PRELIMINARY **CGIAR INITIATIVE** OUTLINES

Conservation and Use of Genetic Resources (Genebanks)

Initiative Lead and Co-Lead	Primary CGIAR Action Area	Estimated 2022 - 2024 Budget
Mariana Yazbek Michael Abberton	Genetic Innovation	$45 - $75 M

Challenge

An unprecedented rate of biodiversity loss is one of the defining global challenges of our times. Reduced biodiversity will undermine resilience of agricultural systems, threaten nutritional security, and put at risk the foundations of crop improvement. SDG 2.5 highlights the importance of maintaining genetic diversity of crops and their wild relatives, including through soundly managed genebanks, and ensuring access to that diversity and equitable benefit sharing, in accordance with international law (Scope and roles of the CGIAR genebanks: 2030 vision - https://bit.ly/3sselGG)

Interrelated with biodiversity loss, the changing climate is putting our increasingly homogeneous farming systems at risk of failure through extremes of abiotic stresses and continuously evolving pests and diseases. The difficulty in predicting trends in climate change, as well as socioeconomic trends, makes it essential to keep options open (How may food systems evolve: looking ahead in an uncertain world - https://bit.ly/32jAoVpn)

Global simplification of diets (and increasing reliance on decreasing diversity of plants) is contributing to the double burden of malnutrition. Meanwhile international disagreement concerning the governance of genetic resources and genomic information is exacerbating genetic resources nationalism as reflected in the reluctance of some countries to cooperate internationally exchanging genetic resources and related information., with negative impacts on AgR&D. These unresolved tensions are also contributing to unprecedented international scrutiny of CGIAR programs' compliance with international laws.

Objective

While ensuring that annual germplasm requests are met in compliance with Plant Treaty and phytosanitary regulations, CGIAR aims to consolidate collections through strategically aligning processes, standards, and curation, deploying one data management system, and to have either reached or sustained performance targets for availability, safety duplication, documentation, and quality management.

By 2028, CGIAR aims to deploy strategic, cost-efficient methods for conserving (including cryobanking), testing and cleaning at least six priority cultivated crops or wild relatives, while ensuring that the international policy environment is increasingly supportive of CGIAR's work through active engagement in Plant Treaty, Convention on Biological Diversity and International Plant Protection Convention developments.

CGIAR crop curators will engage in cross-initiative teams to support researchers in meeting the needs laid out in product profiles through providing data, tools, and genetic resources, in so doing accelerating trait discovery as well as enriching data resources to increase the value of the collections. Curators will actively engage with increasing numbers of genebank users (>2000 external requests/yr.) from outside Genetic Innovation or CGIAR to support the appropriate use of the diversity available from CGIAR genebanks in underpinning efforts to adapt to climate change, increase nutrition and improve food security and livelihoods.

CGIAR will provide services and build capacity for more effective conservation and use of plant diversity in at least 50 medium or low-income countries by 2028. It will promote a "Greenpass" system, and access and benefit-sharing initiatives, to facilitate and increase international germplasm exchanges

Theory of Change

The CGIAR Genebanks (hereafter Genebanks) will conserve, make available and promote use of agrobiodiversity, in compliance with international obligations, for current and future generations, directly responding to Sustainable Development Goal 2.5. It will actively curate global ex-situ collections of crops, crop wild relatives, forages, and trees to ensure their viability, health, and genetic integrity in a rational and effective system (Annex I). Researchers will expand utilization of 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 increase precision and accelerate genetic gains for climate resilience, nutrition and processing traits ("Accelerating crop improvement through precision genetic technologies"). Genebanks, through providing trends in germplasm requests, will establish a feedback loop on priority crops and desirable traits with "Market Intelligence for More Equitable and Impactful Genetic Innovation". Diverse users' will draw on genetic diversity for landscape management ("ASPIRE - agri-silvo-pastoral food systems resilience"), and crop diversification ("SeEdQUAL: delivering genetic gains in farmers' fields " and ALL regional initiatives), will be met.

Genebanks and germplasm health units, in collaboration with "Plant Health and rapid response to protect Food and Livelihood Security", will develop more efficient methods for long-term conservation, disease-cleaning and testing, and deploy capacity development packages with international and national partners, on conservation, exchange, and use (Genebank Costs and Operations - https://bit.ly/3aiKMkO).

Stronger and more interactive partnerships with national genebanks and a wide range of germplasm requesters/users worldwide will enable the generation and use of genetic resources, tools, and information. New modalities of collaboration will strengthen joint collection and conservation with national partners expanding the scope and efficiency of the global system of plant genetic resources.

Conservation and Use of Genetic Resources (Genebanks)

Highlights

Genebanks conserve efficiently and effectively the largest and most widely used collections of crop diversity in the world. The initiative will mainstream strategic curation of crop collections through adoption of one data management system, unified quality management and phytosanitary systems, harmonized policy compliance, and streamlined services to expand use.

CGIAR has succeeded in cryopreserving potato and banana on a uniquely large scale. Genebanks will expand this success to other collections under CGIAR management and create specialist cryo conservation hubs to support national genebanks to secure their collections of vegetative propagated crops and potentially additional crops with recalcitrant seeds.

Genebanks facilitate the identification and use of genetic variation for crop improvement as part of cross-initiative teams responding to cultural demands, market intelligence and product profiles, and will ensure data on genebank collections is enriched through closer interaction with the user community and other stakeholders.

Genebanks contribute to development of new international policies and instruments (concerning Access to Benefit Sharing (ABS) and phytosanitary regulation) that support future availability and exchange of genetic resources and genomic information.

Genebanks underpin the global system of plant genetic resources conservation and use and, in partnership with the Crop Trust, deploys CGIAR's wide experience in international policy and technical skills to build capacity worldwide for more effective conservation and use of plant diversity in response to SDG 2.5 and its successor.

Work Packages

	Scope of Work	3-year Outcomes
Guarantee availability of diversity in perpetuity	Ensuring "In perpetuity" operations that are required to meet CGIAR's legal, moral, and technical obligations to maintain and make available designated collections under Article 15 of the Plant Treaty. Every actively curated accession in the collection must be adequately documented, viable, healthy, true-to-type and safety duplicated according to international standards	Breeding, research and development actors continuously make advances through utilizing Genebank material
Futureproofing collections & exchange	New innovations to improve future efficiency and effectiveness of genebanks and GHU operations under an enabling policy environment. Priorities include pioneering novel approaches to seed quality management, mainstreaming cryopreservation, piloting new conservation and phytosanitary diagnostic advances, and contributing to the development of new or revised international policies and instruments.	Global System of germplasm conservation and exchange is more efficient and cost effective through sharing information, technologies and capacity building.
Supporting breeding programs and increasing value and use of collections	Focuses on supporting the active participation of genebanks in MIPP-driven trait discovery and facilitating full use of the diversity options for application 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.	Breeding, research and development actors continuously make advances through utilizing Genebank material
Strengthening the Global System	Maximizing synergies and coordination between Genebanks, GHUs and other actors in the global system, focusing on capacity strengthening and partnerships with NARES and NPPOs to co-develop tools, methods, standards, best practices, policies etc., culminating in enhanced sharing of responsibilities in support of SDG 2.5 and its successor.	Global System of germplasm conservation and exchange is more efficient and cost effective through sharing information, technologies and capacity building

Conservation and Use of Genetic Resources (Genebanks)

Impact Area Contributions

Nutrition, health & food security	Agrobiodiversity available in genebanks includes nutritional traits and variation and resilient landraces to underpin farming system diversification and crop improvement in support of planetary and human health and nutritional and food security
Poverty reduction, livelihoods & jobs	Agrobiodiversity available in genebanks includes specific crops and genotypes to underpin crop improvement, and farming system diversification in support of efforts to increase farmers' employment and income and hence reduce poverty and enhance livelihoods.
Gender equality, youth & social inclusion	Needs of women, men and youth addressed by providing improved technologies (varieties with adaptive traits) that respond to their preferences (such as drudgery reduction, quality traits, and income generating traits) and by repatriating landraces that have been selected by women over time for particular preferred traits.
Climate adaptation & greenhouse gas reduction	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.
Environmental health & biodiversity	Agrobiodiversity conserved in genebanks and made available for use underpins efforts to reduce the loss of genetic variation at all levels and to safely restore and diversify agroecosystems, supporting the provision of environmental services as well as crop products.

Impact on SDGs

Regions

Global

Countries

Conservation and Use of Genetic Resources (Genebanks)

Innovations

New methods of non-destructive viability testing, automated germination scoring, and a dormancy-germination toolbox developed to reduce use of resources for viability monitoring and better understand the longevity of seeds in genebank storage for use primarily by curators and genebank managers, and other workers in seed storage and delivery systems.
Reliable cryopreservation methods for vital crops where long-term conservation methodologies do not exist, to ensure the long-term availability of these crop collections, in base collections and safety back-up cryopreservation facilities for CG genebanks and the wider international Genebank community conserving clonal crops and recalcitrant seeds
Novel strategies to identify user-defined dynamic subsets combining information (Passport, phenotypic, environmental, genotypic) for prioritized adaptive traits (climate change, nutritional quality, gender- & social inclusion) to enhance allele mining, trait discovery, and subsequent evaluation of the defined subsets ensuring information backflow to finetune strategies for and in collaboration with breeders.
A "Greenpass" system with published common internal standards for phytosanitary certification of all imported and exported materials exchanged with CGIAR with the aim of achieving recognition of such standards by the International Plant Protection Convention (IPPC) to facilitate and accelerate safe germplasm exchange involving all CGIAR germplasm transactions.
A one-stop, centralized service/ helpdesk providing decision support tools, information, one-on-one feedback for OneCGIAR scientists to ensure compliance with Centers' obligations under Article 15 of the Plant Treaty, national access and benefit-sharing laws, and phytosanitary regulations

Key Partners

Demand	Academic, Training and Research	Advanced Research Institutes
		Universities
	Government	National Agriculture Research Organizations
	Private Sector	Farmers
		Small and large private sector companies
Innovation	Academic, Training and Research	Aarhus University, Wageningen University, University of Reading, National universities in host countries
	International NGO	The International Seed Testing Association (ISTA), The International Society for Biological and Environmental Repositories (ISBER), The DivSeek International Network, International Seed Federation (ISF)
	Other	Other Treaty Article 15 signatories and international genebanks (World Vegetable Center, Centre for Pacific Crops and Trees (CePaCT), International Center for Biosaline Agriculture (ICBA), The Tropical Agricultural Research and Higher Education Center (CATIE)
		Secretariats of Plant Treaty, Commission on Genetic Resources for Food and Agriculture, International Plant Protection Convention, Crop Trust
	Other Public Sector	National Genebanks and Research institutes: Kenya, Ethiopia, Zambia, Ghana, Nigeria ("Seeds for Resilience" partners); Brazilian Agricultural Research Corporation (EMBRAPA); South Korea Rural Development Administration; Centre for Genetic Resources, the Netherlands (CGN), Leibniz-Institute (IPK); United States Department of Agriculture (USDA)
Scaling	International NGO	World Vegetable Center, International Center for Biosaline Agriculture
	Other	Governing Body of the Plant Treaty
	Other Public Sector	National genebanks and National Plant Protection organizations NPPOs
	Private Sector	Farmers
	Regional NGO	Regional Agriculture Research Organizations:West and Central African Council for Agricultural Research and Development (CORAF); Association of Agricultural Research Institutions in the Near East & North Africa (AARINENA); The Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA); Regional economic and political organizations (ECOWAS. SADC Southern African Development Community); Arab Organization for Agricultural Development (AOAD)

Theory of change - Genebanks

CGIAR Initiatives:
- Accelerated Breeding: Meeting Farmers needs with Nutritious, Climate-Resilient Crops
- Accelerating crop improvement through precision genetic technologies
- Market Intelligence for More Equitable and Impactful Genetic Innovation
- ASPIRE - agri-silvo-pastoral food systems resilience
- SeEdQUAL: delivering genetic gains in farmers' fields
- Plant Health and rapid response to protect Food and Livelihood Security
- ALL regional initiatives

Challenge

- **Loss of biodiversity** underpinning food systems to provide adequate and more nutritious and diverse diets
- **Climate change** creating new challenges to crops and causing failure of food systems
- **Limited capacities of national systems** to share conservation res-ponsibilities
- **Reluctance of key actors to share plant genetic resources** impeding research

Demand Partners

- National Agriculture Research Organizations
- Advanced Research Institutes
- Farmers
- Universities
- Seed companies

Work Packages

- **Guarantee availability of diversity in perpetuity** through actively curated collections in compliance with international laws and standards
- **Futureproofing collections & exchange** to increase efficiency and effectiveness
- **Supporting breeding programs and increasing value and use of collections**
- **Strengthening the Global System** by enhancing capacity building and partnerships with NARES

Innovation Partners

- Secretariats of ITPGRFA, CGRFA, IPPC
- Crop Trust
- National and Regional Plant Genetic Resources networks
- Other Treaty Art. 15 signatories
- "Seeds for Resilience" African genebanks
- Regional genebanks
- Universities

Outputs

- **Disease-free, viable, documented germplasm** provided to diverse users
- **New efficient and effective methods** to strategically conserve difficult crops introduced
- **Evidence-based contributions made to international policy-making**
- **Smarter and more targeted use of collections** facilitated for diverse users
- Complementary roles strengthened and conservation actions taken to **enable international and national partners and to expand the scope and the efficiency of the global system**

Scaling Partners

- NARS (National and Regional genebanks
- Regional Agriculture Research Organizations
- Regional economic and political organizations
- Governing Body of the Plant Treaty
- Farmers

Outcomes

- **Breeding, research and development actors** continuously make advances through utilizing Genebank material
- **Global System of germplasm conservation and exchange** is more efficient and cost effective through sharing information, technologies and capacity building

Impact areas

- **Nutrition, health and food security:** more diverse, resilient and nutritionally diverse agrifood systems
- **Poverty reduction, livelihoods and jobs**: higher yielding crops increase farmers' employment and income
- **Gender equality, youth and social inclusion:** varieties with adaptive traits respond to men, women and youth preferences
- **Climate mitigation and adaptation:** climate proofed varieties with novel traits from genebanks increase resilience
- **Environmental health and biodiversity:** agrobiodiversity conserved to reduce the loss of genetic variation

...ntributing to

SUSTAINABLE DEVELOPMENT GOALS

2024

2030

sphere of influence

sphere of interest

Participatory process

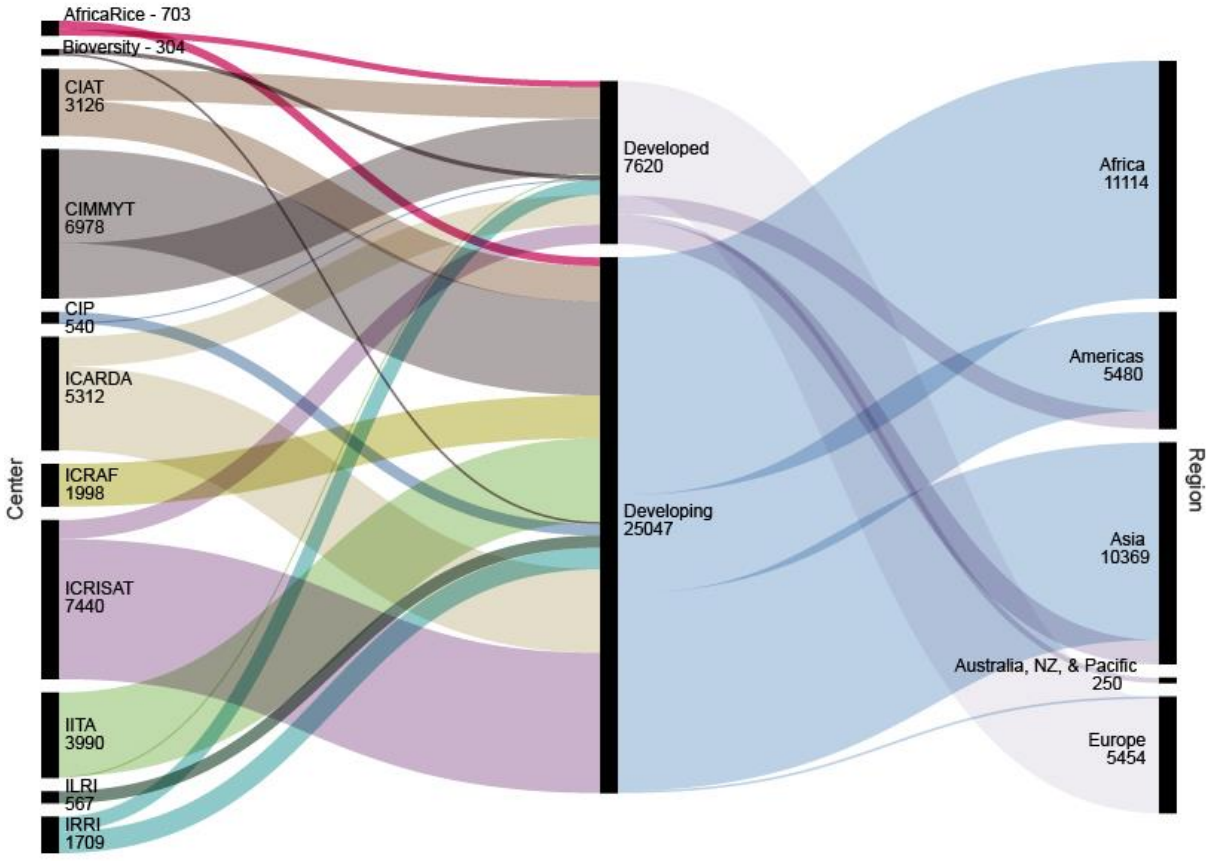
Extended ToC

Annex I. Genebanks Initial design for the Investment Plan

Table 1. CGIAR genebanks and collections in 2020

Center	Location	Crops	Accession numbers	Conservation form
AfricaRice	Cote D'Ivoire	Rice	21,815	Seed
Alliance	Belgium	Banana	1,624	In vitro & cryo
	Colombia	Beans, tropical forages	58,668	Seed & field
		Cassava	5,779	In vitro & cryo
CIMMYT	Mexico	Maize, wheat	147,842	Seed & field
CIP	Peru	Andean roots & tubers, potato, sweetpotato	18,156	Seed, in vitro, field, cryo
ICARDA	Lebanon	Wild cereals, grain legumes, temperate forages	152,609	Seed
	Morocco	Cultivated wheat, barley, chickpea, lentil		Seed
ICRAF	Kenya & multiple countries	Tree species	14,919	Seed & field
ICRISAT	India[1]	Sorghum, pearl millet, small millets, chickpea, groundnut	129,034	Seed, field & in vitro
IITA	Nigeria	Cowpea, maize, Bambara groundnut & other legumes	25,359	Seed
		Banana, cassava, yams	9,415	In vitro, field & cryo
ILRI	Ethiopia	Tropical forages	18,662	Seed & field
IRRI	Philippines	Rice	132,140	Seed
		Grand total	**736,210**	

Figure 2. Distribution of germplasm from CGIAR genebanks in 2020



[1] Not including collections in Niger, Kenya & Zimbabwe