2017 Annual Report CGIAR Genebank Platform

CGIAR Genebank Platform

CROP TRUST

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Acronyms

AGM	Annual Genebanks Meeting
ARI	Advanced Research Institute
CBD	Convention on Biological Diversity
CGRFA	Commission on Genetic Resources for Food and Agriculture
CIAT	International Center for Tropical Agriculture, Colombia
CIMMYT	International Maize and Wheat Improvement Center, Mexico
CIP	International Potato Center, Peru
Crop Trust	Global Crop Diversity Trust
CRP	CGIAR Research Program
DG	Director General
DOI	Digital Object Identifier
EiB	Excellence in Breeding
FAO	Food and Agriculture Organization of the United Nations
FTA	CGIAR Research Program on Forests, Trees and Agroforestry
GHU	Germplasm Health Unit
GLIS	Global Information System
GOAL	Genebank Operations and Advance Learning
GRIN	Germplasm Resources Information Network
ICARDA	International Center for Agricultural Research in the Dry Areas, Morocco
ICRAF	World Agroforestry Centre (International Council for Research in Agroforestry)
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IITA	International Institute for Tropical Agriculture, Nigeria
ILRI	International Livestock Research Institute
IPPC	International Plant Protection Convention
IRRI	International Rice Research Institute, Philippines
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
NARS	National Agricultural Research System(s)
ORT	On-line Reporting Tool
PDCI	Passport Data Completeness Index
PGR	Plant Genetic Resources
PGRFA	Plant Genetic Resources for Food and Agriculture
QMS	Quality Management System
RTB	CGIAR Research Program on Roots, Tubers and Bananas
SGSV	Svalbard Global Seed Vault
SMTA	Standard Material Transfer Agreement
SOP	Standard Operating Procedures
SPC	Secretariat of Pacific Community, Fiji
USDA	United States Department of Agriculture

Key Results

Highlight Platform Outputs

CGIAR germplasm distribution
The activities of the Genebank Platform are targeted specifically to bring about increased conservation and use of genetic resources with the aim of achieving CGIAR System Level Outcomes (Sub-IDO 4.4) and UN Sustainable Development Goals (Target 2.5). The annual distribution of genetic resources from CGIAR genebanks provides a rough proxy for their use. It should be recognized that numbers distributed only correspond with what is a highly volatile level of demand in any one year rather than the general scale of use of these resources.

CGIAR genebanks distributed a total of 109,339 germplasm samples (88,749 accessions) to users in 2017 (Figure 1). Of these, 47,963 samples

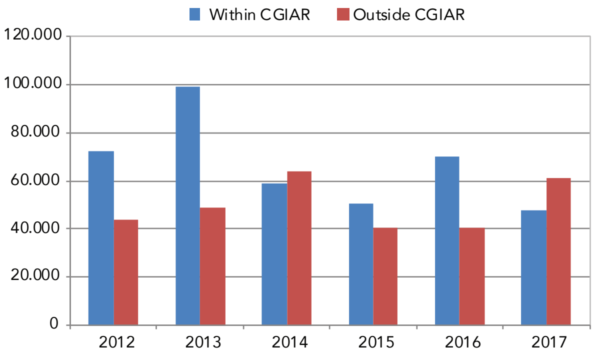


Figure 1. Annual total samples distributed by CGIAR genebanks from 2012 to 2017

Amina Jomaa collects *Medicago* seeds in a regeneration plot at ICARDA's Terbol station in Lebanon. Photo: Michael Major

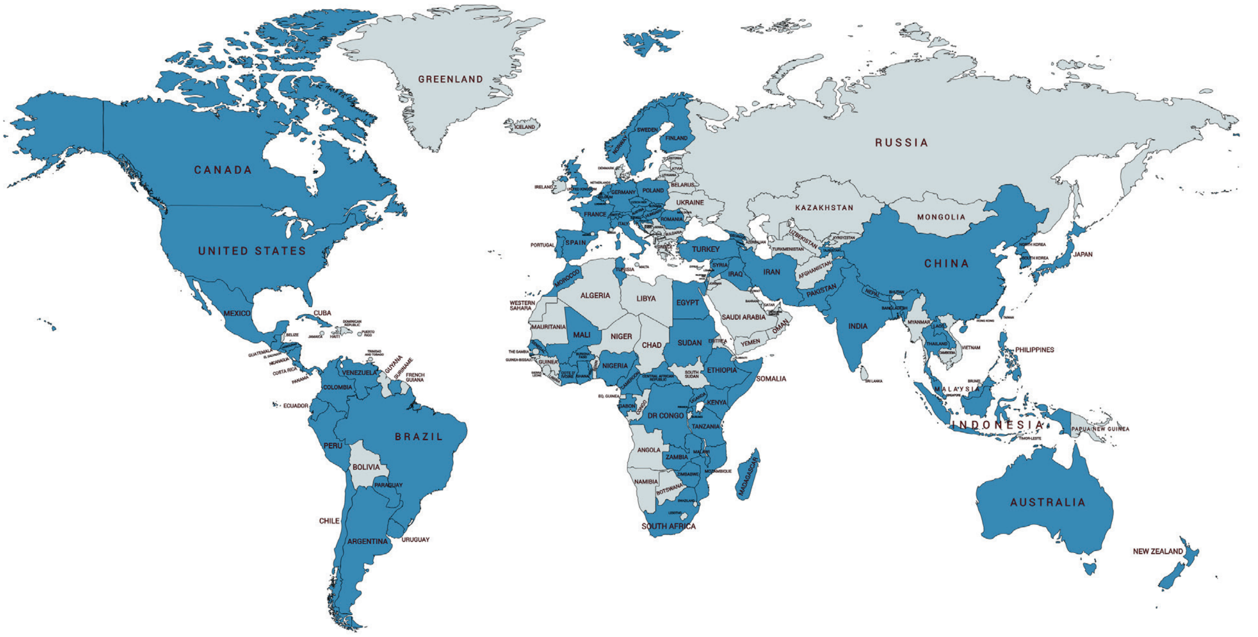


Figure 2a. Distribution of germplasm from CGIAR genebanks in 2017 (see Annex 1 for geographical distribution by Center).

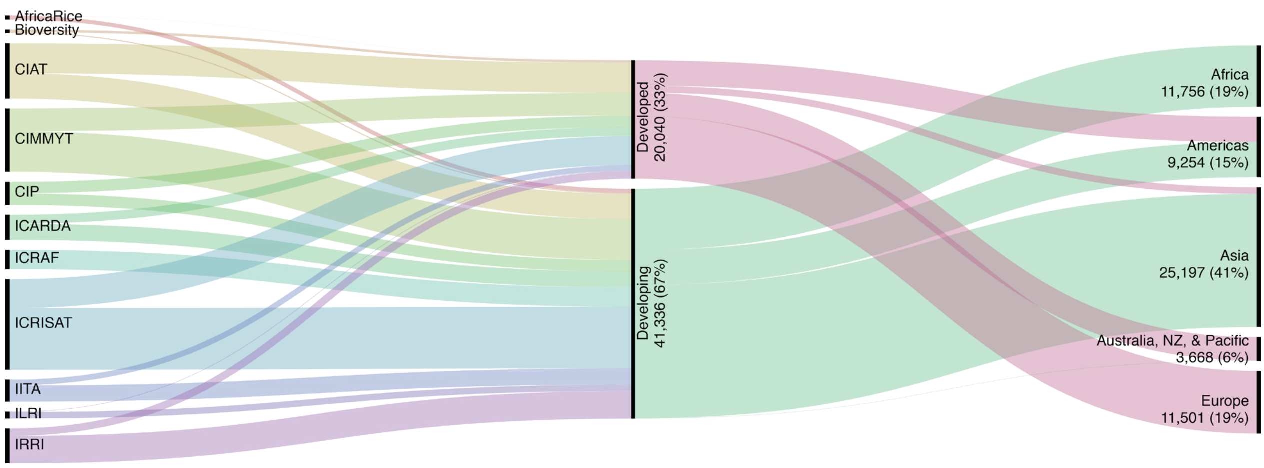


Figure 2b. Samples distributed by each Center to users outside the CGIAR and geographical region of recipient in 2017

(44%) were provided to CGIAR Research Programs (CRPs) and 61,376 (56%) were distributed to recipients outside the CGIAR in 95 countries; the majority of samples being received in developing countries (Figures 2a and 2b). Annex 1 shows maps of the distribution of germplasm from individual Centers. Of the external distributions, 50% went to NARS and national genebanks, 32% were sent to advanced research institutes and universities, 4% went to the private sector and 6% directly to farmers (Figure 3).

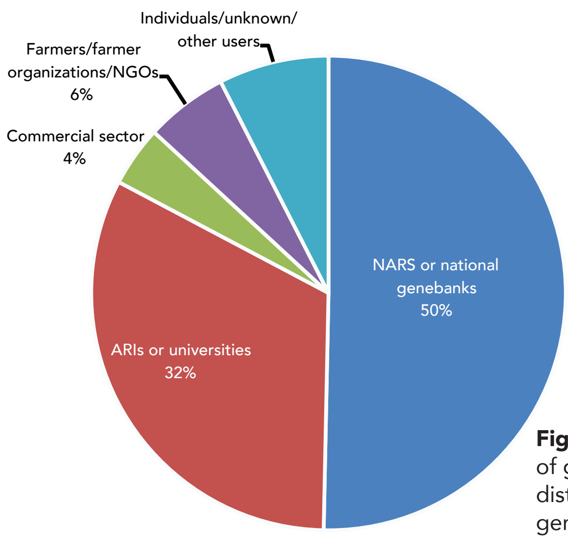


Figure 3. Recipients of germplasm distributed by CGIAR genebanks in 2017

The majority of resources distributed are traditional landraces and wild relatives (53%) (Figure 4). An increasing proportion of germplasm is used for research, but crops like tropical forages, dryland crops and tree species continue to be requested for evaluation and direct use (Figure 5). Table 1 lists the top developing and developed country recipients of plant genetic materials from CGIAR genebanks.

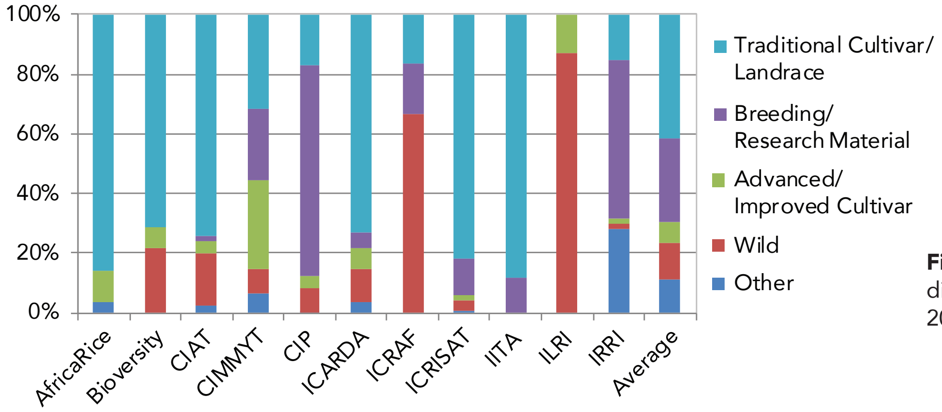


Figure 4. Accession types (%) distributed by each Center in 2017

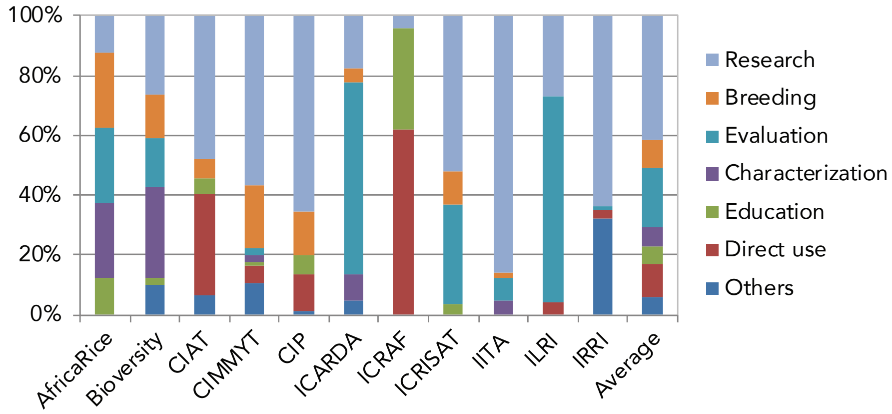


Figure 5. External requests (%) for germplasm according to purpose of request in 2017

Table 1. Top 10 developing and developed countries receiving germplasm from CGIAR Centers in 2017

	Developing			**Developed**		
Rank*	**Country**	**Number of Accessions**	**Number of Samples**	**Country**	**Number of Accessions**	**Number of Samples**
1	India	9,849	11,439	Italy	6,834	6,834
2	China	6,475	6,480	United States	3,797	3,844
3	Morocco	2,711	2,736	Australia	3,597	3,600
4	Nigeria	1,663	2,187	Germany	2,076	2,124
5	Mexico	1,798	1,818	Japan	949	949
6	Ethiopia	1,075	1,587	Sweden	490	592
7	Mali	112	1,577	Switzerland	437	437
8	Korea, DPR	1,422	1,422	United Kingdom	330	429
9	Peru	1,019	1,109	Netherlands	378	398
10	Chile	955	955	France	272	272
	Sub-total (% from total)	**35,967 (75%)**	**41,336 (76%)**	**Sub-total** (% from total)	**19,160 (97%)**	**19,479 (97%)**
	Others (% from total)	8,888 (25%)	10,026 (24%)	Others (% from total)	547 (3%)	561 (3%)
	Total	**35,967**	**41,336**	**Total**	**19,707**	**20,040**

Note: *Ranking by number of samples. Excludes distributions to CGIAR programs

CIMMYT's genebank staff prepare a seed shipment set for Svalbard. Photo: Alfonso Cortés/ CIMMYT

Progress on key performance indicators
The CGIAR genebanks presently manage 768,576 accessions, including 25,301 *in vitro* accessions and 28,063 accessions held as plants or trees in the field. Approximately 79% of total accessions are immediately available for international distribution (Figure 6). The genebanks' work in 2017 continues the steady increase in the availability of accessions since the CRP was initiated in 2012 (when 66% of accessions were available). Of the seed accessions, 55% is secured in safety duplication at two levels and 73% is duplicated at the Svalbard Global Seed Vault (SGSV). 79% of clonal crop collections is safety duplicated in the form of cryopreserved samples or usually *in vitro* cultures that must be replaced with fresh cultures annually, which results in substantial changes in overall percent safety duplicated between years.

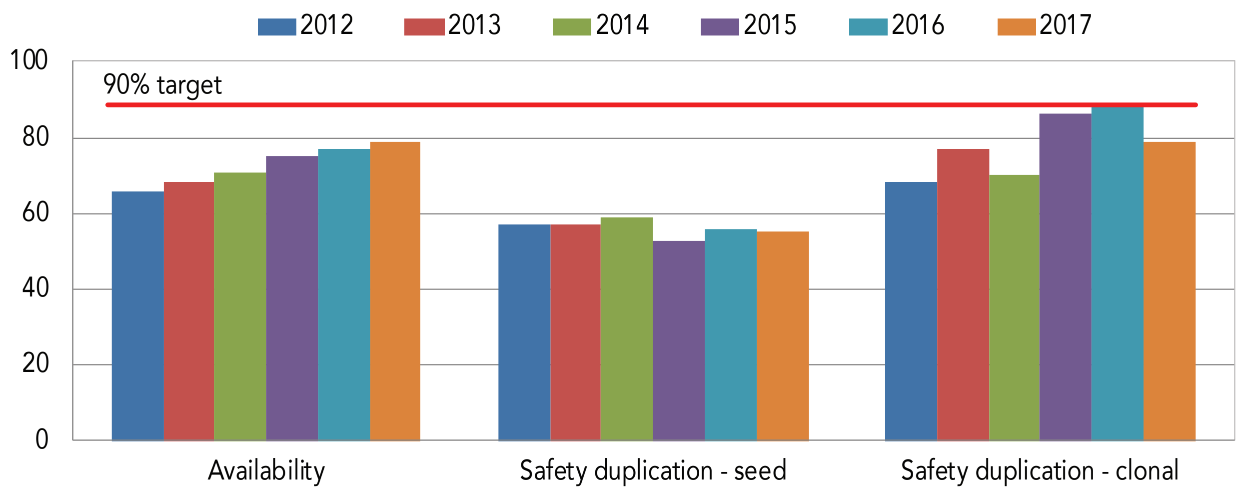


Figure 6. Status (%) of availability and safety duplication of accessions in CGIAR genebanks between 2012 and 2017

The ICRISAT genebank achieved its target of making 90% of its seed collection available in 2017. Photo: Michael Major

Table 2 provides an update of the current accession numbers of the aggregate collection under CGIAR management. Several seed genebanks (e.g. AfricaRice, CIMMYT wheat, ICRISAT, IITA) are now reaching 90% targets for availability after making tremendous progress in improving the status of accessions (Figure 7).

Table 2. Key statistics of the aggregate CGIAR collection between 2012 and 2017

Indicator	Description	2012	2013	2014	2015	2016	2017
1. Total number of accessions	Base number of accessions in the collections (excluding barley at CIMMYT, rice at CIAT, *Rhizobium* and mycorrhiza at CIAT and ICARDA, and regional collections of ICRISAT).	710,001	725,244	738,215	750,604	757,767	768,576
2. Total number of accessions that are currently available	Numbers of accessions that are viability tested, disease-free and with sufficient seed number for immediate distribution.	465,358	492,654	525,410	559,053	580,706	608,751
3. Number of seed accessions held in long-term storage and safety duplicated at two levels	Numbers of accessions in seed collections held in long-term storage and safety duplicated in a major genebank and in SGSV.	386,037	375,271	413,448	381,932	404,074	408,323
4. Number of RTB accessions in cryopreservation or safety duplicated	Number of vegetative-propagated accessions in cryopreservation or safety duplicated as *in vitro* samples.	15,643	16,141	15,554	19,369	19,803	19,065

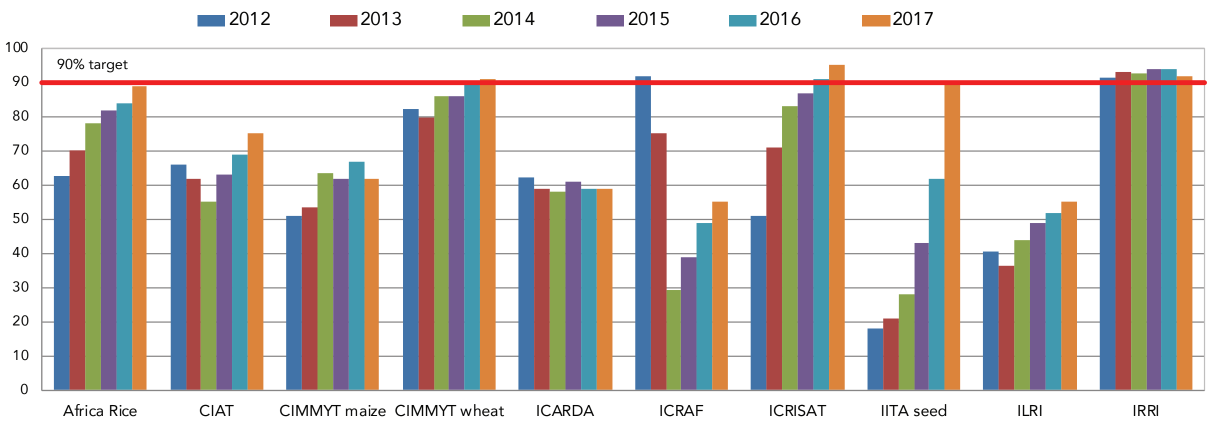


Figure 7. Availability (%) of seed collections between 2012 and 2017

CIP is systematically resolving trueness to type of its tissue culture collections. Photo: Luis Salazar

Other collections are progressing towards targets at a slower pace because of the preponderance of wild species in the collections (e.g. forage and tree collections) (Figure 8) or because of specific viruses (e.g. endogenous banana streak virus, cassava frogskin, yam mosaic virus) in tissue culture of clonal collections (Figure 9). The individual status of the genebanks is provided in Table 3.

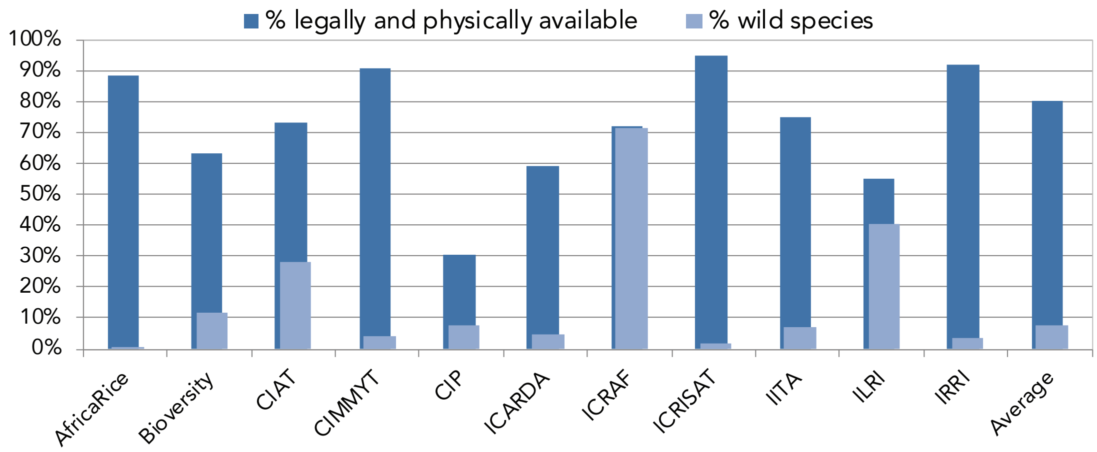


Figure 8. Total accessions (%) available in seed collections illustrating proportion which are wild species

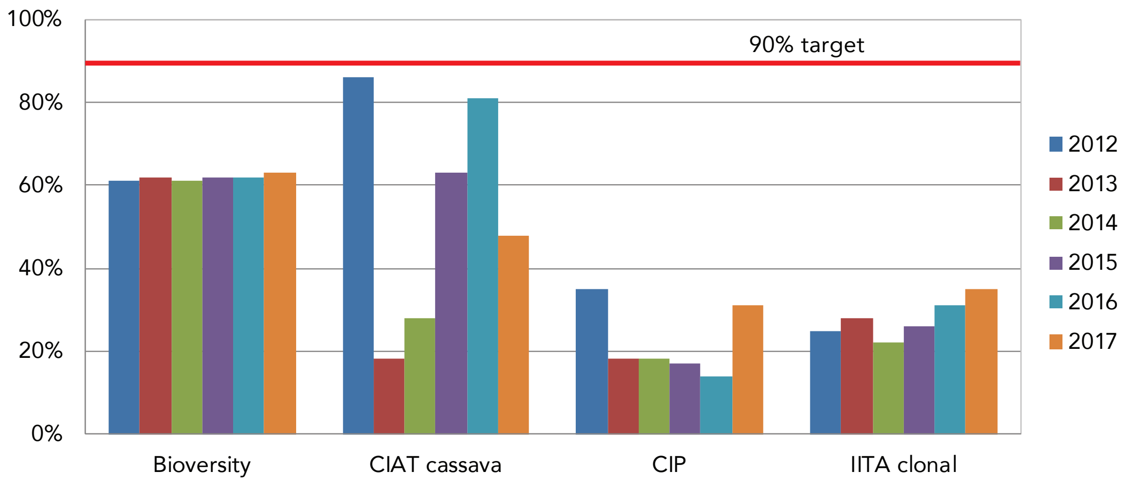


Figure 9. Availability (%) of clonal collections between 2012–2017

Table 3. Status of CGIAR genebanks with respect to performance targets in 2017

Center	% Availability 2017	% Increase from 2016	% Safety duplication 2017	% Increase from 2016	Comments
AfricaRice	89	6	62	19	Efforts in the field have brought AfricaRice close to targets for availability despite the move of the bank to Cote D'Ivoire. Consolidating the long-term storage in Mbe and safety duplication are now the focus for continued work. Expect to reach targets in 2020.
Bioversity	63	2	60	0	New strategy to deal with Banana Streak Virus will improve availability but will take time to put into action. Expect to reach targets in 2020.
CIAT seed	75	9	81	7	Continued increases in availability and safety duplication but progress is slowing as the more difficult accessions are the focus of field work. Rationalization of the forages collection has started. Expect to reach targets in 2020.
CIAT cassava	48	-45	60	58	Decrease in available accessions occurred after new discoveries concerning the causal agent of Cassava Frogskin Virus. Testing and cleaning the entire collection will take at least two years.
CIMMYT wheat	91	1	81	35	A batch of accessions is being built up for safety duplication in 2019. Expect to reach targets in 2020.
CIMMYT maize	62	-7	76	0	Major hurdles in regeneration of maize (especially highland varieties) are gradually being overcome.
CIP	31	121	68	-12	CIP is systematically resolving trueness-to-type of the tuber, screenhouse, cryo and tissue culture collections. The accessions in the collections are being reconstituted from a confirmed parent plant. This will vastly reduce the need for conservation of field-derived tubers and yearly re-planting.
ICARDA	59	0	29	-43	Major efforts underway to reconstitute the collection from deposits from SGSV. These figures still include the collection in Syria.
ICRAF seed	55	12	13	-13	Availability and safety duplication is expected to change as ICRAF executes its acquisition and retention plan in 2018.
ICRISAT	95	4	15	0	Targets for availability reached. Safety duplication is low because of lack of first level duplication. ICRISAT is seeking a host institute. Expected to reach targets by 2020.
IITA seed	90	45	47	-6	Strong efforts in regeneration has resulted in significant increases in availability. There is a lag in safety duplication because of phytosanitary issues. Expected to reach targets in 2020.
IITA clonal	35	17	40	33	Significant increases in availability through introducing field accessions into *in vitro* for the first time and construction of screenhouses to increase the rate of health testing.
ILRI	55	6	19	0	Low levels of safety duplication because of the slow rate of regeneration of forages. Rationalization of the collection and alignment with CIAT forages has started.
IRRI	92	-2	89	0	Targets have been reached and sustained. Crop Trust is in negotiation with IRRI to develop for the first time a Long-Term Partnership Agreement to support the full costs of routine operations forever.

Platform specific quality control activities

The Genebank Platform and the Centers are working to ensure that the genebanks are complying with international standards and operating at a high level of competency through the development and strengthening of genebank-specific Quality Management Systems (QMS). In particular, activities in 2017 include:

- Aligning and documenting standard operating procedures (SOPs) in a common format
- Training national staff and strengthening succession planning
- Identifying and mitigating risks specific to the genebank
- Barcoding accessions throughout the genebank workflow
- Securing genebank facilities with access control systems
- Auditing SOPs through internal and external reviews
- Calibrating and replacing equipment.

By the end of 2017, a total of 41 standard operating procedures (SOPs) have been written, reviewed and approved by genebank staff and their managers (Figure 10). The first audit was undertaken to assess the conformance of the Distribution SOPs to international standards. Two Genebank Operations and Advanced Learning (GOAL) workshops took place in 2017; one through Genebank Platform funding and one supported by the Crawford Foundation.

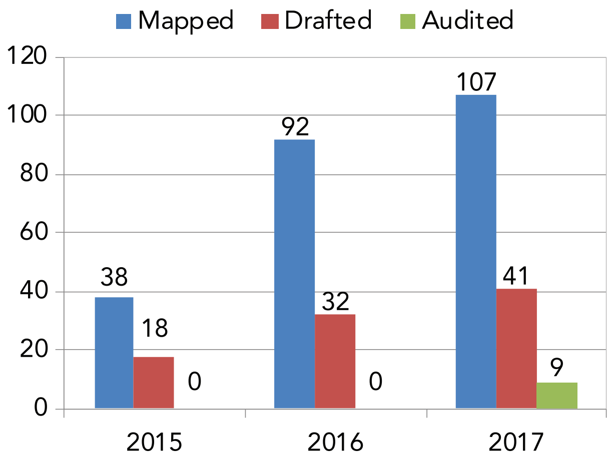


Figure 10. SOPs mapped, drafted and audited in 2017

GOAL workshops were held in Malaysia (top) and Belgium (bottom) in 2017.

Progress by Platform Modules

Conservation Module

The progress of individual genebanks in upgrading collections, reaching performance targets and strengthening QMS is described above. Other major outputs of the Conservation Module in 2017 are summarized below and in Table 4.

- *Strategic curation and merging collections:* The Platform is supporting the development of guidelines for more strategic approaches to curating collections. Certain accessions or portions of collections may be candidates for de-prioritization or archiving for various reasons. CIMMYT, CIP, Bioversity, ILRI, IITA and ICRAF are in the process of identifying samples or accessions for archiving or removal. ILRI and CIAT have embarked on a major initiative to align and rationalize their tropical forages collections and bring both under unified management.
- *Measuring diversity and gap analysis:* The Genebank Platform is pursuing an ambitious goal of developing a metric to express the level of coverage of the crop's genepool represented by individual collections. In 2017, three methodologies were developed to assess the level of coverage and identify important gaps, involving (1) the ecogeographic analysis of the distribution of landraces, (2) modelling the distribution of specific desired traits, (3) and hierarchical groups structured according to expert-defined characteristics.
- *Improving phytosanitary capacity:* CGIAR Germplasm Health Units (GHUs) are building the physical and technical capacity to improve phytosanitary service delivery to genebanks, breeders and research programs by developing a common operational framework, harmonizing technical protocols, developing QMS and new procedures for phytosanitary cleaning of germplasm.
- *"Greenpass":* GHUs, with international stakeholders and International Plant Protection Convention (IPPC), are mobilizing support to develop a unique "Greenpass" phytosanitary protocol that would facilitate the movement of CGIAR germplasm through national phytosanitary controls and avoid unwarranted delays.
- *Seed longevity:* All genebanks managing seed collections have received visits by IRRI seed scientists, Fiona Hay and Katherine Whitehouse, who have made individualized recommendations for improving seed processing, re-testing and management procedures in order to gain seed quality and longevity in storage. At least six genebanks are now actively pursuing evidence-based approaches to adjusting seed management procedures.
- *Automation:* Following IRRI's embarkation into automated seed sorting in 2016, the feasibility of automated seed sorting for other crops (e.g. CIAT beans and forages) and of germination testing are being investigated (e.g. IRRI and CIMMYT).
- *Data management:* Progress continues in the implementation and development of the genebank data management system, GRIN-Global, with seven Centers sharing and developing software applications and approaches to implementation. Efforts to improve data quality, presentation and accessibility to the user are having results, including, for instance, a significant increase in Centers' Passport Data Completeness Index (PDCI) (Table 8).

Germination testing at ICRAF. Photo: Michael Major

Seed sorting at IRRI. Photo: Shawn Landersz

Table 4. Progress against 2017 milestones

Module	Platform Outcome 2022	Milestone 2017	Milestone status	Evidence
Conservation	Output 1.1 Disease-free, viable documented germplasm made available	79% accessions available	Achieved	Online reporting, Genesys
		60% seed accessions safety duplicated	55% seed accessions safety duplication	Safety duplication is currently hampered by various factors
		75% clonal accessions safety duplicated	79% clonal accessions safety duplicated	
		80% relevant requests met	96% requests met	
	Output 1.2 Crop diversity conserved in a rational and effective global system	30 SOPs in place	41 SOPs in place	SOPs are not yet publicly available
		500 accessions successfully introduced into cryobanks	556 accessions introduced into cryo: 79 banana at Bioversity 413 potato at CIP 38 sweetpotato at CIP 26 cassava at IITA	Cryotanks at Bioversity, CIP and IITA
		20 NARS staff involved in capacity building events	123 NARS staff involved capacity-building events at Platform level and more than 7,000 NARS staff involved in Center-organized capacity-building events.	Online reporting
Use	Output 2 More effective access and use of germplasm enabled	50% accessions with DOIs	67% accessions with DOIs	Genesys
		Consultation on user needs for searching on Genesys undertaken	Consultation undertaken. Recommendations being addressed	Report available
		One new subset for a defined user developed in each genebank	A total of 185 subsets developed	Subsets will be made available through Genesys in next two years
Policy	Output 3 Supportive policy environment developed	Two white papers submitted to DGs	Regular briefs are being used instead of white papers to provide more flexibility for getting information out to DGs and SMB	Reports, briefs, updates. Available online at http://bit.ly/2K8HGok and http://bit.ly/2lDUuod
		Representation at six international PGR policy meetings	CGIAR representation at six international meetings: CGRFA (four CGIAR staff); WG-EFMLS 6 (seven CGIAR staff); Swiss Governments informal consultation meeting (two CGIAR staff) WG-EFMLS 7 (five CGIAR staff); GB7/ITPGRFA (16 CGIAR staff); WHO/PIP Framework consultation (one CGIAR staff)	Reports. Available online at http://bit.ly/2ItgBX4 (English) and http://bit.ly/2tIOeiC (French) and http://bit.ly/2yISiVF
		Decision-making tool for national implementation of International Treaty on Plant Genetic Resources for Food and Agriculture developed	Decision-making tool developed	Publication. Available online at http://bit.ly/2twT1En and http://bit.ly/2N2dB7w

Use Module

In its first year of operation, the Use Module has accomplished several milestones with the help of "frontrunner" genebanks (Bioversity, CIMMYT, CIP and IRRI). These have provided support to other genebanks and led the way in developing innovative approaches and solutions to promoting the use of collections, including the implementation of Digital Object Identifiers (DOIs), integrating data from research and breeding programs into genebank databases, improving Genesys for users, and enriching data on accessions.

- *Digital Object Identifiers:* CGIAR Centers were among the first institutes worldwide to implement DOIs for germplasm accession identification under the Global Information System (GLIS) of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). DOIs will provide a global standard by which unique germplasm may be traced as it moves from collection to release as improved varieties or to research results published in scientific papers. In 2017, 67% of CGIAR genebank accessions were assigned a DOI and the Platform now aims to support the establishment of DOIs throughout CGIAR's research and breeding programs in collaboration with the Excellence in Breeding Platform's Module 5 advisory committee. The genebanks have also initiated efforts to expand the utility of DOIs to internal operations, and to support the adoption of DOIs by national genebanks and the user community outside CGIAR. This has been an important collaboration between CGIAR and the ITPGRFA, providing a significant enhancement to the GLIS.
- *Genesys (www.genesys-pgr.org):* The Genesys database and website continue to be developed and enhanced in response to consultations with users and genebank managers. Major enhancements in 2017 include the inclusion of DOIs and the development of an automated link between Genesys and GLIS. Genesys is now recognized as a central pillar of the GLIS.
- *Integration between genebanks and breeding programs:* In 2017, the Use Module developed strategies for linking trait data to genebank accessions. All genebanks are coming up with new ways to interact with the breeding and user communities to capture and link trait data to genebank accessions. Developments include:

ICARDA lentil breeder Shiv Kumar is using a FIGS set in his field evaluations. Photo: Michael Major

  - A wizard for GRIN-Global to facilitate downloading breeders' data (CIP)
  - Approaches to associate trait data in published literature to genebank data (CIP, Bioversity)
  - Linking GRIN-Global with B4R through BrAPI GOBII, DNA Tracker, Germinate, GRIS, IWIS, and GIS (Bioversity, CIMMYT)
  - Development of CoreHunter as a GRIN-Global wizard (CIMMYT)
  - Extrapolating training population data to a broader set of accessions, based on DArTseq (CIMMYT)
  - Converting DArTseq to known, sequenced gene markers, to enable predictive phenotyping for breeder relevant traits (CIMMYT)
  - Identifying common identifiers to harmonize ontologies (Bioversity, CIP)
  - Developing scripts to combine datasets and interoperability tools between institutional databases (Bioversity, IRRI)
  - Encouraging, through personal interactions, seminars and institutional structures, active participation of genebank staff in user-led initiatives on phenotyping, trait discovery, pre-breeding and breeding and vice versa (CIP, IRRI)
- *Subsetting:* A total of 185 subsets were developed in 2017, and 76 were distributed to recipients within and outside the CGIAR, including:
  - Mini-cores and cores (cassava, beans, potato, wheat, yam, cowpea, lablab, African rice)
  - DNA collection and GWAS panel (banana)
  - FIGS sets (cowpea, wheat, barley, lentil, faba bean, chickpea)
  - Trait subsets (cassava, bean, wheat, maize, potato, lentil, faba bean, chickpea, barley, tropical forages, rice).

Policy Module

The Policy Module has worked rapidly to develop strong engagement with partners both inside and outside the CGIAR involved in international plant genetic resources policy, starting with official representation in January 2017 of the CGIAR at the Commission on Plant Genetic Resources for Food and Agriculture (CGRFA). Equally, it has been important for the Policy Module to establish appropriate processes for consultation and approval of CGIAR policy positions and statements within the CGIAR, involving Article 15 (A15) DGs and the System Management Board (SMB), as well as other experts and representatives within the System.

- *Enhancing Centers' contributions to international Plant Genetic Resources for Food and Agriculture policy fora:* The Policy Module coordinated CGIAR representation at seven intergovernmental meetings in 2017. A delegation of CGIAR scientists participated in the Governing Body of the ITPGRFA in Kigali, Rwanda. Several side events and a booth were organized, and CGIAR scientists discussed key issues to the CGIAR (e.g. investigation into CGIAR Centers' use of the Standard Material Transfer Agreement (SMTA), intellectual property and licensing practices) with Party members. The Policy Module also mobilized CGIAR delegations for two negotiating meetings of the ITPGRFA's Working Group to Enhance the Functioning of the Multilateral System of Access and Benefit-sharing (WG-EFMLS) including developing policy positions, written submissions and statements for approval by the A15 DGs and SMB (Table 5). In 2017, responding to increasing concern about the appropriate sharing of benefits in the use of digital sequencing information, the Policy Module developed a paper describing in detail the wide-ranging benefits of digital sequencing data to genetic resources management and use.[1] This was shared with the A15 DGs for comment and approval before being submitted to the Convention on Biological Diversity (CBD) Secretariat. The paper has since been widely circulated, referenced and used.
- *Promoting compliance of CGIAR Centers with PGRFA policies and laws:* The Policy Module finalized the development of the *Guide to Centers Operation in Compliance with the Nagoya Protocol.*[2] The document was approved by the A15 DGs in February 2018. The first meeting of the CGIAR Genetic Resources Policy Working Group was organized, comprising legal experts, genebank managers, intellectual property focal points, CRP, System Management Office (SMO), Big Data and Excellence in Breeding Platform representatives. The Working Group facilitates the two-way flow of information between the Policy Module and the entire CGIAR System to help develop and disseminate relevant PGRFA policy positions and increase capacity for compliance. The Policy Module organized a four-day genetic resources policy workshop in November 2017, hosted by ICARDA in Rabat, for French-speaking CGIAR scientists and NARS representatives.[3] A Helpdesk to respond to requests for advice from Centers on PGRFA policy issues has been set up.
- *Capacity building for national programs to implement international genetic resources agreements:* The Policy Module co-organized two workshops for national ITPGRFA and Nagoya Protocol focal points from 24 countries.[4] One was held at IRRI, in March 2017, for South and East Asian countries. The second was held in Rome in October, with participants coming from Africa, Central Asia, and Near East. These workshops were in partnership with the Access and Benefit Sharing Capacity Development Initiative, Convention on Biological Diversity (CBD) Secretariat, ITPGRFA Secretariat, and the UN Development Program, who also financially supported the workshops. The Policy Module coordinated the development of two decision-making tools for national policy makers and other stakeholders developing and operationalizing national access and benefit-sharing law: *Mutually supportive implementation of the Nagoya Protocol and the Plant Treaty: Scenarios for consideration by national focal points and other interested stakeholders* and *Decision-making tool for developing national policies to implement the multilateral system.*[5] Both were developed in partnership with CCAFS under the rubric of the FAO/Bioversity International/Treaty Secretariat Joint Program to help countries implement the ITPGRFA's multilateral system of access and benefit-sharing.

[1]Available online at http://bit.ly/2K8HGok
[2]Available online at http://bit.ly/2lDUuod
[3]Available online at http://bit.ly/2ItgBX4 (English) and http://bit.ly/2tIOeiC (French)
[4]Available online at http://bit.ly/2yISiVF
[5]Available online at http://bit.ly/2twT1En and http://bit.ly/2N2dB7w

The 2017 Annual Genebank Meeting was held between 10-15 September in Meise, Belgium. Photo: Michael Major

Table 5. Key Platform results from 2017

Sphere	Indicators	Data	Comments
Influence	I1/I2. Projected uptake (women and men) /hectares from current CRP investments	n/a	n/a
	I3. Number of policies modified in 2017, informed by CGIAR research	Article 15 DGs and SMB endorsed 5 policy positions recommended by the Genebank Platform to be advanced on behalf of CGIAR during the negotiations to revise the multilateral system/SMTA under the ITPGRFA's WG-EFMLS and Governing Body Interim acceptance in principle by the WG-EFMLS of 3 positions advanced by CGIAR. Negotiations will continue in 2018-2019. Governing Body Resolution 4/2017 revised following CGIAR representations	Available to CGIAR community and external reviewers upon request. See report of the Sixth Meeting of the Ad-hoc open-ended working group to enhance the functioning of the multilateral system, available at: http://www.fao.org/3/a-br666e.pdf See report of the Seventh Session of the Governing Body of the ITPGRFA, available at: http://www.fao.org/3/MV606/mv606.pdf
Control	C1. Number of innovations by phase - new in 2017	1 available for uptake (DOIs) 1 innovation at proof of concept (automated seed sorting)	See Table 8 (DOIs) See Conservation Module report in Section 1.3 (seed sorter)
	C2. Number of formal partnerships in 2017, by purpose (ongoing + new)	3 policy partnerships (ITPGRFA, CGRFA, IPPC) 2 delivery partnerships (FAO, Svalbard Global Seed Vault)	See Table 9
	C3. Participants in CGIAR activities 2017	326 'end-users' in farmer field days 6,922 'next users' in genebank events	See Table 7
	C4. People trained in 2017	Short term: 357	See Table 6
	C5. Number of peer-reviewed publications	52 journal publications by genebank staff in 2017 of which 33 (63%) are open access	See Figure 11
	C6. Altmetrics	n/a	n/a

Table 6. Platform and Module level capacity building events in 2017

Date	Event	Location	Number CGIAR participants	Number non-CGIAR participants	Total number of participants
27-30 Apr	Tandem workshop for Nagoya Protocol and Plant Treaty National Focal Points for South and Southeast Asia	IRRI, Philippines	4	28	32
22-26 May	Seed Quality Management (SQM) workshop	ILRI, Ethiopia	26	1	27
5-9 Jun	CGIAR GHU Working Group Meeting	CIMMYT, Mexico	22	3	25
6 Jun	Genetic Resources Policy training workshop for CGIAR IP focal points	FAO, Italy	22	7	29
10-14 Jul	GRIN-Global workshop	CORPOICA, Colombia	29	5	34
9-13 Oct	Genesys and GRIN-Global workshop	CIMMYT, Mexico	34	5	39
10-15 Sep	Annual Genebank Meeting	Meise, Belgium	50	29	79
13-15 Nov	Germplasm Health Units – GOAL workshop	University of Liege, Belgium	20	1	21
21-23 Nov	Capacity-building workshop on mutually supportive implementation of ITPGRFA and Nagoya Protocol	FAO, Italy	5	26	31
27-30 Nov	Capacity building workshop on genetic resource policies for CGIAR francophone scientists and partners	ICARDA, Morocco	22	18	40
		Total	**234**	**123**	**357**

Cross-Cutting Dimensions

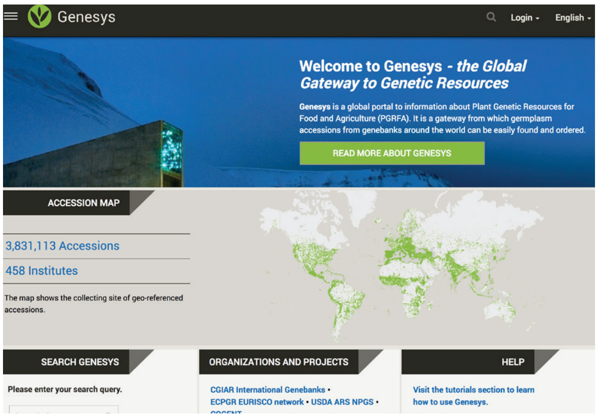
Gender, Youth and Capacity Development

The Genebank Platform undertakes numerous capacity building activities to the benefit of both CGIAR staff and national partners at the level of the Platform, Modules and individual Center genebanks. Several of these capacity building activities are supported by bilateral funding sources. At the Platform level, 10 capacity building events took place in 2017 involving 357 participants from CGIAR Centers and national institutes (Table 6). The participants of capacity building events gained knowledge and skills that allowed them to adhere to international standards and policy in genebank management activities and the distribution of germplasm and related information.

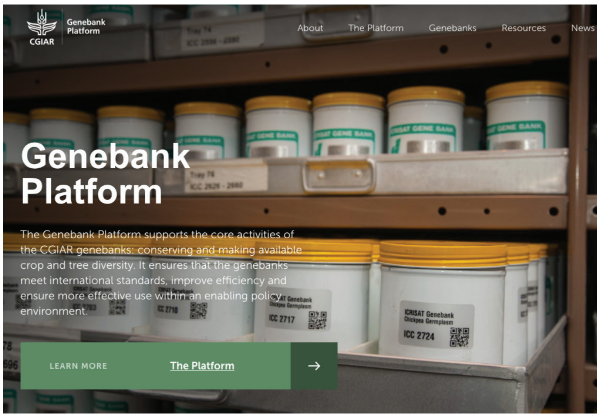
While genebanks carry out services to CRPs and national partners to conserve, test, clean and distribute germplasm, they also serve as the primary knowledge hub in their respective regions for the crops they conserve. In 2017, more than 500 capacity building events took place across the Center genebanks (Table 7). The activities involved the participation of more than 7,000 participants in 44 countries. This includes over 400 tours of genebanks provided to visitors to promote the importance of crop diversity and

Table 7. Capacity building events in 2017

Event category	Number of events	Number of participants
Genebank visits and tours	441	5,045
Genebank-organized training/ workshop	19	237
Genebank staff as resource person in a capacity development event	42	980
Visit from partners for research/ scientific work	24	96
Hosting a scholar/student in the genebank for educational purpose	20	64
Phytosanitary awareness week	8	~500
Farmers' open day	2	326
Total	**556**	**~7,248**



Genesys website – https://www.genesys-pgr.org/



Genebank Platform website – https://www.genebanks.org/

the work of the CGIAR. Outreach to NARS and national genebanks has contributed to increased learning within the global system for PGRFA conservation and use.

Open Data

The Center genebanks' management of genetic resources and data complies with the CGIAR Principles on the Management of Intellectual Assets and Open Access Policy. Genesys (www.genesys-pgr.org), the global web portal on genebank accessions, publishes data supplied by CGIAR and genebanks worldwide in accordance with data sharing agreements between the Crop Trust and the individual data providers. The principles and goals of the portal are to make the data public and universally available. The initial sharing of data is relatively straight forward within the framework of the Genebank Platform. However, updating data and improving data quality are major challenges and a focus of sustained effort.

In a major push to improve available data, all CGIAR genebanks updated their Genesys data in 2017 (Table 8). In total, more than 434 institutes and 2.4 million records were updated in Genesys in 2017. Genesys now contains records on 3.6 million accessions. Detailed information on data updates is accessible online. The Passport Data Completion Index (PDCI) increased significantly in a number of Centers (Table 8).

The Genebank Platform website was launched in September 2017. The website features an overview of the Platform, the 11 CGIAR genebanks and GHUs and the crops conserved. The Crop Genebank Knowledge Base is also being migrated to the new website. Research papers, policy briefs, conservation protocols, training materials, submissions to international policy fora are made publicly available through the Platform's website or journals in conformance with the CGIAR Open Access and Data Management Policy.

Table 8. CGIAR germplasm data publicly available in 2017

Center	Number of accessions uploaded	Number of accessions with DOI	% target accessions with DOI	PDCI		
				2015	2016	2017
AfricaRice	19,868	0	0%	5.62	5.62	5.60
Bioversity	1,546	1,546	100%	5.27	5.77	5.57
CIAT	67,770	0	0%	4.51	4.51	6.70
CIMMYT	165,396	162,516	98%	5.3	5.31	5.65
CIP	5,101	4,820	94%	5.38	5.43	5.61
ICARDA	155,414	153,256	99%	5.83	5.75	6.76
ICRAF	5,391	0	0%	5.34	5.34	6.69
ICRISAT	125,050	0	0%	6.05	6.05	6.89
IITA	33,713	16,950	50%	4.66	4.69	4.69
ILRI	18,640	18,640	100%	6.46	6.56	6.88
IRRI	129,423	124,510	100%	5.22	5.50	5.45
All	**727,312**	**482,238**	**66.3%**	**5.42**	**5.50**	**6.04**

IRRI's Ruaraidh Sackville Hamilton points out countries that have received IRRI germplasm under the Multilateral System of Access and Benefit Sharing. Photo: Shawn Landersz

In 2017, the genebanks reported a total of 77 publications by genebank staff in journals, conference proceedings, books and book chapters, covering a range of topics (Figure 11). Out of 52 peer-reviewed journal articles, 63% are publicly available in open-access publications.

Intellectual Assets
All CGIAR genebanks have agreements with the ITPGRFA, placing their germplasm collections under the Multilateral System of Access and Benefit Sharing. In 2017, 95% of samples externally distributed by the Centers where transferred under Standard Material Transfer Agreements (SMTA).

The collections and germplasm contained within them remain publicly available and no patents or plant variety protection rights sought on the germplasm.

Critical policy issues and challenges involving the CGIAR genebanks are addressed and reported under the Policy Module.

Platform Effectiveness and Efficiency

Variance from Planned Platform Activities

No significant variance from planned activities has taken place.

Use of W1-2 Funding

In 2017, 21.4% of the Genebank Platform costs was funded by the Crop Trust and the rest was funded by W1-2 funding. The Crop Trust funding is intended to cover a significant part of the essential operations of nine of the 11 genebanks. W1-2 funding covers the remaining costs in all 11 genebanks, and the other activities of the Genebank Platform that support upgrading of the genebanks and GHUs, and activities of the Conservation, Use and Policy Modules. All of the achievements described in the report have been either fully or partly funded by W1-2 funding.

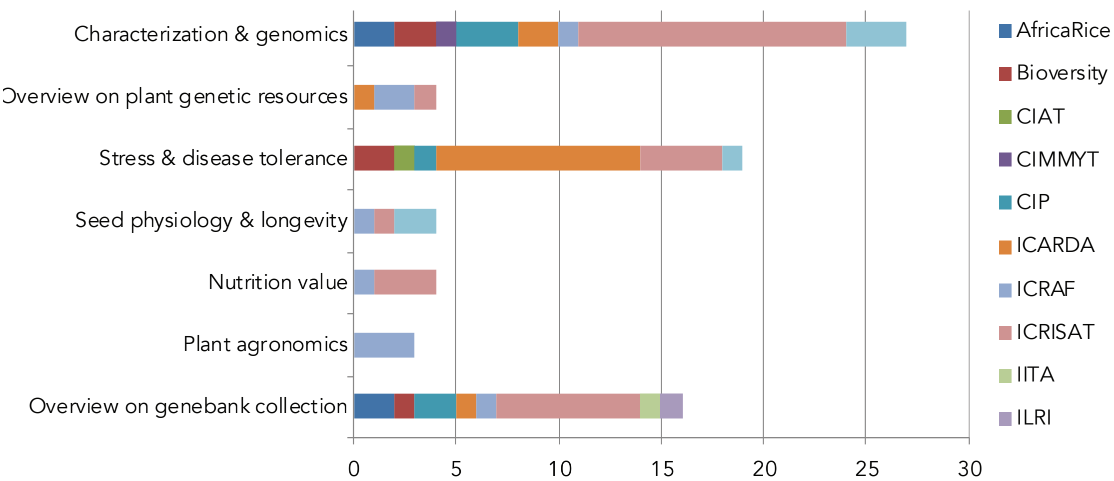


Figure 11. Topic of publications by genebank staff in 2017

Key External Partnerships

The key external partnerships are presented in Table 9. The primary partners of the genebanks are the wide-ranging users from 95 countries, who send requests to genebank managers and staff seeking advice and genebank materials to respond to their specific needs and environments. The provision of this germplasm as well as other aspects of conservation, germplasm health and use take place within a policy framework that demands close partnership with the ITPGRFA, CGRFA and IPPC. The Svalbard Global Seed Vault has also proved an essential partner in long-term conservation, as well as in communicating the importance of crop diversity and the organizations that conserve it to the wider world.

CGIAR genebanks provide much more than germplasm to users. Individual genebanks provide a range of services, capacity building and support to national partners (Figure 12). The services rendered involved working with 62 institutes in 38 countries.

Table 9. Key external partnerships of the Genebank Platform in 2017

Module	Stage of research*	Name of partner	Partner type+	Main area of partnership
Conservation	1	Svalbard Global Seed Vault	International	Safety duplication of CGIAR germplasm
	1	National genebanks	NARES/NARS	Hosting safety duplicates on behalf of partners or colleagues
	1	CGRFA	International	Global Plan of Action
	1	IPPC and national plant protection agencies	Multilateral, NARES/NARS	Phytosanitary
Use	3	ITPGRFA	Multilateral	Global information system (GLIS) on PGRFA
	3	95 countries	Multiple	Provision of germplasm
Policy	1	ITPGRFA and CBD Secretariats	Multilateral	International PGRFA policy development, capacity building for national programs' policy development

+Partner types: Academic and Research/Development organizations/NARES/NARS/CBOs and farmers' groups; Private Sector; Foundations and Financial Institutions; Governments; Bilateral and Donor governments; Multilateral; CGIAR

*Stage 1: end of research phase (discovery/proof of concept), Stage 2: end of piloting phase (if relevant); Stage 3: available for uptake; Stage 4: uptake by next user

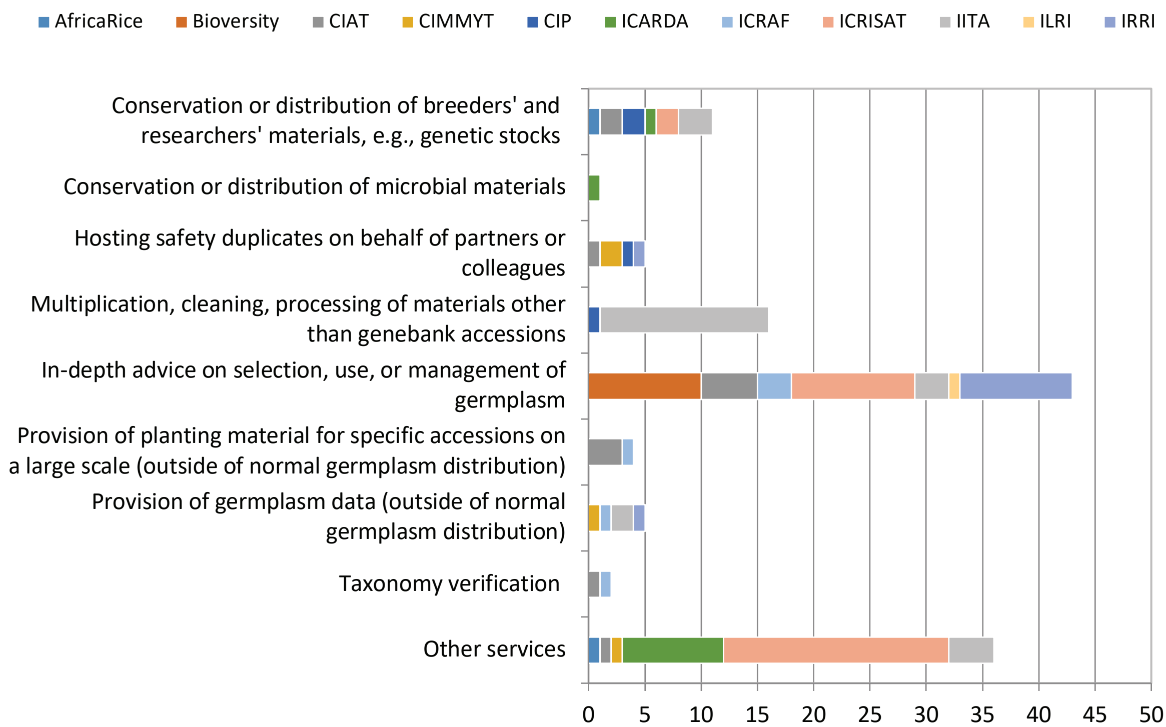
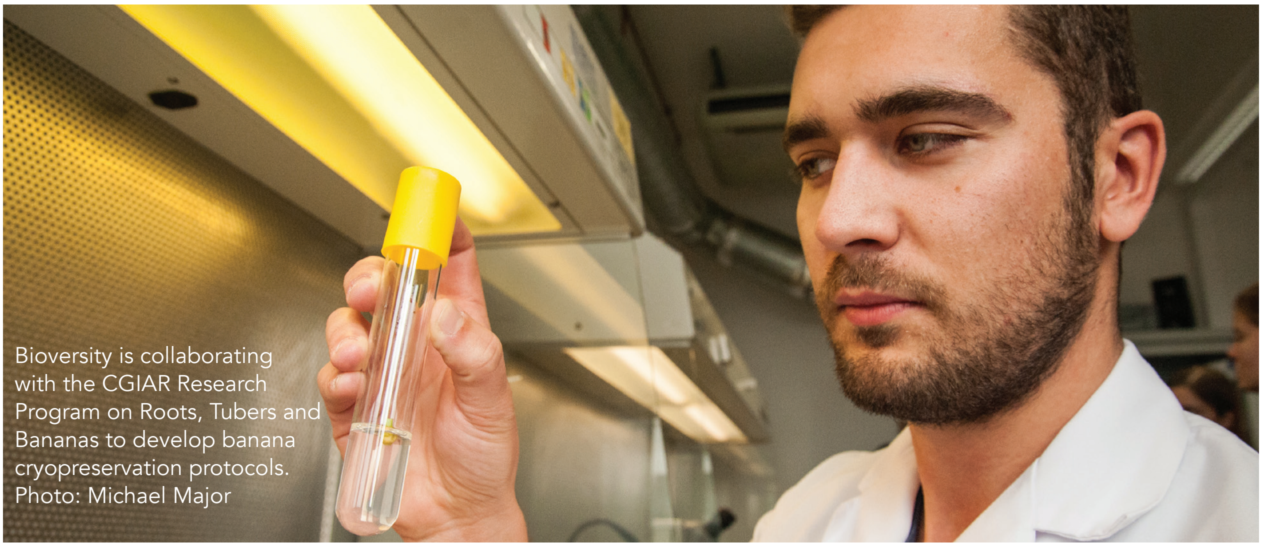


Figure 12. Number of partners receiving genebank services by category in 2017



Bioversity is collaborating with the CGIAR Research Program on Roots, Tubers and Bananas to develop banana cryopreservation protocols. Photo: Michael Major

Cross-CGIAR Partnerships

The most significant cross-CGIAR exchange occurring within the framework of the Genebank Platform concerns the movement of germplasm and associated data: the acquisition of materials from CGIAR breeding programs by genebanks and the distribution of germplasm from genebanks to research and breeding programs. In 2017, 3,435 samples were acquired from CGIAR breeding programs and 47,963 samples were sent to breeding programs. In addition, various forms of exchange occurred in 2017, between genebanks and individual CRPs (Table 10).

Table 10. Partnerships between genebanks and CRPs and Platforms

Name of CRP or Platform	Brief description of collaboration and value added	Relevant Module
Rice	The rice genebanks are integrated in the new outcome Theme "Harnessing Genetic Diversity to Accelerate Impact" with the aim of contributing to a complete integrated pathway to impact from genebank to consumers (IRRI, AfricaRice).	Use
Livestock	ILRI's genebank is fully integrated into the Feed and Forage Development Program for the use and deployment of forage genetic resources. A workshop was held with INIFAP, Mexico, to review activities under the forage germplasm project in October 2017 (ILRI).	Use
RTB	RTB Cluster D1.4 on Diversity involves a collaboration with the genebank on developing approaches to linking *ex situ* and *in situ* conservation (IITA). Developing banana seed cryopreservation and low temperature conservation protocols (Bioversity). High throughput phenotyping of the banana collection for drought tolerance (Bioversity).	Conservation and Use
Wheat	A significant number of CIMMYT-held wheat accessions in the process of being DArTseq genotyped through the MasAgro Seeds of Discovery project (CIMMYT).	Use
GLDC	ICARDA is working with breeders to evaluate barley accessions for heat tolerance and resistance to major diseases in Sudan and for disease resistance in Australia, Ethiopia, Morocco and India (ICARDA).	Use
Maize	Collaboration between genebanks and the CRP involves the screening of a landrace germplasm pool for key traits (IITA).	Use
FTA	Close collaboration with FTA is key for the promotion of use of the genebank collection and generation of evaluation data (ICRAF).	Use
EiB	Genebank representatives participated in the "Planning meeting of the Excellence in Breeding Platform", 13-15 March 2017 and in Expert Advisory groups of all EiB Modules. IRRI worked with EiB on a small-scale test of low-cost, low-density SNP chips for identity verification as a quality control tool to guard against labelling errors during regeneration undertaken under EIB Module 3. Results will be analysed in 2018 and used to assess whether DNA-based identity verification should be incorporated as a routine element of genebank operations (IRRI). DOI capability has been incorporated into B4R to assign DOIs to breeders' lines.	Use

Monitoring, Evaluation, Impact Assessment and Learning

An Independent Evaluation Arrangement (IEA) commissioned study on the *CGIAR research support program for Managing and Sustaining Crop Collections: Genebanks CRP* was published in April 2017. Most of the report's recommendations have already been addressed. Table 11 lists actions undertaken in 2017 relevant to remaining recommendations.

Improving Efficiency

The individual genebanks planned 154 improvements in facilities, operations and use of collections in 2017, based on previous reviews and QMS recommendations, as well as other priorities captured in annual Improvement Plans. In total, 136 improvements have been fully or partly addressed. Notable improvements and gains in efficiency include:

- Reduced seed processing time (e.g. pneumatic seed counting trays at CIMMYT, high volume thresher at IITA, automated seed sorter at IRRI)
- Improved seed monitoring and storage processes for seed longevity (CIP, ICARDA, IITA, ILRI)
- Improved screenhouses and regeneration techniques (CIAT, ICARDA, IITA)

The Genebank Platform helped IITA to improve its screenhouses and regeneration techniques. Photo: Shawn Landersz

Table 11. 2017 activities to address CGIAR IEA recommendations

CGIAR IEA recommendations	Actions in 2017
Recommendation 3. Given the shortcomings in the original Costing Study, and despite difficulties encountered earlier, the Genebank Platform management should give high priority to revisiting the Parity Study to establish realistic and transparent budget for each Center genebank.	A new costing study has been planned and initiated with a review of IRRI genebank costs in 2017 and will continue in 2018 with other Centers.
Recommendation 6. The Crop Trust should incentivize and empower the Genebank Platform management to promote the Platform independently from the Crop Trust's own communications, in order to ensure that a comprehensive communications strategy is developed to promote the visibility and accountability of the Platform and the CGIAR genebanks.	New website was launched in 2017 (www.genebanks.org). The new communication strategy is being implemented to enhance visibility of the CGIAR Genebank Platform, genebanks and GHUs.
Recommendation 7. Given that the Quality Management System (QMS) has become a kewy mechanism for enhancing Genebank operations, the Genebank Platform should build on this success by: • Compiling lessons learned from QMS to operationalize the FAO Genebank Standards into easily implementable approaches and procedures, and report regularly to the FAO Commission on their use which would help genebanks worldwide to enhance their performance; • Determining, at the earliest opportunity, if external validation of QMS is needed and if so, what form it should take, and to whom such a validation role might be assigned.	Crop Trust has been interacting with the FAO to link the lessons learned from the QMS initiative and to support the development of the FAO Genebank Standards. A joint workshop is planned for 2018. Internal audits of the genebank SOPs commenced in 2017 with the program moving into external audits in 2019.
Recommendation 8. Use of germplasm for research and crop improvement requires access to germplasm that has been adequately characterized and evaluated for resistance to and tolerance of biotic and abiotic stresses. In its future data development efforts, the Genebank Platform management should: • Enhance linkages between genebank characterization and breeders' evaluation and pedigree data; and • Expand the utility of GRIN-Global more specifically for *in vitro* collections.	The activities of individual genebanks and the front runners under the Use Module have been directed towards enhancing linkages between breeders' evaluation and pedigree data and genebank accessions. GRIN-Global (GG) development is rapidly progressing within a Community of Practice including CGIAR genebanks and several national genebanks (esp. USDA). CIAT has developed GG capacity for use *in vitro* collections.

- Barcoding of laboratory and field operations (AfricaRice, CIAT, CIP, ICARDA, IITA, ILRI)
- Use of mobile devices and apps to capture data (Bioversity, CIAT, IITA, ILRI)
- Improved lighting and conditions of *in vitro* conservation to extend subculture period and reduce contamination (CIAT, CIP, CIP/EMBRAPA, IITA)
- Improved indexing and regeneration success rate through modified facilities or procedures in the field (CIAT beans and forages, CIMMYT maize, IITA)
- Testing of trueness-to-type and removal of off-types (Bioversity, CIP, IITA)
- Improvements in *in vitro* and cryopreservation protocols (CIP, IITA)
- Elimination of duplicate samples or duplicate accessions (CIP, IITA)
- Use of DOIs for tracking germplasm (Bioversity, CIMMYT, CIP, ICARDA, IITA, ILRI, IRRI)
- Increased rate of germplasm health testing (CIAT, ICARDA, ICRISAT, IITA)

Seed moisture testing at ICRISAT. Photo: Michael Major

Cryopreservation at Bioversity. Photo: Cierra Martin

Germplasm health testing at CIAT. Photo: Shawn Landersz

Barcoding at IRRI. Photo: Shawn Landersz

Seed preparation for storage at IITA. Photo: Shawn Landersz

Seed characterization at ICRAF. Photo: Michael Major

Platform Management

Platform Management and Governance

There have been no major changes to governance arrangements. Management of the Genebank Platform is dependent on a strong and trusting collaboration between the CGIAR, at the Center and System levels, and the Crop Trust. A Memorandum of Understanding is being developed between the both organizations to consolidate this relationship and to clarify the roles and responsibilities of either party.

Management of Risks

Programmatic risks: Funding of the Genebank Platform continues to be under threat. The Crop Trust works assiduously to raise funds to support both the Genebank Platform and the endowment for the long-term financing of the CGIAR genebanks. New staff members have been recruited to boost person-power to develop donor partnerships and communications, and efforts are being made to work more closely with the System Management Office.

Contextual risks: A major discussion in the PGRFA policy community concerns the sharing of benefits arising from the use of sequence data associated with genebank accessions. Tensions surrounding this debate risk undermining policy support provided by the ITPGRFA for Centers' operations, as well as any public-funded initiative to sequence genebank collections and make data available. The Policy Module submitted a detailed paper, which has been widely referenced, on the benefits of genetic sequencing to the conservation and use of genetic resources to the CBD Secretariat in 2017. Continued engagement in international policy discussions is important. The Policy Module has raised the issue to the level of SMB and will develop a draft communication statement for DGs consideration concerning CGIAR digital sequencing work and partnerships.

Institutional risks: Four genebank managers will be recruited out of the 12 manager positions in 2018. One was recruited in 2017. The Platform will have an important role in supporting the new recruits to participate in the environment of international plant genetic resources conservation and use and to address the range of policy and management issues that regularly arise.

Financial summary

	Planned budget 2017			Actual expenditure 2017			Difference		
	W1/2	W3/ bilateral	Total	W1/2	W3/ bilateral	Total	W1/2	W3/ bilateral	Total
Module 1	22,081	6,750	28,831	20,678	6,308	26,986	1,403	442	1,845
Module 2	1,255	0	1,255	1,145	0	1,145	110	0	110
Module 3	831	0	831	831	0	831	0	0	0
Crop Trust –- Management and Support Costs	693	0	693	693	0	693	0	0	0
Platform Total	**24,861**	**6,750**	**31,611**	**23,346**	**6,308**	**29,654**	**1,515**	**442**	**1,956**

Note: Values in US$ thousands.

Annex 1. Germplasm distribution

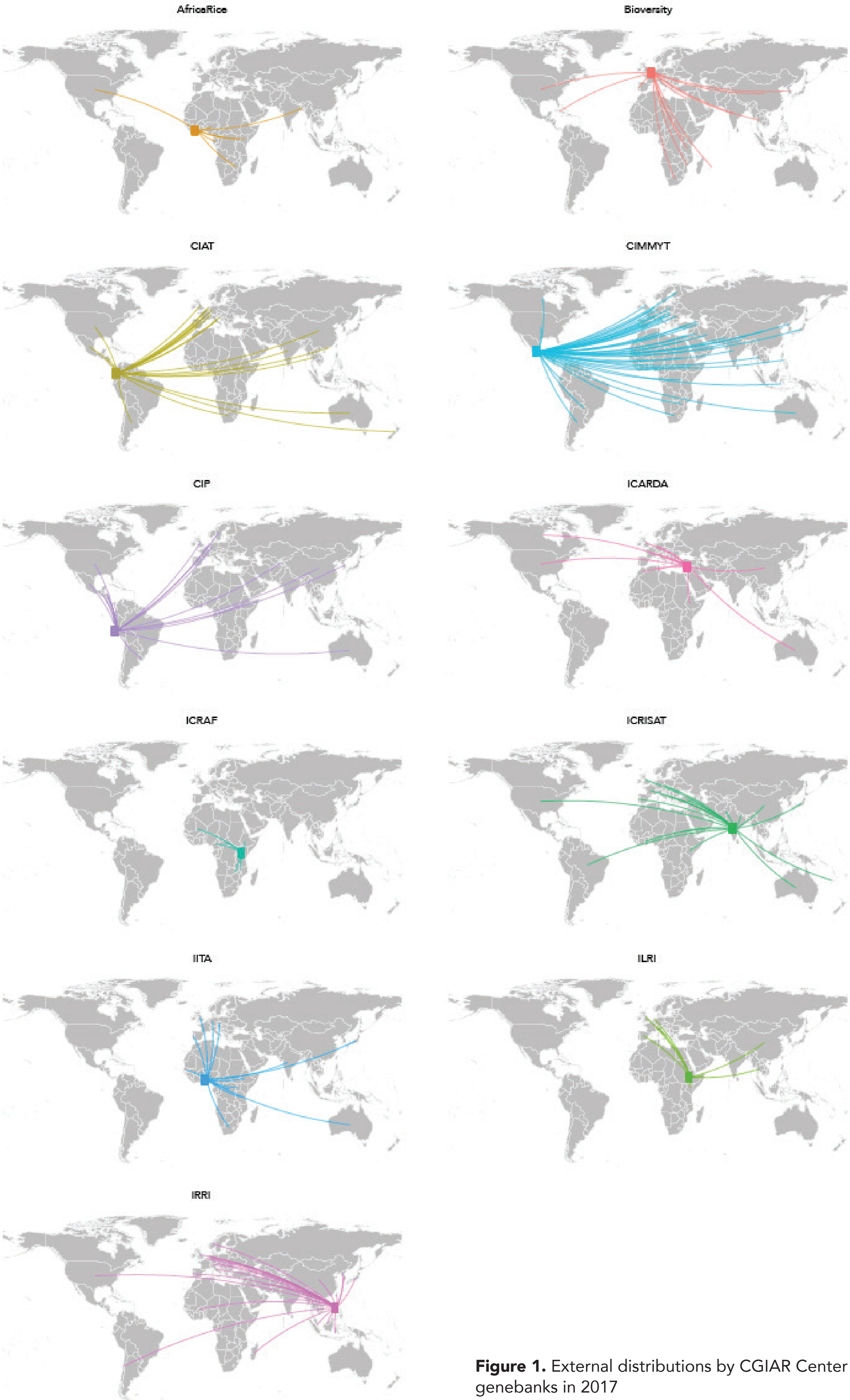


Figure 1. External distributions by CGIAR Center genebanks in 2017

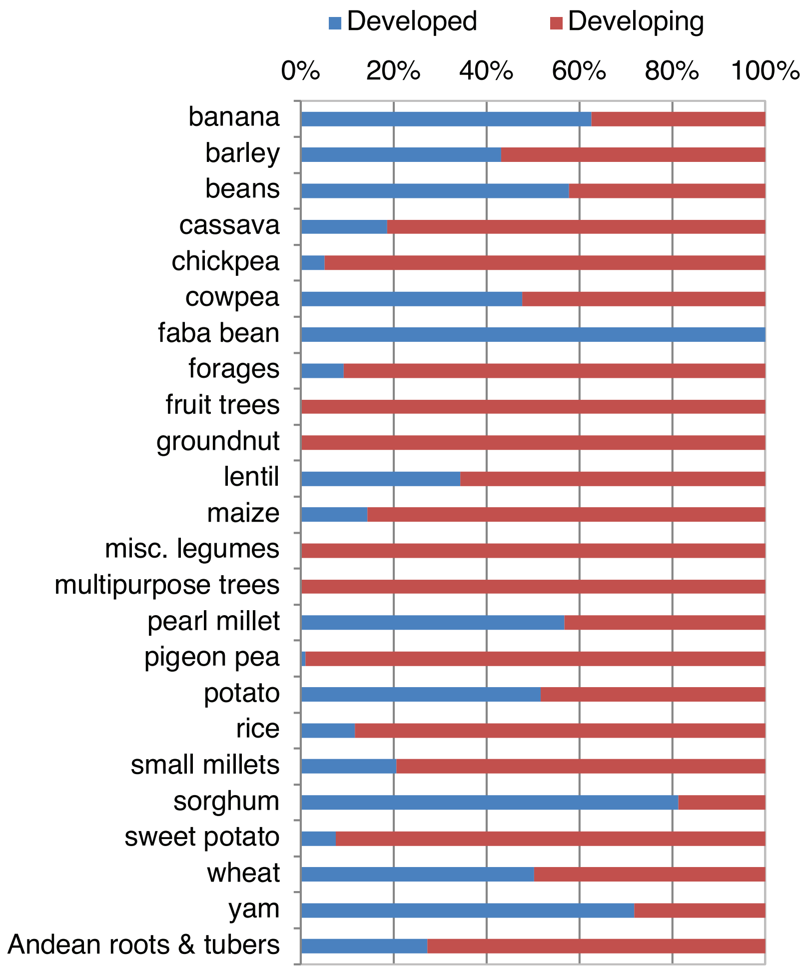


Figure 2. Breakdown of samples distributed by CGIAR center by crop and developing/developed country

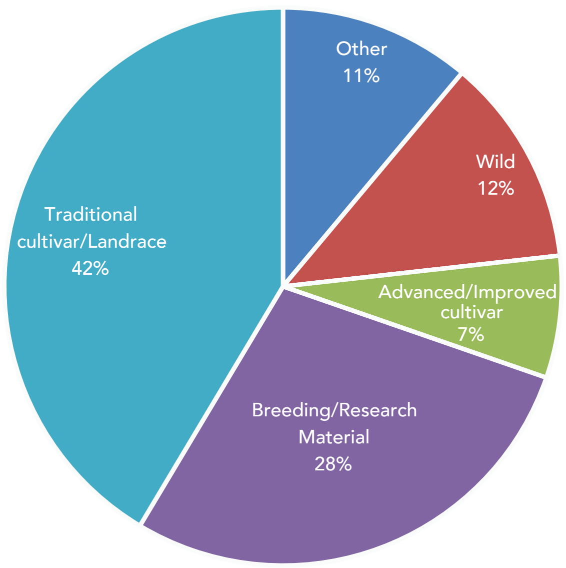


Figure 3. Germplasm distribution by type

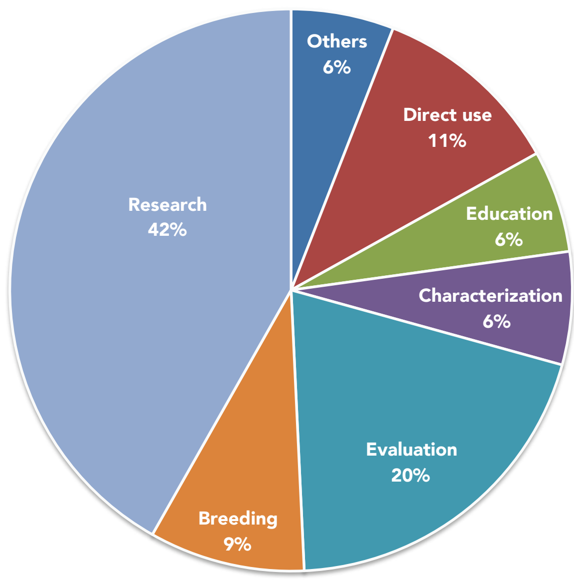


Figure 4. Purpose of germplasm requests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