GLOBAL CROP CONSERVATION AND USE METRICS

BREADFRUIT
(*Artocarpus* J.R. Forst & G. Forst.)

CROP TRUST

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Global crop conservation and use metrics

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With support from

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International Treaty on Plant Genetic Resources for Food and Agriculture

Federal Ministry of Agriculture, Food and Regional Identity

Description

This report provides an up-to-date overview of the global status of *ex situ* conservation of genetic resources of breadfruit and its wild relatives, including key metrics on:

- the identity and composition of genebank collections;
- the Multilateral System (MLS) status of accessions in these collections;
- storage, regeneration, and safety duplication status;
- documentation, information systems, and research resources;
- germplasm distribution; and
- varietal registrations and releases.

The report also includes global statistics on crop production, trade, and availability in food supplies, as well as information about crop networks and partnerships. It is meant to provide an update to some of the information presented in the Global Conservation Strategy for breadfruit (Crop Trust, 2007), but is primarily based on publicly available datasets, rather than a new survey of genetic resource collections and expert consultations.

Introduction and background on breadfruit

Breadfruit [*Artocarpus altilis* (Parkinson) Fosberg] has been a traditional staple starch crop throughout Oceania for thousands of years, with British and French colonialists introducing varieties to Caribbean islands and other regions during the late 18th century as a cheap food source for enslaved people (Audi *et al.*, 2023; Yang *et al.*, 2022; Zerega *et al.,* 2004). Today it is grown in more than 90 countries throughout South and Southeast Asia, Pacific and Caribbean islands, Central America, and Africa. The fruit is a good source of essential amino acids, including leucine, isoleucine, and valine, and has a low to moderate glycemic index that could be beneficial for controlling diabetes (Mehta *et al.*, 2023). As one of the most productive crops known, fruiting up to three times a year, and producing abundant food with minimal labor, breadfruit has significant potential to help alleviate hunger in the tropics (Yang *et al.*, 2022). Beyond food, the versatile trees provide construction materials, medicine, fabric, glue, insect repellent, and animal feed (NTBG, 2025a).

Global cultivation and consumption statistics are rather limited for breadfruit, with FAOSTAT placing the crop within generalized categories both in production metrics (“Fruit, tropical fresh nes”) and food supply metrics (“Fruits, Other”). Estimates are provided in Table 1.

Table 1. Global status of breadfruit production, trade, availability in food supplies, and public interest. Production, trade, and food supply statistics from FAOSTAT (2015 to 2018 average). The crop is placed within generalized categories both in production metrics ("Fruit, tropical fresh nes") and food supply metrics ("Fruits, Other"). For production, the value for "Fruit, tropical fresh nes" was divided evenly among crops within the general category to estimate a production value for each crop. For food supply, the value for "Fruits, Other" was divided among crops within the general category using a weighted average based on crop production statistics (Khoury *et al*., 2023). Number of countries refers to the count of countries where the crop is reported as within the top 95 percent of crops in terms of contribution to production, trade, or food supply. The evenness metric quantifies evenness of production, trade, or availability in food supplies across world regions, where 0 equals highly uneven and 1 equals completely even. The international interdependence metric quantifies degree of production, trade, or availability in food supplies outside of the primary region of diversity of the crop, where 0 equals low estimated international interdependence and 1 equals high estimated international interdependence. Wikipedia metric is public pageviews over one year (2019) of the taxon name of the crop. All values from Khoury *et al*. (2023).

Metric	Global value	Number of countries where significant contributor	Evenness of contribution across world regions	Estimated international interdependence
Harvested area (ha)	9,808	0.00	0.16	0.76
Total production (tonnes)	69,917	0.00	0.19	0.72
Gross production value (current thousand USD)	36,404	0.00	0.12	0.78
Export quantity (tonnes)	2,604	0.00	0.10	0.57
Export value (current thousand USD)	3,894	0.00	0.10	0.54
Import quantity (tonnes)	2,543	0.00	0.07	0.96
Import value (current thousand USD)	4,695	0.00	0.06	0.95
Contribution to calories in food supplies (kcal/capita/day)	0.09	0.00	0.71	0.98
Contribution to protein in food supplies (g/capita/day)	0.00	0.00	0.70	0.99
Contribution to fat in food supplies (g/capita/day)	0.00	0.00	0.59	0.98
Contribution to food weight in food supplies (g/capita/day)	0.07	0.00	0.68	0.98
Number of public pageviews on Wikipedia over one year	4,933			

Identity and composition of *ex situ* collections

Based on the latest data in global genetic resource databases, germplasm collections of breadfruit and its wild relatives (i.e., genus *Artocarpus* J. R. Forst. & G. Forst.) are present in at least 37 institutions worldwide, collectively maintaining 537 accessions (Table 2, Table 3; Supplementary Table 1). The major collections listed in the genetic resource databases are mainly distributed in the production regions in the Pacific and Caribbean, and include USDA collections (maintained in Hilo, Hawaii), University of West Indies in Trinidad and Tobago, the Centre for Pacific Crops and Trees (CePaCT) (an international collection located in Fiji), Southern Regional Centre Laloki (NARI) (Papua New Guinea), Institute of Plant Breeding-National Plant Genetic Resources Laboratory (Philippines), Department of Agriculture, Peninsular Malaysia (Malaysia), and the Horticultural Research Farm Pasyala (Sri Lanka); these collectively maintain over three-quarters of accessions documented in the major germplasm databases worldwide. The largest collection of breadfruit globally, maintained at the Breadfruit Institute at the National Tropical Botanical Garden (NTBG) in Hawaii, is unfortunately not currently listed in these databases. Information from its website indicates that around 150 cultivars of three species collected from 34 Pacific islands are conserved there, totaling over 350 trees (NTBG, 2025b).

Reported information on the status of accessions under the Multilateral System of Access and Benefit Sharing (MLS) of the International Treaty on Plant Genetic Resources for Food and Agriculture (Plant Treaty), as recorded in the Global Information System (GLIS) and in pertinent fields in Genesys and FAO WIEWS (Table 2; Table 4), likely underestimate the full degree to which accessions are currently included in the MLS, as several of the breadfruit collections without information on MLS status are in countries that are contracting parties to the Plant Treaty (such as USA, Trinidad and Tobago, and Philippines) and distribute samples using the Standard Material Transfer Agreement (SMTA).

Based on a stakeholder survey and meeting, and compiled breadfruit network resources, the 2007 Strategy identified several breadfruit collections in Pacific Island countries, which were generally in research stations and appear to be largely absent from the global genetic resource databases, although some of the germplasm may have been moved or duplicated into institutes that are now reported in these databases (Crop Trust, 2007). These include collections in Fiji, Federated States of Micronesia, Kiribati, New Caledonia, Marshall Islands, Samoa, Solomon Islands, and Vanuatu. The Strategy also listed many "minor" collections across the Pacific, Caribbean, West Africa, and other regions. It

Table 2. Major *ex situ* collections of breadfruit genetic resources. Top 20 institutions listed in descending order by total number of accessions. Number of accessions and storage condition information from Genesys and FAO WIEWS (2024), with supplementary information as noted. Multilateral System (MLS) status from Plant Treaty GLIS (2025) and from Genesys and FAO WIEWS (2024).

Institution Code	Institution name	Number of accessions	Percent of total	Cumulative percent	Number of accessions conserved *in vitro* or in cryo storage	Number of accessions included in MLS (from Plant Treaty GLIS)	Number of accessions included in MLS (from genebank collections databases)
USA042	National Germplasm Repository, USDA-ARS (Hilo, Hawaii)	251	46.7%	46.7%	1	0	0
TTO001	Faculty of Agriculture, University of the West Indies	42	7.8%	54.6%	0	0	0
FJI049	Centre for Pacific Crops and Trees (CePaCT)	40	7.5%	62.0%	40	13	0
PNG004	Southern Regional Centre Laloki (NARI)	24	4.5%	66.5%	0	0	24
PHL129	Institute of Plant Breeding-National Plant Genetic Resources Laboratory	19	3.5%	70.0%	0	0	0
MYS109	Department of Agriculture, Peninsular Malaysia	18	3.4%	73.4%	0	0	0
LKA097	Horticultural Research Farm Pasyala	17	3.2%	76.5%	0	0	0
JPN183	NARO Genebank	15	2.8%	79.3%	0	0	0

Institution Code	Institution name	Number of accessions	Percent of total	Cumulative percent	Number of accessions conserved *in vitro* or in cryo storage	Number of accessions included in MLS (from Plant Treaty GLIS)	Number of accessions included in MLS (from genebank collections databases)
USA047	Subtropical Horticultural Research Unit, National Germplasm Repository – Miami, USDA	11	2.1%	81.4%	0	0	0
USA108	Tropical Agricultural Research Station, Clonal Repository USDA/ARS	10	1.9%	83.2%	0	0	0
BGD003	Bangladesh Agricultural Research Institute	9	1.7%	84.9%	0	0	0
GUY021	National Agricultural Research and Extension Institute	8	1.5%	86.4%	6	0	0
PHL024	Bureau of Plant Industry-Davao National Crop Research and Development Center	8	1.5%	87.9%	0	0	1
LKA235	Horticultural Research Farm	7	1.3%	89.2%	0	0	0

Table 3. Composition of *ex situ* collections of breadfruit genetic resources. Main *ex situ* collections data from Genesys and FAO WIEWS (2024). Primary and secondary regions information from Khoury *et al*. (2023) and subsequent research for this summary. Botanic gardens data from BGCI PlantSearch (2024).

Metric	Number	Percentage
Total number of accessions in genebank collections	537	
Number of institutions holding genebank collections	37	
Number of distinct taxonomic names in genebank collections	15	
Number of accessions of crop wild relatives (CWR) in genebank collections	11	2.1%
Number of accessions of weedy materials in genebank collections	0	0%
Number of accessions of landraces in genebank collections	130	24.2%
Number of accessions of breeding materials in genebank collections	67	12.5%
Number of accessions of improved varieties in genebank collections	69	12.9%
Number of accessions of other materials in genebank collections	191	35.6%
Number of accessions not marked with an improvement type in genebank collections	69	12.9%
Number of countries where germplasm has been collected for genebank collections	27	
Number of accessions in genebank collections from the primary region(s) of diversity	223	41.5%
Number of accessions in genebank collections from the primary and secondary region(s) of diversity	278	51.8%
Number of taxa in botanic garden collections	40	
Number of botanic gardens holding collections of crop or its wild relatives	159	

listed the NTBG collection as holding around 220 accessions and the USDA collection as maintaining around 33 accessions at that time.

Artocarpus J.R. Forst. & G. Forst. (Poaceae) contains around 60 species and several infraspecific taxa, native to Southeast Asia and the Pacific region (USDA, 2025). The two main crop species in the genus – breadfruit (*A. altilis*) and jackfruit (*Artocarpus heterophyllus* Lam.) – are widely cultivated in the tropics. A third cultivated species – breadnut (*Artocarpus camansi* Blanco) – is cultivated to a more limited degree. The likely wild progenitor of breadfruit – *A. camansi* – is native to Indonesia and Papua New Guinea, and most Melanesian and Polynesian cultivars of breadfruit appear to originate from this species. On the other hand, most Micronesian breadfruit cultivars may be the descendants of hybridization between *A. camansi*-derived plants and *Artocarpus mariannensis* Trécul., a wild species native to the high islands of the western north Pacific (Zerega *et al.*, 2004; Crop Trust, 2007). A published genepool concept for breadfruit includes the progenitor *A. camansi* as well as *A. altilis*, *Artocarpus bergii* E. M. Gardner et al., *Artocarpus horridus* F. M. Jarrett, and *A. mariannensis* in the primary genepool, with 29 additional species assigned to the tertiary genepool (USDA, 2025). Cultivated varieties outside of Oceania are considered to have low genetic diversity due to genetic bottlenecks during dispersal (Crop Trust, 2007).

Data compilation for this report on breadfruit genetic resources included all taxa in *Artocarpus*. Along with the breadfruit and jackfruit, ten taxa as well as hybrids and accessions only recognized to the genus level are present in germplasm collections (Supplementary Table 2). These are mainly composed of relatively large collections of the two crop species. Across all accessions, landraces make up the largest proportion of collections (24.2%), followed by improved varieties (12.9%) and breeding materials (12.5%) (Table 3). Wild relatives comprise only 2.1% of accessions. These percentages are rough estimates based on available data, noting that 35.6% of accessions are marked as "other materials" and another 12.9% do not list biological status data.

Artocarpus germplasm has been collected from at least 27 countries, with approximately 41.5% of accessions originating from the primary region of diversity of breadfruit (i.e. the Pacific region) and 51.8% from primary and secondary (i.e. South, East, and Southeast Asia; tropical South America and the Caribbean; and Australia and New Zealand) regions; these statistics are also estimates, as 14.6% of breadfruit landrace accessions, for example, do not contain information even of the country where the accession was collected. Information on botanic garden collections from BGCI PlantSearch indicate that 159 botanic gardens collectively conserve 40 *Artocarpus* taxa; comparing these to genebank collections, 27 are only conserved in botanic gardens.

Aside from the large number of taxa that appear to be entirely missing from, or with very small representation in, germplasm collections, the global genetic resources databases do not offer insights on diversity gaps, but published research has indicated specific priority species and geographic regions for further collecting for conservation. The 2007 Strategy identified gaps in the NTBG collection at that time, including: *A. altilis* from Solomon Islands, Vanuatu, Fiji and the Caribbean Islands; *A. altilis* x *A. mariannensis* from Chuuk and Kosrae, Federated States of Micronesia, Marshall Islands, Palau and Tuvalu; and *A. mariannensis* from Palau, Guam and the Mariana Islands (Crop Trust, 2007).

In a global *ex situ* conservation gap analysis of the wild relatives of major crops, Castañeda-Álvarez *et al.* (2016) listed all of the 31 assessed breadfruit wild relatives as of high priority for further collecting. Ramirez-Villegas *et al.* (2022) identified geographic gaps for breadfruit landraces in specific localities across Indonesia and Papua New Guinea.

Multilateral System status of accessions in *ex situ* collections

Breadfruit (*A. altilis* only; jackfruit as well as other *Artocarpus* are excluded) is listed in Annex I of the International Treaty on Plant Genetic Resources for Food and Agriculture (Plant Treaty) and is thus included in its Multilateral System of Access and Benefit Sharing (MLS). Of the 537 accessions conserved globally, approximately 7.8% are held in international institutions (i.e., mainly CePaCT), and are included in the MLS under Article 15 of the Plant Treaty or similar arrangements, with the remainder maintained in national and other collections (Table 4).

Of the 537 accessions of *Artocarpus* species (328 are *A. altilis*) conserved around the world as listed in the global germplasm databases, 13 accessions are formally included in the MLS according to the Plant Treaty's GLIS database, and 23 accessions have been assigned Digital Object Identifiers (DOIs) (Table 4). Per the relevant fields in the global genetic resources databases, 32 accessions (6% of world total) are listed as included in the MLS; this is likely an underestimate, noting that 70.9% of accessions do not have MLS status data. The collection maintained at the Breadfruit Institute is not included in the MLS.

Table 4. Representation of breadfruit accessions in international and national institutions, number of accessions with DOIs, and representation of accessions in the Multilateral System of Access and Benefit Sharing of the International Treaty on Plant Genetic Resources for Food and Agriculture. Main *ex situ* collections data from Genesys and FAO WIEWS (2024). DOI and MLS data from Plant Treaty GLIS (2025).

Metric	Number	Percentage
Number of accessions in genebank collections in international institutions	42	7.8%
Number of accessions in genebank collections in national or other institutions	495	92.2%
Number of accessions in genebank collections in Annex I	328	61.1%
Number of accessions with DOI (Plant Treaty GLIS 2025)	23	
Number of accessions included in the Multilateral System (MLS) (Plant Treaty GLIS 2025)	13	
Number of accessions included in the Multilateral System (MLS) (genebank collections databases)	32	6.0%
Number of accessions included in the Multilateral System (MLS) that are in international collections (genebank collections databases)	0	0%
Number of accessions not included in the Multilateral System (MLS) (genebank collections databases)	124	23.1%
Number of accessions without information regarding inclusion in the Multilateral System (MLS) (genebank collections databases)	381	70.9%

Storage conditions, regeneration status, and safety duplication

Breadfruit germplasm collections are mainly maintained in the field (48.2% of accessions), with only 9.1% of accessions listed as conserved *in vitro* (Table 5). Only 0.4% of accessions are recorded as conserved in seed collections and 0.2% in cryopreservation. Information on storage type is not available for 1.1% of accessions, while 42.1% of accessions were listed in an unspecified "other" storage category.

Current regeneration status and needs cannot be directly derived from the global germplasm databases. FAO WIEWS reporting for the *Third State of the World's Plant Genetic Resources for Food and Agriculture* (FAO, 2025b) for the years 2014 to 2019, documented five breadfruit accessions regenerated during this time by reporting institutions.

Analysis of the location of safety duplication sites of breadfruit germplasm, as listed in Genesys, indicates that none of the accessions listed are safety duplicated in an active collection outside of the country of the main collection (Table 5). Information from the Svalbard Global Seed Vault (SGSV) database from 2024 indicated that zero accessions were duplicated in Svalbard.

The 2007 Strategy remarked that the NTBG collection was partly duplicated at that time, with about 11% of accessions also held at the USDA collection in Hilo; NTBG also had collections from other institutes in Solomon Islands, Federated States of Micronesia, and Samoa (Crop Trust, 2007). The Strategy prioritized the full duplication of the NTBG collection *in vitro*, and as a field collection, in other institutes.

Table 5. Storage conditions of breadfruit *ex situ* collections, regeneration status, and safety duplication status. Main *ex situ* collections data from Genesys and FAO WIEWS (2024). Regeneration status information from FAO WIEWS (2024); data from 2012 to 2014. Safety duplication out of the country data based only on Genesys (2024) data. Svalbard Global Seed Vault data from SGSV portal (2024).

Metric	Number	Percentage
Number of accessions held in seed storage in genebank collections	4	0.7%
Number of accessions held in short-term seed storage in genebank collections	0	0%
Number of accessions held in medium-term seed storage in genebank collections	1	25.0%
Number of accessions held in long-term seed storage in genebank collections	0	0%
Number of accessions held in seed storage of undefined type in genebank collections	3	75.0%
Number of accessions held in field storage in genebank collections	259	48.2%
Number of accessions held in *in vitro* storage in genebank collections	49	9.1%
Number of accessions held in cryo storage in genebank collections	1	0.2%
Number of accessions held as DNA in genebank collections	0	0%
Number of accessions held in other storage in genebank collections	226	42.1%
Number of accessions not marked with a storage type in genebank collections	6	1.1%
Number of accessions in genebank collections regenerated 2014–2019	5	15.6%
Number of accessions in genebank collections in need of regeneration 2014–2019	0	0%
Number of accessions in genebank collections in need of regeneration without budget for regeneration 2014–2019	0	0%
Number of accessions safety duplicated out of the country in genebank collections	0	0%
Number of accessions in genebank collections safety duplicated in Svalbard	0	0%

Documentation, information systems, and research resources

Descriptor lists relevant to *Artocarpus* include a publication focused on jackfruit (IPGRI, 2000) and a more recent descriptor for breadfruit (Ragone and Wiseman, 2007). A prioritized list of characterization and evaluation descriptors for breadfruit was published in 2009 (Bioversity International and NTBG, 2009).

The estimated completeness of passport information for breadfruit accessions listed in Genesys was 5.1 on a scale of 0 (no data) to 10 (complete data), which indicates that some data is available, but also that there are gaps that it would be valuable to fill. Four metrics of the current degree of digital sequence information (DSI) for breadfruit (from the National Center for Biotechnology Information USA database), two metrics of published literature on the crop (Google Scholar and PubMed Central), and one metric of the degree of research resources such as herbarium specimens (from the Global Biodiversity Information Facility – GBIF), are listed in Table 6.

The 2007 Strategy recognized extensive gaps in passport information for existing breadfruit collections, and for the NTBG collection also prioritized completing morphological and other descriptor information (Crop Trust, 2007). It also envisioned the need for the development of a "breadfruit database" for all the world's breadfruit collections. Information management for crop genetic resources has evolved substantially since the 2007 Strategy. The current Genesys and FAO WIEWS databases likely fulfill some needs in terms of essential taxonomic, institutional, and passport data, although it is apparent that many breadfruit collections currently do not report to these databases. A dedicated online "breadfruit database", including complete accession-level passport, characterization, and evaluation data for breadfruit germplasm collections remains a gap.

Table 6. Documentation, information systems, and research resources for breadfruit. Passport data completeness index (PDCI) from Genesys (2024), based on the methods outlined in van Hintum et al. (2011). Global Biodiversity Information Facility data from GBIF (2025). All other metrics data from Khoury et al. (2023).

Metric	Number
Passport data completeness index (range 0-10) as a median value across accessions in genebank collections	5.1
Number of genes as recorded in NCBI's Entrez database as of 2022	132
Number of genomes as recorded in NCBI's Entrez database as of 2022	0
Number of nucleotides as recorded in NCBI's Entrez database as of 2022	521
Number of proteins as recorded in NCBI's Entrez database as of 2022	336
Number of publications listed in Google Scholar with taxon name in title published between 2009 and 2019	530
Number of publications listed in PubMed Central with taxon name in text as of 2022	348
Number of research materials as recorded in GBIF (2025)	80,148

Germplasm distributions and varietal registrations and releases

Germplasm distribution and varietal development statistics for breadfruit are listed in Table 7. Germplasm distribution data from FAO WIEWS and the Plant Treaty Data Store reflect different reporting scopes: FAO WIEWS primarily reports distributions from national genebanks, while the Plant Treaty Data Store includes all transfers made under the SMTA, encompassing distributions made by genebanks as well as by breeding programs and other organizational types (Khoury *et al.*, 2025). While distribution of breadfruit germplasm appears to be active, with thousands of samples (likely individual genotypes) distributed on average annually, varietal registration and release appears to be very marginal.

The 2007 Strategy mentioned that the aim of NTBG to serve as a global resource for distribution of breadfruit germplasm was constrained by insufficient propagation material, remoteness of the collections from phytosanitary inspection centers, costs of handling and shipping, and other financial and staffing constraints (Crop Trust, 2007). Plans were in process to develop *in vitro* methods to conserve a core collection and facilitate distribution. These would be managed by the Canadian Conservation Research Institute for Sacred Plants (CCRISP; University of Guelph, Ontario, and the University of British Columbia, Canada) and by CePaCT.

Table 7. Breadfruit germplasm distributions and varietal registrations and releases. FAO WIEWS distributions data is annual average over years 2014 to 2019. Plant Treaty Data Store distributions data is annual average over years 2015 to 2021. Evenness metric quantifies evenness of germplasm distributions across world regions, where 0 equals highly uneven and 1 equals completely even. International Union for the Protection of New Varieties of Plants (UPOV) PLUTO data is annual average over years 2014 to 2018. FAO WIEWS varietal releases data is annual average over years 2015 to 2019. All metrics data from Khoury *et al*. (2023), with Plant Treaty Data Store additions for more recent years (2019 to 2021).

Metric	Number
Average annual number of accessions distributed worldwide as recorded in FAO WIEWS	67.6
Average annual number of samples distributed worldwide as recorded in FAO WIEWS	673.8
Average annual number of samples distributed worldwide as recorded in the Plant Treaty Data Store	8.3
Number of countries receiving germplasm as recorded in the Plant Treaty Data Store	2.3
Evenness of distributions across world regions as recorded in the Plant Treaty Data Store	0.0
Average annual number of varietal registrations worldwide as recorded in UPOV's PLUTO	0.0
Average annual number of varietal releases worldwide as recorded in FAO WIEWS	0.0

Networks and partnerships

- The Breadfruit Institute at the NTBG, including through its partnerships with USDA, CePaCT, and many other collections, continues to play a central role in breadfruit germplasm conservation.
- The 2007 Strategy mentioned that there was no established global or regional network for breadfruit, but that the Pacific Agricultural Plant Genetic Resources Network (PAPGREN) had prioritized the crop. Among other things, this had facilitated partnerships between the NTBG and CePaCT to disseminate breadfruit germplasm as pathogen-tested tissue cultures, in particular within the Pacific region (Crop Trust, 2007).
- Currently active networks focused on the crop include:
  - PAPGREN continues to be an active network for the Pacific region.
  - The African Orphan Crops Consortium
  - The Ghana breadfruit network

Conclusions

Breadfruit continues to hold a central place in tropical island food security in the Pacific and other regions, and it is possible that the crop will grow in importance in future food systems due to its versatility, productivity and resilience. Its genetic resources are bolstered by the activities taking place at the Breadfruit Institute of the NTBG, the international collection at CePaCT, and in national and other agricultural research organizations in the Pacific and in other production regions, although only a few of these are currently listed in global genetic resources databases. The crop, as well as its genetic resources, is poorly tracked globally, and gaps in information make it very difficult to assess current status of production and consumption, germplasm holdings and their coverage under the MLS of the Plant Treaty, gaps in collections, safety duplication status, and other priorities. It is very likely that increased efforts are needed to strengthen existing collections, comprehensively include all unique breadfruit germplasm collections under the MLS of the Plant Treaty, fill gaps in collections, make the information accompanying accessions more complete and more accessible in online databases, and improve safety duplication.

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Methods and materials

Primary data sources for the metrics reported in this summary include: Genesys; World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture of the Food and Agriculture Organization of the United Nations (FAO WIEWS); Botanic Gardens Conservation International PlantSearch database (BGCI PlantSearch); Global Information System of the International Treaty on Plant Genetic Resources for Food and Agriculture (Plant Treaty GLIS); Data Store of the International Treaty on Plant Genetic Resources for Food and Agriculture (Plant Treaty Data Store); Svalbard Global Seed Vault portal (SGSV portal); International Union for the Protection of New Varieties of Plants (UPOV) PLUTO database; FAOSTAT; National Center for Biotechnology Information's Entrez database (NCBI Entrez); Google Scholar; PubMed Central; Wikipedia; and the Global Biodiversity Information Facility (GBIF). Some of these data were acquired from literature/databases including Khoury *et al*. (2023) and Khoury *et al*. (2025). Data processing, metric calculation, and table generation were conducted in R, with code available on this GitHub repository. Extended methods are available here.

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Supplementary information

Supplementary Table 1: Full list of *ex situ* collections of breadfruit genetic resources, in descending order by total number of accessions. Number of accessions and storage condition information from Genesys and FAO WIEWS (2024), with supplementary information as noted. Multilateral System (MLS) status from Plant Treaty GLIS (2025) and from Genesys and FAO WIEWS (2024).

Institution Code	Institution name	Number of accessions	Percent of total	Cumulative percent	Number of accessions conserved in vitro or in cryo storage	Number of accessions included in MLS (from Plant Treaty GLIS)	Number of accessions included in MLS (from genebank collections databases)
USA042	National Germplasm Repository, USDA-ARS	251	46.7%	46.7%	1	0	0
TTO001	Faculty of Agriculture, University of the West Indies	42	7.8%	54.6%	0	0	0
FJI049	Centre for Pacific Crops and Trees	40	7.4%	62.0%	40	13	0
PNG004	Southern Regional Centre Laloki (NARI)	24	4.5%	66.5%	0	0	24
PHL129	Institute of Plant Breeding-National Plant Genetic Resources Laboratory	19	3.5%	70.0%	0	0	0
MYS109	Department of Agriculture, Peninsular Malaysia	18	3.4%	73.4%	0	0	0
LKA097	Horticultural Research Farm Pasyala	17	3.2%	76.5%	0	0	0
JPN183	NARO Genebank	15	2.8%	79.3%	0	0	0
USA047	Subtropical Horticultural Research Unit, National Germplasm Repository - Miami, USDA	11	2.0%	81.4%	0	0	0
USA108	Tropical Agricultural Research Station, Clonal Repository USDA/ARS	10	1.9%	83.2%	0	0	0
BGD003	Bangladesh Agricultural Research Institute	9	1.7%	84.9%	0	0	0
GUY021	National Agricultural Research and Extension Institute	8	1.5%	86.4%	6	0	0
PHL024	Bureau of Plant Industry-Davao National Crop Research and Development Center	8	1.5%	87.9%	0	0	1
LKA235	Horticultural Research Farm	7	1.3%	89.2%	0	0	0
ECU023	Departamento Nacional de Recursos Fitogenéticos	6	1.1%	90.3%	0	0	3

Institution Code	Institution name	Number of accessions	Percent of total	Cumulative percent	Number of accessions conserved in vitro or in cryo storage	Number of accessions included in MLS (from Plant Treaty GLIS)	Number of accessions included in MLS (from genebank collections databases)
LKA234	Rambutan Research Unit	6	1.1%	91.4%	0	0	0
PER045	Estación Experimental Agraria Pucallpa	6	1.1%	92.6%	0	0	0
LKA155	Agricultural Research Station, Girandurukotte	5	0.9%	93.5%	0	0	0
TTO019	Agricultural Services Division, Ministry of Food Production and Fisheries	4	0.7%	94.2%	0	0	0
CUB003	Instituto de Investigaciones en Fruticultura Tropical	3	0.6%	94.8%	0	0	0
BEL002	Gembloux agro-biotech, Université de Liège, département des Sciences agronomiques, Phytotechnie tropicale et Horticulture	2	0.4%	95.2%	0	0	2
BGD014	Bangladesh Forest Research Institute (BFRI)	2	0.4%	95.5%	0	0	0
CRI001	Centro Agronómico Tropical de Investigación y Enseñanza	2	0.4%	95.9%	0	0	0
IND001	National Bureau of Plant Genetic Resources	2	0.4%	96.3%	2	0	0
LKA094	Regional Agricultural Research and Development Centre, Makandura	2	0.4%	96.6%	0	0	0
LKA169	Agricultural Research Station, Rahangala	2	0.4%	97.0%	0	0	0
LKA232	Agriculture Research Station,Rahangala	2	0.4%	97.4%	0	0	0
PHL008	Bureau of Plant Industry, Department of Agriculture	2	0.4%	97.8%	0	0	0
PNG001	Islands Regional Centre Keravat	2	0.4%	98.1%	0	0	2
SLV050	CENTA - Banco de Germoplasma	2	0.4%	98.5%	0	0	0

Institution Code	Institution name	Number of accessions	Percent of total	Cumulative percent	Number of accessions conserved in vitro or in cryo storage	Number of accessions included in MLS (from Plant Treaty GLIS)	Number of accessions included in MLS (from genebank collections databases)
TTO010	Central Experiment Station, Research Division, Ministry of Agriculture, Land and Fisheries	2	0.4%	98.9%	0	0	0
BGD016	Bangladesh Agricultural University (BAU)	1	0.2%	99.1%	0	0	0
BGD028	Bangladesh Institute of Nuclear Agriculture (BINA)	1	0.2%	99.3%	0	0	0
LKA128	Regional Agriculture Research and Development Centre, Bandarawela	1	0.2%	99.4%	0	0	0
NIC080	Centro de Desarrollo Tecnologico Campos Azules	1	0.2%	99.6%	0	0	0
NIC092	Centro de Desarrollo Tecnologico Kukra Hill	1	0.2%	99.8%	1	0	0
PAN076	Finca Experimental Rio Hato Sur - CIARG	1	0.2%	100.0%	0	0	0

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Supplementary Table 2: Full list of taxonomic names in *ex situ* genetic resource collections, in descending order by number of accessions conserved. Germplasm data from Genesys and FAO WIEWS (2024).

Taxon	Number of accessions (from genebank collections databases)
Artocarpus altilis (Parkinson) Fosberg	328
Artocarpus heterophyllus Lam.	90
Artocarpus hybr.	46
Artocarpus integer (Thunb.) Merr.	28
Artocarpus odoratissimus Blanco	13
Artocarpus camansi Blanco	11
Artocarpus sp.	8
Artocarpus lacucha Buch.-Ham.	6
Artocarpus blancoi (Elmer) Merr.	1
Artocarpus hirsutus Lam.	1
Artocarpus hypargyreus Hance ex Benth.	1
Artocarpus integer x *heterophyllus*	1
Artocarpus lanceifolius Roxb.	1
Artocarpus rigidus Blume	1
Artocarpus sericicarpus F. M. Jarrett	1

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