Proposal for the Conservation and Use of Genetic Resources (Genebanks) Initiative

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Proposal

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Initiative name	Conservation and Use of Genetic Resources (Genebanks)
Primary Action Area	Genetic Innovation
Geographic scope	Global
Budget	US$ 78,000,000

1. General information

- Initiative name: Conservation and Use of Genetic Resources (Genebanks)
- Primary CGIAR Action Area: Genetic Innovation
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2. Context

2.1 Challenge statement

The unprecedented rate of biodiversity loss is one of the defining global challenges of our time. Reduced biodiversity will undermine the resilience of agricultural systems, threaten nutritional security, and put at risk the foundations of crop improvement. SDG 2.5 highlights the importance of maintaining the genetic diversity of crops and their wild relatives through soundly managed genebanks and ensuring access to diversity and equitable benefit sharing, in accordance with international law[1]. Meanwhile, climate change is putting our increasingly homogeneous farming systems at risk of failure through extremes of abiotic stresses and severe occurrences of pests and diseases. The difficulty of predicting localized climate-related events and socioeconomic trends makes it critical to safeguard a broad range of genetic resources that can harbor valuable applications in many potential scenarios[2].

The homogenization of landscapes and farming systems is matched by the simplification of diets, which is contributing to the additional burden of malnutrition. Meanwhile, international disagreement concerning the governance of genetic resources and genomic information is exacerbating nationalism regarding these resources. This is reflected in the reluctance of some countries to cooperate internationally in exchanging genetic resources and related information, with negative impacts on agricultural research and development. These tensions are also contributing to unprecedented scrutiny of CGIAR programs' compliance with international laws.

To meet these challenges, there is a need to ensure that genetic resources are reliably conserved and made easily available. Better coordination is needed between organizations that are engaged in conserving plant genetic resources for food and agriculture (PGRFA) worldwide and the global system for conserving and making PGRFA available[3] must be strengthened. There are many new opportunities to manage, exchange and use genetic resources more effectively and to speed up plant breeding processes. There are needs for continuous technical improvement and innovation in seed quality management, imaging, cryopreservation, phytosanitary diagnostics as well as for characterizing germplasm and analyzing its potential value.

The Genebanks Initiative will address SDG 2.5 and support the global system for the conservation and use of PGRFA. CGIAR genebanks manage collections of more than 20 staple crops in ten locations across five continents (See Annex I for crop collections). The collections are made freely available upon request to thousands of users worldwide every year under the International Treaty on Plant Genetic Resources for Food and Agriculture (Plant Treaty), accounting for a large amount of the germplasm being exchanged under the multilateral system of access and benefit-sharing. This Initiative will support long-term conservation activities at international standards, develop improved protocols and practices to improve efficiency and future-proof the genebanks and germplasm health units (GHUs). In collaboration with CGIAR researchers and breeders, the Initiative will characterize and help evaluate the usefulness of genebank materials for crop improvement. Working together with strategic partners such as the Global Crop Diversity Trust (Crop Trust), Plant Treaty Secretariat and other international and national genebanks, the Initiative will strengthen the global system. The Initiative will co-develop capacity building programs with these partners, promoting coordination, responsibility-sharing, and the development of, and compliance with, supportive policies.

2.2 Measurable 3-year (end-of-Initiative) outcomes

Users worldwide will have timely access to disease-free, viable germplasm from CGIAR genebanks in compliance with Plant Treaty and phytosanitary regulations. Five more seed collections, in addition to IRRI, will reach performance targets and be eligible for endowment funding. New accession-level information from Genetic Innovation research will lead to increased requests for germplasm from users outside CGIAR (from the current average of 2,000 per year).

Genebank staff will manage collections with increasingly standardized, high-quality data, adopting automated approaches for seed characterization in six genebanks and improving seed quality management of at least 50 species. The cryobanked collection will increase from 5,000 to 7,000 accessions, including three clonal crop species (in addition to banana and potato), through newly optimized protocols. GHUs will develop 28 new cleaning and diagnostic protocols and tools using next-generation technologies. Three international policymaking bodies will adopt decisions and/or policies that incorporate contributions from CGIAR.

CGIAR breeders and researchers will more precisely identify germplasm of value to their work, facilitated by trait-specific subsets (9 additional subsets per genebank) and populations and added-value information available in public data portals (500 accessions per crop genotyped). They will increasingly use genebanks (up to 30,000 accessions distributed within CGIAR) to accelerate trait discovery and breeding thanks to enriched data and tools.

National and international genebanks will conserve and distribute PGRFA more efficiently and reliably. At least 15 NARS, five international genebanks and four international networks will exchange data and germplasm through capacity building, policy implementation, and improved tools and methods co-developed with CGIAR genebanks.

2.3 Learning from prior evaluations and impact assessments (IA)

The Genebanks Initiative builds on learning from several technical reviews and costing studies that have taken place at both a system level and for individual genebanks as detailed in Table 1 (following page).

Table 1 Details of evaluations and assessments conducted for the genebanks in the past decade

Dates	Reviews and assessments	Undertaken by	Key learnings
2011	Costing study of CGIAR genebanks	CGIAR & Crop Trust	• Definition of essential operations • Detailed costs for individual genebank budgets for essential operations
2012–2016	Technical reviews of 11 genebanks	External expert reviewers	• Recommended improvements in genebank capacity and infrastructure • Four performance targets established • Development of genebank quality management system.
2017	Evaluation of Genebanks CRP	Independent Evaluation Arrangement	• Need for more parity in genebank costs • Genebank Platform requires bespoke reporting • Roles and responsibilities of CGIAR and Crop Trust need better defining • Expand utility of GRIN-Global
2017–2020	Costing review of 11 genebanks	Crop Trust	• Refinement of defined essential operations • Refinement of individual genebank budgets for essential operations.
2017–2021	Auditing of key standard operating procedures of genebanks	Crop Trust	• Compliance with FAO genebank standards, ISPM, SMTA, ASTI
2019–2020	Technical reviews of 11 Genebanks	External reviewers	• External validation of documented SOPS • Optimization of processes • Common data management system
2020	Chatham House consultation on future of genebanks	Crop Trust & CGIAR	• Need for PGR in all future scenarios given increasing TUNA (turbulence, uncertainty, novelty, and ambiguousness). • CGIAR genebanks should play a more catalytic role to facilitate use of PGR.
2020	System Level Review of Genebank Costs and Operations	CGIAR & Crop Trust	• Lock funding for essential operations • Review configuration of CGIAR genebanks • Underpinning roles of policy & GHUs • Sustain CGIAR's global system role

2.4 Priority-setting

The priorities for CGIAR genebanks are clear and required by international law. Each genebank manages a set of collections of mandated crop(s), in accordance with the Food and Agriculture Organization of United Nations (FAO) In-Trust Agreements they signed in 1994 and the Article 15 Agreements they signed with the Governing Body of the Plant Treaty in 2006. Under these agreements, CGIAR genebanks are legally bound to:

- provide facilitated access to PGRFA under their management in compliance with the conditions of the standard material transfer agreement;
- recognize the authority of the Governing Body to provide policy guidance relating to *ex situ* collections held by them and subject to the provisions of the Treaty; and
- manage and administer collections in accordance with internationally accepted standards, particularly the Genebank Standards endorsed by the FAO Commission on Genetic Resources for Food and Agriculture.

Effective management and compliance with FAO standards and other relevant standards are achieved through implementing a quality management system based on optimized protocols for specific crops, facilities, locations, and situations. In collaboration with the Crop Trust, the Initiative will continue to update, audit, share and review at least 150 SOPs so that practices continue to comply with standards while being improved. Eight CGIAR genebanks are also committed to long-term agreements that obligate them to reach and sustain four performance targets concerning the availability, safety duplication, documentation, and quality management of their collections.

In general, CGIAR genebanks respond to requests for germplasm or services. However, there has been a consistent message from the donor and user communities that they should perform a more proactive role in facilitating the use of crop diversity and identifying diversity of value to different users (e.g., the 2019 MOPAN assessments report[4] and Chatham House Dialogue report[5]). By closely analyzing user trends and needs and using modern research tools, CGIAR genebanks can make searches to find accessions matching users' specific needs much easier and more precise. The Initiative proposes Work Package 3 for collection curators to adopt and codevelop new search tools, to collaborate with researchers and users, and to enrich accession-related data with new information generated by users. The tools and resources developed on selected crops can be used or applied to all 23 mandated crops managed by CGIAR genebanks.

The activities of WP 2 and 4 have been prioritized to address the most severe bottlenecks in genebank and GHU operations. The planned research specifically addresses recommendations in several external genebank reviews (Table 1) and other assessments (e.g., CGIAR's role in advancing the cryobanking of clonal crop collections worldwide was recommended through an in-depth feasibility study[6]).

The priorities of the Initiative have also been strongly influenced by the 2020 System Level Review of Genebank Costs and Operations[7], which was based on consultation with the expert community outside CGIAR and 10 years of information on genebank operations. The GCO Panel recommended that CGIAR invests in the futureproofing of collections under its management, increases their value and takes a greater leadership role in the global system.

2.5 Comparative advantage

CGIAR genebanks are unique in making available well documented, viable, disease-free collections of 23 mandated crops[1] representing diversity from 196 countries gathered over decades. The value of the CGIAR collections is specifically recognized in Article 15 of the Plant Treaty. CGIAR genebanks and breeders together provide approximately 90% of all the

[1] Banana and plantain, Bambara groundnut, barley, beans, cassava, chickpea, cowpea, faba bean, temperate and tropical forages, grasspea, groundnut, lentil, maize, various underutilized legumes, pea, potato, rice, soybean, sweet potato, wheat, yam, and Andean roots and tubers.

germplasm being exchanged in the multilateral system (see Figure 2a “Distribution of germplasm from CGIAR genebanks in 2019” on page 2 of the 2019 Genebank Platform Annual Report).

CGIAR’s long experience and its range of crops, locations, and areas of expertise allow it to play a leadership role in genebanking, PGRFA policy, and phytosanitary controls, especially in regions and countries where there is limited capacity.

CGIAR genebanks underwent two costing studies in 2010 and 2020 (Table 1). The average annual per-accession costs of CGIAR seed genebanks are approximately 33% less than those of benchmark genebanks, while operations were occurring at a higher rate. Over the past decade, there has been a strong movement to bring all CGIAR genebanks to the same high standards of operation while sustaining routine operating costs. An opportunity exists to improve the genebanks’ efficiency as a system and to consolidate conservation activities across the genebanks.

The 2020 costing study stresses that operational costs will increase, but cost-efficiency may be achieved by concentrating conservation activities and expertise in fewer, larger collections with high through-put. These findings were further endorsed by the GCO report, which suggests that collections of the same crop or crop type conserved in multiple locations could be strategically curated by a single curator.

2.6 Participatory design process

The priorities of the Genebanks Initiative are framed by the Plant Treaty and Global Plan of Action, which are the results of years of highly participatory engagement between members of the international community and other stakeholders including farmers, seed industry, research organizations and civil society organizations.

Much of the Initiative describes the management of the genebank and the services they provide upon request from users. CGIAR genebanks have a range of published catalogs, searchable online databases and search tools that help users to find accessions of interest and order germplasm.

All accession data are also available and orderable online from Genesys, the global accession portal at pgr-genesys.org. Past data on germplasm distributions provides strong evidence for continued demand from both within and outside CGIAR from a wide range of users for the full range of crops being conserved by CGIAR genebanks from a wide for a range of purposes. Genebank users are surveyed to monitor their satisfaction with the service.

A wide range of stakeholders and community members have been engaged in the design of the Genebanks Initiative, as follows.

CGIAR Genebank managers: All CGIAR genebank managers have been regularly consulted and updated through meetings of the Article 15 group and the Platform Management Team, which has monthly meetings that include all genebank managers. These meetings were continued during the Initiative design process (with at least one per month since March 2021).

CGIAR partners: Program-level planning meetings; during the Initiative design process, discussions with other Initiatives were held, including those outside the GI Action Area.

National genebanks: National genebank managers and government representatives collaborate and interact regularly with CGIAR genebanks, including at the Annual Genebanks Meeting organized by the CGIAR Genebank Platform; during the Initiative design process, national partners were involved in the Initiative Design Team.

High-level stakeholders meetings: The Initiative design has been informed by stakeholder consultations with donors, national partners, private sector stakeholders, farmers' groups and the Plant Treaty, including through the recent Genebank Costing and Operations (GCO) Review[7] and subsequent Chatham House Dialogue[5]. These have influenced the content and structure of the Initiative. (Plant Treaty Letter of support)

The Crop Trust: Consultations occurred with Crop Trust staff to discuss cooperation including specifically with BOLD and Seeds for Resilience projects targeted to national genebanks. (Crop Trust Letter of support)

National and international plant protection agencies: GHUs have been consulted through their regular Community of Practice meetings. (APAARI Letter of support; Nigeria NAQS letter of support)

Key users: Consultations took place with genebank users during a workshop, "Adding Value to germplasm", which was organized by the Genebank Platform to identify priority activities to improve collection access and use. The workshop included representatives from the private sector, NGOs, NARS, as well as CGIAR users. (Add Value workshop report)

2.7 Projection of benefits

The projections below transparently estimate reasonable orders of magnitude for impacts which could arise as a result of the impact pathways set out in the Initiative's theories of change. Initiatives contribute to these impact pathways, along with other partners and stakeholders.

For each Impact Area, projections consider breadth (numbers reached), depth (expected intensity of effect per unit) and probability (a qualitative judgement reflecting the overall degree of certainty or uncertainty that the impact pathway will lead to the projected order of magnitude of impact).

Projections will be updated during delivery to help inform iterative, evidence-driven, dynamic management by Initiatives as they maximize their potential contribution to impact. Projected benefits are not delivery targets, as impact lies beyond CGIAR's sphere of control or influence.

Impacts of genetic innovations materialize when improved varieties are adopted by smallholder farmers, including women. All Initiatives in the GI Science Action Area jointly contribute to more efficient and faster development, release, dissemination, and adoption of improved, in-demand varieties through common impact pathways. Besides producing and delivering better quality seed to target beneficiaries in priority market segments, the proposed work aims at modernizing and transforming the genetic innovation system (Figure 1). Selected examples across all five Impact Areas show the aggregated projected benefits of all GI Initiatives working in collaboration and contributing at different stages along the impact pathways.

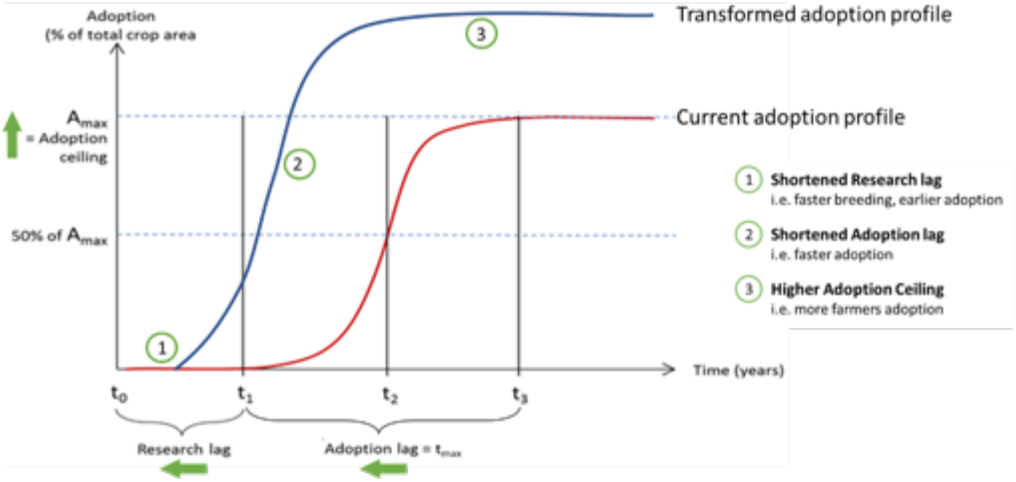


Figure 1 Impact of GI Initiatives on the adoption profile of genetic innovations

Market intelligence shortens the adoption lag and increases adoption levels as new varieties are targeted to specific market segments. This leads to faster and more complete replacement of existing varieties and accelerated varietal turnover. Investment in genebanks reduces the research lag by making germplasm available to breeding programs, reducing the search time and cost for traits. In addition, potentially game-changing traits are preserved and made accessible, thus elevating future impact-levels.

Development of improved varieties with producer/consumer-demanded traits improves livelihoods and food security. Modernized strategies and approaches accelerate breeding, thus reducing the research lag, and generating multiplier effects on the benefits from breeding and seed systems. Improved tools and services enable breeders to create more complex, multi-trait products that match desired product profiles.

Modernizing enabling tools and services increase the speed of breeding, thus shortening the research lag and accelerating variety release. Efficient seed delivery accelerates and increases adoption as targeted products reach even disadvantaged farmers faster. Moreover, enabling access to high-quality, clean seed and planting material ensures the potential of genetic innovations are realized in farmers' fields.

Breadth	Depth	Probability
Impact Area: Nutrition, health & food security **Impact Indicator:** No. of people benefiting from relevant CGIAR innovations		
HY Vit A rich cassava: 19.5 million people (3.9 million HH) *Orange-flesh sweetpotato*: 14.8 million people (3.1 million HH) **TOTAL: > 23.1 million people (> 4.7 million HH)**	**Significant**: 100% of annual income or 10% permanent impact on income	**High certainty**: 50–80% expectation of achieving these impacts by 2030, at this point
Impact Area: Poverty reduction, livelihoods & jobs **Impact Indicator:** No. of poor people benefiting from relevant CGIAR innovations		
HY high zinc rice: 12.3 million poor people (2.8 million poor HH) *Stress tolerant maize*: 24.5 million poor people (5.2 million poor HH) *HY wheat*: 10.0 million poor people (1.9 million poor HH) **TOTAL: > 42.6 million poor people** (> **9.0 million poor HH)**	**Significant**: 100% of annual income or 10% permanent impact on income	**High certainty**: 50–80% expectation of achieving these impacts by 2030, at this point
Impact Area: Gender equality, youth & social inclusion **Impact Indicator**: No. of women benefiting from relevant CGIAR innovations		
HY fast cooking Beans: 1.9 million women producers *HY fast cooking Beans*: > 3.4 million women/girls in all adopting HH *Orange-flesh sweetpotato*: 1.5 million women producers **TOTAL: > 2.5 million women producers > 3.4 million women/girls in all adopting HH**	**Significant**: 100% of annual income or 10% permanent impact on income	**High certainty**: 50–80% expectation of achieving these impacts by 2030, at this point
Impact Area: Climate adaptation & mitigation **Impact Indicator**: No. of people benefiting from climate-adapted innovations		
Stress tolerant maize: 69.9 million people (14.7 million HH)	**Significant**: 100% of annual income or 10% permanent impact on income	**High certainty**: 50–80% expectation of achieving these impacts by 2030, at this point
Impact Area: Environmental health & biodiversity **Impact Indicator:** No. of plant genetic accessions available and safely duplicated		
Aggregate increase to 2030: 15% (70,000 additional accessions become available)	*Not required for this indicator*	**Very high certainty**: > 80% expectation of achieving these impacts by 2030, at this point in the design process

2.7.1 Nutrition, health, and food security

Number of people benefiting from relevant CGIAR innovations:

Vitamin A deficiency is a major disease affecting 48% of children aged 6–59 months in sub-Saharan Africa (SSA)[8]. We project that the nutrition, health and food security status of about 23.1 million people (i.e., 4.7 million households) in 16 SSA countries will improve significantly through the adoption of yellow cassava varieties with high β-carotene (a precursor of Vitamin A) content and high dry matter, and orange-fleshed sweet potatoes with high β-carotene and improved productivity (details in Annex). Benefits for adopting households arise through increased production, consumption, and sale of crops with higher nutritional value that increase diet quality. The number of beneficiaries is projected using crop/country specific adoption profiles based on past evidence and expert estimates, secondary data on national crop production area (narrowed down to target domains), average household size, and crop area per HH. We did not include benefits arising for end-consumers when they buy biofortified crops. The combined total number of beneficiaries accounts for an estimated 80% overlap (HHs growing both cassava and sweet potatoes) in eight countries included in both projections. Projected impact is in the lower bound of high certainty because dissemination

and adoption of the varieties may be challenged by available seed systems and face market constraints in some countries.

2.7.2 Poverty reduction, livelihoods, and jobs

Number of poor people benefiting from relevant CGIAR innovations:

By enabling poor smallholder households to achieve higher yields and hence 'living income', adoption of improved varieties of rice, wheat and maize is expected to significantly benefit 42.6 million poor people (9 million poor HH) by 2030 (details in Annex). While the GI initiatives have identified 12 priority crops for breeding, only three innovations (higher yielding rice in South and Southeast Asia[9]; high-yielding wheat in South Asia[10,11]; and stress-tolerant maize in sub-Saharan Africa[12,13] are included in the projection. These varieties are at an advanced stage, almost ready to be released and benefits are expected to materialize soon and with high certainty. The number of poor people benefiting is estimated by multiplying the projected number of adopters by 2030 in each country with the poverty headcount ratio at national poverty lines (World Development Indicators, most recent year available). To avoid double-counting in the projected total number of beneficiaries, we accounted for the overlap, especially in the Indo-Gangetic Plain, where HHs frequently grow both rice and wheat[14], by reducing numbers accordingly[15,16].

2.7.3 Gender equality, youth, and social inclusion

Number of women benefiting from relevant CGIAR innovations:

While approximately half of all beneficiaries of improved varieties are women, the Genebanks Initiative focuses on crops and traits explicitly aiming at improving women's livelihoods. Two examples are bean varieties with increased yield and reduced cooking time [17,18] and orange-fleshed sweetpotatoes[19]. Women are benefiting from these varieties through different impact pathways: i) increase of income if grown as "women's cash crops"; ii) fast cooking (targeted 30% reduction) benefits women by freeing time because collection of firewood and meal preparation are mostly conducted by women; and iii) health benefits for women and youth consumers. For our benefit projection, we focus on i) and ii) and follow the general steps outlined for indicators above, and then compute the share of women producers among all adopters (see Annex PB for details). For the 'time-saving' benefit, we assume one woman/girl benefits per adopting HH. Because most HH in SSA cultivate several crops, we use an 80% overlap for countries included in both crop projections. We project that at least 2.5 million women producers and 3.4 million women/girls in adoption HH will benefit significantly and with high certainty from these two crops in the included 17 countries alone.

2.7.4 Climate adaptation and mitigation

Number of people benefiting from climate-adapted innovations:

The projection of beneficiaries from climate-adapted innovations is derived from the number of farmers in Sub-Saharan Africa adopting maize varieties tolerant to abiotic stress (details in Annex). Droughts have become an almost regular occurrence in SSA, severely reducing yields of many crops[20]. Maize is an important staple crop in the region and the new drought and heat resistant varieties[12,13] achieve 20% higher yields under drought conditions[21]. This effect is on the upper end of the "significant" depth criteria in terms of % permanent increase in income.

We assume an s-shaped logistic adoption function and use country-level rates of current adoption of improved varieties as adoption ceilings[22], in some cased adjusted upward thanks to significant recent donor investment in the seed sector in target countries. With first adoption by farmers expected in 2022 and an estimated 10-year period to maximum adoption, we project that by 2030 about 14.7 million HH across the target domain will be adopting these improved varieties. This translates to at least 69.9 million persons benefiting from this climate-adapted innovation over the next 9 years.

2.7.5 Environmental health and biodiversity

Number of plant genetic accessions available and safely duplicated:

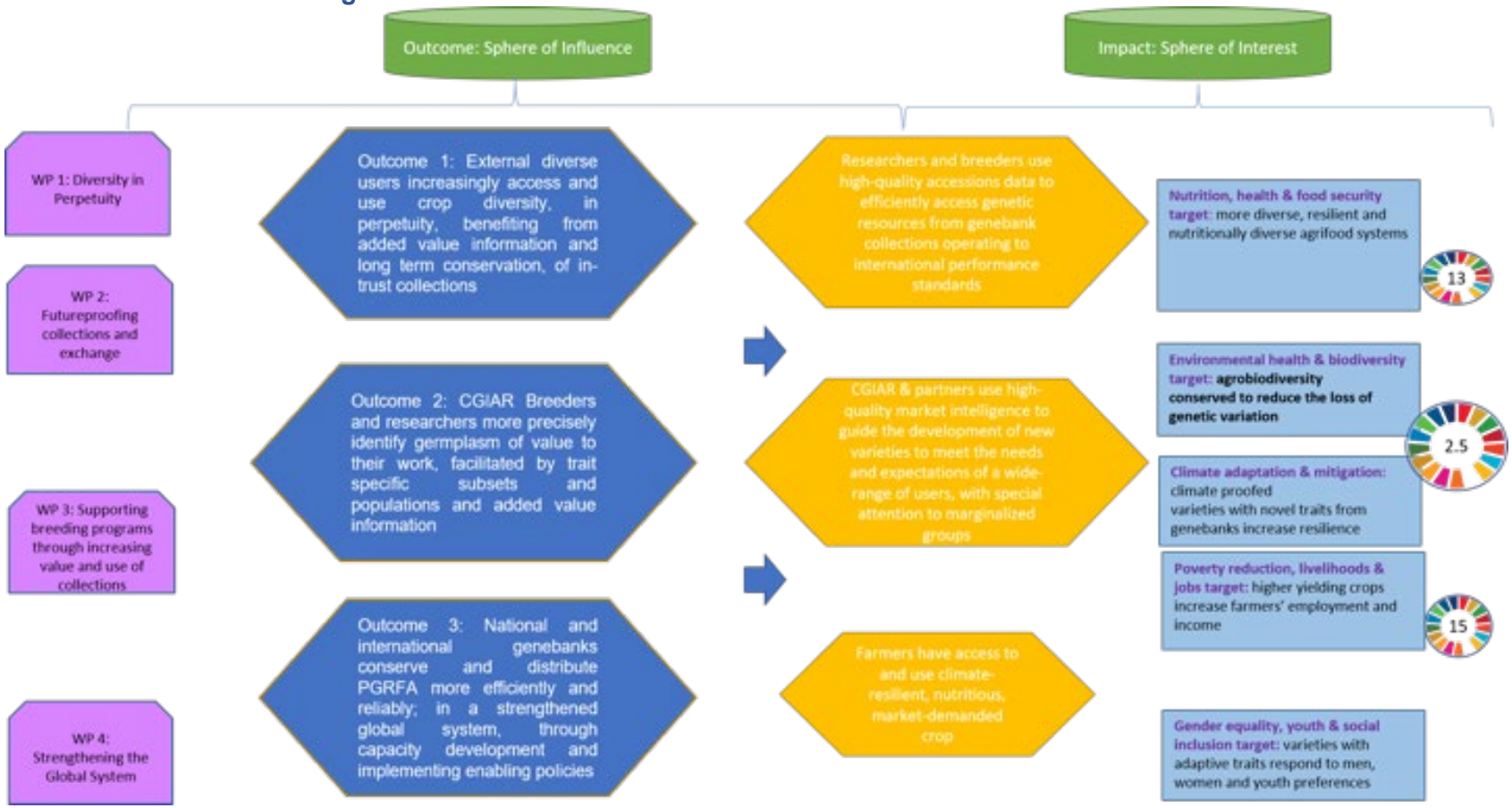
CGIAR has an obligation to conserve and make available crop collections under their management, according to the provisions of the Plant Treaty. Making accessions available for international distribution requires germplasm to have acceptable viability, be free of quarantinable diseases, with adequate stock, and legally available. In 2020, CGIAR genebanks were managing a total collection of 592,257 crop and forage accessions with 79% availability (not including ICRISAT and CIFOR-ICRAF). By 2030, CGIAR genebanks will achieve and maintain 90% availability (i.e., 70,000 additional available accessions). This progress is monitored through an online reporting tool (managed by the Crop Trust) and reported annually[23]. The genebanks will process backlogs (e.g. health testing and cleaning, seed regeneration, verifying trueness-to-type, etc.) to reach this performance target[24]. Achieving and maintaining 90% availability enables genebanks to operate at a steady, efficient state, making them eligible for endowment funding, as well as ensuring users have access to germplasm. The effects of the pandemic and examples such as CGIAR's evacuation from Syria illustrate the importance of sustaining performance targets[25].

3. Research plans and associated theories of change (TOC)

3.1 Full Initiative TOC

The goal of the Initiative is to provide improved genebank and GHU services within a stronger, collaborative global system addressing SDG 2.5.]

3.1.1 Full Initiative TOC diagram



3.1.2 Full Initiative TOC narrative

The four Work Packages (WPs) are similar to the Modules in the current Genebank Platform, with an increased focus on developing tools and resources to promote use of crop diversity and more support for collaboration and building National Agricultural Research System (NARS) capacity. 1) WP 1 comprises routine genebank operations and curation of collections of 23 crops to ensure germplasm viability, health, and availability in the long-term as well as for immediate use. The outputs will ensure genebanks are able to distribute, in compliance with legal obligations, disease-free, well documented germplasm to diverse users in response to requests.

WP 2 focuses on improving the efficiency and effectiveness of specific conservation (e.g. seed quality management, cryopreservation) and phytosanitary protocols that cause chronic bottlenecks or inefficiencies in processes or risk management. This WP will also ensure that CGIAR perspectives are represented in international policy-making processes. WP 2 builds on CGIAR's areas of expertise not only to futureproof the collections and the way CGIAR functions within the international policy environment, but to feed into NARS capacity building efforts (which is the focus of WP 4).

WP 3 goes beyond the genebank service of providing germplasm on request by supporting the active participation of collection curators in collaborative efforts to evaluate and discover traits required in product profiles and in response to priority activities to address the five Impact Areas. Outputs include PGRFA subsets tailored to specific traits and ready-made genetic resources for trait development. Data generated by research partners will be harnessed to add value to collections, which will increase interest in materials from users outside CGIAR and result in more germplasm requests in WP 1. WP 3 will enable researchers to utilize fully characterized germplasm to identify novel sources of genetic variation and mine collections ("Accelerated Breeding: Meeting Farmers needs with Nutritious, Climate-Resilient Crops"). Breeders will use landraces and wild relatives as sources of novel alleles to accelerate genetic gains for climate resilience, nutrition, and processing traits ("Accelerating crop improvement through precision genetic technologies"). Genebanks, through analyzing trends in germplasm requests, will feed new information into "Market Intelligence for More Equitable and Impactful Genetic Innovation." Diverse users' may also draw on genetic diversity for rangeland management ("Livestock Systems Climate and Resilience").

While WP 2 and 3 focus primarily on R&D in CGIAR Initiatives, WP 4 leverages the skills and innovations in WP 1-3 to strengthen capacities of key actors outside CGIAR. WP 4 will help define mutually supportive roles and responsibilities of CGIAR and partners to strengthen the global system and increase the coverage of PGRFA conserved and made available worldwide. CGIAR genebanks will work with NARS, National Plant Protection Organizations, regional networks, universities, seed industry and international policy-making bodies to source and conserve threatened or useful diversity (including fruit and vegetable diversity), co-develop conservation strategies, policy instruments, and training materials to promote efficiencies and responsibility-sharing.

3.2 Work Package research plans and TOCs

Work Package title	**WP 1 – Diversity in perpetuity (Routine activities)**
Work Package main focus and prioritization (max 100 words)	Work Package 1 supports CGIAR's unique contribution to UN SDG 2.5 and enables it to fulfil its legal agreements under Article 15 of the Plant Treaty. In total, CGIAR manages 592,000 accessions of 23 crops in the form of seeds, tubers, tissue samples in vitro and cryopreservation, plants, and trees. Managing germplasm involves the implementation of routine

	operations at a level that meets or exceeds published Genebank standards, ensuring that crop collections are both secured in long-term storage as well as being readily available for distribution. Every year, up to 100,000 samples are provided to CGIAR Initiatives and to hundreds of requesters worldwide.
Work Package geographic scope (Global/Region/Country)	Global

WP 1 - The science

CGIAR genebanks have provided conservation services for more than four decades, spearheading a global community of national and international genebanks and users. CGIAR genebanks manage collections which are made up predominantly of landraces, heritage varieties, crop wild relatives and other materials that have been gathered from 196 countries over many years for both long-term conservation and immediate use. Essential genebanks operations are defined and costed. To reach standards for long-term conservation, each accession (and germplasm sample) must be:

- Legally acquired
- Phytosanitary tested and cleaned
- Characterized
- Taxonomy and identity verified
- Processed, dried, packed and stored at −18°C and 5°C for seed
- Viability tested and re-tested
- Regularly subcultured and eventually cryopreserved for clonal crops
- Regularly monitored in the field or screenhouse for live plants and trees
- Multiplied for storage and distribution
- Regenerated when below accepted viability thresholds
- Selected and distributed upon request following legal and phytosanitary regulations
- Inventoried and documented at every intervention

Collections are managed and curated by crop experts with the aim of adequately representing crop genepools without redundancy. Curators provide the best possible information when germplasm or services are requested. Germplasm distribution varies unpredictably from year to year with up to 70% going to NARS, NGOs, the commercial sector, and private users in low- and middle-income countries worldwide. Germplasm distribution is critically dependent on GHUs providing phytosanitary controls and the Policy Helpdesk in ensuring legal compliance.

All CGIAR genebanks and GHUs follow a quality management system (QMS) approach, involving documenting, auditing and externally validating SOPs, which comply with international standards for genebanks26, phytosanitary health27, relevant seed testing rules28 and legal obligations[29]. This QMS approach supports each genebank and GHU to review and improve operations. Genebanks aim to reach and sustain four performance targets concerning the availability and security of the collections in order to become eligible for long-term partnership agreements funded through an endowment mechanism managed by the Crop Trust. Seed collections across CGIAR will become eligible for LPAs between 2022 and 2024.

To ensure that the collections, for which CGIAR have a legal responsibility, are adequately conserved for future use and that CGIAR is responsive to users' requests for germplasm and information, WP 1 has the following outputs:

1. Timely responses to more than 90% of legitimate requests
2. 150 SOPs updated and audited
3. Performance targets newly reached by five seed genebanks

WP 1 - The theory of change

CGIAR accounts for a large part of the materials being exchanged annually under the multilateral system for access and benefit sharing. The implementation of WP 1, therefore, will result in highly visible and publicly monitored outputs, influencing the reputation and credibility of CGIAR internationally.

The demand for WP 1 outputs is wide-ranging in terms of crops, types of diversity, purposes and user types and can change significantly as result of new technologies or information being made available. In the past decade, more than one third of distributed samples have gone to CGIAR rice and wheat research alone. CGIAR genebank use will, therefore, be heavily influenced by the priorities and activities of Genetic Innovation Initiatives. CGIAR scientists require genetic resources or associated information for research, breeding, capacity building, landscape restoration, seed systems and other projects. CGIAR tissue culture genebanks also manage breeders' materials and provide clean source material for seed systems.

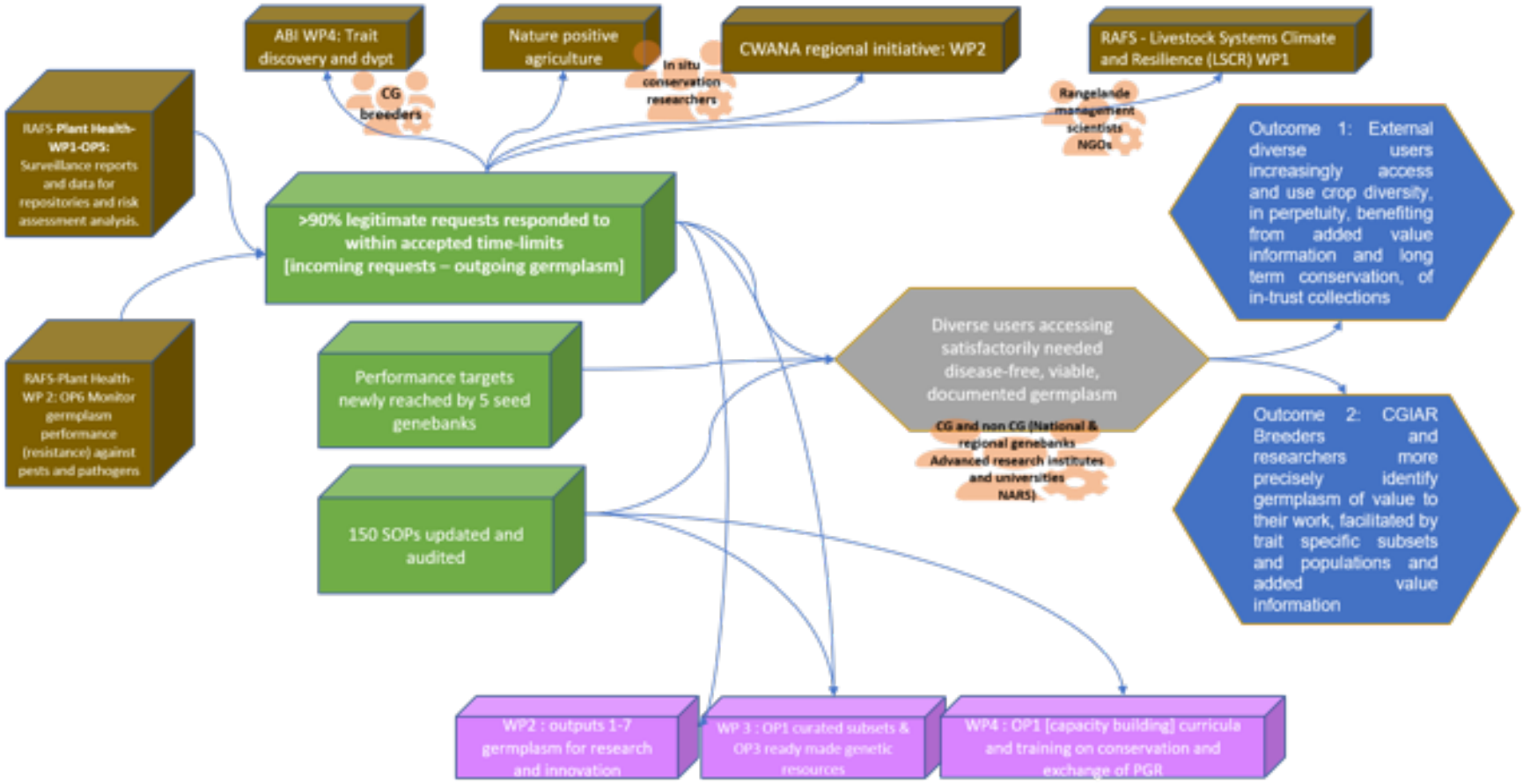
Beyond CGIAR, demand for CGIAR genebank services and GHUs has greater potential for increase or change as NARS' capacity grows and value-adding information on accessions or collections makes materials more attractive for use. In 2020, despite the pandemic, 75% of germplasm distributions went outside CGIAR to recipients in 78 countries; 42% of samples were sent to universities or research institutes, 31% to NARS and the rest to the commercial sector, NGOs, and farmers. Most samples (78%) were traditional cultivars or crop wild relatives.

WP 1 comprises everyday operations to deliver a world class service. Its outcomes and impact are determined by the actions of its users. The genebanks, themselves, do not expressly direct the use of specific materials for a specific purpose. Genebanks should, therefore, be envisaged as an upstream component of the Genetic Innovation impact pathway.

WP 1 directly feeds into and benefits from all the other WPs in the Genebanks Initiative and other CGIAR initiatives influencing all five Impact Areas, which provide improved intelligence technologies, policies, and tools to characterize or support the use of genetic resources, the pests and diseases that affect them, the trends in demand for them or the seed systems that adopt them.

An important output of WP 1 is the satisfaction of users of genebank services. Time limits for requests to be addressed will be defined and monitored. Genebank operations are monitored by the Crop Trust as part of their oversight of long-term agreements funded by the endowment fund. The Crop Trust will audit at least 150 SOPs and organize five-yearly external reviews. Five seed collections are expected to reach performance targets and be eligible for increased endowment funding.

WP1 – Guarantee availability of diversity in perpetuity



Work Package title	**WP 2 - Futureproofing collections and exchange (Improvement & research)**
Work Package main focus and prioritization (max 100 words)	Work Package 2 focusses on innovations to improve the efficiency and effectiveness of genebank and GHU operations under an enabling policy environment. Priorities include pioneering novel approaches to seed quality management, mainstreaming cryopreservation, piloting new conservation and phytosanitary protocols and tools, strengthening capacity across CGIAR to comply with international access and benefit sharing and phytosanitary regulations, and contributing to the development of new or revised international policies and instruments.
Work Package geographic scope (Global/Region/Country)	Global

WP 2 - The science:

Although the CGIAR genebanks have made many advances in daily operations under the Genebank Platform, further innovations are needed to improve efficiency and effectiveness in conservation protocols and take better advantage of synergies across genebanks. These measures will ensure that CGIAR genebanks continue to be at the forefront of reaching and setting standards for germplasm conservation and exchange as part of the global system. Research activities can be divided into four key areas: seed quality management, cryobanking, germplasm health, and genetic resources policy.

Research questions	**Methods**	**Outputs**
How unique are seed morphological traits to accessions; how can we use these traits to improve accession management, promote use? How much does seed longevity vary within/among accessions and how reliable are storage experiments coupled with monitoring data in predicting seed longevity? What is the optimum harvest time for CWR and forages and how should seeds be treated post-harvest to ensure maximum quality when deposited into genebanks? What is the best method for overcoming dormancy?	Image capture; multivariate data analysis; development of SOPs for automating characterization and improving accession management. Development of an AI model using real-time viability monitoring and experimental data; incorporation of model into genebank information management system. Studies on pre- and post-harvest physiological quality. Dormancy-breaking / germination experiments.	2.1 Automated seed characterization using seed imaging equipment 2.2 Customized monitoring intervals and prediction of rejuvenation requirements and storage conditions. 2.3 Improved harvesting, post-harvest handling and viability monitoring protocols for diverse species, including forages and CWR.
How can we ensure long-term conservation of difficult crops (clonal and recalcitrant) and otherwise exceptional species/accessions? How can we scale up the implementation of cryopreservation protocols to cryobank large collections?	Create robust cryopreservation protocols for important crops. Develop workflows so that sufficient clean, true-to-type, satisfactory plant material can be cryopreserved at scale; develop and agree standards, quality control.	2.4 Cryopreservation protocols optimized 2.5 Expanded cryobanking for relevant crop collections under CGIAR management.
How can we efficiently and accurately detect relevant pathogens in and ensure timely transfer of germplasm?	Review phytosanitary processing bottlenecks; pilot, apply, expand use of new cleaning and diagnostic	2.6 Next-generation phytosanitary protocols developed

	multispectral image analysis, markers) tools.	2.7 Novel diagnostic tools for sensitive and broad detection of pests and pathogens for germplasm health certification.
How do international/national access and benefit sharing and phytosanitary rules affect ability to access, use and distribute PGRFA and related information? How does that in turn impact on our R4D partnerships? What policy reforms or initiatives are necessary to provide better support for the conservation and availability of PGRFA, the CGIAR mission, and AgR4D generally?	Surveys of CGIAR genebanks and breeders concerning the influence of genetic resources policies on daily operations. Analysis of options for policy reforms, including through multistakeholder genetic resources policy roundtables.	2.8 Proposals for international policy reforms presented to international policymaking bodies (policy briefs, CGIAR reports, side events). 2.9 Guidelines, decisionmaking tools, training courses, and a Policy Helpdesk for CGIAR scientists promoting compliance with laws governing genetic resources.

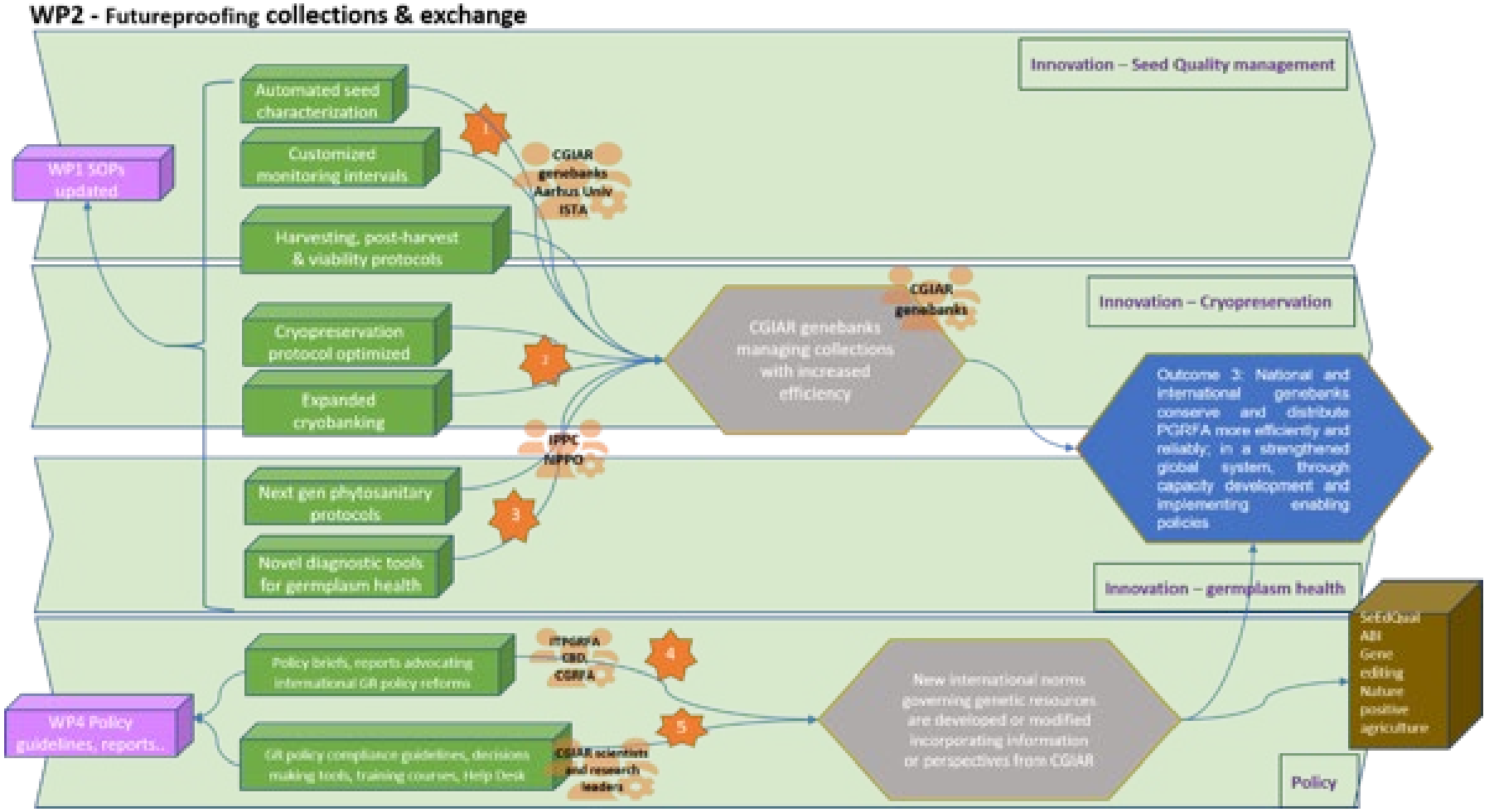
WP 2 - The theory of change

WP 2 is focused on research and capacity building to improve the CGIAR genebank operations in WP 1. As well as integrating innovations into CGIAR genebank operations and updating SOPs, research results will be shared as part of capacity building activities in WP 4 and through scientific conferences and journals. Outputs will also be reflected in changes to operational guidelines under existing legal frameworks and in submissions to international bodies reforming / developing genetic resources policies.

There are various specific bottlenecks in genebank, GHU and PGRFA policy processes that cause either delays in international germplasm exchange, difficulty in regeneration or germination processes or challenges to reaching performance targets. These bottlenecks have been clearly identified in technical reviews reports and international policy processes. For instance, the crops (e.g. clonal crops) and locations (e.g. where quarantinable diseases occur) that are subject to particularly challenging germplasm exchange because of lack of phytosanitary diagnostics or lengthy processes are well known. Similarly, crops (e.g. wild species) or genotypes that do not germinate or store well are evident in genebank records and inventory databases. These troublesome areas are the focus of WP 2. Such bottlenecks have wide-reaching effects on the use of PGRFA.

The demand for WP 2 outputs comes from the genebanks and other Genetic Innovation Initiatives (Accelerated Breeding, Traits and Services, and SeEdQUAL), Regional Initiatives accessing and distributing germplasm and genomic data; the RAFS Initiative on Plant Health; other genebanks and organizations conserving and/or setting standards for the conservation of PGRFA; National Plant Protection Organizations (NPPOs) who require robust procedures to ensure phytosanitary compliance and seek the transfer of technologies and procedures for capacity development; funders of PGRFA conservation including the Crop Trust; and germplasm users. Key innovation partners will include technology providers and University/IARC scientists; the IPPC and NPPOs; FAO and the Secretariats to the ITPGRFA, CGRFA and CBD; civil society; and seed industry organizations. Scaling partners include national genebanks and others involved in PGR conservation/distribution, and regional delegates to international policy negotiations.

Outputs of WP 2 will be adopted by the genebanks to deliver more efficiently on outputs of WP 1, 3 and 4. Many of the SOPs followed in WP 1 will be updated to reflect the optimization or incorporation of new protocols for seed harvesting, processing, characterisation, and viability testing, and cryobanking of clonal germplasm, as well as best practices to ensure compliance with evolving laws and policies. Key expertise represented in this WP will be important for WP 4 capacity building, including in relation to the Community of Practice of the Global Cryopreservation Initiative. WP 2 outputs related to policy and germplasm health will directly contribute to and will have synergies with Initiatives of Genetic Innovation, RAFS and Systems Transformation, and with all the Regional Initiatives. In this context, innovation and scaling processes are most relevant to this WP.


WP2 - Futureproofing collections & exchange
Innovation – Seed Quality management
Automated seed characterization
Customized monitoring intervals
Harvesting, post-harvest & viability protocols
WP1 SOPs updated
CGIAR genebanks Aarhus Univ ISTA
Innovation – Cryopreservation
Cryopreservation protocol optimized
Expanded cryobanking
CGIAR genebanks managing collections with increased efficiency
CGIAR genebanks
Outcome 3: National and international genebanks conserve and distribute PGRFA more efficiently and reliably, in a strengthened global system, through capacity development and implementing enabling policies
IPPC NPPO
Next gen phytosanitary protocols
Novel diagnostic tools for germplasm health
Innovation – germplasm health
SeEdQual ABI Gene editing Nature positive agriculture
Policy briefs, reports advocating international GR policy reforms
ITPGRFA CBD, CGRFA
WP4 Policy guidelines, reports..
GR policy compliance guidelines, decision-making tools, training courses, Help Desk
CGIAR scientists and research leaders
New international norms governing genetic resources are developed or modified incorporating information or perspectives from CGIAR
Policy

Causal linkage #	Actor Type	Assumption
1	Research. CGIAR	New processes and protocols are incorporated into standard operating procedures
2	Research CGIAR	Sufficient quantities of seeds / clonal material will be available for the required research. Actor: CGIAR genebank staff.
3	Research CGIAR, NPPO	New/upgraded innovations are efficient, cost-effective, and accelerate germplasm phytosanitation and health certification in the genebanks of CGIAR and partners.
4	Policymakers (international)	International policymakers respond to evidence-based contributions
5	Research, CGIAR	CGIAR researchers will assume transaction costs associated with compliance with national land international GR laws

Work Package title	WP 3: Supporting breeding programs through increasing value and use of collections (Use)
Work Package main focus and prioritization (max 100 words)	Support the active participation of genebanks in trait discovery and facilitating full use of the diversity in measures to adapt to climate change and increase nutrition and food security through genotyping collections, improving data management and accessibility, and developing discovery-ready genetic resources.
Work Package geographic scope (Global/Region/Country)	Global

WP 3 - The science:

Much of the value in genebank collections maintained under WP 1 exists in the under-utilized genetic variation for important traits. Breeding programs are establishing a trait development pipeline under the Accelerated Breeding Initiative to ensure high-quality reliable outputs (genes, markers) for the breeding process. WP 3 aims to connect with and enable this pipeline by generating value-added information and resources to relieve bottlenecks typically encountered by users. The improved usability will result in more targeted, reliable, cheaper trait development products, producing flow-on effects in more trait demand from breeding programs and thereby more frequent investigation of genebank material.

Research question	Activities and methods	Key outputs
How can genebanks increase the likelihood of users finding desirable traits?	• Curation and improvement of passport data • Extending passport data with additional datasets such as seed imaging and NIR spectrometry together with traits issued from calibrations • Identifying enriched panels for target traits through FIGS-type approaches • Enriching environmental, edaphic and stress layers to fine-tune subsetting and improve eGWAS studies • Promoting direct use of suitable accessions, particularly for crops without a dedicated breeding program	3.1 Subsets and panels of material enriched for traits sought by users.
Can genebanks enable more effective querying of genetic diversity through	• Identify priority accessions for genotyping based on breeding utility, trait value, or genetic diversity.	3.2 High-density genotyping data on priority accessions, to inform efforts such as allele mining and exploration of genetic diversity.

genotyping of collections?	• Generate high-density genotyping information on priority accessions, for example through resequencing. • Process through SNP calling and make available through portals such as SNPseek.	This will be made accessible through portals such as SNPseek.
Can genebanks relieve bottlenecks in trait development through creating value-added genetic resources?	• Appropriate genetic resource strategy worked out for target crops: o GWAS panels o CSSL or NAM populations o NIL libraries for major genes such as disease resistance • Target high-value accessions identified for use as donor parents in the populations (this would link with subsetting and genotyping above) • Populations created and/or stored • Information (genotypic data and ordering process) disseminated through web portals.	3.3 High-value genetic resources (panels, populations, libraries) available to relieve bottlenecks usually encountered in trait development efforts. Having these resources immediately available will enable trait development teams to quickly and cheaply determine the genetic basis contributing to traits required in breeding efforts
How can genebanks make data and materials more accessible?	• Web portals will be implemented to organize and provide access to materials and datasets created in the previous activities. • Where possible these will take advantage of existing tools such as: o SNPseek for genome-wide resequencing and high-density genotyping data o EBS or similar platform for phenotypic data o Passport and curation data through Genesys o Promote use of Digital Object Identifiers by breeders and other users o NIL/NAM/CSSL libraries, GWAS panels and FIGS subsets through SNPseek or Genesys	3.4 Web portals to simplify access to and querying of materials created in previous activities.

WP 3 - The theory of change

WP 3 is focused on connecting the genebank collections with the primary users, being trait development teams from the breeding programs (Accelerated Breeding Initiative) within CGIAR, and with similar teams from NARS partners, CSOs and other partners outside CGIAR. The primary value of genebank collections to breeding and selection programs is as a source of under-utilized genetic diversity. The Accelerated Breeding Initiative is establishing trait development pipelines to systematically search and incorporate valuable diversity into breeding efforts. Hence, the focus of WP 3 is to create resources that connect with and facilitate throughput of those pipelines. The same resources will be useful in trait development efforts from other programs, whether inside or outside CGIAR.

The logical flow of information and resources is given in the accompanying diagram. The key beneficiary of genebank work is breeding and selection programs, both inside and outside CGIAR. These establish demand for the genetic diversity preserved in the genebanks.

However, connecting this diversity to their programs faces challenges, both in terms of identifying valuable diversity, and in packaging that in a form the breeding programs can utilize. The activities described in WP 3 are aimed at enabling faster, more effective interrogation of genebank materials for useful diversity (phenotypic or allelic), creating genetic resources to relieve the bottlenecks associated with population development, and making

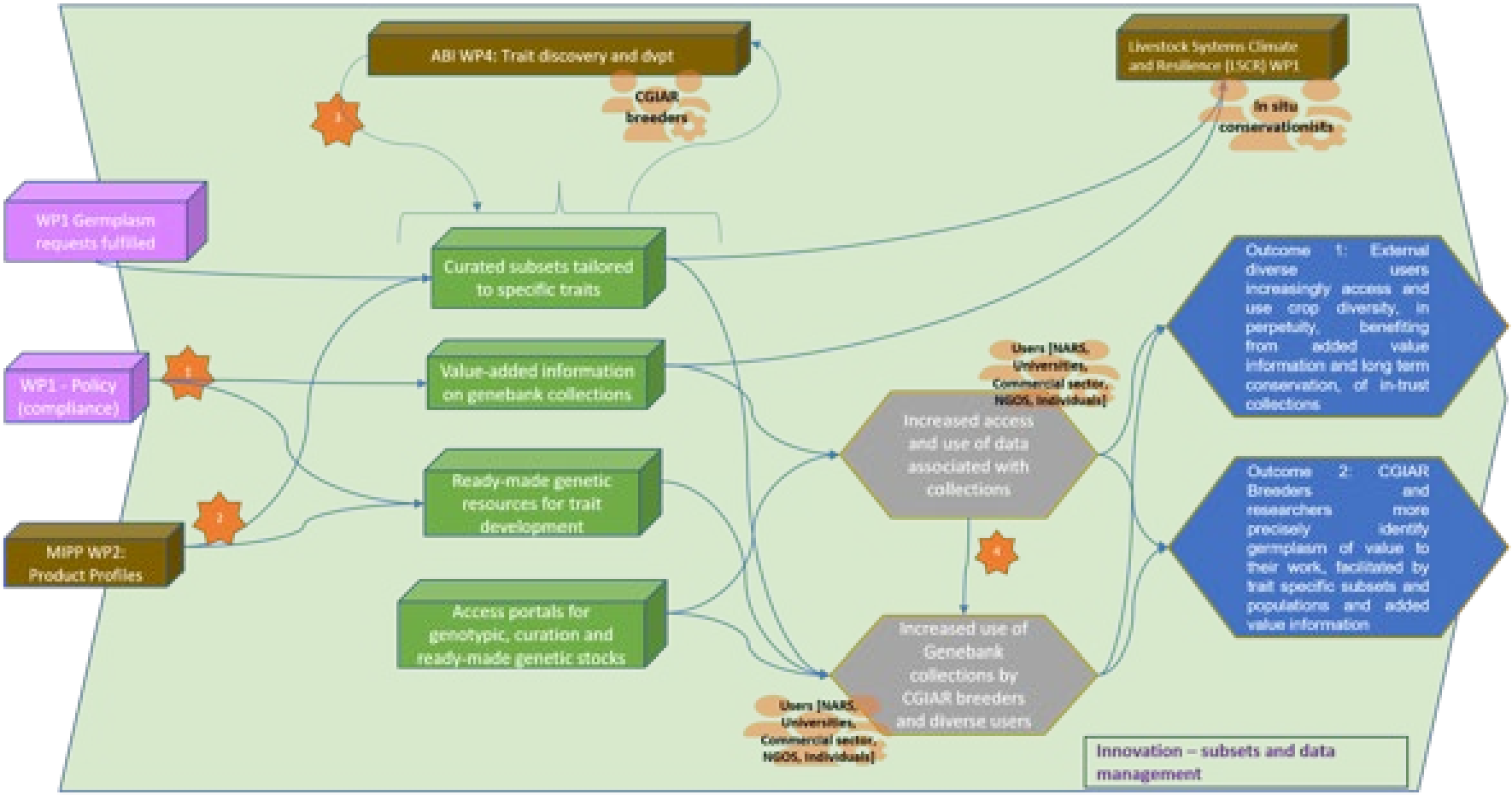
such data and materials easily accessible to researchers. Together these activities will enable more efficient evaluation of genebank collections, thereby lowering barriers to Accelerated Breeding Initiative and external partners utilizing the collections.

The work of the Genebanks Initiative on enhanced use of germplasm extends beyond One CGIAR, particularly in terms of the direct use of non-mandated crops in partnerships with other actors involved in value chain development

Key assumptions and risks of WP 3 include the following:

- Breeding programs and NARS have a desire to explore the genetic diversity in the genebanks.
- Traits in demand have significant genetic control. If there is no genetic component to the trait variation (it is all environmental or management) then trait development is not possible.
- Usable genetic variation for target traits exist in the genebank collections. If no variation exists in the collections, trait development will have to use other sources.
- The limitations of trait development can be eased through the activities presented. These activities have been conducted on small scale on certain species with significant success. Consultation with trait development teams in many crops.

WP 3 - Supporting breeding programs and increasing value and use of collections [Use]



Causal linkage #	Actor type	Assumption
1	Research, CGIAR	Pending resolution of ongoing international level negotiations about the governance of DSI, CGIAR researchers will adopt best practices that are consistent with our mission, and sensitive to equity concerns raised by many countries/stakeholders.
2	Research, CGIAR	Genebanks getting intelligence from MIPP on priority traits
3	Research, CGIAR	Traits not available in elite material
4	Research, CGIAR	Genotypic data increases use of material

Work Package title	***WP 4: Strengthening the global system***
Work Package main focus and prioritization (max 100 words)	Work Package 4 promotes mutually supportive roles of national partners and CGIAR to improve the function/scope of the global system. Genebanks will work with NARS, NPPOs, regional networks, universities, seed industry and international policy-making bodies to co-develop curricula on PGRFA collection management in compliance with international laws. It will support consultations, training and capacity strengthening with other Article 15 organizations and national partners on priorities for new collecting, the Global Cryopreservation Initiative, Greenpass System, and best practices for implementation of the Plant Treaty's' multilateral system of access and benefit sharing.
Work Package geographic scope (Global/Region/Country)	*Global*

WP 4 - The science

CGIAR genebanks do not conserve PGRFA in isolation. Many other organizations — including national genebanks — around the world are also engaged in conserving PGRFA as part of a global system. To address SDG 2.5 and increase the collective efficiency of all organizations involved in these efforts, it is important to analyze how much diversity should be conserved, who is conserving what, and what kinds of support national partner organizations need to be able to play more active roles to conserve PGRFA and make it available.

Research question	Activities and methods	Key outputs
What is the range of genetic diversity of key crops and forages? How much of that diversity is currently represented in globally available *ex situ* collections (including CGIAR, national programs, selected national collections)? What additional materials need to be collected, from where, to fill gaps across studied collections? How do evolving global challenges including climate changes, biodiversity loss, the triple burden of malnutrition, influence the prioritization of which PGRFA should be collected, conserved, characterized and evaluated? How is accession level characterization data currently being generated, stored, and exchanged among organizations world-wide? How can bottlenecks for generating and sharing such data be addressed?	Analysis of gaps and redundancies within, and across collections Analysis of accession level data, storage and sharing practices by the organizations hosting those collections Genebank user and request analysis and follow up. Assessments of organizational capacities to potentially play more active roles re: managing complementary active collections, safety back up including cryopreservation, characterization, evaluation, information system development and use, etc.	4.2 Analyses of gaps within and across PGRFA collections, and proposals for prioritized collecting missions. 4.3 Global Cryopreservation Initiative

What significant gaps (e.g., globally networked cryo facilities) exist in the overall architecture/structure of the global system? What outstanding roles need to be filled (and by whom) to ensure the efficient conservation and availability of the world's PGRFA?	Partnership with Crop Trust and Plant Treaty Initiatives to support national partners	
What are the technical and policy-related bottlenecks to CGIAR and organizations outside CGIAR playing more active roles in the global system? What opportunities exist for CGIAR to strengthen partnerships with national/subregional/regional programs to support their increased, efficient participation in the global system, in mutually supportive way with CGIAR? How can national partners (and subregional organizations) take advantage of their countries' commitments under the plant Treaty, Nagoya Protocol, IPPC, to enhance their conservation, exchange and use of PGRFA, and equitable benefit sharing?	Co-convening (with the GCDT, FAO, regional organizations) meetings and consultations for knowledge sharing, strategy development. Jointly developed training programs/curricula on • Collection structure/gap analysis • Seed/reproduction material storage and reproduction techniques, • cryopreservation, • germplasm health testing tools and methods, • accession level information systems • generation and use of genomic sequence information • characterization • implementing/ complying with the Plant Treaty, Nagoya Protocol, IPPC in ways that support AgR&D and the global system	4.1 Curricula & Training on germplasm management and policy 4.4 Draft guiding principles and options to implement/operate under the Plant Treaty and Nagoya Protocol 4.5 "Greenpass" phytosanitary protocol system with published common internal standards for phytosanitary certification of exported materials exchanged with CGIAR

WP 4 - The theory of change

CGIAR's contributions to the global system include conserving and making available healthy plant germplasm in accordance with international legal obligations (WP 1), improving techniques and policies for improved conservation and availability of materials (WP 2) and facilitating use of those materials by breeders and others (WP 3). WP 4 is the vehicle by which CGIAR brings the outputs and lessons learned through WP 1–3 to CGIAR and organizations outside CGIAR that are also engaged in conserving PGRFA and making it available. With support from WP 4, partners may adopt and/or adapt those outputs for their own use and build upon them to develop complementary approaches with CGIAR, GCDT, FAO, IPPC, and others.

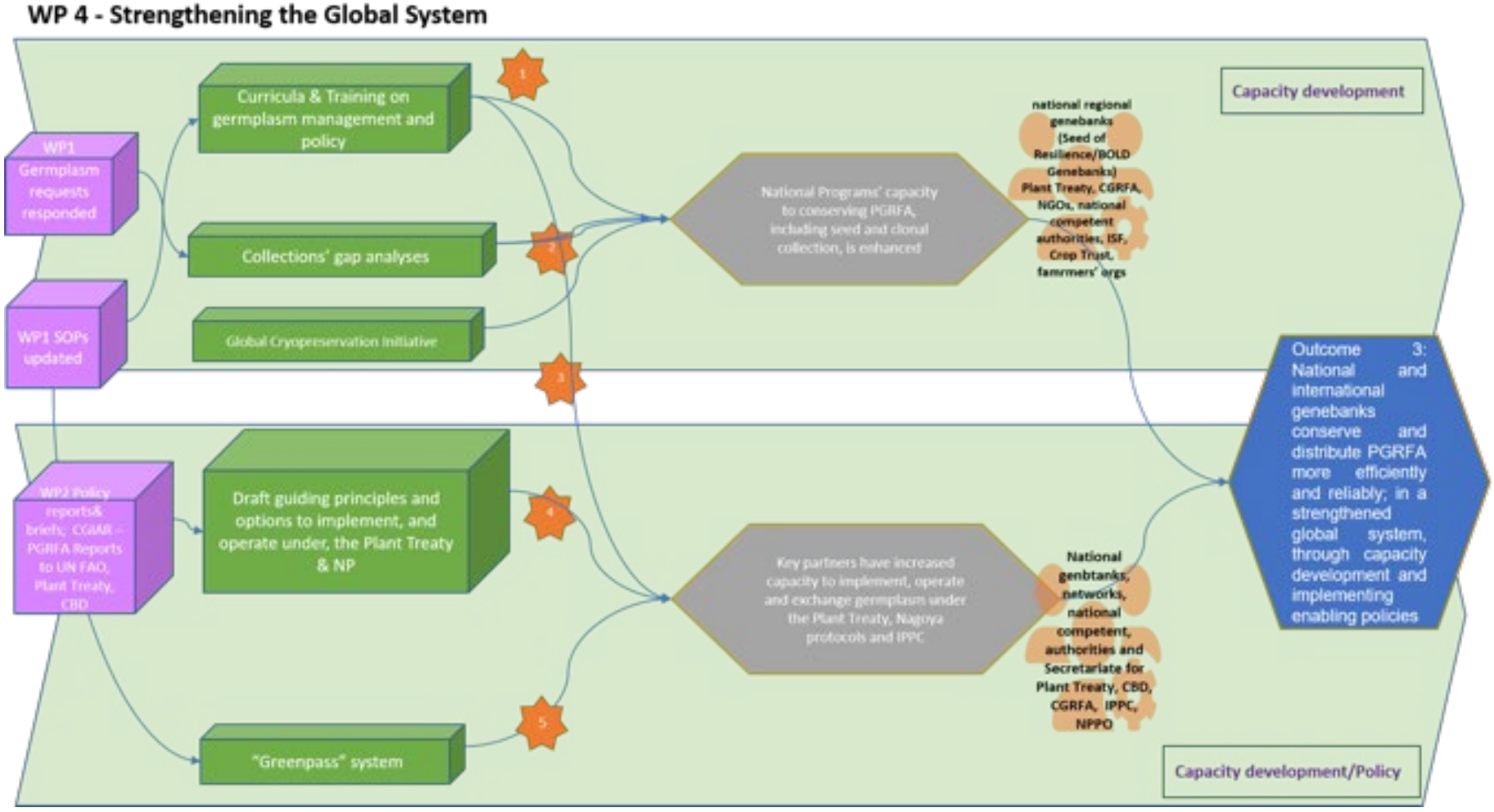
WP 4 will facilitate this adoption and adaptation by co-developing training curricula and training courses; promoting cooperation between organizations conserving and making PGRFA available; analyzing options for creating a supportive policy environment through national implementation of the Plant Treaty (in mutually supportive ways with the Nagoya Protocol). WP 4 will emphasize partnerships with countries and organizations that can play increased roles conserving materials that are currently poorly represented in publicly available *ex situ* collections. While the primary focus will be on *ex situ* conservation, complementarity will be sought with *in situ*/on farm conservation efforts of other initiatives (e.g., Nature-Positive Agriculture) and external partners (such as IUCN – Crop Wild Relatives Species Group and Global Environmental Facility), especially for wild and or recalcitrant species. WP 4 will link to ongoing projects (e.g., BOLD and Seeds for Resilience projects coordinated by the Crop Trust)

that can support the participation of national partners from up to 20 countries in joint activities. All of these activities will contribute to the 'End of Initiative Outcome': Efficient, functional global system with shared responsibilities between genebanks and other collection holders.

Most demand for WP 4 outputs and scaling activities comes from national and regional genebanks and agricultural research programs, other Article 15 organizations, policymakers in countries responsible for implementing the Plant Treaty's multilateral system of access and benefit-sharing and NPPOs responsible for administering phytosanitary regulations pursuant to the IPPC, and ultimately from plant breeders and other users of PGRFA from national genebanks. It also comes from the UN FAO Commission on Genetic Resources for Food and Agriculture and the Plant Treaty's Governing Body, both of which have repeatedly called for redoubled efforts by countries and organizations to increase their investments and partnerships to improve the coverage and functioning of the global system. And from the Conference of the Parties for the CBD which also sets goals for worldwide *ex situ* conservation of crop genetic diversity.

Outcomes promoted by WP 4—in particular increased capacity of partners to conserve and make germplasm available—are also useful to the Initiatives on Accelerated Breeding, SeEdQUAL, Traits and Services and Market Intelligence, and RAFS initiative on Plant Health and Regional Initiatives.

Key innovation partners are the Crop Trust, ISTA, Aarhus University, Open University of the UK, Secretariats of the Plant Treaty and CGRFA, UN FAO Plant Protection Division, IPPC, ISF, AVRDC, SPGRC, the national genebanks of Kenya, Ethiopia, Ghana, Malawi, Nigeria, and crop networks. Key scaling partners include the Crop Trust, regional agricultural research organizations, regional economic organizations, crop networks, the Governing Bodies of the Plant Treaty and CGRFA and CBD.


WP 4 - Strengthening the Global System
Capacity development
WP1 Germplasm requests responded
WP1 SOPs updated
Curricula & Training on germplasm management and policy
Collections' gap analyses
Global Cryopreservation Initiative
National Programs' capacity to conserving PGRFA, including seed and clonal collection, is enhanced
national regional genebanks (Seed of Resilience/BOLD Genebanks) Plant Treaty, CGRFA, NGOs, national competent authorities, ISF, Crop Trust, farmers' orgs
Outcome 3: National and international genebanks conserve and distribute PGRFA more efficiently and reliably; in a strengthened global system, through capacity development and implementing enabling policies
WP2 Policy reports& briefs; CGIAR – PGRFA Reports to UN FAO, Plant Treaty, CBD
Draft guiding principles and options to implement, and operate under, the Plant Treaty & NP
"Greenpass" system
Key partners have increased capacity to implement, operate and exchange germplasm under the Plant Treaty, Nagoya protocols and IPPC
National genbtanks, networks, national competent, authorities and Secretariate for Plant Treaty, CBD, CGRFA, IPPC, NPPO
Capacity development/Policy

Causal linkage #	Actor Type	Assumption
1	National partners managing genebanks	GCDT can provide funds where for national partners to adopt priority tools and methods
2	National competent authorities for ITPGRFA and Nagoya Protocol	competent public authorities will permit priority GRs to be collected /transferred
3	CGIAR host countries, GCDT	CGIAR offices, host countries, and GCDT can agree on respective roles and responsibilities
4	National competent authorities for the ITPGRFA, Nagoya Protocol	NARS will be motivated to implement the ITPGRFA and Nagoya Protocol in ways that support the global system
5	NPPOs	NARS do not want unnecessary technical barriers to transfer of germplasm

4. Innovation Packages and Scaling Readiness Plan

4.1 Innovation Packages and Scaling Readiness Plan

The Initiative plans to design and assess at least five core innovations and 15 support innovations within five Innovation Packages related to conservation of seed collections, conservation of clonal collections, adding value to collection and increasing use, germplasm health, and policy. The current Scaling Readiness of innovations is variable for the proposed innovations; some areas already at medium to high readiness for scaling, such as conservation and germplasm health protocols, and others needing more time and investment, such as novel genetic diversity and cryopreservation hubs.

The Initiative aims to apply the Innovation Packages and Scaling Readiness approach to 26%–50% of the total Initiative innovation portfolio by end of 2024 as part of the First Scaling Backstopping Wave.

The first wave will commence capacity development on innovation and scaling (Light Track) in Q1–2022, and subsequently work on profiling core innovations, designing Innovation Packages, scaling readiness assessment and development of innovation and scaling strategies (Standard Track) from Q4–2022 onwards.

The Genebanks Initiative allocated US$350,000 to implement the Innovation Packages and Scaling Readiness plan (2022: US$100,000; 2023: US$150,000; 2024: US$100,000). Dedicated activities, deliverables, indicators, and line-items are included in the Management Plan, MELIA, and Budget Sections.

5. Impact statements

5.1 Nutrition, health & food security

Challenges and prioritization

Global simplification of diets, malnutrition, and “hidden hunger” affect more than two billion people in the world who do not get enough essential vitamins and minerals. The development of new varieties of food crops that contain higher amounts of key nutrients requires access to crop diversity available in genebanks, including materials with identified nutritional traits, plus subsets and other genetic resources presenting variation in nutritional values. Underutilized crops, forages and resilient landraces conserved in the genebanks can also have immediate uses in strengthening food security and bringing nutritional diversity to farming and food systems, especially in emergency situations and as a means of providing a reliable source of food for households at times of scarcity or famine.

Research questions

WP 3: How can genebanks create and provide targeted subsets of germplasm to increase the likelihood of finding promising traits for biofortification or other nutritional benefits e.g. low glycemic index? How can genebanks relieve bottlenecks in nutrition-related trait development through creating value-added genetic resources?

WP 4: What is the range of genetic diversity of key crops and forages? How much of that diversity is currently represented in globally available *ex situ* collections (including CGIAR, national programs, selected national collections)? What additional materials need to be collected, from where, to fill gaps across studied collections?

Components of Work Packages

WP 2: efficient and effective conservation and delivery of genetic resources rich in nutritional traits and pathogen resistance

WP 3: trait discovery and use of targeted subsets to increase nutrition and food security

WP 4: engagement with scaling partners for broad impact, in particular with breeding programs targeting biofortification (Section 6.1 C).

Measuring performance and results

WP 3 Outcomes 3.1 and 3.2: Increased use of genebank collections and data by breeders.

WP 4: (all Outcomes): National programs capacity for conserving germplasm is enhanced; collecting missions; Key partners have increased capacity to implement and operate under international laws; Recognition/endorsement of Greenpass protocol by national programs (Section 6.1 C for metrics)

Partners

CGIAR trait development teams and breeders; IPPC, NPPOs; FAO, ITPGRFA, CBD; civil society organizations; the seed industry; universities, IARCs, national, regional, and international genebanks.

Human resources and capacity development

The required human resources and skills are already embedded in the staffing of the Initiative; no additional resources or capacity development required.

5.2 Poverty reduction, livelihoods & jobs

Challenges and prioritization

Crop diversity available in genebanks underpins crop improvement and farming system diversification in efforts to increase farmers' employment and income and, hence, reduce poverty and enhance livelihoods. Crop improvement has also contributed not only to the volume of crop yields, but also to their stability. Yield stability is especially critical for farmers in vulnerable and marginal situations.

CGIAR genebanks contribute to crop improvement through other CGIAR initiatives (e.g., the Accelerated Breeding Initiative) as well as through NARS breeding programs. Additionally, impacts on poverty reduction and improving livelihoods are realized through NARS, NGOs and farmers directly using material from the genebanks, including the use of high market value landraces and heirloom varieties, which can contribute to increasing household income. The scope of materials that can contribute in this way expands when taking account of the global genebank community, in which CGIAR collaborates. Through partnership with other national and international genebanks, germplasm of a wide range of crops, including fruits, vegetables, and minor crops, may be more easily accessed and used.

Research questions

WP 3: How can genebanks increase the likelihood of users finding desirable traits? Promoting direct use of suitable accessions, particularly for crops without a dedicated breeding program

WP 4: How can national partners take advantage of their countries' commitments under the plant Treaty, Nagoya Protocol, IPPC, to enhance their conservation, exchange, and use of PGRFA, and equitable benefit sharing?

Components of Work Packages

Subsets and panels of material enriched for traits sought by users (Section 6.1 C).

Measuring performance and results

WP 3 Outcomes 3.1 and 3.2: Increased use of Genebank collections by CGIAR breeders; increased access and use of data associated with collections

WP 4: Capacity development for conserving and accessing germplasm is enhanced focusing on two-way flow of germplasm under benefit haring agreements (Section 6.1 C for metrics)

Partners

CGIAR: Accelerated Breeding Initiative; non-CGIAR: advanced agricultural research institutes, national agricultural research institutes, universities, the private sector, and farmers

Human resources and capacity development

The required human resources and skills are already embedded in the staffing of the Initiative; no additional resources or capacity development required.

5.3 Gender equality, youth & social inclusion

Challenges and prioritization

Some needs of women, men and youth may be addressed by providing improved technologies (varieties with adaptive traits) that respond to their preferences (such as those that can reduce processing labor, quality traits, and income-generating traits) and by repatriating landraces that have been selected by women over time for particular preferred traits.

Many landrace varieties have been proven to be resilient to agroclimatic pressures over the centuries. However, changes in consumer and market preferences pose challenges to maintaining the diversity of landraces in farming communities. The crucial role of women, especially in the conservation and repatriation of landraces, has been documented by Ocampo et al. (2020). Women in Jala Valley, Mexico check the storage where grains and seed are kept, collect the ears which will be cooked, and indirectly care for the seed during the storage time. In addition, while men select the maize variety for commercialization and women select the varieties that will be consumed in the household. Because the women in the households recognize the nutritional and flavorful traits of Jala maize, the landrace variety has been identified for repatriation. CGIAR genebanks have been instrumental in this process.

Indirect contribution

Genebanks largely contribute to this Impact Area indirectly via impact pathways through other initiatives such as ABI with CGIAR and other breeders external to CGIAR, thus responding to the needs of women and youth and breeding for traits of their preference.

5.4 Climate adaptation & mitigation

Challenges and prioritization

The changing climate is putting our increasingly homogeneous farming systems at risk of failure through extremes of abiotic stress and continuously evolving pests and diseases. The difficulty in predicting trends in climate change, makes it essential to keep options open. Crop diversity is expected to play a significant role both in mitigating the adverse effects of, and adapting to, climate change. A key to achieving adaptation, according to Asfaw and Lipper[30], is broadening the genetic base of crops. Simulation studies have demonstrated simple and feasible changes in farm practices that can have significant impacts on crop productivity.

The continued availability and accessibility of both traditional and improved varieties is key to future improvements in crop productivity. Genebanks are a rich source of adaptive traits and alleles in both landraces and wild relatives that can be made available through a range of tools and approaches in adaptive breeding, developing new stable varieties of globally important crops under new challenges from climate change.

Research questions

WP 3: How can genebanks provide subsets of germplasm to increase the likelihood of users in finding traits (such as climate change adaptive traits) sought by them?

WP 4: How do evolving global challenges such as climate changes, influence the prioritization of which PGRFA should be collected, conserved, characterized, and evaluated?

WP 4: With climate change being a global challenge, what opportunities exist for CGIAR to strengthen partnerships with national/subregional/regional programs to support their increased, efficient participation in the global system, in mutually supportive way with CGIAR?

Components of Work Packages

WP 2: This WP involves the efficient and effective conservation and delivery of genetic resources tolerant to diverse climate conditions and biotic stresses associated with it (such as new disease outbreaks).

WP 3: This WP involves trait discovery and use of targeted subsets to increase tolerance to extreme climate conditions and natural disasters.

WP 4: This WP will enable engagement with scaling partners for broad impact, in particular with breeding programs targeting climate mitigation and adaptation; A “Greenpass” phytosanitary protocol system and enabling policies to ensure timely transfer of germplasm with traits needed for climate mitigation and adaptation and resistance to arising diseases. (Section 6.1 C)

Measuring performance and results

WP 3 (Outcomes 3.1 and 3.2): Increased use of genebank collections by CGIAR breeders, increased access and use of data associated with collections.

WP 4 (all Outcomes): National programs capacity for conserving germplasm is enhanced; collecting missions; key partners have increased capacity to implement and operate under international laws; recognition/endorsement of Greenpass protocol by national programs (Section 6.1 C for metrics).

Partners

CGIAR trait development teams; breeders; non-CGIAR breeders; the IPPC and NPPOs; the FAO, ITPGRFA and CBD; civil society organizations and the seed industry; universities and IARCs, national, regional, and international genebanks.

Human resources and capacity development

The required human resources and skills are already embedded in the staffing of the Initiative; no additional resources or capacity development required.

5.5 Environmental health and biodiversity

Challenges and prioritization

Agrobiodiversity conserved in genebanks and made available for use not only underpins current efforts towards crop improvement, but also reduces the loss of natural capital and the genetic variation contained within it. This natural capital plays a role in many aspects of the environment and human health and wellbeing. SDG 2.5 places emphasis on the conservation of genetic resources in soundly managed genebanks and ensuring access to that diversity and equitable benefit sharing.

Large, international genebanks, such as those of CGIAR, play a pivotal role between farmer and scientist. Through gathering genetic resources in one place and adding value through cleaning, testing, adding knowledge and making diversity available internationally and at scale, the genebanks are vastly improving access to such important public resources. At the same time, they ensure these materials are in secure conservation for use in perpetuity. Importantly, the data, policies and processes surrounding these interactions are key to ensuring benefits are felt by all.

Research questions

WP 2: Seed Quality management: How can we improve the efficiency and consistency of managing seed collections using automation, predictability of storage periods, optimizing standard operations of viability testing and post-harvest handling focusing on difficult crops?

WP 2: Cryopreservation: How can we ensure long-term conservation of difficult crops (clonal and recalcitrant seeds) and otherwise exceptional species or accessions and scale out cryobanking to whole collections?

WP 2: Germplasm health: How can we efficiently and accurately detect relevant crop pathogens, and ensure timely transfer of disease-free germplasm?

WP 2: Policy: How do international laws affect CGIAR genebanks' (and other Initiatives') ability to access, use and distribute PGRFA and related information and how does that in turn impact on our research and development partnerships?

WP 4: What is the range of genetic diversity of key crops and forages? How much of that diversity is currently represented in globally available *ex situ* collections (including CGIAR, national programs, selected national collections)? What additional materials need to be collected, from where, to fill gaps across studied collections?

WP 4: How do evolving global challenges including climate changes, biodiversity loss, the triple burden of malnutrition, influence the prioritization of which PGRFA should be collected, conserved, characterized, and evaluated?

WP 4: How can national partners (and subregional organizations) take advantage of their countries' commitments under the plant Treaty, Nagoya Protocol, IPPC, to enhance their conservation, exchange and use of PGRFA, and equitable benefit sharing?

Components of Work Packages

The Genebanks Initiative's four WPs deliver on this Impact Area. Of these, the most important for this Impact Area is WP 1. Please see information on WP 1 in Section 3.2.1 for TOC, Section 3.2.2 for activities and outputs, and Section 6.1 C).

Measuring performance and results

WP 1: Outcome 1.1: Diverse users satisfactorily access disease-free, viable, documented germplasm.

WP 2: Outcomes 2.1, 2.2, 2.3, 2.4: CGIAR genebanks managing seed collections with increased quality and standardized data; CGIAR genebanks building capacity to conserve diverse species including CWR and other difficult crops; GHU improving phytosanitary efficiencies and eliminating backlogs, CGIAR complies with, and contributes to further

development of, international laws governing genetic resources (see Section 6.1 C for metrics).

Partners

CGIAR breeders (including the ABI Initiative) and scientists (researching Livestock Systems Climate and Resilience, Nature-Positive Agriculture, Plant Health], non-CGIAR scientists (NARS, ARIs, universities, the commercial sector, NGOS, and individuals); and international organizations (e.g., CBD, ITPGRFA, CFRFA, IPPC), and regional and national genebanks.

Human resources and capacity development

The required human resources and skills are already embedded in the staffing of the Initiative; no additional resources or capacity development required.

6. Monitoring, evaluation, learning and impact assessment (MELIA)

6.1 Result framework

CGIAR impact areas				
Nutrition, health, and food security	**Poverty reduction, livelihoods, and jobs**	**Gender equality, youth, and social inclusion**	**Climate adaptation and mitigation**	**Environmental health and biodiversity**
Collective global 2030 targets				
The collective global 2030 targets are available centrally here to save space.				
Common impact indicators that your Initiative will contribute to and will be able to provide data towards (refer to page 5 of the Guidance for MELIA for selection of appropriate indicators)				
# people benefiting from relevant CGIAR innovations	# people benefiting from relevant CGIAR innovations	# women benefiting from relevant CGIAR innovations #youth benefiting from relevant CGIAR innovations	#people benefiting from climate-adapted innovations	# of plant genetic accessions available and safely duplicated
SDG targets				
				2.5

Action Area: Genetic Innovation	
Action Area outcomes	**Action Area outcome indicators**
Researchers and breeders use high-quality accessions data to efficiently access genetic resources from genebank collections operating to international performance standards	Number of accessions data used at various levels of the breeding pipeline (level of use: used in crosses, backcrosses, incorporated in elite germplasm)
CGIAR & partners use high-quality market intelligence to guide the development of new varieties to meet the needs and expectations of a wide-range of users, with special attention to marginalized groups	Proportion of new released varieties developed in alignment with market intelligence-informed product profiles
Farmers have access to and use climate-resilient, nutritious, market-demanded crop	Number of farmers who grow climate-smart crop varieties, disaggregated by gender.
	Number of farmers who grow crop varieties with increased nutritional content, disaggregated by gender.
	Area weighted average age of varieties in Farmers' fields

Initiative and Work Package outcomes, outputs, and indicators											
Result	**Result**	**Indicator**	**Unit of measurement**	**Geographic scope**	**Data source**	**Data collection method**	**Frequency of data collection**	**Baseline value (outcome only)**	**Baseline year (outcome only)**	**Target value**	**Target year**
Outcome	WP 1 Intermediate Outcome 1.1.	At least 80% user survey responses satisfied or very satisfied	Qualitative measure of	Global	Genebank users	User surveys	Ongoing	Customer satisfaction of 80% or	2017	80% or higher	2024

Initiative and Work Package outcomes, outputs, and indicators											
Result	**Result**	**Indicator**	**Unit of measurement**	**Geographic scope**	**Data source**	**Data collection method**	**Frequency of data collection**	**Baseline value (outcome only)**	**Baseline year (outcome only)**	**Target value**	**Target year**
	Diverse users satisfactorily accessing disease-free, viable, documented germplasm	No. of external user requests annually by CGIAR genebanks No. of accessions legally and physically available for distribution from CGIAR genebanks	satisfaction Nos. of external requests according to specific categories (e.g. NARS. NGOs, Farmers, etc.) Numbers of accessions		Annual reports on collection status gathered by Crop Trust/CGIAR.	Online reporting tool		higher 601,811 accessions	2020	650,000	2024
Output	Output 1.1 Performance targets newly reached by five seed genebanks	1. % Availability 2. % Safety duplication 3. Passport Data Completeness Index 4. Minimum QMS	1. % accessions in total collection 2. Passport data fields; 3. QMS elements	Global	Genebank databases	Online reporting External audit and review	Annual online reporting Ongoing external audit five-yearly external review	One genebank has reached performance targets	2018	Six seed genebanks at performance targets	2024
Output	Output 1.2 150 Standard Operating Procedures (SOPs) updated and audited	Number of SOPs audited	Number of SOP documents	Global	Repository for SOPs	Crop Trust/auditor receives updated SOPs from genebank staff or online repository	At least two SOPs (per genebank) audited per year	150 SOPs not yet revised and audited	2021	150 SOPs revised and audited	2024
Output	Output 1.3 > 90% legitimate requests responded to within accepted time-limits	No. of requests met within defined time period	No. of requests responded to within set time	Global	Automated online resource	Automated online resource	Ongoing	Currently there is no standard time limit in which responses to requests	2021	At least 90% requests addressed within accepted time limit	2024

Initiative and Work Package outcomes, outputs, and indicators											
Result	**Result**	**Indicator**	**Unit of measurement**	**Geographic scope**	**Data source**	**Data collection method**	**Frequency of data collection**	**Baseline value (outcome only)**	**Baseline year (outcome only)**	**Target value**	**Target year**
								should be made		(time limit to be defined)	
Outcome	WP 2. Intermediate outcome 2.1. CGIAR genebanks managing collections with increased efficiency	Viability monitoring schedule requires fewer re-testing events Number of accessions with seed images increased Number of clonal accessions in in vitro/field reduced as a result of cryobanking. Time for seed health testing less than 6 months.	No. of accessions	Global	Genebank databases	Online reporting tool Annual report	Annual	141,090 accessions have images in Genesys	2020	200,000 accessions	2024
Output	Output 2.1 Automated seed characterization using seed imaging equipment	Seed collections using automated seed characterization increased	No. of seed collections for which automated seed characterization is used	Global	Annual reports	Annual reports	Annual	One genebank currently automating seed characterization	2021	Six genebanks with seed collections using automated seed characterization	2024
Output	Output 2.2 Customized monitoring intervals and prediction of regeneration and storage conditions.	Viability monitoring intervals customized for individual accessions for three crops	No. of crops	Global	Genebank databases	Annual reports	Annual	Currently no viability monitoring intervals are customized to individual accessions or crops	2021	Accessions of three crop will have customized viability monitoring intervals	2024
Output	Output 2.3 Improved harvesting, post-harvest handling and viability	New procedures (SOPs) for dormancy-breaking / germination protocols and for	No. of species/genera with revised SOPs	Global	Repository for SOPs & audit reports	Annual reports and audit	Annual	Current SOPs for germination, harvest, and post-harvest	2021	Revised SOPs for germination, harvest, and post-harvest	2024

Initiative and Work Package outcomes, outputs, and indicators											
Result	**Result**	**Indicator**	**Unit of measurement**	**Geographic scope**	**Data source**	**Data collection method**	**Frequency of data collection**	**Baseline value (outcome only)**	**Baseline year (outcome only)**	**Target value**	**Target year**
	monitoring protocols for diverse species, including forages and CWR	harvest/postharvest treatment						treatment for 50 species and 10 genera		treatment for 50 species and 10 genera	
Output	Output 2.4 Cryopreservation protocols optimized	Cryopreservation protocols optimized to attain 99% chance of post-cryopreservation whole plant regeneration rate	No. of optimized cryopreservation protocols	Global	Documented protocols and results of cryopreservation experiments	Annual reports and published protocols	Annual	Currently two crops have optimized protocols (banana and potato)	2021	Three additional protocols optimized and documented (yam, cassava, sweetpotato)	2024
Output	Output 2.5 Expanded cryobanking for relevant crop collections under CGIAR management	Total no. of accessions successfully cryobanked	No. of accessions cryobanked using optimized protocols	Global	Results of cryopreservation activities reported by genebanks	Annual reports	Annual	5032 accessions cryobanked	2020	7000 accessions successfully cryopreserved	2024
Output	Output 2.6 Next generation phytosanitary protocols developed	At least eight new/augmented phytosanitary cleaning procedures for clonal and seed germplasm being successfully implemented	No. of new protocols No. of samples tested per crop/per year	Global	Reported number of samples tested by GHUs using revised procedures	Annual reports	Annual	40% pest elimination efficiency	2021	Eight new procedures with 80% pest elimination efficiency	2024
Output	Output 2.7 Novel diagnostic tools for sensitive and broad-specific detection of pests and pathogens for germplasm health certification	At least 20 new/augmented diagnostics protocols for established/new pests detection	No. of new protocols No. of samples tested per crop/per year	Global	Repository for germplasm health unit SOPs	Annual reports and audit	Annual	Existing diagnostic protocols as documented in SOPs	2021	20 new/improved diagnostics procedures established	2024

Initiative and Work Package outcomes, outputs, and indicators											
Result	**Result**	**Indicator**	**Unit of measurement**	**Geographic scope**	**Data source**	**Data collection method**	**Frequency of data collection**	**Baseline value (outcome only)**	**Baseline year (outcome only)**	**Target value**	**Target year**
Outcome	WP 2. Intermediate outcome 2.2. New international norms incorporating information or perspectives from CGIAR	Four new or modified policies/ laws/guidelines/decisions by international bodies informed by CGIAR research.	No. of policies/ strategies/guidelines/ laws/decisions/	Global	Plant Treaty, CGRFA, CBD	Websites and reports	Annual	International negotiations are under way but no policy documents are as yet developed	2020	Four policies/ laws/ decisions re: Post 2020 GBF; ABS for DSI; Improving the MLS; Farmers' rights	2023
Output	Output 2.8 Policy submissions to CBD; Plant Treaty, UN FAO CGRFA	Submissions to international bodies	No. of submissions to international bodies	Global	Reports and websites of international bodies. Reports of Genebanks Initiative	International bodies post submissions Genebanks Initiative maintains its own records	Annual	CGIAR submissions to 2017—2021 international GR policy fora, 2017—2021	2021	Five CGIAR reports to Plant Treaty Governing Body (2022, 2024), CGRFA (2023), CBD/NP (2022, 2024) Six CGIAR policy briefs; Three CGIAR-convened GR policy round tables	2023
Output	Output 2.9 Genetic resources policy compliance guidelines, decision-making tools, training courses, and dedicated	Guidelines/decision making tools Helpdesk requests CGIAR scientists trained	No. of reports, tools, requests addressed and trainees at training events	Global	Reports of the Genebanks Initiative Tools and reports on Genebanks	Annual reports, etc.	Annual	Three genetic resources policy compliance-related guidance documents	2021	Two compliance reports to Plant Treaty (2022, 2024); 3 guidelines;	2024

Initiative and Work Package outcomes, outputs, and indicators											
Result	**Result**	**Indicator**	**Unit of measurement**	**Geographic scope**	**Data source**	**Data collection method**	**Frequency of data collection**	**Baseline value (outcome only)**	**Baseline year (outcome only)**	**Target value**	**Target year**
	helpdesk for CGIAR scientists and research leaders				Initiative Website Helpdesk requests Training records			adopted during 2017—2021		2 policy instruments; 75 helpdesk requests; 200 CGIAR scientists trained	
Outcome	WP 3. Intermediate outcome 3.1. Increased use of Genebank collections by CGIAR breeders	No. of accessions used at various levels of the breeding pipeline (level of use: used in crosses, backcrosses, incorporated in elite germplasm)	No. of accessions	Global	Genebanks databases	Online reporting tool	Annual or more frequent	Average annual no. of accessions distributed to CGIAR users between 2017—2020 was 25,666	2017—2020	30000 accessions distributed to CGIAR breeders	2024
Outcome	WP 3. Intermediate outcome 3.2. Increased access and use of data associated with collections	Increase in registered users of relevant websites	Number of registered users of websites	Global	Genebanks databases and Genesys	Website monitoring	Annual or more frequent	399 new users of Genesys in 12 months	2020	500 new registered users per year to Genesys or genebank portals	2024
Output	Output 3.1 Subsets tailored to specific traits	Trait-specific subsets developed and made available	No. of trait-specific subsets	Global	Genesys	Genebanks submit available subsets in Genesys	Annual or more frequent	103 trait-specific subsets available	2020	80 trait-specific subsets	2024
Output	Output 3.2 Value-added information on genebank collections	Sequence and high-density genotyping data available on chosen accessions	No. of accessions with value added information	Global	Genebank/SNP-seek	Genebank database with sequence data linked	Annual or more frequent	5000 rice accessions with sequence data	2020	6200 accessions of diverse crops with	2024

Initiative and Work Package outcomes, outputs, and indicators											
Result	**Result**	**Indicator**	**Unit of measurement**	**Geographic scope**	**Data source**	**Data collection method**	**Frequency of data collection**	**Baseline value (outcome only)**	**Baseline year (outcome only)**	**Target value**	**Target year**
						to specific accessions				sequence data	
Output	Output 3.3 Ready-made genetic resources for trait development (e.g. GWAS, CSSL, NIL panels)	Populations and panels for trait development efforts	No. of populations/panels	Global	Genebank/SNP-seek	Records in the appropriate database detailing the population/ panels available	Annual or more frequent	Currently no populations or panels have been developed by genebanks	2020	Target no. will be determined by demand coming from breeders in GI consultations on crop product profiles	2024
Output	Output 3.4 Access portals for genotypic, curation and ready-made genetic stocks	Web portals in place	No. of portals	Global	URL	Annual reports	Annual or more frequent	Genesys, SNP-seek for rice	2020	One common database/portal per key data type, as needed.	2024
Outcome	WP 4. Intermediate outcome 4.1. National programs capacity for conserving germplasm, including seed and clonal collections, is enhanced	Increased capacity of key actors from 20 countries to conserve plant genetic resources	No. of countries with increased capacity	Global	Surveys of trainees, Genebanks Initiative reports, Genesys	Training surveys	Annual	Data not available	2017—2021	Increased availability of accessions of 20 genebanks according to Genesys records	2024
Outcome	WP 4. Intermediate outcome 4.2. Key partners have increased capacity to implement,	National, and network partners adopt new operational plans/procedures. Germplasm and information exchanged in	No. of operational procedures adopted No. of exchanges of germplasm and information	Global	Partners	Reports and surveys	Annual	National partners organizational strategies for exchanging germplasm	2021	Partners from up to 20 countries, subregions, networks adopt new operational	2024

Initiative and Work Package outcomes, outputs, and indicators											
Result	**Result**	**Indicator**	**Unit of measurement**	**Geographic scope**	**Data source**	**Data collection method**	**Frequency of data collection**	**Baseline value (outcome only)**	**Baseline year (outcome only)**	**Target value**	**Target year**
	operate and exchange germplasm under the Plant Treaty, Nagoya Protocol, and IPPC	compliance with applicable laws.						and info Status of use of SMTA by national partners		standards; Legal germplasm exchanges (with same partners) increased 20% from 2021.	
Output	Output 4.1 Curriculum & Training on germplasm management and policy	Curriculum on germplasm management and policy Annual training events for NARS	Curriculum available No. of annual training events for NARS	Global	Genebanks Initiative website; Training event feedback	Annual reports	Annual	No CGIAR on-line curriculum currently exists Annual average of 57 NARS training events took place and 3,786 individuals were trained between 2017-2020	2017—2020	15 on-line training modules 50 annual NARS training event and 3,500 individuals trained	2024
Output	Output 4.2 Collections' gap analyses	Crop gap analyses updated with new information from NARS	No. of NARS engaged	Global	Annual reports and published papers	Annual reports	Annual	Gap analyses for 22 crops completed with data from CGIAR genebanks	2020	22 crop gap analyses updated with new information from 20 NARS	2024
Output	Output 4.3 Global Cryopreservation Initiative	Global Cryopreservation Initiative proposal in active fund-raising effort	Finished proposal in circulation	Global	n/a	n/a	n/a	Cryopreservation	2020	Cryopreservation hubs established	2024

Initiative and Work Package outcomes, outputs, and indicators											
Result	**Result**	**Indicator**	**Unit of measurement**	**Geographic scope**	**Data source**	**Data collection method**	**Frequency of data collection**	**Baseline value (outcome only)**	**Baseline year (outcome only)**	**Target value**	**Target year**
								feasibility study			
Output	Output 4.4 Guiding principles and options for partners to operate under the Plant Treaty, Nagoya Protocol, and IPPC	Guiding principles and options codeveloped with national partners	No. of guiding documents	Global	Genebanks Initiative website, annual reports	n/a	Annual	Generic guidance documents for national level implementation of Plant Treaty, Nagoya Protocol	2020	Guiding principles and options codeveloped with national partners from up to 15 countries, two regional organizations and four networks	2024
Output	Output 4.5. A “Greenpass” protocol for expedited germplasm exchange between countries and CGIAR	Greenpass protocol	Greenpass protocol	Global	Published protocol	n/a	n/a	No protocol currently exists	2020	Greenpass protocol published and adopted by at least 10 NPPOs	2024

6.2 MELIA plan:

a. Narrative for MEL plans

An established monitoring system for genebanks has been in place since 2014 to gather data annually in an online reporting tool on the status of collections and the distribution of germplasm. A QMS approach framed by FAO genebank standards and other specific standards relevant to genebanks and GHUs ensures that operations are documented in SOPs that are audited on a regular basis. External reviews every 5 years are organized by the Crop Trust to validate SOPs and to provide expert input. The most recent took place in 2019–2020 and are due to take place in 2024–2025.

Standard Operating Procedures provide the policies and tools to support staff training and succession and to align and improve practices across genebanks. This is particularly relevant to fast-evolving areas of operation such as automation, cryopreservation and phytosanitary testing and cleaning, where protocols that are being optimized in one genebank may be tested and shared with others. These SOPs also provide a basis, together with the shared data management system, by which multiple collections of the same crop may be curated as one coherent collection under One CGIAR.

The conservation, policy and phytosanitary research in WP 2 revolve around incorporating new or advanced technologies, approaches, and policies into genebank and GHU SOPs. This follows a strong tradition in CGIAR genebanks and GHUs of testing new protocols experimentally and scaling them up across locations and crops before fully implementing them as established protocols and sharing them with partners. Cryopreservation protocols, for instance, have been well optimized for banana and potato, but remain less effective for sweetpotato, yam, and cassava. Further experimental work is required on both the protocols. The monitoring and success of this work will be evident in the revision and improvement of SOPs, which then enter the cycle of auditing, validation and review described above.

The Genebanks Initiative will increase focus on gathering relevant information on the distribution and use of germplasm, user satisfaction and related trends to assess the impact of activities in WP 3 and 4 and improve genebank services. Through a standardized approach, CGIAR will be able to document the purpose and nature of user requests and, to a limited extent, the outcome of germplasm distribution. Promoting the use of digital object identifiers by genebank users may potentially generate more information on specific genebank materials in research and breeding. Through actively monitoring changes in requests, the use of germplasm, subsets, and data online and offline, trends will be analyzed and can feed into market analysis in collaboration with MIPP.

b. Narrative for impact assessment research plans

The Genebanks Initiative does not plan to dedicate significant resources to impact assessment beyond what is described above under MEL plans. The genebanks represent an upstream component of the research and breeding pipelines and therefore contribute to the same shared impact. Added to this, CGIAR will continue collaborating with the Crop Trust, which carries out small research projects to assess the specific contribution of genebanks to crop improvement, research and use of PGRFA.

6.3 Planned MELIA studies and activities

Type of MELIA study or activity	Result or indicator title that the MELIA study or activity will contribute to.	Anticipated year of completion (based on 2022—24 Initiative timeline)	Co-delivery of planned MELIA study with other Initiatives	How the MELIA study or activity will inform management decisions and contribute to internal learning
Other MELIA: Annual monitoring of genebank performance by Crop Trust	Genebank performance targets: • % collection available for immediate distribution; • % collection safety duplicated; • Passport data completeness Index; • Minimum elements of quality management system.	2022, 2023, 2024	n/a	• Influences allocation of endowment funding to management of individual collections; • Drives improvement in genebank performance.
Other MELIA: Auditing and validation of SOPs	Compliance with FAO, IPPC, SMTA genebank and germplasm exchange	2022, 2023, 2024	n/a	• Recommendations lead to improved compliance; • In the event of continued lack of compliance additional actions may be necessary that would ultimately lead to management decisions.
Other MELIA: Five-yearly external genebank reviews	Collections are adequately and strategically conserved and made available	Next phase begins in 2024	n/a	Recommendations will inform next phase of genebank activities
Other MELIA: Genebank user monitoring and feedback	Smarter and more targeted use of collections facilitated for diverse users	Long-term	MIPP	User trends will inform genebank management and use
Scaling Readiness Assessment Study	No. of Initiative Innovation Packages that have undergone evidence-based and quality controlled/validated Scaling Readiness assessments informing innovation and scaling strategies	2023 (three) and 2024 (two)	Innovation Package linkages with Initiatives [linkage with ABI, MIPP, LCSR, Nature positive Agr]	The study will inform the design, implementation and monitoring of an innovation and scaling strategy, and scaling readiness metrics can feed an optional Initiative innovation portfolio management system

7. Management plan and risk assessment

7.1 Management plan

The Genebanks Initiative represents a long-term program of work that will benefit from a stable, system-level management structure. The Crop Trust will continue to provide specialist, independent oversight for the monitoring of genebank performance, which covers WP 1. Overall Initiative management will be provided through the Genebank Program, where leaders of seed and clonal crops, Policy and GHU units will form the Management Team under the Genebank Director. They will represent the genebank managers to support management decisions and priority re-setting in a similar way to the current Platform Management Team.

Feedback from specific partners will influence the development and implementation of individual workplans (e.g., NPPOs, international policy fora, genebank community, etc). WPs 2 and 4 will be implemented by the same Communities of Practice so that priorities identified by NARS and other partners for capacity building will contribute to the annual planning and prioritization processes that shape the conservation, phytosanitary and policy research activities implemented in both WPs.

WP 3 depends on close collaboration with genebank users both within and external to CGIAR. Cross-initiative teams within the Genetic Innovation and other Action Areas, will be required to align efforts towards shared research goals.

An Oversight Committee comprising Initiative Management Team, CGIAR Board representatives, the Plant Treaty, and the Crop Trust will be formed to meet annually or more frequently to provide representation of the legal entities and major stakeholders in governance and strategic and risk management decisions. PGRFA policy representation and compliance decisions will be made by the CGIAR System Board.

7.2 Summary management plan Gantt table

Initiative start date		Timelines												Description of key deliverables (maximum 3 per row, maximum 20 words per deliverable)
		2022				2023				2024				
Work Packages	Lead organization	Q1	Q2	Q3	Q4	Q 1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Work Package 1:		3		1				2						**1.** Six seed genebanks at performance targets; **2.** 150 SOPs revised and audited; **3.** At least 90% requests addressed within accepted time limit (time limit to be defined)
Work Package 2:		2	3		1									**1.** Six genebanks with seed collections using automated seed characterization; **2.** Three additional protocols optimized and documented (yam, cassava, sweet potato); **3.** Seven CGIAR reports to Plant Treaty, CBD, CGRFA.
Work Package 3:		1		2		3								**1.** Nine trait-specific subsets per CG genebank; **2.** 500 new accessions per crop across all crops with sequence data; **3.** One common database/portal per key data type, as needed.
Work Package 4:		1,3		2										**1.** Updated gap analyses for 22 crops based on inputs from 20 countries; **2.** Global Cryopreservation Initiative; **3.** Guiding principles & Treaty implementation options with partners from 15 countries, four networks, two regional organizations.
Innovation Packages & scaling readiness			1										2	**1.** Five documented scaling ambition, vision of success and roadmap for use of Scaling Readiness for selected two priority Core Innovations. **2.** Five evidence-based Scaling Readiness assessment reports and related scaling strategies for Innovation Package.
MELIA		2			1						3			1.Annual monitoring of genebank performance by Crop Trust. 2. Auditing and validation of SOPs. 3. Five-yearly external genebank reviews
Project management		1,2		2		3								1. Genebank Program established with Management Team, 2. Crop curators assigned, 3. Annual Genebanks meetings,

7.3 Risk assessment

The Initiative team undertook a risk assessment exercise to identify and evaluate the main risks and mitigating actions for the Initiative. Risks considered included around science, cohesion (including intended and unintended consequences of technologies/innovations for natural resources, GHG emissions, and social and economic aspects), legacy work, partnerships, talent, operational, ethical, and legal and other. At this phase, the risk assessment is used to highlight areas of concern and improvement recommendations for the Initiative.

The risk assessment also provides visibility to the different bodies that are needed from a good governance perspective in line with the Risk Management Framework of the CGIAR System. Following the Initiative's approval, the risk assessment will be integrated into the Initiative's workplan for continuous monitoring and management.

Genebanks Initiative risk assessment table

Top risks	Description	Likelihood (rate from 1 to 5)	Impact (rate from 1 to 5)	Risk score (Likelihood x Impact)	Opportunities (positive impact on objectives)	a) Existing controls / mitigation actions or mechanisms	b) Further controls / mitigation actions or mechanisms to be taken
#1. Loss of accessions or collections caused by unforeseen events (inadequate funding, extended lockdown, catastrophic incident) results in failure to make biodiversity available in perpetuity in line with Article 15 agreements. (WP1)	Unforeseen events (civil unrest, lack of funding, extreme weather, emerging phytosanitary threats, theft, or loss) impact the genebank's ability to maintain and/or make available the germplasm. Loss of biodiversity affects the Initiative's ability to underpin activities in support of human health and agricultural diversification.	2	5	10	New collaborations with partners for collecting, safety duplication services or sharing germplasm to replace materials that may have been lost.	A safety duplicate sample (also called primary or first-level backup) of each accession is stored within the host country in a geographically distant area A secondary sample of each accession is stored outside the host country as a "black box" Orthodox seed accessions are stored at the Svalbard Global Seed Vault as part of an international system to conserve genetic resources under permafrost conditions.	New, reliable cryogenic approaches are being explored to store and safety duplicate the existing biodiversity in a safe and efficient manner.

Top risks	Description	Likelihood (rate from 1 to 5)	Impact (rate from 1 to 5)	Risk score (Likelihood x Impact)	Opportunities (positive impact on objectives)	a) Existing controls / mitigation actions or mechanisms	b) Further controls / mitigation actions or mechanisms to be taken
#2. Lack of adequate funding to capture technical advances and innovations results in not being able to reduce costs or increase efficiencies in conservation methods. (WP2)	Research on novel approaches to seed quality management, cryopreservation and new phytosanitary diagnostic advances is required to improve the technical capability of the CGIAR genebanks and reduce the costs of conservation and distribution of germplasm. Failure to innovate will mean that genebank costs will stay the same or even increase, resulting in insufficient funds to maintain genebank operations adequately.	3	3	9	NA	Budget controls are in place to monitor spending and costs Communities of Practice (CoP) have been created to oversee the development of technical advances Audits and reviews contribute to improvement of management procedures	Continued partnership with the Crop Trust (beyond 2021) will ensure secure funding. Impact of introducing innovations at one or more CG or national genebanks will be evaluated before wider adoption
#3. Failure of genebanks to supply/provide relevant germplasm and information in a form that can be queried by users due to lack of data, accessible data portals, or relevant genetic stocks, results in genebanks becoming under-utilized (WP3)	Genebanks need to continue to take a proactive role in ensuring collections are relevant and usable by target groups. Curation data is useful, but needs to be amplified through sequencing, creation of value-added genetic materials and subsets, and appropriate data portals. Failure to address these issues will result in less demand for genebank materials.	4	3	12	NA	Germplasm subsets have been created in the last 2-3 years to target specific users Characterization data has been uploaded to global platforms such as GENESYS to provide easier access A "User Group" was created to periodically assess the needs of users and implement relevant practices to increase the demand for genebank material	Leverage and use materials being developed by existing trait development programs. Connect with and pursue collaborative bilateral funding opportunities, as part of the mainstream trait development efforts in breeding programs.

Top risks	Description	Likelihood (rate from 1 to 5)	Impact (rate from 1 to 5)	Risk score (Likelihood x Impact)	Opportunities (positive impact on objectives)	a) Existing controls / mitigation actions or mechanisms	b) Further controls / mitigation actions or mechanisms to be taken
#4. The International community adopts policies that undermine the ability of genebanks to partner with outside organizations in activities that involve exchanging germplasm and digital sequence information, resulting in the unavailability of additional biodiversity to address climate adaptation and farming system diversification. (WP4)	There are currently a number of international policy-making initiatives with potential (if they go wrong) to undermine the willingness or ability of organizations outside the CGIAR to provide access to germplasm and associated information, and by extension, to participate in coordinated activities with CGIAR to increase the scope of PGRFA in the global system that is available for research and breeding.	2	3	6	Negotiation of agreements with partners from outside CGIAR (wherein benefit-sharing concerns can be addressed). Participation in ongoing international level negotiations of new laws and policies affecting the governance of genetic resources and genomic information.	CGIAR participates in international policy making negotiations (as informed stakeholder/observer) making science-based contributions urging negotiators to adopt measures that support/encourage exchange and sharing of PGRFA and related information.	CGIAR genebanks (and other initiatives) will integrate adequate non-monetary benefit-sharing (e.g., training, tech transfer, information sharing) into projects to overcome partner's policy-inspired reluctance to exchange and share resources.
#5. Changes arising from the One CGIAR reform call into question the value/impact of genebank collections resulting in reduced funding, loss of credibility and the genebanks inability to fulfill a major role in international systems. (WP4)	11 Centers signed Article 15 agreements with the Plant Treaty's Governing Body, committing themselves to international standards in management of those collections. Uncertainties about Article 15 collections managed by Centers that do not participate in OneCGIAR, and the possibility of reduced funding for those collections within One CGIAR may raise questions about the costs/benefits, management and impact of One CGIAR. Similarly, if overall support for the Article 15 collections managed by CGIAR drops significantly, that too will raise questions about value/impact of One CGIAR reforms at the levels of	4	3	12	There is opportunity to issue convincing, clear statements to the international community with regards to the status and support of Article 15 collections. These statements demonstrate good will and responsibility for working with the full range of interested parties (CGIAR, Crop Trust, FAO) to ensure that none of the relevant Article	Active engagement with CGIAR, Crop Trust and Plant Treaty Secretariat, to map out changes in relationships and funding support for collections as a result of the One CGIAR reform, including focus on collections managed by Centers not included in One CGIAR.	Develop transparent communications about the levels of support and management of the collections under One CGIAR, and implications for collections/Centers that are not included in One CGIAR

Top risks	Description	Likelihood (rate from 1 to 5)	Impact (rate from 1 to 5)	Risk score (Likelihood x Impact)	Opportunities (positive impact on objectives)	a) Existing controls / mitigation actions or mechanisms	b) Further controls / mitigation actions or mechanisms to be taken
	the Plant Treaty Governing Body, UN, FAO, CGRFA and the CBD.				15 collections are negatively affected.		

8. Policy compliance, and oversight

8.1 Research governance

Researchers involved in the implementation of this Initiative will comply with the procedures and policies determined by the System Board to be applicable to the delivery of research undertaken in furtherance of CGIAR's 2030 Research and Innovation Strategy, thereby ensuring that all research meets applicable legal, regulatory and institutional requirements; appropriate ethical and scientific standards; and standards of quality, safety, privacy, risk management and financial management. This includes CGIAR's CGIAR Research Ethics Code and to the values, norms and behaviors in CGIAR's Ethics Framework and in the Framework for Gender, Diversity and Inclusion in CGIAR's workplaces.

8.2 Open and FAIR data assets

Researchers involved in the implementation of this Initiative shall adhere to the terms of the Open and FAIR Data Assets Policy.

The Genebanks Initiative will align with the OFDA Policy's Open and FAIR requirements, ensuring:

- Rich metadata conforming to the CGIAR Core Schema to maximize Findability, including geolocation information where relevant.
- Accessibility by utilizing unrestrictive, standard licenses (e.g. Creative Commons for non-software assets; General Public License (GPL)/Massachusetts Institute of Technology (MIT) for software), and depositing assets in open repositories.
- Wider access through deposition in open repositories of translations and requiring minimal data download to assist with limited internet connectivity.
- Interoperability by annotating dataset variables with ontologies where possible (controlled vocabularies where not possible).
- Adherence to Research Ethics Code (Section 4) relating to responsible data (through human subject consent, avoiding personally identifiable information in data assets and other data-related risks to communities).

In managing and sharing data assets, the Genebanks Initiative will align with the OFDA Policy's Open and FAIR requirements, the CGIAR Principles on the Management of Intellectual Assets, and Section 4 of the CGIAR Research Ethics Code. Continuous inclusion of the data generated by the Initiative in existing specialized tools and platforms will guarantee data curation and accessibility. Initiative researchers will make publications and other information products available under non-restrictive conditions whenever possible. To maximize the findability and interoperability of data managed by the Initiative, researchers will also adhere to relevant ontologies (including the Crop Ontology) and the CGIAR Core Schema.

9. Human resources

9.1 Initiative team

Category	*Area of expertise*	*Short description of key accountabilities*	*Full-time equivalents (FTE)*
Research	Genetic resources	Genebank management, Initiative, and Work Package leaders	15
Research	Genetic resources	Plant Genetic Resources Policy: policy research, engagement with international policy bodies	4
Research	Genetic resources	Crop curators, genetic resources characterization, subsetting, diversity analysis	25
Research	Genetic resources	Germplasm Health – coordinator, unit leaders, specialist staff on diagnostics research, controls, disease cleaning	28
Research	Genetic resources	Seed quality and data management, workflow management, germplasm documentation	22
Research	Genetic resources	Genebank operations: seed lab, viability monitoring	86
Research	Genetic resources	Genebank operations: in vitro	50
Research	Genetic resources	Genebank operations: field bank management, accession characterization, seed regeneration	140
Research	Genetic resources	Genebank operations: cryopreservation expertise on protocol development, cryobanking technicians	30

9.2 Gender, diversity, and inclusion in the workplace

The Initiative team will meet CGIAR's gender target of a minimum of 40% women in professional roles (1) and will comprise individuals from diverse backgrounds. Genebank teams have a relatively balanced gender ratio. The current group of genebank managers and leaders are 50% female. Minorities, and other underrepresented groups will hold leadership roles in the Initiative team. This will be seen in the composition of our senior team and will extend to the fair allocation of leadership activities and accountabilities. The Initiative Team is predominantly made up of nationally recruited technicians and researchers, often with a long association with the genebanks and germplasm health units and with specific skills and knowledge relating to the crops and the key forms of conservation in fieldbanks, seedbanks, in vitro culture, and cryopreservation. Several staff are uniquely knowledgeable in the taxonomy and origins of the collections and the behaviour of diverse landraces and wild species in storage and in the field. Specialist staff lead projects or units on seed quality management, cryopreservation, germplasm health, PGRFA policy, taxonomic and geographical gap analyses, genotyping genebank accessions, subsetting tools and data management.

9.3 Capacity development

Initiative team leaders and managers will complete training on inclusive leadership within 3 months of launch and within 6 months of launch, respectively. The Initiative team members will complete training on gender, diversity, and inclusion, including on whistleblowing and how to report concerns. The Initiative kick-off will also include an awareness session on CGIAR's values, code of conduct and range of learning opportunities available within CGIAR.

The genebank quality management system supports capacity building as an intrinsic component of the Initiative. The required level of training and training records for staff are documented and validated as part of the process of drafting, auditing, and reviewing individual SOPs. New recruits to genebank teams undergo training to enable them to take responsibility for the specific activities and operations that they are assigned to. Staff succession continues to be an important area for attention as long-serving staff retire.

Thematic CoPs, annual Genebank Operations and Advanced Learning (GOAL) workshops and on-site intensive training sessions are the focus of cross-CGIAR exchanges with regular meetings to improve and update conservation standards.
One CGIAR reform provides further opportunities for the alignment of operations, mentorships and sharing of expertise among genebanks, especially among young professionals and under-represented groups.

10. Financial resources

10.1.1 Activity breakdown

USD	2022	2023	2024	Total
Crosscutting across Work Packages	1,160,000	1,160,000	1,160,000	3,480,000
WP 1: Diversity in perpetuity	12,463,844	9,838,682	8,131,456	30,433,982
WP 2: Futureproofing collections & exchange	5,659,000	5,495,000	5,495,000	16,649,000
WP 3: Use	4,130,000	6,130,000	8,297,018	18,557,018
WP 4: Strengthening the global system	2,210,000	3,010,000	3,310,000	8,530,000
Innovation packages & Scaling Readiness	100,000	150,000	100,000	350,000
Total	**25,722,844**	**25,783,682**	**26,493,474**	**78,000,000**

The budget does *not* include projected funding from Crop Trust, which would be essential to achieve the stated outputs and an adequate level of genebank and GHU operation.

10.1.2 Geographic breakdown

USD	2022	2023	2024	Total
Global	25,722,844	25,738,682	26,493,474	78,000,000
Total	**25,722,844**	**25,738,682**	**26,493,474**	**78,000,000**

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