frameworks and tools will continue in Breeding for Tomorrow to drive both (a) interconnectivity within and across breeding networks and of AoWs, and (b) transparency of priorities, activities and progress of breeding. Leveraging of innovation

[6] RACI ("responsible, accountable, consulted, and informed") is an acronym used in project management to describe the roles of an organization, team, individual or other entity in completing activities and producing outputs/deliverables.

management approaches from other R4D organizations such as NASA will be one of the emerging work areas for ENABLE.

Holistic impact assessment activities including more rigorous approaches to identifying causal effects using experimental and quasi-experimental methods and a diversity of data types and sources. Although CGIAR and partners have conducted impact assessments of crop improvement activities for decades, there is an opportunity to systematize these assessments and improve their rigor. Efforts in the GI Initiatives saw these activities become more focused and more targeted in understanding causal relationships across a range of products, innovations, and market segments. Outcomes and results will inform critical reflection on past and current efforts to inform future strategies and approaches in the Breeding for Tomorrow Program. Continuation is critical to not only document outcomes and impact but to better steer Breeding for Tomorrow toward meeting the needs of end-users.

Efforts to identify and respond to capacity-sharing needs and opportunities across the entire breeding-to-delivery pipeline at the level of networks, organizations, and individuals. Efforts in this space were pursued in the GI Initiatives, but scaling and mainstreaming of work is needed to achieve a clear overview of the key design to deliver capacity-sharing intervention points that may accelerate and improve the effectiveness of product delivery to farmers, thereby taking us from AoW-specific needs to a broader value chain perspective on the highest value actions.

Efforts to design and test organizational innovations that aim to enhance transdisciplinarity in informing decision-making and to foster horizontal and collaborative interactions across social and biophysical scientists. This includes data-driven adjustments to incentive mechanisms for facilitating collaboration between breeders and social scientists. Work to foster transdisciplinary and inclusivity was broached within the GI Initiatives, and coordinated continuation of these endeavors under ENABLE will strengthen the breadth of expertise and understanding within Breeding for Tomorrow.

Developing principles for breeding product development, exchange, and sharing. Efforts in this area are highlighted by a cross-cutting CGIAR working group and cross-Center discussions involving CGIAR genebanks, breeding programs, delivery activities, and precision genetics research teams for crops, forages, livestock, and aquatic species. An expansion of this work is needed to inform and provide recommendations to breeding product development.

ENABLE will build upon and strengthen these activities by bringing them into one coordinated Area of Work rather than individual pockets of excellence within Initiatives.

High-level summary of internal/external partnerships

Narrative high-level summary of partnerships

ENABLE's HLOs are achieved through engagement, clear communication and buy-in from Breeding for Tomorrow breeding network actors described in the other AoWs. Key partners that will contribute to the enabling scientific, technical, policy, and institutional environments that ENABLE seeks to foster include ministries of agriculture and environment, regulatory agencies, advanced research institutions, universities, think-tanks, non-governmental organizations, and regional/sub-regional development organizations.

How to achieve equitable research, scaling, and impact partnerships

ENABLE's underlying driver is the achievement of impactful, effective, and efficient breeding through transparent, equitable, and informed partnerships and networks. ENABLE does not formulate breeding network partnerships itself but supports other AoWs to do so in a manner infused with an ethos of transparency and openness, data-driven reflection, decision-making, and trust.

Collaboration with other Programs/Accelerators to deliver on key outputs or outcomes

ENABLE (and Breeding for Tomorrow in general) will establish clear and regular lines of communication to enhance cross-program understanding, coordination, and co-development opportunities. Actors within the Breeding for Tomorrow ecosystem are the primary contacts for ENABLE. Broader system actors who align most closely with ENABLE include the Sustainable Animal and Aquatic Foods Program (focusing on frameworks and tools for innovation management), the Sustainable Farming Program (for coordination and leveraging complementarities), and the three Accelerators (to help build the essential architecture for innovation management).

7. Country integration

7.1. Example of integration in a country or set of countries

Breeding for Tomorrow will adopt a co-creation approach that engages partners across all CGIAR's defined regions and the 107 countries in which it is active, building on its longstanding collaborative networks with NARES and SMEs, and expanding its focus to serve food systems' needs. This co-creation approach is firmly grounded in creating target product profiles (TPPs) for specific market segments, where partners in CGIAR-NARES-SME networks contribute to the Breeding for Tomorrow's AoWs by contributing to the design, development, and delivery of genetic gain in farmers' fields, while also benefiting from Breeding for Tomorrow's ENABLE activity and BREEDING RESOURCES functions (see Figure 8). The division of breeding network roles is based on comparative advantages, with CGIAR largely playing an upstream role in supporting inter-country integration among national TPPs, favoring intra-country synergies across TPPs and partners, and facilitating fund-raising for specific impact opportunities (Figure 8).

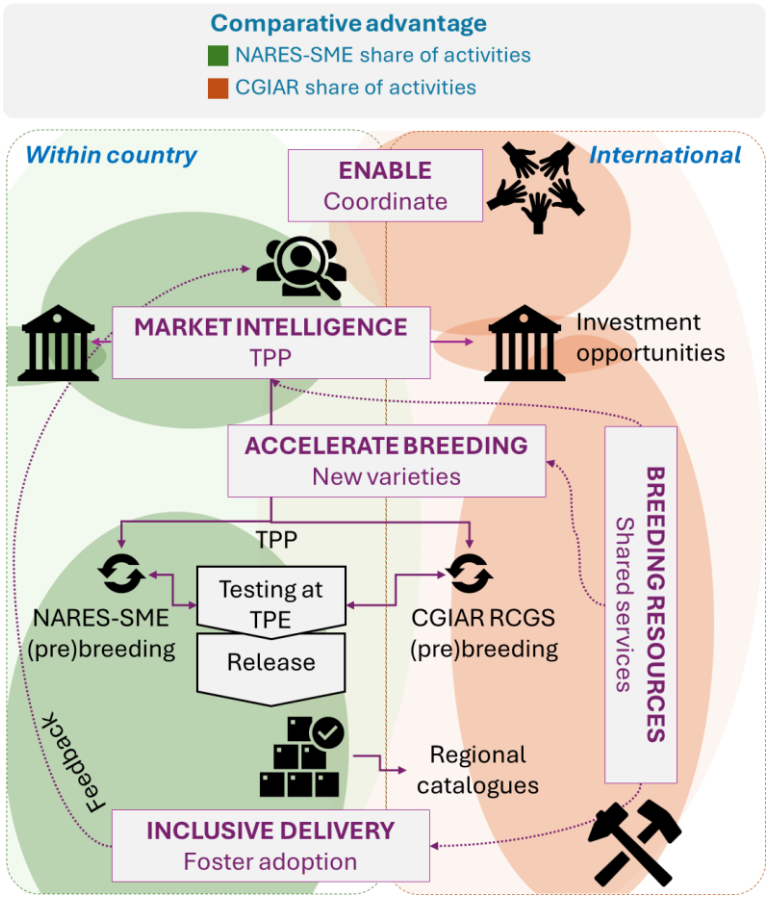

Figure 8. Fostering co-creation in Breeding for Tomorrow

Note: The figure depicts the co-creation process at the national and global levels with CGIAR-NARES-SME networks and the Breeding for Tomorrow AoWs. Darker background coloration (orange – CGIAR; green – NARES-SME) defines greater comparative advantage for the specific activity within the breeding network

CGIAR has observed considerable success with this approach since 2020 and will scale it further in Breeding for Tomorrow. In 2022 and 2023, NARES leadership meetings in Nairobi, Marrakech, and Istanbul brought together high-level representatives of NARES and Regional Groups to define a shared path forward gathering country and regional level learnings for informing breeding work (see here, here, and here). Breeding for Tomorrow's foundation stands on the recommendations and action items resulting from these events to seek greater engagement with more diverse partners, more cross-CGIAR synergies to favor impact, and a firm commitment to transfer more activities and resources to partners. Breeding for Tomorrow will also facilitate the integration of other GCIAR Programs and Accelerators within the partner network, defining formal "hand-over" mechanisms to further maximize adoption and impact.

To showcase Breeding for Tomorrow's vast global reach, we highlight below one example for each CGIAR-defined target region, where integration of CGIAR capabilities has led to significant impacts, and where good science and deep partner collaboration are expected to deliver continued impacts.

In **Ethiopia** (East and Southern Africa)**,** Breeding for Tomorrow counts 71 TPPs covering most CGIAR crops, with all CGIAR Centers actively partnering with SME-NARES breeding networks to breed and deliver improved varieties and quality seed[7]. Many successes have been achieved through these collaborations. Recently, the 2024 launch of the National Potato and Sweet potato Development Strategy[8] , and projects such as[9] Provision of Adequate Tree Seed Portfolios[10] and seed systems for vegetable crops have been recognized by the local Ethiopian Government as "*essential for Ethiopia's large landscape and livelihood improvement programs.*" In 2023, Dr. Akin Adesina, the president of African Development Bank (AFDB), provided another example of success when he stated: "*…Heat-tolerant wheat varieties delivered by TAAT* [the Technologies for African Agricultural Transformation program] *allowed the country to expand area under cultivation* [and] *…in just three years, Ethiopia achieved self-sufficiency in wheat and expects to be a net exporter of wheat by this year [..] An amazing achievement!"*[11]

In **India** (South Asia)**,** Breeding for Tomorrow counts 52 TPPs spanning most CGIAR and vegetable crops, positioning it as a country with the largest impact opportunity for Breeding for Tomorrow based on GloMIP data. The historical partnership between India and CGIAR dating back to CGIAR's inception remains strong today under the guidance of the Indian Council of Agricultural Research (ICAR). Since 2017, annual meetings between ICAR and CGIAR have been held to ensure that collaborative research-for-development and co-creation of innovations remain at the top of the shared workplans. In its first summary document on ICAR-CGIAR cooperation achievements, H.E. R.M. Singh, then Minister of Agriculture and Farmers Welfare, declared that, "*There has been a long association*

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[7] Ethiopian Ministry of Agriculture. 2019. *Transforming the Ethiopian Seed Sector: Issues and Strategies*. Addis Ababa: MoA. https://ensp-seed.org/2019/11/22/transforming-the-ethiopian-seed-sector-issues-and-strategies/.

[8] Maru, J., Kirui, L., Saikah, S., and Gebeyehu, S., 2024. Launch of the National Potato and Sweetpotato Development Strategy of Ethiopia. CGIAR Blog. https://hdl.handle.net/10568/145146.

[9] Mekonnen, D.K., Abate, G.T., Yimam, S., Benfica, S., Spielman, D.J., and Place, F., 2021. *The Impact of Ethiopia's Direct Seed Marketing Approach on Smallholders' Access to Seeds, Productivity, and Commercialization*. IFPRI Discussion Paper 1998. Washington, DC: IFPRI. https://doi.org/10.2499/p15738coll2.134247.

[10] Provision of Adequate Tree Seed Portfolio in Ethiopia (PATSPO) project. World Agroforestry Centre. https://www.worldagroforestry.org/project/provision-adequate-tree-seed-portfolio-ethiopia.

[11] Speech by Dr. Akinwumi A. Adesina, President, African Development Bank Group at the Agribusiness and Science Week Forum for Agricultural Research in Africa, Durban, South Africa. June 5, 2023. https://www.afdb.org/en/news-and-events/speeches/speech-dr-akinwumi-adesina-president-african-development-bank-group-agribusiness-and-science-week-forum-agricultural-research-africa-durban-south-africa-june-5-2023-61817.

between CGIAR institutions and Indian NARES, and their mutual collaborative efforts have contributed immensely in achieving a remarkable growth in food production in India".[12]

In **Nigeria** (West and Central Africa)**,** Breeding for Tomorrow counts 45 TPPs spanning all CGIAR Centers. Nigeria's Minister of Agriculture and Rural Development, Alhaji Muhammad Sabo commended the release of CGIAR-derived cassava varieties, stating that: *"the foundation of a solid crop value chain is based on best-bet varieties. As a country, we are excited that the new NextGen cassava varieties address the needs of the cassava industry…"*[13]*.* Similarly, Chiedozie Egesi, Executive Director of Nigeria's National Root Crops Research Institute (NRCRI) commended *"the releases [of improved potato varieties] mark a significant milestone as they are the first varieties to be introduced in Nigeria in over a decade, incorporating modernized breeding technologies supported by the CIP breeding program and the national program of Nigeria."* [14]

In the **Philippines** (South-East Asia)**,** Breeding for Tomorrow counts 4 TPPs, spanning three CGIAR Centers. In 2023, the Philippine Department of Agriculture entered a Memorandum of Understanding (MoU) with the International Rice Research Institute (IRRI) to continue their collaborative efforts to enhance the country's rice sector by implementing rice research for development (R4D) projects anchored in the four-point strategy of the government's Masagana Rice Industry Development Program[15]. This agreement demonstrates the joint intention of co-creating the next varieties after the recent release and commercialization of flood-, drought-, and salinity-tolerant rice varieties.[16]

In **Morocco** (Central West Asia and north Africa)**,** Breeding for Tomorrow counts 17 TPPs spanning three CGIAR Centers and eight crops. When addressing the19th CGIAR System Council meeting, Morocco's Ministry of Agriculture called for increased efforts in genetic innovations to achieve the national "Generation Green" vision of increasing crop yield by 50%, using 50% of nationally produced germplasm by 2030"[17]. A recent assessment of the Moroccan seed sector by CGIAR revealed severe market loss by NARES-SME networks, which exposed the whole country to an increased risk of

[12] Mittal R.K., 2017. *ICAR-CGIAR Agricultural Cooperation*. Department of Agricultural Research and Education, Indian Council of Agricultural Research. ICAR, New Delhi.

[13] International Institute of Tropical Agriculture (IITA), 2021. "Nigeria releases five cassava varieties developed with genomics-assisted breeding and consumer preference studies," March 28, https://mel.cgiar.org/projects/411/381/nigeria-releases-five-cassava-varieties-developed-with-genomics-assisted-breeding-and-consumer-preference-studies

[14] International Potato Center (CIP), 2023. "Four new climate smart potato varieties released in Nigeria to boost seed security and resilience," June 22, https://cipotato.org/pressreleases/four-new-climate-smart-potato-varieties-released-nigeria/

[15] International Rice Research Institute (IRRI), 2024, "IRRI and Department of Agriculture sign agreement anew to boost PH rice industry development," February 18, https://www.cgiar.org/news-events/news/irri-and-department-of-agriculture-sign-agreement-anew-to-boost-ph-rice-industry-development/

[16] CGIAR Research Program on Rice, 2020. Rice Annual Report 2020. Innovations: Flood tolerant variety IR13F265 (NSIC Rc 590) for the Philippines. https://cgspace.cgiar.org/items/2fe63b6f-157f-43ed-9145-d95eaadf36c9; Drought tolerant variety NSICRc 602 for the Philippines,https://cgspace.cgiar.org/items/03670d90-2ea9-4c41-91f8-58b9ffc73517; Salinity tolerant Variety IR15T1094 (NSICRc 610) for the Philippines.https://cgspace.cgiar.org/items/b1b94e93-fa5f-4205-b2ab-11d753782d0a.

[17] Moussadek, R., Ouabbou, H., El Gharras, O., Dahan, R., and El Mourid, M., eds., 2024. *Research for Promoting Sustainable Farming Systems in Arid and Semi-Arid Areas of Morocco*. Rabat, Morocco: INRA.

susceptibility to climate change[18]. Rapid action was taken, and CGIAR-NARES-SME networks in the country are heading again toward achieving the set goals[19].

In **Mexico** (Latin America and the Caribbean)**,** Breeding for Tomorrow counts 25 TPPs spanning three CGIAR Centers. In the past decade, the MasAgro[20] program, sponsored by Mexico's Secretariat of Agriculture and Rural Development (SADER) has helped 500,000 farmers adopt improved maize and wheat varieties across 1 million hectares. MasAgro has involved national and local research organizations, universities, companies, and non-government organizations working in over 40 research platforms and 1,000 demonstration modules.

7.2. Overview of selected work in top 15 countries

Breeding for Tomorrow works across all CGIAR regions. GloMIP is our database of choice to record the market segments currently served by the 21 core CGIAR crops, their TPPs, and linked breeding networks. Information for the vegetable species bred by WorldVeg has also been recorded on GloMIP but not yet completed, while under Breeding for Tomorrow also food-feed crops, forage and tree species, livestock and aquatic foods will be added to GloMIP. Table 3 below is generated using the records for 20 crop species as reported on GloMIP accessed in June 2024 and it is meant to demonstrate the wide-ranging scope of Breeding for Tomorrow's work.

Table 3. Records in GloMIP available as of June 2024 across CGIAR-defined regions

CGIAR Regions	Market segment (N)	Target product profile (N)	Species targeted (N)	Breeding pipelines (N)
West and Central Africa	160	113	12	42
South Asia	79	35	9	30
East and Southern Africa	190	135	19	74
Southeast Asia and the Pacific	68	18	5	12
Central and West Asia and North Africa	64	52	7	26
Latin America and the Caribbean	62	39	8	28
Europe	0	0	0	0

Note: Records are for the following species, others will be added in the near future: barley, maize, millet, rice, sorghum, wheat, forages, beans, chickpea, cowpea, faba bean, grasspea, groundnut, lentil, pigeonpea, soybean, banana, cassava, potato, sweetpotato, and yam.

[18] Bishaw, Z., Yigezu Y.A., Niane, A.A., Telleria Juárez, R.A., and Najjar D., eds., 2019. *Political Economy of the Wheat Sector in Morocco: Seed Systems, Varietal Adoption, and Impacts*. Beirut, Lebanon: ICARDA.

[19] Bassi, F., Yigezu, Y. Bishaw, Z., Amri, A., Tadesse, W., Niane, A.A., and Baum, M., 2021). Morocco's seed system makes progress, but some challenges still remain. Mimeo, https://hdl.handle.net/20.500.11766/12701

[20] International Maize and Wheat Improvement Center (CIMMYT), 2024, "A Mexican farm research program gains praise and interest for use abroad," August 24, https://www.cgiar.org/news-events/news/a-mexican-farm-research-program-gains-praise-and-interest-for-use-abroad/

8. Boundaries and linkages with other components of the Portfolio

8.1. Boundaries with other components of the Portfolio

Breeding for Tomorrow will extend its coverage in the 2025-30 Portfolio to integrate (1) vegetable crops and neglected and underutilized species (*opportunity crops*), (2) tree and agroforestry species, and (3) animal breed, fish strains, and aquatic species. Each element represents a separate opportunity to pursue a fit-for-purpose integration strategy.

Opportunity crops will be included in Breeding for Tomorrow's MARKET INTELLIGENCE, ACCELERATED BREEDING, and INCLUSIVE DELIVERY framework, and will be pursued in collaboration with the Better Diets and Nutrition Program and their work on food systems analysis. Trees, food-feed crops, forages and agroforestry species will be similarly mainstreamed in Breeding for Tomorrow, with additional guidance and support from Programs where forestry, agroforestry and forages are critical elements, such as the Multifunctional Landscapes and Sustainable Animal and Aquatic Foods Programs.

Animal and aquatic species will be supported by Breeding for Tomorrow with genomic selection tools, breeding management systems, and other support mechanisms, while actual breeding and delivery activities for livestock, fish, and aquatic species will reside in the Sustainable Animal and Aquatic Foods Program as part of its integrated livestock value-chain approach. This represents an exciting and novel opportunity to realize synergies between plant and animal sciences.

Work on *in situ* biodiversity conservation, landraces, and community seedbanks will be concentrated in the Multifunctional Landscapes Program but will inform product design. Similarly, phytosanitary cleaning of landraces and making those available through seed systems to farmer communities will remain the domain of Multifunctional Landscapes and Genebanks.

Breeding for Tomorrow work on diets and nutrition will be managed in close coordination with a range of programs and partners. The core R&D agenda on biofortification and other nutrition- and health-related traits will reside in Breeding for Tomorrow, and will rely on intelligence and guidance on consumer preferences and demand signals, social marketing strategies, food system transformation pathways, and policy-driven value chain development and scaling solutions from the Better Diets and Nutrition, Policy Innovations, and Scaling for Impact Programs. Breeding for Tomorrow's work on diets and nutrition will also extend beyond biofortified food staple crop varieties to encompass the opportunity crops noted above as critical to diversifying diets. See Section 8.2 for additional details on links with these three Programs.

Finally, Breeding for Tomorrow's efforts to accelerate the uptake and impact of improved varieties in farmers' fields will rely on these same three Programs—Better Diets and Nutrition, Policy Innovations, and Scaling for Impact—to design, test, and assess the impact of sociotechnical innovation bundles that combine improved varieties with innovations in seed systems, agronomic advisory services, financial services, enterprise development, and digital agriculture.

8.2. Linkages across the Portfolio

Sustainable Animal and Aquatic Foods

Sustainable Animal and Aquatic Foods and Breeding for Tomorrow will collaborate to create a cohesive environment for integrating genetic improvement techniques and precision genetic approaches across food, feed, and forage resources. They will develop joint positions, and influence policy and regulations regarding the access and sharing of genetic resources including the responsible use of genetic innovations. In addition, the Programs will jointly examine market segmentation for

animal and aquatic species' breeding programs, through contextualization of existing methodologies and tools to animal, aquatic and combined species systems (including mixed crop-livestock and pastoral systems), and jointly negotiate with genotyping service providers for cost savings.

Sustainable Farming

Collaboration with Sustainable Farming cuts across all of Breeding for Tomorrow's AoWs. In the MARKET INTELLIGENCE AoW, the two Programs will work on aligning targeting and design of product-management bundles (focusing on plant health and specific cropping system needs and opportunities); in ACCELERATED BREEDING and INCLUSIVE DELIVERY, the Programs will target phenotyping opportunities for addressing biotic stresses, undertake appropriate testing in product development and candidate varietal evaluation to better represent predominant and emerging farmer management practices, and capture "genotype by market" opportunities and recommendations. In the BREEDING RESOURCES AoW, the Programs will share cross learnings and scaling of complementary service offerings, including in the space of data and interoperability; and in the ENABLE AoW, the Programs will harmonize interactions with common partners and seek to leverage more than the sum of the parts of each Program.

Climate Action

The Climate Action Program's work on "Assessing Impacts of Climate Change on Production, Environment, and Livelihoods" will link with Breeding for Tomorrow's MARKET INTELLIGENCE AoW to provide foresight on climate change impacts in each region. The goal is to develop new varieties adapted to (or even taking advantage of) these anticipated changes, understand the physiological requirements for plant adaptation, and assess the consequences of a lack of adaptation. Additionally, this work involves identifying extreme events in different regions to enhance the insight of seed systems, ensuring that quality seed, and varieties adapted to these extreme events, are available in a timely manner. The Climate Program's work on "Accelerating Adaptation of Innovations for Climate Resilience" will similarly link with ACCELERATED BREEDING to co-create and evaluate improved varieties with multiple climate-resilience traits, including traits that (a) confer tolerance to climate-induced stresses such as heat, drought, cold, waterlogging, and emerging pests and diseases, (b) mitigate climate change by reducing GHG emissions and increasing carbon sequestration, (c) complement agronomic practices that enhance a cropping system's mitigation capabilities, and (d) can be combined with nutrition traits. The Climate Action Program's work on "Developing and Testing Novel Climate Adaptation and Mitigation Innovations" will collaborate with INCLUSIVE DELIVERY to accelerate the deployment of these varieties through technological, market, and institutional innovations.

Better Diets and Nutrition

Breeding for Tomorrow and the Better Diets and Nutrition Program will collaborate to implement discovery breeding by convening a transdisciplinary community of practice and integrating plant and human nutrition sciences. This initiative will assess the current status and future direction of biofortification, focusing on incorporating impactful traits into target product profiles. Additionally, the collaboration will evaluate the feasibility and cost-effectiveness of breeding for mineral absorption enhancers, new nutrients of public health significance (such as calcium and resistant starch), and health-promoting phytochemicals. This would entail identifying specific nutritional traits that are considered beneficial for human health. Traits and targets will include increasing the content of essential nutrients such as vitamins (e.g., vitamin A, vitamin C), minerals (e.g., iron, zinc), antioxidant phytochemicals (e.g., phenolics), improving their bioavailability, and the balance of macronutrients (e.g., protein).

Policy Innovations

The Breeding for Tomorrow and Policy Innovations Programs will advance a joint agenda that focuses on improving policy decision-making by governments, private enterprises, and civil society engaged in the generation, exchange, and application of genetic resources, breeding products, and improved varieties in global and local food systems. The agenda will be pursued through broad-based stakeholder participation in co-designing, testing, and evaluating policy options for technical and social change, and strategic engagement with partners on the application of credible, timely, and relevant evidence to policy, regulatory, and investment decision-making. Emphasis is placed on three areas. First, the Policy Innovations Program will support market intelligence activities related to foresight analysis, with an emphasis on projecting the current market segments and indicators to the future (2030-50) to enable forward-looking product design. Second, the Policy Innovations Program will collaborate on the design and evaluation of sociotechnical bundles involving financial, digital, informational and other services that complement Breeding for Tomorrow products. Third, the Policy Innovations Program will collaborate to on social inclusion topics to ensure that governments design and implement interventions that not only reduce inequality but also level the playing field between food system actors, compensate those left behind due to scientific, technical, and economic change, and pursue explicit gender-intentional or -transformative approaches to policy and program interventions.

Scaling for Impact

The objective of Breeding for Tomorrow's linkage with the Scaling Impact Program is to enhance the delivery of quality seed of improved varieties at scale. The collaboration between these two Programs will revolve around four main topics. First, systematically analyze and document CGIAR's vast experience with new varieties and quality seed to provide partners with adaptable and replicable strategies and models for scaling. Second, expand the breadth and depth of partnership strategies to a "partners unusual" approach that creates new scaling pathways with innovative stakeholders beyond conventional CGIAR-NARES-SME networks. Third, leverage country and regional partners for an integrated approach to advancing seed policy, regulatory, and business reforms where local context knowledge and tailored solutions are critical to success. Fourth, collaborate on data and analysis to inform Breeding for Tomorrow's entire activity with an emphasis on generating informative demand signals to design new CGIAR products.

Gender Equality and Inclusion Accelerator

Critical evidence has been generated by HER+, MIPPI, and ABI to demonstrate that preference for varieties is not gender neutral, with certain traits driving adoption by different cultural, gender, and age groups. The objective of linking with the Gender Equity and Inclusion Accelerator is to prevent the introduction of social bias when designing Target Product Profiles, and to consider discrete cultural, gender, and age feedback when delivering varieties to end users. This link will be ensured by co-funding gender specialists to work in the MARKET INTELLIGENCE, ACCELERATED BREEDING and INCLUSIVE DELIVERY AoW activities, prioritizations, and monitoring mechanisms.

Capacity Sharing Accelerator

Collaborating with Breeding for Tomorrow, the Capacity Sharing Accelerator will utilize tools and approaches such as the *CapSha-Lab*, *CapSha-Marketplace*, and *CapSha-Knowledge House* to meet the needs of partners and CGIAR. Together, Breeding for Tomorrow and the Capacity Sharing Accelerator will collaborate to optimize the impact of capacity-sharing initiatives across CGIAR Centers, Programs, and partners by:

- Mapping, guiding, and aligning breeding related capacity-sharing offers with demand.
- Establishing a community of practice for leaders of capacity development programs to foster collaboration opportunities.

- Creating a forum to explore various models of capacity sharing, systematize lessons learned, and define standards for capacity-sharing activities in collaboration with partners.

Digital Transformation Accelerator

Linking Breeding for Tomorrow and Digital Transformation will leverage the skills, resources, and expertise of both by co-developing new IT technologies, supporting the formation of a crosscutting portfolio of digital solutions, and addressing the need for a data-driven breeding program. Joint strategic partnerships will allow CGIAR to fast-track the implementation of IT strategy while enhancing overall IT and AI capabilities within CGIAR. With research data coming from various programs through the Enterprise Breeding System, BMS and Breedbase, building connectivity and interoperability must be a key deliverable of this linkage. To achieve this, shared funding and resources including development of a matrix talent structures is important. This will pave the way for sustained partnerships in IT solutions and platform development.

Genebanks

To enhance breeding programs' access to future traits, Breeding for Tomorrow will link with Genebanks. Shared activities include co-developing AI tools to enable targeted selection of genetic resources and breeding lines from the existing databases and joint phenotyping germplasm for key traits highlighted in TPPs and connecting the latter to market intelligence. International distribution and exchange of germplasm and breeding lines will continue to rely on the pivotal services of CGIAR Germplasm Health Units, an integral part of the genebank structure, on cost recovery basis. Breeding for Tomorrow will also work with the Genebanks policies research team to provide actionable recommendations on policies and practices for efficient, effective, and equitable management of genetic resources. This will be complemented by bilaterally funded efforts to co-design, share capacity, and implement biosafety systems for precision genetics within CGIAR and among Breeding for Tomorrow partners.

9. Monitoring, Evaluation, Learning, and Impact Assessment (MELIA)

9.1. Monitoring, Evaluation, and Learning (MEL)

Breeding for Tomorrow's Monitoring, Evaluation, Learning (MEL) program will develop a results framework and systematically assess progress in achieving results throughout the Program and in relation to its Theory of Change. The MEL function for the Program will rely on two full time MELIA officers (senior and junior), a research fellow, and the community of practice formed by the MELIA officers from the participating Centers and target countries. Emphasis is placed on mainstreaming MEL best practices across Breeding for Tomorrow's AoWs, and the pooled and bilaterally funded activities that comprise the wider Breeding for Tomorrow portfolio.

Program specific data collected for output and outcome reporting aim to demonstrate a) use of market intelligence in breeding pipelines; b) genetic gain; and c) changes in weighted variety average age (or other similar measures). To calculate Breeding for Tomorrow indicators the primary data points include market segments, targeted product profiles, breeding pipelines, links with CGIAR's Impact Areas, advancement decisions indicators (Recycling; Early Testing; Late Testing; On Farm Testing), genetic gain in farmers' fields, variety and date released, quantity (Tons) of early generation, certified/quality declared seeds produced, and planted area to calculate weighted variety average age.

Breeding for Tomorrow's MELIA system will be executed through three interrelated approaches:

1. **Activity monitoring**: The system will track the implementation of activities and report on associated deliverables and outputs. All deliverables will be recorded on a web-based platform jointly with other Programs. Activity monitoring will serve to (a) plan, coordinate, and monitor progress against targets; (b) validate and analyze outputs; and (c) recommend corrective measures where necessary.
2. **Outcome evaluation**: The team will evaluate Program-level outcomes though a series of analyses conducted at baseline (within the first 6 months of Program inception), at midline (3 years after inception), and at endline (just prior to the Program's completion). These analyses will draw on key performance indicators and targets for activity-specific and overarching Program outcomes articulated in the Breeding for Tomorrow Theory of Change.
3. **Learning:** Breeding for Tomorrow will embrace an adaptive management approach, featuring a continuous process of collecting feedback from internal and external sources, critical reflection discussions, reviewing and revising the Theory of Change as needed, exchanging data and findings with the impact assessment function, and learning from both positive and negative experiences. This will allow for effective annual planning, priority re-setting, and concise progress reporting.

9.2. Impact Assessment (IA)

Public investments in product breeding and improvement are often justified by high projected benefits. However, such projections are typically based on models that make strong assumptions about the socio-economic and biophysical environment, the extent to which innovations are adopted by farmers and consumers, and how yield improvements translate into higher farm incomes or lower food prices, and hence higher dietary diversity and/or better nutrition. Projected benefits also tend to neglect the need for investment in supporting institutions such as seed systems and markets, and rarely project benefits in Impact Areas beyond the basics: productivity growth and food security.

Breeding for Tomorrow's Impact Assessment activities will systematically evaluate the effects of breeding and delivery on CGIAR Impact Areas specified in the Breeding for Tomorrow Theory of

Change. Specifically, Breeding for Tomorrow's ENABLE AoW will generate rigorous empirical evidence of real world, observed impacts, using a holistic approach to quantify the combined impacts of investments in breeding and delivery, and the mechanisms through which these impacts are achieved. ENABLE will select and guide a portfolio of evaluations across key CGIAR Impact Areas to generate credible evidence for informed decision-making, building on a competitive call for proposals issued in 2024. Each evaluation will estimate adoption and the impacts of (a) the introduction of improved, market intelligence-driven varieties, (b) innovations in seed delivery, and (c) a combination of the two, over a period of 3-5 years. Studies will use harmonized research designs to facilitate data pooling, method development, and learning, and will ultimately culminate in a cross-country, cross-crop meta-analysis. These empirical findings will be communicated to decision-makers in the Breeding for Tomorrow ecosystem to guide strategic investments, policy formulation, and institutionalization of best-fit practices.

10. Capacity sharing

Breeding for Tomorrow builds on CGIAR's longstanding commitment to capacity sharing with its breeding and product delivery partners—over 500 organizations and companies across the Global South. Breeding for Tomorrow will expand CGIAR's efforts to transform capacity-sharing approaches from the simple model of "supporting" partners with knowledge transfers to an innovative model of intense and fruitful collaboration to build organizational capabilities and to broker more expansive networks of talents, skills, and resources. In doing so, Breeding for Tomorrow will prioritize the development of local capacity that ensures the sustainability of capacity sharing efforts and promotes long-term self-reliance of its partners.

Breeding for Tomorrow's capacity sharing approach closely aligns to several recent learning agendas that were developed to improve the design and management of interventions in the agriculture and nutrition sectors. These agendas emphasize (a) opportunities to learn iteratively by systematically assessing critical evidence gaps and building actionable capacity development plans; (b) both technical and functional capabilities among individuals and organizations; (c) monitoring the success of activities with comprehensive measurement tools; and (d) a systems approach in which results, roles, relationships, rules, and resources are critical to success when contributions depend on multiple and interconnected local actors. The objective of this capacity sharing approach is to improve partners' and CGIAR's ability to take responsibility, ownership, and co-deliver improved products more efficiently and equitably.

By capturing opportunities to learn by systematically assessing critical evidence gaps, Breeding for Tomorrow will continue working with national and regional breeding programs and NARES-SME-networks to assess their needs (through Breeding Program Assessments), introduce planning templates, co-develop concrete and actionable improvement plans, and monitor progress against these plans. This work will be based on a foundation of over 100 in-depth assessment and planning meetings held with partners through ABI in 2022-24, in sub-Saharan Africa and South Asia. Similar assessments will also expand to include LAC, CWANA, and SE Asia, as well as breeding programs in organizations beyond CGIAR's usual networks.

Breeding for Tomorrow will take a similar approach to developing seed sector capacity with deep dives into solutions to challenges identified by SeedSAT, developed by the Alliance for a Green Revolution in Africa (AGRA) and the African Seed Access Index (TASAI), and developed by Cornell University and partners. Efforts will be made to extend this work to South Asia and other regions, with an additional emphasis on addressing gender and social inclusion in capacity sharing in the seed sector space.

To augment these efforts, Breeding for Tomorrow will continue to monitor the success of its capacity sharing activities by developing and applying comprehensive measurement tools. This will be done by further developing, validating, and measuring the health, performance, and impact of CGIAR's partnerships through partnership metrics that are currently being co-developed by CGIAR and NARES high-level leadership.

Breeding for Tomorrow's capacity sharing strategy will be integrated across the entire pipeline—from MARKET INTELLIGENCE, to ACCELERATED BREEDING, to INCLUSIVE DELIVERY—and will leverage the advanced thinking of CGIAR Accelerator on Shared Capacity. It will also incorporate a strong focus on gender and social inclusion by engaging women, youth, and disadvantaged social groups, both in its external focus on farmers and other seed system actors and its internal focus on CGIAR-NARES breeders, seed technologists, extension agents, and others. Finally, Breeding for Tomorrow will establish a system for recognizing and rewarding outstanding contributions to capacity sharing, encouraging a culture of continuous learning and knowledge exchange within the breeding and delivery community.

11. Gender and social inclusion

Extensive research shows that women are important custodians, producers, processors, and traders of seeds and the traits they embody. The same holds true for the youth and many indigenous communities.[21] And as consumers, these groups often have distinct demands for traits, distinct access channels for seed, and distinct ways of realizing the benefits of use. Yet social, cultural, economic, and structural factors often constrain their articulation of demand, access, and realization of benefits, thereby limiting opportunities when compared to men and other privileged groups.[22]

Breeding for Tomorrow aims to design, develop and deliver climate-resilient, market-preferred, healthy, and nutritious varieties and to make food systems more productive, inclusive, and sustainable. To do so, it must account for youth, gender- and socially-differentiated demands using a set of agreed-upon standards and practices that are gender-intentional or -transformative in nature. Breeding for Tomorrow will proactively engage women in their multiple roles as smallholders, seed-entrepreneurs, food producers, processors, traders, and consumers, and will extend this engagement to other socially disadvantaged groups, including: youth who, as both smallholders and entrepreneurs, often find themselves marginalized; to indigenous social and cultural groups who are critical custodians of biodiversity but often are unable to realize the benefits of crop improvement efforts; and to other socially disadvantaged groups who are unable to unlock the benefits of breeding programs and seed delivery systems.

Breeding for Tomorrow's Theory of Change incorporates this goal by prioritizing the co-design of products, development of breeding pipelines, and delivery of genetic gain through a fundamental reorganization of the structures, practices, and conduct of its breeding networks, and through a deep expansion of its engagement with gender and social inclusion issues.

Breeding for Tomorrow's gender and social inclusion agenda builds on prior research by CGIAR and partners, including work conducted under CGIAR Gender and Breeding Initiative, CGIAR Gender Platform, Genetic Innovation Science Group, CGIAR collaborative research programs, and bilateral projects[23] This research addresses the role and contribution of women farmers in participatory

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[21] For example, see: Puskur, R., Mudege, N. N., Njuguna-Mungai, E., Nchanji, E., Vernooy, R., Galiè, A., & Najjar, D., 2021. Moving beyond reaching women in seed systems development. In R. Pyburn and A. van Eerdewijk (eds.), *Advancing Gender Equality through Agricultural and Environmental Research: Past, Present, and Future* (pp. 113-145). Washington, DC: IFPRI. https://doi.org/10.2499/9780896293915_03; Cullen B., and Debevec, L., 2024. Integrating social inclusion perspectives in agricultural food systems research for development: a background paper. CGIAR GENDER Impact Platform Background Paper. Nairobi, Kenya: CGIAR GENDER Impact Platform. https://hdl.handle.net/10568/151613.

[22] A related challenge, though not addressed in detail here, is the weak representation of gender and social diversity in the leadership, management, and staffing of breeding and delivery organizations, networks, and programs, including within/among CGIAR, NARES, private sector, and civil society organizations. The lack of diversity leads to a lack of diverse perspectives on research-for-development, in turn affecting prioritization, funding, and research itself and the impacts of breeding. This is addressed in Section 10 on Capacity Sharing.

[23] For example, see: Ashby, J. A., and Polar, V., 2019. The implications of gender relations for modern approaches to crop improvement and plant breeding. In C. E. Sachs (Ed.), *Gender, Agriculture and Agrarian Transformations* (pp. 11-34). Routledge; Delaquis, E., & Almekinders, C. J. (2020). COVID-19, seed security and social differentiation: When it rains, it pours. *Food Chain*, *9*(2), 103-106. https://doi.org/10.3362/2046-1887.20-00003; Farnworth C.R., Galiè, A., Gumucio, T., Jumba, H., Kramer, B., and Ragasa C., 2024, Women's seed entrepreneurship in aquaculture, maize, and poultry value chains in Ghana, Kenya, and Tanzania. *Frontiers in Sustainable Food Systems,* 8, https://doi.org/10.3389/fsufs.2024.1198130; Galiè, A., Jiggins, J., Struik, P. C., Grando, S., and Ceccarelli, S., 2017. Women's empowerment through seed improvement and seed governance: Evidence from participatory barley

breeding and varietal selection; the gender dimensions of trait preferences and varietal adoption patterns; and topics such as gendered social network effects, information transmission, bundled products and services, and seed business development. A related research thread addresses related topics regarding youth, Indigenous communities, and other marginalized groups.[24]

But more work needs to be done. Breeding for Tomorrow acknowledges that there are still evidence gaps that must be filled to inform investment priorities in breeding and delivery. This is attributable to the lack of gender-differentiated data and analysis that map gender and social inclusion elements to CGIAR's TPPs and market segments, and a dearth of rigorous causal evidence linking breeding and delivery innovations to women's empowerment, social inclusion, or related outcomes.

Breeding for Tomorrow will do more than just provide diagnostics of the problem. It will co-develop innovative strategies to address gender and social inequality, from designing new product concepts to delivering genetic gain directly to women and youth farmers. By engaging socially disadvantaged groups in breeding networks, Breeding for Tomorrow will capture new insight into specific demands and preferences. By collecting, analyzing, and providing more inclusive market data, Breeding for Tomorrow will enable breeding teams to make informed decisions regarding which traits to prioritize and for whom. Gender intentionality will be one of the four criteria in the Product Design Standard (see Market Intelligence Area of Work) that will be used to validate TPPs. By generating causal evidence on which innovations are effective in addressing gender and social inequality, Breeding for Tomorrow will improve targeting of women smallholders with gender-intentional and gender-transformative delivery mechanisms that bundle new varieties with complementary inputs, market linkages, financial products, and advisory services.

To ensure sustained success, Breeding for Tomorrow will develop a systemic collaboration framework within its transdisciplinary teams to recommend gender and social inclusion strategies in product design, advancement and delivery activities for each market segment across multiple TPPs. This will be supported by stakeholder consultations, data analysis, and impact assessment that continuously strengthen Breeding for Tomorrow's gender and social inclusion agenda. Ultimately—and as a result of these activities— Breeding for Tomorrow will increase the share of women, youth, and marginalized social groups adopting improved varieties and using quality seed. Key performance indicators will focus on more equitable access, use, and benefit realization across social groups differentiated by wealth, ethnicity, gender, age, and economic activity, and on changes that the role of gender and social inclusion play in the structure, organization, and management of Breeding for Tomorrow's breeding networks.

12. Climate change

Climate change is significantly impacting the current and future viability of food production systems, posing challenges to production, impacting biodiversity, and threatening nutrition and food security. The rapid pace of climate change impacts the natural ability of species to adapt to their environments due to species' adaptation rate lagging behind the rate of climatic change, resulting in species migration, endangerment, or extinction. Temperature fluctuations reduce crop, tree, and animal productivity, as all are highly sensitive during critical growth stages. High temperatures accelerate crop maturation, shortening the growing season and affecting productivity; yields can significantly decline under heat stress at key developmental stages, leading to reduced food security; and extreme weather events, such as droughts and intense rainfall, increase soil erosion and reduce soil fertility,

breeding in pre-war Syria. *NJAS—Wageningen Journal of Life Sciences,* 81, 1-8. https://doi.org/10.1016/j.njas.2017.01.002.

[24] Expanded from species portfolio under the mapped GI Initiatives. Expanded regarding new opportunities for breeding modernization and enhanced impact.

subsequently impacting crop and tree growth. In particular, semi-arid regions face stronger temperature-moisture coupling, exacerbating the impacts of climate warming and intensifying the frequency of extreme events, undermining production stability. Similarly, climate change is altering forest composition and productivity, and many tree species face challenges such as altered phenology, reduced fruit set, and changes in wood quality, affecting both food production, ecosystem functions, and timber value. The changing environment is also associated with unpredictable pest and disease patterns, which seriously challenge food productivity. Pests and diseases may move from tropical to temperate regions, where crops and tree species are highly susceptible to disease, thereby reducing genetic gains due to disease susceptibility.

Droughts, floods, and extreme weather events may also impact seed stocks, pushing seed systems to request imports from neighbors and affecting sovereignty, productivity, and local adaptation of varieties; Seed systems must be equipped with infrastructure to deliver varieties that are aligned with the required climate related traits for the market segments they serve and these systems need to be supported by a robust enabling environment, including policy and regulatory environments, that allow quick and targeted responses to needs of farmers in diverse and equitable manners.

Planned Work on Climate Change Adaptation and Mitigation

Breeding innovations are crucial to coping with these climatic impacts as breeding facilitates faster genetic gain that can match the rapidly changing environmental factors and climatic patterns resulting from climate change. Breeding for Tomorrow's work to adapt to and mitigate the effects of climate change rests on a thorough understanding and prioritization of traits that serve adaptation and mitigation purposes for incorporation into breeding efforts. In this light, Breeding for Tomorrow's MARKET INTELLIGENCE AoW includes robust climate change foresight capacities, through its GloMIP Platform, which estimates and predicts potential climate adaptation and mitigation impacts of product concept designs and alongside the ACCELERATED BREEDING AoW delivers impactful, feasible targeted product profiles that match future climatic conditions in their relevant market segments.

Consequently, MARKET INTELLIGENCE will deliver product designs, per market segment, validated by partners, that include the traits to enable crops, forages and animals to adapt to climatic shifts (note, actual animal breeding will be done in the Sustainable Animal and Aquatic Foods Program). Work in ACCELERATED BREEDING will undertake breeding, creating these new products that include traits related to, for example, water and nutrient use efficiency, drought and flooding adaptation, adjusted crop cycles, enhanced root development, improved crop productivity, and conservative and regenerative agronomic practices. For tree breeding, for example, this involves selecting and developing genotypes that can thrive in predicted future climates while maintaining or enhancing their contribution to food security, nutrition, and ecosystem services. Work in INCLUSIVE DELIVERY will support CGIAR partners to deliver climate-resilient varieties to farmers via seed systems that can cope with potential climatic impacts. Further, INCLUSIVE DELIVERY will support seed sector development to increase farmer access to affordable climate-resilient varieties by guiding the design, testing, validation, and scaling of best-fit delivery strategies, approaches, and models alongside enabling policies and regulations, and improved capacity to address humanitarian assistance needs in conflict-affected and fragile settings. Moreover, the breeding pipeline 'loop' will be closed by fostering links between the MARKET INTELLIGENCE and INCLUSIVE DELIVERY AoWs, which ensure that seed systems utilize foresight information to plan and increase access to the best-adapted varieties according to predicted climate patterns, and inversely, MARKET INTELLIGENCE uses information from seed systems on the most appropriate climate-targeted varieties in their design of product concepts. These approaches will provide a more resilient portfolio of varieties and efforts which are crucial for safeguarding food security and ensuring the sustainability of agricultural systems.

Planned work on translating science into climate policies

The INCLUSIVE DELIVERY AoW will work on policies for improving seed systems to foster enabling environments that promote access to climate resilient varieties. Moreover, this policy work will also be target safely permitting and fast tracking the movement of climate resilient varieties that suit the current and future climatic conditions of the target geography as well as supporting the conservation of genetic diversity, both in situ (on-farm) and ex situ (in gene banks), to ensure a broad genetic base for breeding climate-resilient crops.

13. Risk management

Risks will be finalized and mitigation actions will be developed as part of the risk management plan during the Inception Phase.

Table 4. Preliminary risks identified for Breeding for Tomorrow

Risk title	Risk statement including potential event, sources, and consequences
R1. Prioritization and loss of country partner capacity	Prioritization of breeding 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.
R2. Operational culture: Resistance to change	Resistance to operational and culture changes impedes the effective implementation of modernization and aligned, outcome-oriented breeding.
R3. 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 objectives.
R4. Environmental and political risks to field evaluation and seed multiplication	Failure of breeding trials or seed multiplication plots, caused by severe and widespread drought or flood, results in a delay of one or more years in achieving objectives.
R5. 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.

14. Funding sources

Over the past three years, the Genetic Innovation Initiatives received a total of USD 154 million in pooled (CGIAR Trust Fund Windows 1 and 2 [W1/2]]) funding matched by 3-4 times that amount in bilateral/W3 funding. The largest portion of resources across the Initiative period, 56 per cent, was allocated to the Accelerated Breeding Initiative, with 21 percent being allocated to the Seed Equal Initiative. The Market Intelligence Initiative and Breeding Resources Initiative received 14 percent and 9 percent, respectively. The highest annual funding, USD 56.4 million, was received in 2024, while the lowest, USD 46.2 million, was received in 2023 (Figure 9).

Caveats

Impact-oriented budget definition is guided by numerous factors including critical elements of opportunity identification, costing, impact estimation, and prioritization. During the definition of Breeding for Tomorrow, a series of HLOs have been defined (opportunities). Strategic- and business-level impact estimation and prioritization are ongoing. Until these exercises are completed, we will rely on past experience to indicate potential budget allocations rather than take a forward-looking approach.

In the estimates provided below [to be provided in the final version], we recognize that the resourcing envelope required for delivery against the proposed expanded[25] portfolio needs to commensurately increase to permit the delivery of the desired quality of science and partnerships. As such, we define a “minimum viable” pooled resourcing envelope, estimated by practitioners involved in GI Initiative implementation, required to deliver Breeding for Tomorrow intermediate and ultimate outcomes across an expanded range of commodities at the desired scale. This minimum viable envelope considers current available data on W3/bilateral projects and assumes that this funding mechanism continues to operate and grow. In the table below (to be provided in the final version), we include a minimum viable scenario allocation across AoWs (for undertaking all breeding work across all geographies, including new tree and vegetable breeding work), a split of the base and surge budgets by AoW considering continuation of critical work and desired expansion of scope, and we indicate gaps between the minimum viable and base/surge scenarios. This allows an elucidation of the funding gaps representing what could be achieved in an ideal scenario and what would be achieved in a scenario with less funding where worked (and, therefore, potential impact) is stripped back to a minimum.

The projected budget for all AoWs in the base and surge scenarios is accompanied by several important caveats. First and foremost, it assumes a scope and level of work that approximates the current (2024) scope and level under the GI Initiatives, and does not address the new, emerging, and expanded activities described in the AoW narrative presented. This implies a binding constraint on (a) immediate expansion into activities for vegetables, trees, agroforestry, opportunity crops, livestock, fish, and aquatic species, (b) expanding the geographical footprint of Breeding for Tomorrow in terms of country and regional coverage, and (c) other work described in the AoW narratives. This also limits Breeding for Tomorrows capacity to engage with and benefit from the expertise, experience, and talent that resides not only in several Centers that are recent entrants to Breeding for Tomorrow, but also among their partners and networks. We have attempted to reflect on opportunities of scale in the proposed scenario allocations with some AoWs benefiting more from surge resourcing from others reflecting this adaptive capacity.

When ongoing prioritization exercises are completed and validated with stakeholders, improved impact- and needs-based resource allocations can be determined and proposed. Until then, the Breeding for Tomorrow breakdown should be considered in light of the caveats detailed above.

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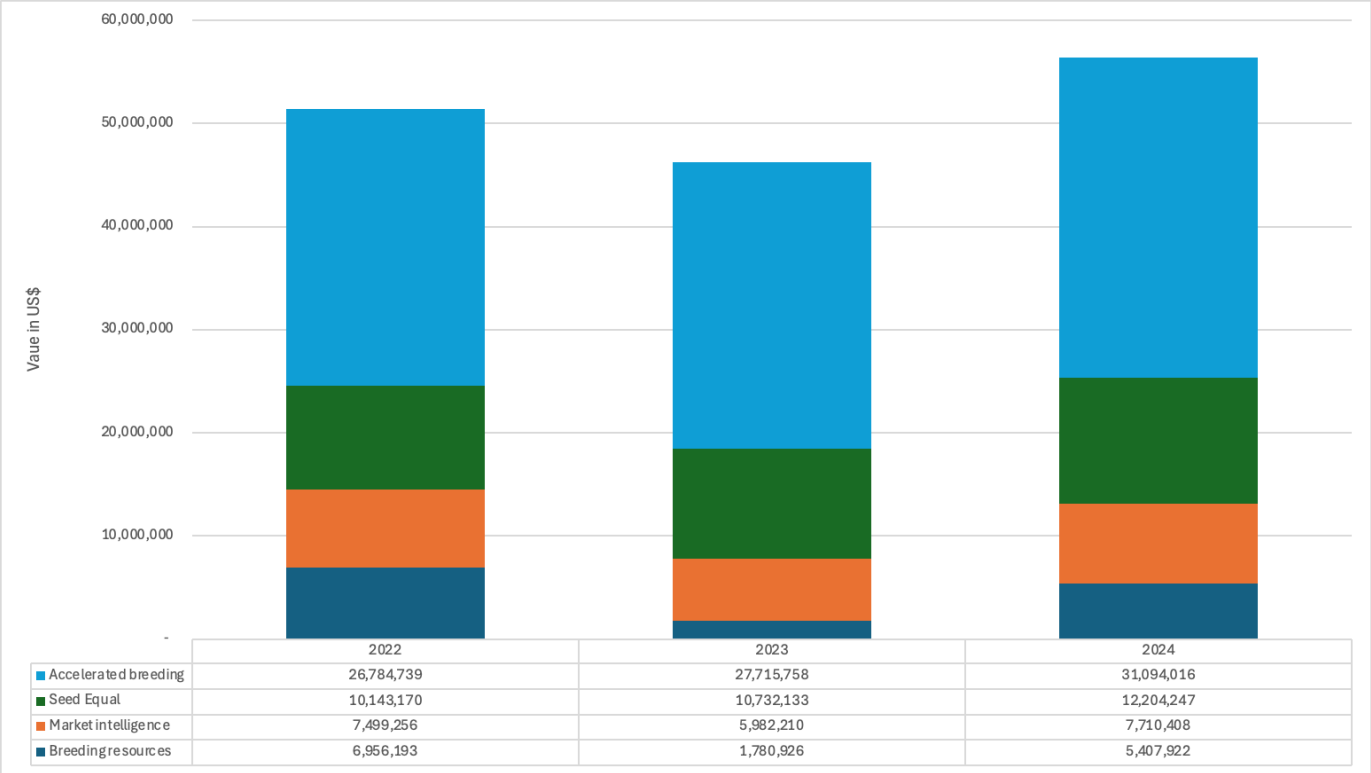

	2022	2023	2024
Accelerated breeding	26,784,739	27,715,758	31,094,016
Seed Equal	10,143,170	10,732,133	12,204,247
Market intelligence	7,499,256	5,982,210	7,710,408
Breeding resources	6,956,193	1,780,926	5,407,922

Figure 9. Pooled funding for Genetic Innovation Initiative, 2022-2024 (USD)

In the final version, a table will be inserted here, showing the breakdown of pooled funding by Area of Work for different budget scenarios.

Bilaterally funded projects and programs mapped to Breeding for Tomorrow

A total of 12 Centers (AfricaRice, ABC, CIP, CIMMYT, ICARDA, ICRAF, ICRISAT, ILRI, IFPRI, IRRI, IITA, and WorldVeg) have mapped 83 key bilateral projects under Breeding for Tomorrow (Table 5). These projects will have funding support amounting to US$342.55M from 2025 to 2030 and represent only a fraction of the bilateral support that has been mapped and will be ultimately received in that period.

Table 5. Selection of key bilateral projects mapped by Centers to Breeding for Tomorrow

Project Name	Center	Approximate Remaining Budget	Funder Name	Start Date	End Date
1078-CHI0 Supporting preparation work of CCCAP in China	CIP	1,500,000	China-Ministry of Finance	2015-01-01	2024-12-31
1523-BMGF RTB Breeding Investment	CIP	2,000,000	BMGF-Bill & Melinda Gates Foundation	2023-07-01	2024-12-31
1572-MIPO Impulsando la Agroindustria Rural y el Uso de la Diversidad del Yacón conservada en Pataz y CIP, a través de la Bioeconomía y los Alimentos Funcionales	CIP	700,000		2024-07-01	2027-06-30

Project Name	Center	Approximate Remaining Budget	Funder Name	Start Date	End Date
A-AG10140-KAFACI Phase 3	AfricaRice	2,409,732	Korea-RDA-Rural Development Administration	2020-01-01	12/31/2025
A-AG10173-HealthyDiets4Africa	AfricaRice	3,532,202	EC-European Commission	2023-01-01	12/31/2028
A-AG10181-BMGF MultiHarvestRice	AfricaRice	3,532,923	BMGF	2023-10-04	9/30/2027
A-HP2023-003-World Bank-Food Systems Resilience	AfricaRice	2,215,879	World Bank	2024-06-01	31/06/2026
Bill & Melinda Gates Foundation (BMGF)-1000 Farms Research Platform	ABC	1,298,398	BMGF	2021-10-11	1931-12-25
BIUSA (BEF)-Screening, developing, and deploying anti-methanogenic feedstock into livestock systems in the Global South	ABC	10,559,157	Bioversity International	2023-06-13	2028-06-13
BIUSA (Bezos Earth Fund)-Using genetic diversity to capture carbon through deep root systems in tropical soils (Research and Capacity development)	ABC	5,411,542	Bioversity International	2022-05-24	2027-12-31
BMGF - Anti-methanogenic feedstock for livestock systems in global south	ABC	10,212,207	BMGF	2023-10-19	2028-10-31
CANADA -GAC - Beans for Women For Empowerment in Eastern DRC (BEANS4WOMEN)	ABC	6,760,362	Canada-Global Affairs Canada	2023-03-28	2028-03-31
CANADA-GAC-Building Equitable Climate-Resilient African Bean and Insect Vectors (BRAINS)	ABC	11,992,978	Canada-Global Affairs Canada	2024-01-30	2028-03-31
Climate-smart initiatives for climate change adaptation and sustainability in prioritized agricultural production systems in Colombia (CSICAP)	ABC	81,434,681	Colombia-MADR-Ministerio de Agricultura y Desarrollo Rural		
D-100892-Intensive Agriculture Program including Revival and Sustainable Intensification of Forgotten Crops (IAP)	ICARDA	1,500,000	India-State Government of Odisha-Directorate of Agriculture and Food Production	2024-01-01	
D-100893-Comprehensive Project on Rice Fallow Management (CRFM)	ICARDA	5,000,000	India-Government of Odisha	2024-01-01	2025-12-30

Project Name	Center	Approximate Remaining Budget	Funder Name	Start Date	End Date
D-200347-India Collaborative Program 2022/2023 to 2026/2027	ICARDA	2,085,961	India-ICAR-Indian Council of Agricultural Research	2022-04-01	2027-03-31
D-200375-ICARDA - Screening, developing, and deploying anti-	ICARDA	2,158,978	CIAT-International Center for Tropical Agriculture	2023-10-19	2028-07-31
D-200385-BMGF - Anti-methanogenic feedstock for livestock	ICARDA	2,095,436	CIAT-International Center for Tropical Agriculture	2023-10-19	2028-09-30
L-CIA024-Anti-methanogenic feedstock for livestock systems in Global South	ILRI	3,135,000	BMGF-Bill & Melinda Gates Foundation	19/10/2023	30/09/2028
L-UOE012-Centre for Tropical Livestock Genetics and Health -	ILRI	7,974,063	University of Edinburgh	1/9/2022	31/08/2027
M-D0006-VACS Crop Improvement Coalition	CIMMYT	14,998,521	USA - USAID	2023-10-01	2026-09-30
M-M0377-VACS Quick Wins Project	CIMMYT	4,987,372	USA - USAID	2023-10-01	2026-09-30
M-R0218-Accelerating Genetic Gains in Maize & Wheat (DFID-DF	CIMMYT	11,838,415	BMGF	2020-03-23	2025-03-15
M-R0223-Mining useful alleles for climate change adaptation	CIMMYT	17,490,064	BMGF	2021-10-04	2026-12-31
M-R0230-Mining useful alleles for climate change adaptation	CIMMYT	4,084,854	FFAR-Foundation for Food and Agriculture Research	2022-01-01	2026-12-31
M-R0235-USAID-VACS BT Pigeon Pea	CIMMYT	4,500,000	USA - USAID	2024-01-01	2025-12-31
M-W0500-Verify global potential of biologic. Nitrific. Inhib	CIMMYT	8,916,010	Novo Nordisk Fonden (NNF)	2024-01-01	2029-07-12
N-300044-Biotechnology Innovations	IFPRI	5,005,616	USA - USAID	2022-03-06	2026-07-12
N-606022-Nutrition Resilience Zimbabwe	IFPRI	630,710	Happel Foundation	2022-01-07	2028-06-06
N-606023-Smart Crops-North Nigeria	IFPRI	936,361	United Kingdom-FCDO	2022-01-08	2026-07-07
P-1464-USAI-Feed the Future Global Biotech Potato Partnership	CIP	1,032,478	USA - USAID	2022-12-09	2026-03-23
P-1505-USAI-Tools4SeedSystems: working towards resilience	CIP	1,042,984	USA - USAID	2022-08-31	2026-08-30

Project Name	Center	Approximate Remaining Budget	Funder Name	Start Date	End Date
P-1530-GIZ0-Construction and implementation of a new Cryoban	CIP	1,151,863	Germany-Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH	2023-05-15	2026-05-15
P-1560-DGUL-Andean Crop Diversity for Climate Change	CIP	800,000	DAI Global, LLC	2023-12-01	2026-11-30
P-1568-WBS0-Developing Local Seed Potato Production System i	CIP	3,100,000	Government of West Bengal	2024-03-06	2027-03-31
PJ-003903: Strengthening Emergency Preparedness and Response to Food Crisis for Burundi, Comoros, Somalia and South Sudan (SEPAREF)	IITA	346,916	The African Development Bank (AfDB)	3/25/2024	6/30/2025
PJ-003978: Cassava Source Sink (CASS) Phase III	IITA	2,595,505	Bill and Melinda Gates Agricultural Innovations LLC (Gates Ag One)	5/1/2024	4/30/2029
Tackling emerging diseases and insect pest problem in rice through innovative Genomic approaches	IRRI	468,955	DBT-India	3/1/21	6/20/28
R-A-2021-28-KOICA-UPLB Project	IRRI	4,044,888	Korea-KOICA-Korea International Cooperation Agency	2021-10-26	2027-10-31
R-A-2021-76-Allele mining	IRRI	1,424,202	BMGF	2022-01-01	2026-12-31
R-A-2022-46-Smallholder Rice Farmers	IRRI	3,866,301	USA - USAID	2022-08-01	2026-07-31
Developing C4 offshoots in rice through genome editing	IRRI	736,484	BMGF	2023-10-01	2028-09-30
R-A-2022-52-Direct Seeding Indo Gangetic	IRRI	4,562,084	BMGF	2022-10-01	2027-09-30
R-A-2022-71-ICAR 2023 - 2027	IRRI	753,212	India-ICAR	2023-01-01	2027-12-31
R-A-2022-85-OneRicePH	IRRI	824,774	Philippines-BAR-DA	2024-01-01	2025-12-31
R-A-2023-19-EBS Phase 3	IRRI	1,457,845	Multi-Funder	2024-01-01	2025-12-31
R-A-2023-34-SGP-AGGRI2 AGGRI Project	IRRI	894,409	BMGF	2023-01-01	2025-02-28
R-A-2023-46-SGP-GENOME EDITING Genome Editing Project	IRRI	1,019,178	Multi-Funder	2022-01-07	2025-06-30

Project Name	Center	Approximate Remaining Budget	Funder Name	Start Date	End Date
R-A-2024-19-ISARC Phase III	IRRI	6,260,764	India-Department of Agriculture and Cooperation and Farmers Welfare	2022-04-01	2027-03-31
T-PJ-003211-Genetic improvement of banana for control of bacterial wilt disease.	IITA	729,623	USAID	1/10/2021	30/09/2025
T-PJ-003407-Improving common bean and cowpea productivity and nutritional quality under conditions of reproductive-stage high-temperature stress	IITA	111,250	Foundation for Food and Agriculture Research (FFAR)	5/1/2023	10/14/2025
T-PJ-003535-1000Farms Trials Platform	IITA	162,932	BMGF	44207	30/11/2025
T-PJ-003651-Program for Seed System Innovation for VPCs in Africa (PROSSIVA)	IITA	13,737,204	BMGF	9/10/2022	30/09/2027
T-PJ-003668-Identification of mechanisms to regulate growth habits in yam (Dioscorea rotundata) aiming at cost-effective mechanization in farmer's fields	IITA	199,738	Swedish University of Agricultural Sciences (SLU)	30/03/2023	31/12/2026
T-PJ-003716- Combating Malnutrition in Africa Through Diversification of the Food System (HealthyDiets4Africa)	IITA	705,555	European Union (EU)	1/1/2023	31/12/2028
T-PJ-003778-SGP-RTB - Roots Tubers and Bananas Breeding: a consolidated investment	IITA	9,749,441	BMGF	4/5/23	3/31/25
T-PJ-003911-CGIAR Genetic Innovations Public-Private Partnership Platform	IITA	3,664,162	BMGF	12/10/2023	31/10/2027
T-PJ-003917-Strengthening soybean crop improvement in Africa to accelerate development of a stream of climate-smart varieties for small-scale producers, enabling their income growth, improved nutrition and national economic growth.	IITA	4,674,644	BMGF	9/10/2023	31/12/2027
T-PJ-004017-VACS-Breeding: Bambara	IITA	700,000	USAID	7/1/2024	6/30/2026
T-PJ-004023-VACS-Breeding: TARO	IITA	712,790	USAID	7/1/2024	6/30/2026

Project Name	Center	Approximate Remaining Budget	Funder Name	Start Date	End Date
USA-BMGF-Artemis II - Field Phenotyping Prototype	ABC	4,923,022	BMGF	2024-05-06	2026-06-30
YBH01- Bihar Centre Of Excellence For Millets Value Chain (BCoEMVC)	ICRISAT	5,213,170	India-Government of Bihar	2023-07-01	2028-03-31
YOR16- Developing and introducing high-yielding climate-resilient pigeon pea cultivars for intensification and diversification of cropping systems and to satisfy the nutritional requirement of small holder farmers of Odisha	ICRISAT	949,970	India-Government of Odisha	2022-04-01	2027-03-31
YOR24- Enhancing groundnut productivity through increased quality seed access in Odisha	ICRISAT	3,005,820	India-State Government of Odisha-Directorate of Agriculture and Food Production	2023-04-01	2028-08-31
YOR30- MILLETS in upland regions of Odisha for crop diversification, climate resilience and enhanced Food and Nutritional Security	ICRISAT	2,140,030	India-Department of Agriculture and Farmers' Empowerment, Government of Odisha	2024-01-01	2027-03-31
Creating sustainable markets with solid loofah genetics: WorldVeg's leaf curl virus and downy mildew-resistance lines of different market segments essential to develop breakthrough hybrids	WorldVeg	300,000	Private seed sector companies	2024-03-01	2026-02-28
Development of rapid, mass evaluation techniques for heat tolerance in major vegetables (through phenotyping)	WorldVeg	100,000	Rural Development Administration	2024-02-01	1/31/26
CROP/2019/144 International Mungbean Improvement Network 2	WorldVeg		Australian Centre for International Agricultural Research	2020-06-15	2025-06-30
Consumption of Resilient Orphan Products for Healthier Diets (CROP4HD)	WorldVeg	80,000	Swiss Agency for Development and Cooperation	2021-07-01	2025-06-30
Growing new markets with better bitter gourd genetics: WorldVeg's monoecious, gynoecious and predominantly female lines of different market segments developed through recurrent selection to breed breakthrough hybrid	WorldVeg	300,000	Private seed sector companies	2023-02-01	2025-01-31

Project Name	Center	Approximate Remaining Budget	Funder Name	Start Date	End Date
Broad and durable begomovirus resistant tomato varieties through identification of Ty gene combinations targeting aggressive begomo viruses in the Mediterranean Basin, India, and SE Asia	WorldVeg	50,000	Ministry of Science and Technology, Taiwan	2021-02-01	2025-01-31
Opportunity vegetables: reducing poverty and enhancing food and nutrition security in the face of climate change with underutilized vegetable species	WorldVeg	500,000	FCDO	2024-05-01	2026-04-30
Partnerships to breed improved vegetable and dual use amaranth in Africa for better nutrition and higher income	WorldVeg	700,000	VACS/CIMMYT	2024-07-01	2026-06-30
VACS - Okra Breeding	WorldVeg	699,435	VACS/CIMMYT	2024-07-01	2026-06-30
African Plant Breeding Academy (AfPBA) in Nairobi, Kenya	ICRAF	50,000	University of California Davis	2020-03-01	2024-12-31
Training practicing African plant breeders in the most advanced theory and technologies for plant breeding with focus on African Orphan Crops	ICRAF	37,389	University of California Davis	2023-04-18	2024-12-31
Transforming Rwanda Eastern Province through Adaptation (TREPA)	ICRAF	2,000,000	Green Climate Fund	2021-12-23	2027-12-31
Strengthening expertise in production of quality tree seed and seedlings to accelerate landscape restoration and conservation in Africa's Rusizi Basin and The Great Rift Valley	ICRAF	1,500,000	Bezos Earth Fund	2023-09-15	2025-08-31
The right tree in the right place for the right purpose: supplying high-quality tree planting material of native tree species (NTS) for landscape restoration in Sub Saharan Africa (RTRP-Seed).	ICRAF	5,000,000	Bundesministerium für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz	2022-08-01	2029-12-31
Technical Assistance in Forestry and Rural Development	ICRAF	75,000	World Bank	2023-02-16	2024-07-31
Provision of Adequate Tree Seed Portfolio (PATSPO)	ICRAF	1,500,000	Norwegian Ministry of Foreign Affairs	2022-04-01	2025-12-31

Project Name	Center	Approximate Remaining Budget	Funder Name	Start Date	End Date
Strengthening sectoral expertise and strategic framework to support the implementation of Climate Appropriate Portfolios of Tree Diversity (CAPTD) for productive and resilient landscapes and livelihoods in AFOLU across Burkina Faso (acronym R-CAPTD)	ICRAF	1,000,000	Green Climate Fund	2023-10-27	2026-10-27

Note: This table is not intended to be exhaustive. It should provide sufficient information to support the assumptions made about the overall funding mix and high-level breakdown [e.g. the known projects and programs that make up 80% of bilateral funding, mapped to the Program].

Annex - Pooled funding

Pooled funds allocated to Breeding for Tomorrow will be primarily targeted and deployed to continue critical ongoing activities initiated during the 2022-24 Portfolio (as part of GI's Initiatives MI, ABI, SEI, and BRI), subject to prioritization using the Breeding Portal and GloMIP (which facilitate high returns on investment under varying budget scenarios). Pooled funding will ensure continuity of Breeding for Tomorrow's core activities and retain key talent responsible for these activities. The Initiatives from the Genetic Innovation Science Group (GI) in the 2022-24 Portfolio will be broadly mapped to Breeding for Tomorrow's five proposed AoWs in the 2025-26 Portfolio (Table 6).

In the MARKET INTELLIGENCE AoW, this refers specifically to maintaining and expanding the GloMIP platform with more foresight, crop, and climate modeling capacity, developing the Product Design Standard for reviewing TPPs on a regular basis (to ensure their compatibility with market segments), and reviewing, updating, and adding future market segments for more targeted breeding. In a surge scenario, extra funding would be dedicated to steering the design, development, and delivery of nutritious varieties in a coordinated manner across CGIAR Centers in collaboration with Better Diets and Nutrition.

In the ACCELERATED BREEDING AoW, critical activities that will be prioritized for pooled funding include continued development of germplasm by CGIAR-NARES-SME breeding networks and leveraging the global science and capacity across CGIAR Centers. In addition, continued updating of TPPs with partners and the MARKET INTELLIGENCE AoW to ensure breeding teams are targeting the right products is a critical activity. In an elevated funding scenario, ACCELERATED BREEDING will increase annual productivity from 1% to 1.5% to double the reduction in chronic and hidden hunger.

With pooled funding, the INCLUSIVE DELIVERY AoW will prioritize work on co-designing strategies for sustainably positioning improved products in inclusive and equitable seed systems as well as improving strategies to facilitate increased production and delivery of quality seed of improved varieties. In a surge scenario, INCLUSIVE DELIVERY would begin expansion of this work to vegetables, trees, and opportunity crops. BREEDING RESOURCES will use pooled funds to maintain service provision to those breeding networks already receiving services, while ensuring it aligns with partners' needs. In a surge scenario, a greater number of partners will be supported with services, particularly NARES partners. The surge scenario will also support development of new services according to demand. With pooled funding, the ENABLE AoW will use pooled funds to manage partnerships across Breeding for Tomorrow and, where relevant, in conjunction with other Programs. It will also manage policy and impact assessment work, augmenting these capacities (for example, by including extra impact assessment studies) in a surge scenario.

Table 6. Mapping of Genetic Innovation Science Group Initiatives to Breeding for Tomorrow

Genetic Innovation Science Group *Initiatives*	Breeding for Tomorrow *Areas of Work*
Market Intelligence (MI)	MARKET INTELLIGENCE
Accelerated Breeding (ABI)	ACCELERATED BREEDING
Seed Equal (SE)	INCLUSIVE DELIVERY
Breeding Resources (BRI)	BREEDING RESOURCES
Cross-cutting	ENABLE

Notes: (1) No pooled funds will be used to support the Precision Genetics projects. All the Precision Genetics activities including gene validation, product development, regulatory capacity development, and related topics will be funded solely through bilateral grants; (2) The Genebank pooled funds under the GI Genebank Initiative will be mapped to Genebanks in the new Portfolio design.

Continuity: Continuing the core activities of the GI Initiatives under the appropriate Breeding for Tomorrow AoWs is crucial to ensure that the foundations and momentum created by the Initiatives continue in Breeding for Tomorrow.

No specific bilateral funded activities have been identified that could be funded through the pooled funds under the Breeding for Tomorrow. Table 7 lists the emerging or new activities and the key HLOs for various AoWs that would be funded through pooled resources in the 2025-30 Portfolio.

Table 7. New and emerging areas: The following new areas/activities under Breeding for Tomorrow will be prioritized to receive pooled funds

New activity	Breeding for Tomorrow		Other Programs
	Primary AoW	Secondary AoW	
Institutionalization of market intelligence in CGIAR through digital tools (e.g., GloMIP, Breeding Portal, crop observatories, product catalog, etc.) and institutional innovation in governance (e.g., product managers and crop/commodity leads)	MARKET INTELLIGENCE	ACCELERATED BREEDING, INCLUSIVE DELIVERY	
Accelerated Breeding of Product Design Standard, which clearly defines requirements for the process of product design (through transdisciplinary teams) and ensuring that TPPs fulfill the requirements of being (1) in-demand, (2) gender-intentional, (3) impactful, with ACCELERATED BREEDING being responsible for their (4) feasibility.	MARKET INTELLIGENCE	ACCELERATED BREEDING	
Expansion of the market intelligence framework and services to other food, feed, and forage crops, including opportunity crops; trees and other perennial species; breeds of livestock and poultry; strains of fish and other aquatic species, and their integration in GloMIP	MARKET INTELLIGENCE	ACCELERATED BREEDING, INCLUSIVE DELIVERY	Sustainable Animal and Aquatic Foods
Refining the market segmentation approach through geospatial and crop modeling, enabling better targeting of the most marginalized communities	MARKET INTELLIGENCE	ACCELERATED BREEDING	
Projecting the current market segments to the future (2035-2050) and Accelerated Breeding of foresight indicators through economic foresight methods and climate, crop and pest/disease modeling	MARKET INTELLIGENCE		Policy Innovation Climate Action Food Frontiers and Security Sustainable Farming
Expansion of current grower market segmentation to consumer market segmentation to enable better targeting and impacting nutrition, health and food security and gender equality and social inclusion from the consumption angle	MARKET INTELLIGENCE		Better Diets and Nutrition

New activity	Breeding for Tomorrow		Other Programs
	Primary AoW	Secondary AoW	
Implementation of Global Crop Breeding Programs across CGIAR Centers working on the same crop	ACCELERATED BREEDING	BREEDING RESOURCES	
Developing and delivering healthy and nutrient-rich varieties in a targeted and coordinated manner	ACCELERATED BREEDING, INCLUSIVE DELIVERY	MARKET INTELLIGENCE, BREEDING RESOURCES	Better Diets and Nutrition, Scaling for Impact
Reducing greenhouse gas emissions in livestock and crop-livestock farming systems with appropriate breeding of livestock and fodder	ACCELERATED BREEDING	BREEDING RESOURCES	Sustainable Farming
Conducting targeted capacity development and sharing with partners	ACCELERATED BREEDING, INCLUSIVE DELIVERY	BREEDING RESOURCES	Capacity Sharing
Testing candidate products in prevalent current and future farming systems in collaboration with the Sustainable Farming Program	ACCELERATED BREEDING	INCLUSIVE DELIVERY, BREEDING RESOURCES	Sustainable Farming
Screening new breeding materials and candidate varieties for tolerance to biotic constraints, in collaboration with the Plant Health AoW in the Sustainable Farming Program.	ACCELERATED BREEDING		Sustainable Farming (with Plant Health AoW)
Co-developing a portfolio of germplasm products that are climate resilient, nutritious, and market preferred in the form of intermediate germplasm, improved parental lines, and improved candidate products suited to current and future agricultural systems.	ACCELERATED BREEDING		
Trait discovery, development, and delivery including documenting a portfolio of TD&D pipelines/projects and applying current best practice TD&D research and breeding methods, and systematically target traits that are in demand and impactful.	ACCELERATED BREEDING	MARKET INTELLIGENCE	Genebanks
Harmonizing breeding strategies, processes, and systems across crops, forages and Centers.	ACCELERATED BREEDING	BREEDING RESOURCES, MARKET INTELLIGENCE	
Strengthening and empowering partnerships for the co-design, co-development, and delivery of products that are climate resilient, nutritious, and market preferred.	ACCELERATED BREEDING	MARKET INTELLIGENCE, INCLUSIVE DELIVERY	
Developing a public-facing digital seed systems platform	INCLUSIVE DELIVERY		
Integrating seed sector data and information to inform internal priority-setting, management, and partnership activities	INCLUSIVE DELIVERY		

New activity	Breeding for Tomorrow		Other Programs
	Primary AoW	Secondary AoW	
Expansion of seed delivery activities to vegetables, trees, agroforestry, forages, food-feed, and opportunity crops	INCLUSIVE DELIVERY	MARKET INTELLIGENCE, DEVELOP	
Novel seed health, multiplication, and distribution technologies and systems	INCLUSIVE DELIVERY		
Emergency seed assistance and resilience programming in conflict-affected and fragile settings	INCLUSIVE DELIVERY		
Expanded work on women, youth, and social inclusion in seed sector development	INCLUSIVE DELIVERY	MARKET INTELLIGENCE	
Innovation in capacity sharing in product delivery (seed) systems	INCLUSIVE DELIVERY		
Analyze and recommend options to increase seed trade and regulatory harmonization	INCLUSIVE DELIVERY		
Scaling seed and product delivery strategies, business models, and innovation bundles	INCLUSIVE DELIVERY		
Accelerate the uptake of recently developed products in farmers' fields	INCLUSIVE DELIVERY	DEVELOP	Scaling for Impact
Establishing and providing demand-driven shared services (Lab, IT and operational support services – see CGIAR Services Portal for current offerings)	BREEDING RESOURCES		
Adjunctive adoption support to empower service users	BREEDING RESOURCES		
Developing business structures for future sustainability of shared service delivery	BREEDING RESOURCES		
Developing data infrastructure in collaboration with Digital Transformation	BREEDING RESOURCES		
Support Hub and Spoke style partnership model to facilitate shared services need assessment and scaled services	BREEDING RESOURCES		
Co-developing hub and spoke pilot incubators for scaled shared services	BREEDING RESOURCES		