DRAFT THEMATIC STUDY

for

THE THIRD REPORT ON THE STATE OF THE WORLD'S PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

(Not for Quotation or Citation)

Comments must be submitted by filling in the <u>designated table</u>

GERMPLASM EXCHANGE

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Contents

Ex	ecutive	summary	
1.]	Introduc	tion	1
1.1	Plan	t genetic resources and their conservation and use	1
1.2	. The	Third Report on the State of the World's Plant Genetic Resources for Food and Agriculture	e and the
cali	l for a Then	natic Background Study on Germplasm Exchange	
2.	Me	thodology and data sources summary	5
3	Res	ults	6
3.1	Tot	al distributions	6
3.2	Dor	nestic versus international distributions	7
33	Dist	ributions by international centres versus national or other institutions	9
3.4	Dist	ributions by countries regions and income categories	
3.5	Dist	ributions to specific recipient types	
5.5	351	Distributions to recipient organizational types	21
	352	Number of farmers' varieties/landraces distributed by national or local genet	anks to
	farmers		
	3.5.3	Transfers made to international and regional genebank recipients	
	3.5.4	Intergenebank exchanges or safety duplications	27
3.6	Dist	ributions by Contracting Party status of the country in which provider or reci	pient is
loc	ated		
	3.6.1	Distributions by providers and recipients located countries that are, or ar	e not a
	Contrac	ting Party to the Plant Treaty	27
	3.6.2	Distributions by providers and recipients located in countries that are, or are	e not, a
	party to	the Nagoya Protocol	31
3.7	Dist	ributions by crops and crop types	35
	3.7.1	Distributions by crops	35
	3.7.2	Distributions by crop types	
	3.7.3	Distributions by crop improvement types	
	3.7.4 3.7.5	Distributions by crop germplasm and storage benaviour types	43
	3.7.5	Distributions of Clops in the context of their global use	sharing
	(Apper	1) status of crops	snanng. 17
38	Cha	nge over time in distributions within and beyond the study period	
4.	Dis		53
4.1	Key	findings and implications	53
4.2	Cav	eats and information gaps	5/
Re	eferences	·	59
An	inexes		64
An	inex 1: Ez	xtended methodology and data sources	64
An	inex 2: W	forld Information and Early Warning System on Plant Genetic Resources for Fo	od and
Ag	rıculture	(WIEWS), germplasm distributions dataset dictionary	
An	inex 3: Pla	ant Treaty germplasm distribution dataset dictionary	74
Re	ferences	for Annex 1	

1 **Executive Summary**

iv

2 This study of global germplasm exchange is primarily based on an analysis of two complementary information
3 sources, both covering the period 2012 to 2019:

4 The FAO World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (WIEWS) 5 Indicators 28 (Number of accessions), 29 (Number of samples distributed by genebanks to users of germplasm) and 6 (Number of farmers' varieties/landraces distributed by national or local genebanks to farmers). These datasets primarily record 6 7 distributions of germplasm from national genebanks. Provider countries, provider institutions, types of 8 recipient (optionally), crops and total numbers of accessions and samples distributed, are reported for two 9 periods (2012 to 2014 and 2014 to 2019). 10 The Data Store of the Multilateral System of Access and Benefit Sharing of the International Treaty on Plant Genetic Resources 11 for Food and Agriculture (ITPGFRA, herein also referred to as the Treaty). This dataset includes all distributions made 12 under the Treaty's Standard Material Transfer Agreement (SMTA) that have been reported to the Governing

Body of the Treaty, including distributions made by genebanks as well as by breeding programmes and other organizational types. It is primarily composed of distributions made by the genebanks and breeding programmes of CGIAR centres. Countries where providers and recipients are located, the crops involved and

16 the numbers of samples distributed are reported for each year from 2012 to 2019.

17 These datasets were standardized and supplemented with additional information. In the case of providers and 18 recipients, the additions included world region classifications, country income level and Contracting Party 19 status with respect to the Treaty and the Nagoya Protocol on Access to Genetic Resources and the Fair and 20 Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity (Nagoya Protocol). For crops, additional information included use categorization, status with respect to 21 22 inclusion in Annex 1 of the Treaty, FAOSTAT global crop production and food-supply contribution metrics, and information on germplasm type/seed storage behaviour. Supplementary information was also 23 synthesized from CGIAR genebank distribution data and from published literature. 24

This analysis of the 2012 to 2019 period documents the distribution of over 1.2 million accessions (an average of circa 159 000 per year) and over 4.1 million samples (circa 523 000 per year), as recorded in the **WIEWS** *dataset*, and over 3.9 million samples (circa 497 000 per year), as recorded in the **Treaty dataset**. This is a considerably larger number of distributions than were documented in *The State of the World's Plant Genetic Resources for Food and Agriculture* (FAO, 1997) and *The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture* (FAO, 2010).

The *WIEWS dataset* mainly documents domestic genetic resource exchange activities, with well over 90 percent of distributions made within the respective country. In terms of accessions, national agricultural research centres (NARCs) were the foremost in-country recipients, followed by recipients classed as others, farmers or non-governmental organizations (NGOs), the private sector and recipients classed unknown. In terms of samples, the private sector and NARCs received the largest shares, followed by farmers or NGOs,

36 recipients classed others and recipients classed as unknown.

The *Treaty dataset* documents a very different germplasm distribution pattern, with three-quarters (76.5 percent) of distributions occurring across international borders, and only a quarter (23.5 percent) incountry. This dataset primarily reflects CGIAR distributions (88.9 percent of the total) and indicates that 80.8 percent of these were made to recipients outside the country where the CGIAR centre was located.

41 The WIEWS dataset records the distribution of germplasm from providers in 87 countries, with more than half of them distributing more than 1 000 accessions each over the eight-year period. Asia and Europe were 42 the regions that were the foremost providers, followed by Oceania, the Americas and Africa. High-income 43 countries distributed 39.4 percent of all accessions, upper middle-income countries 35.7 percent, lower 44 middle-income 18.9 percent, and low-income countries 6 percent. Analysis of the data at the sample level 45 paints a similar picture, although it may be confounded by the reporting of relatively large numbers of samples 46 47 for a few crops from a few countries; these data may not reflect a consistent interpretation of "samples" 48 across providers. Almost half the countries distributed more than 10 000 samples each over the eight-year 49 period. Providers in the Americas, Europe and Asia distributed the most samples, followed by those in Africa 50 and Oceania. Lower middle-income countries distributed 38.3 percent of all samples, high-income counties 51 33.3 percent, upper middle-income countries 18.8 percent, and low-income countries 9.6 percent. Approximately 69.9 percent of accessions and 86.1 percent of samples were distributed by providers located 52 in countries that were Contracting Parties to the Treaty, while 37.3 percent of accessions and 35.5 percent of 53 samples were distributed by providers located in countries that were Contracting Parties to the Nagoya 54 Protocol. 55

56 The Treaty dataset records the distribution of germplasm from providers located in 48 countries, with more than 1 000 samples distributed by providers in 34 of those countries. Providers located in the Americas 57 58 accounted for 47.9 percent of total distributions, those in Asia for 29.5 percent, those in Africa for 14.1 percent, those in Europe for 8.4 percent, and those in Oceania for 0.2 percent. Approximately 59 59.7 percent of all the samples distributed came from providers in upper middle-income countries, 27 percent 60 from those in lower middle-income countries, 10.5 percent from those in high-income countries, and 61 2.9 percent from those in low-income countries. Approximately 53.2 percent of all samples were provided by 62 63 organizations located in countries that were Contracting Parties to the Treaty, and 52.2 percent by those in countries that were Contracting Parties to the Nagoya Protocol. However, these statistics must be interpreted 64 in light of an understanding that CGIAR centres were the providers of almost 90 percent of distributions in 65 66 the Treaty dataset.

67 The Treaty dataset records distributions to recipients in 179 countries, with over 1 000 samples received in 131 countries over the eight-year period. The countries where recipients received the largest numbers of 68 samples were India, Kenya, Mexico, Türkiye, the United States of America, Germany, Canada, China, Pakistan 69 and the Islamic Republic of Iran, each of which received over 100 000 samples under the SMTA. Recipients 70 in Asia received 42.1 percent of the samples, Africa 22.5 percent, the Americas 21.2 percent, Europe 71 72 13.2 percent, and Oceania 1 percent. Recipients in lower middle-income countries received 38.6 percent of 73 the samples, upper middle-income countries 26.7 percent, high-income countries 23.8 percent, and low-74 income countries 10.8 percent. Recipients in least developed countries (LDCs) received 11 percent of the

samples, those in landlocked developing countries (LLDCs) 12.5 percent, and those in small island developing states (SIDS) 0.3 percent. The relative lack of demand from low-income countries implies a need to further build the capacity of institutions concerned with the conservation and use of crop germplasm. Approximately 80.3 percent of the samples distributed using the SMTA were received by organizations located in countries that were Contracting Parties to the Treaty, and 41.3 percent were received by organizations located in

80 countries that were Contracting Parties to the Nagoya Protocol.

81 The WIEWS dataset records the distribution of germplasm belonging to 843 crops or crop groups. Over 82 100 000 accessions of each of three crops (wheat, rice and soybean) were distributed, between 10 000 and 100 000 accessions of each of 22 crops, between 1 000 and 10 000 accessions of each of 72 crops, between 83 100 and 1 000 of each of 98 crops, and fewer than 100 accessions of each of 643 crops. Specific crops with 84 85 the highest number of accessions distributed included wheat, rice, soybean, barley, common bean, chickpea, 86 Brassica crops, maize, oat, sorghum, pea, cotton, citrus, potato, tomato, broad bean and vetch, tobacco and 87 lentil, each with over 10 000 accessions distributed. In terms of samples, ten crops were reported as having 88 had over 100 000 samples distributed, 48 crops as having between 10 000 and 100 000 samples distributed, 89 126 crops as having between 1000 and 10 000 samples distributed, 133 crops as having between 100 and 1 000 samples distributed, and 526 crops as having between 1 and 100 samples distributed. The specific crops 90 with the highest number of samples distributed were dragon fruit, rice, wheat, citrus crops, pistachio, soybean, 91 92 cocoa, avocado, barley and coffee, all with over 100 000 samples distributed.

93 At the crop-type level, food crop germplasm comprised 86.5 percent of total accessions and 87.8 percent of 94 total samples recorded in the WIEWS dataset. The most distributed in terms of accessions were cereals, oil 95 plants, food legumes and vegetables. The most distributed in terms of samples were nuts, fruits and berries; 96 cereals; medicinal plants, aromatic plants, spices and stimulant plants; vegetables; oil plants; industrial and 97 ornamental plants; and food legumes. Germplasm distribution quantities generally aligned with global 98 production and food-supply metrics. However, on certain metrics, some crops - for example sugar cane, oil 99 palm, beet, cassava, soybean, banana and plantain, grape, yam, sunflower, coconut, groundnut and olive -100 stood out as making very large contributions to global production or food-supply but having relatively few 101 reported germplasm distributions.

102 Approximately 56.3 percent of accessions and 38 percent of samples recorded as distributed in the WIEWS 103 dataset were of crops listed in Annex 1 of the Treaty. Among the non-Annex 1 crops comprising the other 104 43.7 percent of the accessions distributed were soybean, cotton, tomato, tobacco, Capsicum crops, Acacia, 105 pear, sesame, cocoa, okra, teff, flax, tea, beet, cucumber and melon, each with over 5 000 accessions 106 distributed. The non-Annex 1 crops comprising the other 62 percent of samples distributed included dragon 107 fruit, pistachio, soybean, cocoa, avocado, coffee, mango, Arabidopsis, rubber, tomato, Acacia, grape, Annona 108crops, coconut, Capsicum crops, sugar cane, fig, pear, cotton, cucumber, melon, lettuce, guava, tobacco, okra, 109 flax, sapote and papaya, each with over 10 000 samples distributed. This high level of demand for germplasm 110 of non-Annex 1 crops underscores the importance of giving attention to ways and means of further

- 111 facilitating access to genetic resources, while also ensuring the fair and equitable sharing of any benefits arising
- 112 from such access.

The *Treaty dataset* records the distribution of over 270 crops or crop groups. One crop had more than 1000 000 samples distributed, four had between 100 000 and 1 000 000 samples distributed, 16 had between 10 000 and 100 000 samples distributed, 30 had with between 1 000 and 10 000 samples distributed, 38 had between 100 and 1 000 samples distributed, and 181 had between 1 and 100 samples distributed. Crops with the highest total numbers of samples distributed included wheat, maize, rice, barley, chickpea, lentil, bean, sorghum, pearl millet, *Brassicaceae* crops, broad bean and vetch, pigeon pea, cowpea, potato, groundnut, oat, lettuce, grass pea and other *Lathyrus*, soybean and pea, all with over 10 000 samples distributed.

At the crop-type level, food crop germplasm comprised 97.1 percent of the samples recorded as distributed 120 in the Treaty dataset, with cereals, food legumes, vegetables, roots and tubers, forages and oil plants among 121 122 the most distributed. This is not surprising given that the data pertain mainly to distribution of materials from the CGIAR centres, and the numbers of samples distributed generally aligned with global production and 123 124 food-supply metrics. However, for certain metrics, some crops - for example cassava, soybean, potato, tomato, banana and plantain, soybean, sunflower, groundnut and olive - stood out as having high production 125 126 or food-supply values relative to the amount of germplasm reported distributed. This probably reflects the difficulty of conserving and distributing certain crops, the exclusion of some from Annex 1, and/or the 127 relative paucity of major breeding programmes for some. Approximately 95.3 percent of samples belonged 128 129 to crops listed in Annex 1. Chief among the non-Annex 1 crops distributed were groundnut, lettuce, soybean, Capsicum crops, tomato, flax and spinach, each with over 5 000 samples distributed. 130

131

1. INTRODUCTION

132 1.1 Plant Genetic Resources and their Conservation and Use

Seeds and other reproductive propagules of cultivated plant species and their wild relatives are a critically 133 important resource that underpins the productivity, quality, sustainability, resilience and adaptive capacity 134 of food and agricultural systems (Hoisington et al., 1999; Esquinas-Alcázar, 2005; Gepts, 2006). Farmers' 135 varieties (landraces) and their wild relatives have been the basis of agricultural production for over 10 000 136 137 years (Larson et al. 2014), but their value as a genetic resource only began to be recognized by scientists in the late nineteenth and early twentieth centuries (Baur, 1914; Zeven, 1998), in parallel with the rediscovery 138 139 of Mendel's laws of inheritance and the development of modern genetics (Harwood, 2016; Khoury et al., 2021). Ex situ repositories (genebanks) were subsequently established to maintain genetic resource 140 141 (germplasm) collections and distribute them to support the breeding of new crop varieties (Vavilov, 1926; 142 Lehmann, 1981; Saraiva, 2013).

143 In parallel, concerns began to be raised over the loss of crop diversity from farmers' fields and from wild habitats due to rapid agricultural, environmental, socioeconomic and other changes (Baur, 1914; Harlan and 144 Martini, 1936). Such concerns were eventually highlighted at the Food and Agriculture Organization of the 145 146 United Nations (FAO), particularly in light of the large-scale replacement of traditional varieties by modern 147 cultivars during the "Green Revolution" (Bennett, 1964, 1968; Frankel and Bennett, 1970; Frankel, 1974; 148 Pistorius, 1997; Fenzi and Bonneuil, 2016). There was also a growing awareness of the susceptibility of 149 modern crop cultivars to pests and diseases because of their genetic uniformity (Tatum, 1971; National 150 Research Council, 1972; U.S. Senate, 1980).

These concerns resulted in the expansion of efforts around the world to collect and maintain plant genetic resources *ex situ* (Plucknett *et al.*, 1987). At the international level, the International Board for Plant Genetic Resources (IBPGR) was established in 1974 to coordinate a global initiative to conserve threatened genetic resources. IBPGR supported the collecting of over 200 000 samples of landraces, crop wild relatives and other materials in 136 countries between 1975 and 1995, and helped to establish international genebank collections to maintain these samples (Thormann, Engels and Halewood, 2019).

Over the course of the 1980s and 1990s, while national, regional and international *ex situ* collections were amassed, there was growing concern about the vulnerability of these collections, due largely to insufficient funding and infrastructure. Genebanks were encouraged to duplicate their holdings to mitigate these challenges and protect the holdings from natural disasters, war and civil strife (Holden, 1984; Lyman, 1984; Peeters and Williams, 1984).

At the same time, plant genetic resources were increasingly recognized as important not only for breeding but also in underpinning the resilience and adaptive capacity of agrarian communities and their agroecosystems (Mijatovic *et al.*, 2013; Fenzi and Bonneuil, 2016; Sirami *et al.*, 2019). Support for the *in situ* conservation of landraces on farms increased (Brush, 1991; Wood and Lenne, 1997; Bellon, 2004), though some questioned its efficacy in the face of widespread environmental and societal change (Frankel and Soule,
1981; Zeven, 1996; Peres, 2016).

168 In the 1990s, concern about the loss of biodiversity in all its forms became a global priority and resulted in 169 the adoption of the Convention on Biological Diversity (CBD), which mandated its conservation and sustainable use, and the fair and equitable sharing of the benefits arising from such use (CBD, 1992). With 170 171 the coming into force of the CBD, earlier international agreements on plant genetic resources (e.g. FAO, 172 1983) were renegotiated, resulting in the adoption in 2001 of the legally binding International Treaty on 173 Plant Genetic Resources for Food and Agriculture (ITPGRFA, also referred to in this study as the Treaty) 174 (FAO, 2009). In 2004, the Global Crop Diversity Trust (Crop Trust) was established by FAO and the 175 Consultative Group on International Agricultural Research (CGIAR) to help provide long-term funding for 176 the ex situ conservation of PGRFA (Esquinas-Alcázar, 2005).

177 By the end of 2020, 5.7 million accessions of plant genetic resources for food and agriculture (PGRFA) were reportedly conserved under medium- or long-term conditions in 831 genebanks by 114 countries and 17 178 179 regional and international research centres (FAO, 2021a). A proportion of this diversity is safety duplicated 180 among the genebanks themselves and at the Svalbard Global Seed Vault (Westengen, Jeppson and Guarino, 181 2013), where over 1.2 million samples are now duplicated (Norwegian Ministry of Agriculture and Food, 182 2023; NordGen, 2023). Genetic resources are also conserved by botanic gardens, universities, non-profit 183 organizations, community seedbanks, local conservation networks and private companies, while plant 184 breeding and other research programmes also store genetic resources, at least for short periods (Miller et al., 185 2015; Vernooy et al., 2017). Numerous initiatives continue to focus on in situ conservation (e.g. Stenner et al., 186 2016; AGUAPAN, 2023; Global Environmental Facility, 2023).

These decades of efforts have been both substantial and global, but conservation gaps continue to exist (FAO, 2010; Castañeda-Álvarez *et al.*, 2016; Khoury *et al.*, 2021; Ramirez-Villegas *et al.*, 2022). Two Global Plans of Action for Plant Genetic Resources for Food and Agriculture have been adopted to address these gaps (FAO, 1996; FAO, 2011). In recent decades, the Aichi Biodiversity Targets of the CBD and the subsequent Kunming-Montreal Global Biodiversity Framework, as well as the United Nations Sustainable Development Goals set urgent targets for enhanced conservation of plant genetic resources (CBD, 2010, 2023,; United Nations 2015; Díaz *et al.* 2020).

194 The global status, patterns and trends of many important genetic resource activities remain poorly 195 understood. One key area for which information has been historically limited is the distribution of 196 germplasm by genebanks and other providers. The Second Report on the State of the World's Plant Genetic Resources 197 for Food and Agriculture (Second Report) stated that distribution trends from national genebanks were seldom 198 provided in the country reports (i.e. the documents submitted by countries as inputs to the preparation of 199 the global report) and that only data from the international agricultural research centres were 200 comprehensively available (FAO, 2010). The Second Report presented distribution statistics from the 201 international genebanks and provided examples of germplasm distribution data for a few countries, including 202 China, Ethiopia, Germany, India, Japan, Kenya, Malawi, Pakistan, Poland and Switzerland. However, in the

case of the national data, only summary statistics were generally available, thus very limited information 203 could be synthesized regarding the extent of distribution of particular crops to different recipients. While 204 205 these examples meant that the Second Report provided somewhat more information than the original report 206 on The State of the World's Plant Genetic Resources for Food and Agriculture (First Report) (FAO, 1997), it was unable to provide a comprehensive global picture of germplasm distribution. Academic and research 207 208 literature, meanwhile, has generally focused on the distribution of germplasm by CGIAR centres, as data on 209 this were more readily available through the CGIAR System-wide Information Network on Genetic 210 Resources (SINGER) (Fowler, Smale and Gaiji, 2001; Galluzzi et al., 2016) and more recently through the 211 Online Reporting Tool (ORT) maintained by the Crop Trust in its role as coordinator of the CGIAR 212 Genebank Research Programme (2012 to 2016) and Genebank Platform (2017 to 2021) (Halewood et al,.

213 2020).

214 Global germplasm distribution has begun to be much more comprehensively documented over the last 10

to 15 years. At the international level, this is largely the result of increased efforts promoted by the Second

216 Global Plan of Action for Plant Genetic Resources for Food and Agriculture (Second GPA) to standardize

217 national-level reporting through FAO's World Information and Early Warning System on Plant Genetic

218 Resources for Food and Agriculture (WIEWS) (FAO, 2011). In addition, the Data Store of the Multilateral

- 219 System of Access and Benefit Sharing of the ITPGRFA documents germplasm distribution made with the
- 220 Treaty's Standard Material Transfer Agreement (SMTA). These two information systems provide the
- 221 foundation for this present analysis.

222 1.2 The Third Report on the State of the World's Plant Genetic Resources for Food and

223 Agriculture and the call for a thematic background study on germplasm exchange

The First Report was launched in 1996 during the Fourth International Technical Conference on Plant Genetic Resources, in Leipzig (FAO, 1997). Over 155 countries contributed to its preparation, providing the first ever global summary of the state of conservation and use of plant genetic resources. The findings triggered the adoption of the first Global Plan of Action on the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture (First GPA) by the Fourth International Technical Conference

- as basis on which to begin to address gaps and needs (FAO, 1996).
- In 2009, FAO launched the Second Report, which was endorsed by the Commission on Genetic Resources for Food and Agriculture at its Twelfth Regular Session (FAO, 2010). Country reports contributed by 115 countries provided the main source of information, enabling changes and developments that had occurred since the First Report to be highlighted and the identification of the most significant gaps needing to be addressed. In response to the Second Report, the Commission agreed to revise the First GPA and, in 2011, approved the Second GPA, which was subsequently adopted by the FAO Council on behalf of the FAO
- 236 Conference (FAO, 2011).
- 237 In 2013, the Commission decided that a draft Third Report on the State of the World's Plant Genetic Resources for
- 238 Food and Agriculture (Third Report) should be made available at its Eighteenth Regular Session in 2021. In

2017, at its Sixteenth Regular Session, the Commission revised the timeline for the preparation of the Third
Report, and at its Nineteenth Regular Session, it took note of the draft third Report and invited Members
and observers of the Commission and of the Treaty to provide comments on it by 30 November 2023.
The Commission recommended that the Third Report be made available in due time for the Twelfth
Session of the Intergovernmental Technical Working Group on Plant Genetic Resources for Food and
Agriculture in 2024 (CGRFA-19/23/Report).

245 In 2019, the Commission requested National Focal Points (NFPs) to report on the implementation of the 246 Second GPA for the period July 2014 to December 2019 through WIEWS. In addition, it invited the NFPs 247 to provide a summative narrative of progress made between January 2012 and December 2019 and to identify remaining gaps and constraints. The Commission also requested FAO to propose thematic 248 249 background studies, including on the global exchange of germplasm from and to genebanks, to complement 250 the other information to be used for the preparation of the Third Report. It requested FAO to specify the 251 purpose and content of the proposed studies, including how they would contribute to the Third Report 252 (CGRFA-17/19/Report).

A document on progress made in gathering information for the Third Report prepared for the Eighteenth Regular Session of the Commission (FAO, 2021b) reported that the process no longer relied only on standalone country reports but also drew on data gathered and reported to WIEWS in two reporting periods, the first running from January 2012 to June 2014 and the second running from July 2014 to December 2019. The document also included the following statement on the scope of a revised list of proposed thematic background studies:

259 "The thematic background studies shall provide context for the Third Report. They shall review

260 the relevant emerging issues, advances and/or trends, especially in scientific and technological

- 261 disciplines, legal and regulatory matters, policies, norms and societal developments since the
- 262 publication of the Second Report on the State of the World's Plant Genetic Resources for Food and
- 263 *Agriculture* (Second Report)" (FAO, 2021b)

264 It also detailed the terms of the proposed study on germplasm exchange:

265 "Purpose: The purpose of this study is to further explore the contributions of germplasm exchange to the conservation and sustainable use of PGRFA. The continued improvement of 266 food security and nutrition largely depends on the possibility to exchange germplasm across 267 countries and regions. Germplasm exchange and distribution may also play an important role for 268 restoring crop collections in centres of origin or enhancing crop diversity in farmers' fields, 269 270 including after disaster situations. Information on germplasm exchange, as reported by countries 271 through the World Information and Early Warning System on Plant Genetic Resources for Food 272 and Agriculture (WIEWS) Reporting Tool on indicators 6, 28 and 29 of the Second GPA 273 monitoring framework and under the Data Store of the Multilateral System of the International 274 Treaty on Plant Genetic Resources for Food and Agriculture (Treaty) will form the basis for this thematic background study." 275

"Content. The study will go beyond data usually reported by countries and make use of 276 additional sources of information by incorporating data from other existing active collections 277 278 currently not covered by country reporting in WIEWS. The study will also cover the germplasm 279 collections of crops that do not fall under Annex 1 of the Treaty and, thus, complement 280 information about material transferred with the Treaty's Standard Material Transfer Agreement. The study, which will be conducted in collaboration with the Secretariat of the Treaty, will also 281 282 provide information on the possible impacts of the COVID-19 pandemic on germplasm distribution." 283

284 "Contribution to the Third Report: A review of the advances, trends and gaps in these areas
285 shall provide context for data obtained from countries for Chapters 3 and 4 of the Report."
286 (FAO, 2021b).

The scope of this thematic background study was finalized with further inputs from FAO and the Treaty in2021 and early 2022.

289

2. METHODOLOGY AND DATA SOURCES SUMMARY

This study of global germplasm exchange is primarily based on an analysis of two complementary information sources, covering the period 2012 to 2019:

292 The FAO WIEWS Indicators 28 and 29 (Number of accessions and Number of samples distributed by genebanks 1. to users of germplasm) as well as Indicator 6 (Number of farmers' varieties/landraces distributed by national or local genebanks 293 to farmers). These datasets primarily report distributions of germplasm from national genebanks. Provider 294 295 countries, provider institutions, types of recipient (optionally), crops and numbers of accessions (i.e. unique 296 populations or genotypes maintained as individual entities)¹ and samples (i.e. individual packets of seeds or 297 other propagules)² distributed in total as well as to various recipient types are reported for two periods 298 (beginning of 2012 to mid-2014, and mid-2014 to end of 2019); specific recipient countries or recipient 299 institutions are not reported.

2. *The Data Store of the Multilateral System of Access and Benefit Sharing of the Treaty.* This dataset includes all distributions made under the SMTA that have been reported to the Governing Body. It records numbers of samples distributed by any provider, including genebanks as well as breeding programmes and other organizational types; it is primarily composed of distributions made by CGIAR centres (genebanks and breeding programmes). Countries where providers and recipients are located, crops and numbers of samples distributed are reported for each year from 2012 to 2019; specific provider institutions, recipient institutions or recipient organizational types are not reported.

¹ FAO's Genebank Standards defines an accession as "a distinct, uniquely identifiable sample of seeds representing a cultivar, breeding line or a population, which is maintained in storage for conservation and use" (FAO, 2014). This can be extrapolated to other reproductive propagules aside from seed.

² Thus, many samples of a single accession can be distributed.

These datasets were standardized and supplemented with additional data and information. For providers 307 and recipients, these included world region classifications (United Nations Statistical Division region and 308 309 subregion names [M49]) (UNSTATS, 2022), country income levels (World Bank Country and Lending 310 Groups classification system), and Contracting Party status with respect to the Treaty and the Nagoya 311 Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their 312 Utilization to the Convention on Biological Diversity (Nagoya Protocol). For crops, additional data and information included crop use types (based on the Second Report and other categorizations), status with 313 314 respect to inclusion in Annex 1 of the Treaty, crop use metrics (drawing on global production and food-315 supply data from FAOSTAT) and germplasm type/seed storage behaviour types (from literature and from 316 Kew's Seed Information Database [SER, INSBR and RBG Kew, 2023]). Supplementary information was 317 also synthesized from CGIAR germplasm distribution data and from published literature.

An extended description of the methodology and data sources is provided in **Annex 1** to this study. Compiled and processed datasets for the two main data sources are included alongside the study. Their data dictionaries are provided in **Annex 2** and **Annex 3**. Data from the additional sources of information are available in Halewood *et al.* (2020) and Lusty *et al.* (2021).

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3. RESULTS

323 *3.1 Total Distributions*

The *WIEWS dataset* indicates that from the beginning of 2012 to the end of 2019, providers distributed a total of 1 269 818 accessions (**Figure 1**): 258 288 between the beginning of 2012 and mid-2014, and 1 01 530 between mid-2014 and the end of 2019. This equates to an annual average of 158 727.3 accessions distributed over the full eight-year period, including 103 315.2 annually between 2012 and 2014, and 183 914.5 annually between 2014 and 2019.

In terms of samples, the WIEWS dataset indicates that between the beginning of 2012 and the end of 2019, providers distributed a total of 4 182 582 samples (**Figure 1**): 829 939 between the beginning of 2012 and mid-2014,³ and 3 352 643 between mid-2014 and the end of 2019. This equates to an annual average of 522 822.8 samples distributed over the full eight-year period, including 331 975.5 annually between 2012 and 2014, and 609 571.5 annually between 2014 and 2019.

The *Treaty dataset* indicates that, from the beginning of 2012 to the end of 2019, a total of 3 975 709 samples were distributed under the SMTA (**Figure 1**). This equates to an average of 496 963 samples per year.

³ For the first reporting period, one data provider reported a limited number of distributions for a timeframe of 2009 to 2013. These distributions were reported only for samples (not accessions) and totalled 162 753 samples.



341 **Figure 1.** Numbers of accessions and samples distributed during the period 2012 to 2019 (WIEWS and Treaty datasets). For

the WIEWS dataset, distributions for the two reporting periods (beginning of 2012 to mid-2014, and mid-2014 to end of
2019) are shown.

344 3.2 Domestic Versus International Distributions

The WIEWS dataset includes information on the distribution of 793 850 accessions for which specific 345 information is provided on recipient organizational type (62.5 percent of the total accessions covered). Note 346 347 that indicating the amounts distributed to the different categories of recipient was optional for Indicators 28 and 29. Assuming that the recipient categories NARC, Private Sector, Farmer or NGO, Others and 348 349 Unknown all represent domestic organizations, with only the category Foreign Stakeholders representing 350 international distributions, 747 551 accessions (94.2 percent of accessions distributed with recipient type information; 58.9 percent of all accessions distributed) were distributed domestically and 46 299 (5.8 percent 351 352 of accessions distributed with recipient type information; 3.6 percent of all accessions distributed) were 353 distributed internationally. Between 2012 and 2014, 180 336 (69.8 percent) out of 258 288 accessions 354 distributed were attributed to recipient type; of these, 165 424 (91.7 percent of those with recipient information; 64 percent of the total) were distributed domestically and 14 912 (8.3 percent of those with 355 recipient information; 5.8 percent of the total) were distributed internationally. Likewise, between 2014 and 356 2019, 613 514 (60.7 percent) out of 1 011 530 accessions distributed were attributed to recipient type; of 357 these, 582 127 (94.9 percent of those with recipient information; 57.5 percent of the total) were distributed 358 359 domestically, and 31 387 (5.1 percent of those with recipient information; 3.1 percent of the total) were 360 distrusted internationally. These figures equate to an annual average of 93 443.9 accessions distributed domestically and 5 787.4 internationally per year across the full period, including 66 169.6 domestically and 361 362 5 964.8 internationally between 2012 and 2014, and 105 841 domestically and 5 706.7 internationally 363 between 2014 and 2019.

In terms of samples, the WIEWS dataset includes information on a total of 2 788 604 samples distributed 364 with specific information on recipient organizational type, representing 66.7 percent of the total samples 365 366 covered. Assuming that the recipient categories NARC, Private Sector, Farmer or NGO, Others and 367 Unknown all represent domestic distributions, with only the category Foreign Stakeholders representing international distributions, 2 724 239 samples (97.7 percent of samples distributed with recipient type 368 information; 65.1 percent of all samples distributed) were distributed domestically, and 64 365 samples 369 (2.3 percent of samples distributed with recipient type information; 1.5 percent of all samples distributed) 370 371 were distributed internationally. Between 2012 and 2014, 478 148 (57.6 percent) out of 829 939 samples distributed were attributed to recipient type; of these, 454 844 (95.1 percent of those with recipient 372 373 information; 54.8 percent of the total) were distributed domestically and 23 304 (4.9 percent of those with 374 recipient information; 2.8 percent of the total) were distributed internationally. Likewise, between 2014 and 2019, 2 310 456 (68.9 percent) out of 3 352 643 samples distributed were attributed to recipient type; of 375 376 these, 2 269 395 (98.2 percent of those with recipient information; 67.7 percent of the total) were distributed domestically, and 41 061 (1.8 percent of those with recipient information; 1.2 percent of the total) were 377 378 distributed internationally. These figures equate to an annual average of 340 529.9 samples distributed 379 domestically and 8 045.6 internationally per year across the full period, including 181 937.6 distributed domestically and 9 321.6 internationally between 2012 and 2014, and 412 617.3 domestically and 7 465.6 380 381 internationally from 2014 to 2019.

The *Treaty dataset* includes information on 933 984 (23.5 percent) samples distributed domestically and 30 041 725 (76.5 percent) internationally. This equates to an annual average of 116 748 samples distributed domestically and 380 215.6 internationally across the entire period. The annual number of domestic distributions grew on average over the eight-year period, while the number of international distributions fell.



387

388 Figure 2. Proportions of accessions and samples distributed domestically and internationally during the period 2012 to 2019 389 (WIEWS and Treaty datasets). For the WIEWS dataset, domestic versus international distributions were estimated based on 390 information on recipient type, under the assumption that recipient categories NARC, Private Sector, Farmer or NGO, Others 391 and Unknown all represent domestic organizations, with only the category Foreign Stakeholders representing international 392 distributions. For the Treaty dataset, provider and recipient country information was used.

393 3.3 Distributions by International Centres Versus National or Other Institutions

Distributions by international centres were not included in the main WIEWS dataset. A supplementary 394 dataset provided by FAO for the same indicators and the same eight-year period indicates that a total of 395 328 069 accessions were distributed by 11 CGIAR centres and the World Vegetable Center, including 396 397 148 985 accessions between 2012 and 2014, and 179 084 between 2014 and 2019. These equate to an annual 398 average of 41 008.6 accessions distributed by international centres over the full period, including 59 594 399 annually between 2012 and 2014 and 32 560.7 annually between 2014 and 2019. If added to the main WIEWS dataset (covering national and other providers), distributions by international centres would equal 400 20.5 percent of total world distributions of accessions, and those by national and other institutions 401 79.5 percent. From 2012 to 2014, 36.6 percent of world total distributions of accessions were by made by 402 international centres and 63.4 percent by national and other institutions. Likewise, between 2014 and 2019, 403 15 percent of total world distributions of accessions were by made by international centres, and 85 percent 404 405 by national and other institutions (Figure 3).





Figure 3. Proportions of accessions and samples distributed by international centres and national and other providers between
 2012 and 2019 (WIEWS dataset). A supplementary WIEWS dataset for the 2012 to 2019 period and covering 11 CGIAR centres
 and the World Vegetable Center was combined with the main FAO WIEWS dataset for this analysis.

410 In terms of samples, the supplementary international centre **WIEWS dataset** indicates that a total of 707 411 194 samples were distributed by 11 CGIAR centres and the World Vegetable Center during the entire period, 412 including 244 267 samples between 2012 and 2014, and 462 927 between 2014 and 2019. This equates to an 413 annual average of 88 399.3 samples distributed by international centres over the full period, including 414 97 706.8 annually between 2012 and 2014, and 84 168.5 annually between 2014 and 2019. If added to the 415 main (national and other providers) WIEWS dataset, distributions by international centres would equal 416 14.5 percent of total world distributions of samples, and those by national and other institutions would equal 417 85.5 percent. Between 2012 and 2014, 22.7 percent of total world distributions of samples were by 418 international centres and 77.3 percent by national and other institutions. Likewise, between 2014 and 2019, 419 12.1 percent of world total distributions of accessions were by international centres and 87.9 percent by 420 national and other institutions (Figure 3). Note that given the much higher number of samples distributed by international centres reported in the Treaty dataset (see immediately below), the international centre 421 422 WIEWS dataset should not be considered a comprehensive account of these transfers, thus the true 423 proportion of total global distributions made from international centres is likely to be larger than the 424 estimates presented here.

The *Treaty dataset* indicates that 3 534 349 samples (88.9 percent of the total) were distributed by international (CGIAR) centres during the eight-year period and that 441 360 samples (11.1 percent) were distributed by other providers (**Figure 4**). This equates to an annual average of 441 793.6 samples distributed by international centres and 55 170 by other providers across the entire period. The relative proportion of samples distributed by international centres did not change significantly over the eight-year period. Depending on the year, they distributed between 83.7 percent and 92.2 percent of total samples, while other providers distributed between 7.8 percent and 16.3 percent.

The Treaty dataset also indicates that 680 067 (19.2 percent) of samples distributed by CGIAR centres went
to recipients within country where the centre was located, while 2 854 282 samples (80.8 percent) were sent

from CGIAR centres to recipients outside the country. This equates to an annual average of 85 008.4 samples distributed by international centres domestically and 546 785.3 to recipients in other countries

- 436 across the entire period. Distributions from CGIAR centres to recipients within the country where the
- 437 centre was located grew on average annually over the eight-year period, while international distributions
- 438 declined slightly.

439



Figure 4. Proportions of samples distributed by international centres and national and other providers between 2012 and
2019 (Treaty dataset).

442 *3.4 Distributions by Countries, Regions and Income Categories*

According to the WIEWS dataset, germplasm was distributed by 87 provider countries during one or both 443 reporting periods. At the accession level, a total of 81 provider countries distributed more than 100 444 accessions with 54 distributing more than 1 000 accessions, 22 distributing more than 10 000 accessions, 445 and three distributing more than 100 000 accessions over the eight-year period. Those provider countries 446 distributing the largest numbers of accessions included Australia, Bangladesh, Canada, China, Ethiopia, 447 448 France, Germany, India, the Islamic Republic of Iran, Italy, the Kingdom of the Netherlands, Pakistan and 449 Sweden, all of which distributed more than 20 000 total accessions between 2012 and 2019 (Figure 5). In 450 terms of average annual distributions, 56 provider countries reported distributing more than 100 accessions per year over the full period, 27 reported distributing more than 1 000 accessions, and four (Australia, China, 451 452 Germany and India) reported distributing more than 10 000 accessions.

For the 2012 to 2014 period, 63 provider countries were reported. Fifty-three of these countries distributed more than 100 accessions each, 27 of which distributed more than 1 000 and eight of which distributed more than 10 000. Where annual averages are concerned, 42 provider countries distributed more than 100 accessions per year, seven of which distributed more than 1 000 accessions per year and three of which (Bangladesh, Germany and Pakistan) distributed more than 10 000 accessions per year. For the 2014 to 2019 period, 79 provider countries were reported. Sixty-seven of these distributed more than 100 accessions each, 459 44 of which distributed more than 1 000, 18 of which distributed more than 10 000, and two of which 460 (Australia and China) distributed more than 100 000. Where annual averages are concerned, 49 provider 461 countries distributed more than 100 accessions per year, 24 of which distributed more than 1 000 accessions 462 per year, and four of which (Australia, China, Germany and India) distributed more than 10 000 accessions 463 per year.

The total numbers of accessions distributed by providers in the various regions of the world, as recorded in the WIEWS dataset for the full period (**Figure 6**), were as follows (in descending order):

- Asia 627 716 (49.4 percent; 22 countries), largest numbers in Eastern and Southern Asia;
- Europe 314 313 (24.8 percent; 24 countries), largest numbers in Western Europe;
- Oceania 128 466 (10.1 percent; 2 countries), overwhelmingly Australia;
- Americas 99 986 (7.9 percent; 16 countries), fairly evenly distributed across subregions; and
- Africa 99 337 (7.8 percent; 23 countries), largest numbers in Eastern Africa.



471

472 **Figure 5.** Provider-country totals for accession distributions between 2012 and 2019 (WIEWS dataset).

- 473 The numbers of accessions distributed by providers in the various regions of the world during the period
- 474 2012 to 2014 were as follows (in descending order):
- Asia 103 260 accessions (40 percent of the total; annual average 41 304 accessions);
- Europe 94 642 accessions (36.6 percent of the total; annual average 37 856.8);
- Africa 30 466 (11.8 percent of the total; annual average 12 186.4);

4 78 •	Americ	cas – 25 687 (9.	percent of th	ne total; annual	average 10 27	'4.8), and
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• Oceania – 4 233 (1.6 percent of the total; annual average 1 693.2).

480 The numbers for the period 2014 to 2019 were as follows (again in descending order):

- Asia 524 456 accessions (51.8 percent of the total; annual average 95 355.6 accessions);
- Europe 219 671 accessions (21.7 percent of the total; annual average 39 940.2);
- 483 Oceania 124 233 (12.3 percent of the total; annual average 22 587.8);
- Americas 74 299 (7.3 percent of the total; annual average 13 508.9); and
- Africa 68 871 (6.8 percent of the total; annual average 12 522).
- 486 Seventeen countries identified by the United Nations as LDCs⁴ reported distributing 108 223 accessions (8.5
- 487 percent of the total) across the eight-year period, 18 classified as LLDs⁵ reported distributing 66 356
- 488 accessions (5.2 percent of the total), and four classified as SIDS⁶ reported distributing 11 190 accessions (0.9
- 489 percent of the total). Note that countries can be assigned to more than one of these categories.



490

491 Figure 6. Provider-region totals for accession distributions between 2012 and 2019 (WIEWS dataset)

492 Figures from the WIEWS dataset for distributions by providers from countries in the various World Bank

493 country-income categories were as follows (in descending order):

• high-income countries distributed between 499 400 and 501 166 accessions (39.3–39.5 percent)

depending on whether the country classification was based on the first (2012 or 2014) or final (2014 or 2019)
year of the respective reporting period, with an average of 500 283 (39.4 percent);

• upper middle-income countries distributed between 448 533 and 458 650 accessions (35.3–6.1

498 percent), with an average of 453 591.5 (35.7 percent);

⁴ In descending order of accessions distributed, these were Ethiopia, Bangladesh, United Republic of Tanzania, Sudan, Nepal, Zambia, Uganda, Bhutan, Yemen, Chad, Mali, Malawi, Eritrea, Niger, Madagascar, Togo and Senegal.

⁵ In descending order of accessions distributed, these were Ethiopia, Uzbekistan, Nepal, Mongolia, Zambia, Zimbabwe, Uganda, Azerbaijan, Armenia, Bhutan, Botswana, Tajikistan, Chad, Mali, Malawi, Kyrgyzstan, Niger and Republic of Moldova

⁶ In descending order of accessions distributed, these included Trinidad and Tobago, Cuba, Guyana and Papua New Guinea.

- lower middle-income countries distributed between 229 036 and 250 002 accessions (18–19.7
 percent), with an average of 239 519 (18.9 percent); and
- low-income countries distributed between 60 000 and 92 849 accessions (4.7–7.3 percent), with an average of 76 424.5 (6 percent).

503 At the sample level, the WIEWS dataset indicates that a total of 85 provider countries distributed more than 504 100 samples over the full period, 64 of which provided more than 1 000 samples, 39 provided more than 505 10 000 samples, and 12 provided more than 100 000. The provider countries that reported distributing the largest numbers of samples included Australia, Bangladesh, China, Ethiopia, France, Germany, India, 506 507 Indonesia, Nicaragua, Nigeria, Spain and Togo, all with over 100 000 total samples distributed between 2012 and 2019 (Figure 7). In terms of average annual distributions, 65 provider countries reported distributing 508 509 more than 100 samples, 40 more than 1 000 samples, 14 more than 10 000 samples and one (Nicaragua) more than 100 000 samples per year on average over the full period. 510

511 For the 2012 to 2014 period, 65 provider countries were reported. Fifty-eight of these countries distributed 512 more than 100 samples, 40 more than 1 000 samples, 19 more than 10 000 samples and one (France) more 513 than 100 000 samples. Fifty-two provider countries distributed more than 100 samples per year on average, 28 of which distributed more than 1 000, and 11 of which distributed more than 10 000. For the period 514 515 2014 to 2019, 79 provider countries were reported. Seventy-two of these countries distributed more than 100 samples, 54 of which distributed more than 1 000, 31 more than 10 000 and nine more than 100 000. 516 517 Fifty-eight provider countries distributed more than 100 samples per year on average, 37 of which distributed 518 more than 1 000, 15 more than 10 000 and one (Nicaragua) more than 100 000.



520 **Figure 7.** Provider-country totals for sample distributions between 2012 and 2019 (WIEWS dataset).

521 The numbers of samples distributed by providers in the various regions of the world, as recorded in the 522 WIEWS dataset for the eight-year period (**Figure 8**), were as follows (in descending order):

- Americas 1 213 063 (29 percent; 16 countries), largest numbers in Central America;
- Europe 1 204 883 (28.8 percent; 24 countries), largest numbers in Western Europe;
- Asia 1 074 221 (25.7 percent; 22 countries), largest numbers in Eastern, Southern and South eastern Asia;
- Africa 561 788 (13.4 percent; 23 countries), largest numbers in Western and Eastern Africa; and
- Oceania 128 627 (3.1 percent; 2 countries), largest numbers in Melanesia.
- 529 The figures for the 2012 to 2014 period were as follows:
- Europe 408 536 samples (49.2 percent of the total; annual average 163 414.4);
- Asia 236 034 samples (28.4 percent of the total; annual average 94 413.6);
- Americas 95 230 (11.5 percent of the total; annual average 38 092);
- Africa 85906 (10.4 percent of the total; annual average 34 362.4); and
- Oceania 4 233 (0.5percent of the total; annual average 1 693.2).
- 535 Those for the 2014 to 2019 period were as follows:
- Americas 1 117 833 (33.3 percent of the total; annual average 203 242.4);
- Asia 838 187 samples (25 percent of the total; annual average 152 397.6);



• Africa – 475 882 (14.2 percent of total; annual average 86 524); and

540

• Oceania – 124 394 (3.7 percent of total; annual average 22 617.1).



541 542

2 Figure 8. Provider-region totals for sample distributions between 2012 and 2019 (WIEWS dataset)

According to the WIEWS dataset, 17 countries identified by the United Nations as LDCs⁶ distributed 535 433 samples (12.8 percent of the total), 18 classified as LLDCs⁷ distributed 130 627 samples (3.1 percent of total); and four classified as SIDS⁸ distributed 132 910 samples (3.2 percent of total). Note that countries can be assigned to more than one of these categories.

Figures for distributions by providers from countries in the various World Bank income categories were asfollows (in descending order):

- lower middle-income countries distributed between 1 501 429 and 1 701 933 samples (35.9– 40.7 percent), depending on whether the country classification was based on the first (2012 or 2014) or final (2014 or 2019) year of the reporting period, with an average of 1 601 681 (38.3 percent);
- high-income countries distributed between 1 368 055 and 1 418 838 samples (32.7–33.9 percent),
 with an average of 1 393 446.5 (33.3 percent);

• upper middle-income countries distributed between 680 368 and 894 938 samples (16.3– 555 21.4 percent), with an average of 787 653 (18.8 percent); and

low-income countries distributed between 367 377 and 43 226 samples (8.8–10.3 percent), with an
 average of 39 801.5 (9.6 percent).

The *Treaty dataset* contains information on distributions from providers located in 48 countries between 2012 and 2019. Over 100 samples were distributed from 38 countries, more than 1 000 samples from 34 of these, more than 10 000 samples from 21, more than 100 000 samples from nine, and more than 1 million samples from one. The countries from which the largest numbers of samples were distributed included

⁶ In descending order of samples distributed, these were Togo, Bangladesh, Ethiopia, United Republic of Tanzania, Sudan, Nepal, Zambia, Uganda, Malawi, Bhutan, Yemen, Senegal, Chad, Mali, Eritrea, Niger and Madagascar.

⁷ In descending order of samples distributed, these were Ethiopia, Uzbekistan, Nepal, Zambia, Uganda, Mongolia, Malawi, Zimbabwe, Armenia, Azerbaijan, Bhutan, Botswana, Tajikistan, Kyrgyzstan, Chad, Mali, Niger and Republic of Moldova.

⁸ In descending order of samples distributed, these were Guyana, Trinidad and Tobago, Cuba and Papua New Guinea.

562 Colombia, Germany, India, Kenya, Lebanon, Mexico, Morocco, the Philippines and Türkiye, each with over 563 100 000 samples distributed (**Figure 9**). These statistics mainly reflect the presence of CGIAR centres within 564 the borders of the respective countries. With regard to average annual distributions, providers in 37 countries 565 distributed more than 100 samples per year on average over the full period, those in 23 distributed more 566 than 1 000 samples, those in nine distributed more than 10 000 samples, and those in one distributed more 567 than 100 000 samples.

The numbers of samples distributed by providers in the various regions of the world, as recorded in the Treaty dataset (**Figure 10**), were as follows (in descending order):

• Americas – 1 903 518 samples (47.9 percent of the total; annual average of 237 939.8 samples 571 distributed by providers in 8 countries), largest numbers in Central America;

Asia – 1 171 880 samples (29.5 percent of the total; annual average of 146 485 samples distributed
by providers in 11 countries), including large distributions from Western, South-eastern and Southern Asia;
Africa – 560 659 samples (14.1 percent of the total; annual average of 70 082.4 samples distributed
by providers in 15 countries), largest numbers in Northern and Eastern Africa;

- Europe 333 675 samples (8.4 percent of the total; annual average of 41 709.4 samples distributed 577 by providers in 11 countries), largest numbers in Western Europe; and
- Oceania 5 977 samples (0.2 percent of the total; annual average of 747.1 samples distributed by
 providers in 3 countries), largest numbers in Australia.
- 580 These statistics mainly reflect the presence of CGIAR centres within the various regions. The regional
- 581 figures fluctuated considerably from year to year, but there was no discernible pattern of increase or decrease
- 582 over time.



584 **Figure 9.** Provider-country totals for sample distributions between 2012 and 2019 (Treaty dataset).



585 **Figure 10.** Provider-region totals for sample distributions between 2012 and 2019 (Treaty dataset)

Nine countries identified by the United Nations as LDCs⁹ were home to the providers of 70 569 samples (1.8 percent of the total distributed; annual average of 8 821.1 samples across all years). Providers in six countries classified as LLDCs¹⁰ distributed 93 583 samples (2.4 percent of the total; annual average of 11 697.9). Providers in two countries classified as SIDS¹¹ distributed 877 samples (0.02 percent of the total; annual average of 109.6). Note that countries can be assigned to more than one of these categories. The regional figures fluctuated considerably from year to year, but there was no discernible pattern of increase or decrease over time.

593 Figures for distributions by providers from countries in the various World Bank income categories across 594 the eight-year period, as recorded in the Treaty dataset, were as follows (in descending order):

• upper middle-income countries distributed 2 371 934 samples (59.7 percent of the total; annual average of 296 491.8);

lower middle-income countries distributed 1 074 913 samples (27 percent of the total; annual average of 134 364.1);

high-income countries distributed 415 480 samples (10.5 percent of the total; annual average of
 51 935.0); and

• low-income countries distributed 113 382 samples (2.9 percent of the total; annual average of 14 172.8).

603 These statistics again mainly reflect the location of CGIAR centres. The figures fluctuated considerably from

604 year to year, but there was no general discernible pattern of increase or decrease over time for the country

- 605 categories. If only distributions made by CGIAR centres are considered, the general pattern is the same:
- upper middle-income countries distributed 2 346 873 samples (66.4 percent; annual average of 293 359.1

⁹ In descending order of samples distributed, these were Benin, Niger, Ethiopia, Mali, Sudan, Malawi, United Republic of Tanzania, Uganda and Madagascar.

¹⁰ In descending order of samples distributed, these were Zimbabwe, Niger, Ethiopia, Mali, Malawi and Uganda.

¹¹ In descending order of samples distributed, these were Fiji and Papua New Guinea.

over the eight-year period); lower middle-income countries distributed 1 070 497 samples (30.3 percent;
annual average of 133 812.1); low-income distributed 111 803 samples (3.2 percent; annual average of
13 975.4); and high-income countries distributed the considerably lower total of 5 176 samples (0.1 percent;
annual average of 647).

611 The Treaty dataset contains information on samples distributed to recipients in 179 countries between 2012 and 2019. Over 100 samples were distributed to recipients in a total of 158 countries, over 1 000 samples 612 were distributed to recipients in 131 of these countries, over 10 000 samples to those in 61, and over 100 000 613 to those in ten. Countries to which the largest number of samples were distributed included India, Kenya, 614 Mexico, Türkiye, the United States of America, Germany, Canada, China, Pakistan and the Islamic Republic 615 616 of Iran, each of which received more than 100 000 samples under the SMTA (Figure 11). As distributions from CGIAR centres comprised most of the distributions (88.9 percent of the total), these recipients 617 primarily obtained samples under the SMTA from these centres. Where average annual distributions are 618 619 concerned, recipients in 131 countries received more than 100 samples per year on average over the full period, 75 of which received more than 1 000 samples, and 11 of which received more than 10 000 samples. 620

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- 621

- 623 The numbers of samples distributed to recipients in the various regions of the world, as recorded in the
- 624 Treaty dataset (**Figure 12**), were as follows (in descending order):
- Asia 1 672 930 samples distributed to recipients in 46 countries (42.1 percent of the total; annual average of 209 116.3), with Southern and Western Asia receiving the most;

⁶²² **Figure 11.** Recipient-country totals for sample distributions between 2012 and 2019 (Treaty dataset).

- Africa 896 174 samples distributed to recipients in 50 countries (22.5 percent; annual average of
 112 021.8), with Eastern and Northern Africa receiving the most;
- Americas 842 543 samples distributed to recipients in 31 countries (21.2 percent; annual average
 of 105 317.9), with South America, Northern America and Central America receiving roughly similar
 amounts;
- Europe 524 174 samples distributed to recipients in 37 countries (13.2 percent; annual average of
 65 521.8), with Western Europe receiving the most; and
- Oceania 39 888 samples distributed to recipients in 15 countries (1 percent; annual average of 4 986), with Australia and New Zealand receiving the most.

638

636 The regional figures fluctuated considerably from year to year, but there was no discernible pattern of 637 increase or decrease over time.



639 Figure 12. Recipient-region totals for distributions of samples between 2012 and 2019 (Treaty dataset).

640 Recipients in 45 countries identified by the United Nations as a LDCs¹² received 435 535 samples

641 (11 percent of the total; annual average of 54 441.9 samples), 32 classified as LLDCs¹³ received 496 871

samples (12.5 percent of the total; annual average of 62 108.9 samples), and 30 classified as SIDS¹⁴ received

- 643 11 890 samples (0.3 percent of the total; annual average of 1 486.3 samples). Note that countries can be
- 644 assigned to more than one of these categories. The figures fluctuated considerably from year to year, but

¹² In descending order of samples received, these were Ethiopia, Afghanistan, Bangladesh, Sudan, Nepal, Uganda, Zambia, Myanmar, United Republic of Tanzania, Mali, Malawi, Senegal, Niger, Eritrea, Mozambique, Burkina Faso, Rwanda, Madagascar, Burundi, Benin, Democratic Republic of the Congo, Bhutan, Sierra Leone, Angola, Togo, Yemen, Lao People's Democratic Republic, Gambia, Cambodia, Haiti, Guinea, Lesotho, Mauritania, Liberia, Somalia, South Sudan, Guinea-Bissau, Chad, Kiribati, Timor-Leste, Comoros, Tuvalu, Solomon Islands, Central African Republic and Djibouti.

¹³ In descending order of samples received, these were Ethiopia, Zimbabwe, Afghanistan, Bolivia (Plurinational State of), Uzbekistan, Nepal, Uganda, Zambia, Kazakhstan, Azerbaijan, Paraguay, Tajikistan, Mali, Malawi, Niger, Armenia, Burkina Faso, Rwanda, Burundi, Kyrgyzstan, Turkmenistan, Bhutan, Mongolia, Lao People's Democratic Republic, Lesotho, Republic of Moldova, Eswatini, South Sudan, Chad, Botswana, North Macedonia and Central African Republic.

¹⁴ In descending order of samples received, these were Dominican Republic, Guyana, Singapore, Haiti, Suriname, Cuba, Dominica, Fiji, Papua New Guinea, Guinea-Bissau, Jamaica, Mauritius, Trinidad and Tobago, Belize, Kiribati, Timor-Leste, Marshall Islands, Comoros, Tuvalu, Vanuatu, Samoa, Solomon Islands, Niue, Nauru, Grenada, Palau, Bahamas, Saint Vincent and the Grenadines, Cook Islands and Micronesia (Federated States of).

645 there was no generally discernible increasing or decreasing trend, except in the case of SIDS recipients, who 646 received fewer samples in more recent years.

Figures for recipients in countries in the various World Bank income categories across the eight-year period,as recorded in the Treaty dataset, were as follows (in descending order):

recipients in lower middle-income countries received 1 535 605 samples (38.6 percent of the total;
 annual average of 191 950.6);

• recipients in upper middle-income countries received 1 063 435.5 samples (26.7 percent; annual average of 132 929.4);

• recipients in high-income countries received 947 390 samples (23.8 percent; annual average of 118 432.8); and

• recipients in low-income countries received 429 214 (10.8 percent; annual average of 53 651.8).

656 The figures fluctuated considerably from year to year, but there was no general discernible increasing or

decreasing trend. If only CGIAR distributions are considered, the general pattern is similar: recipients in

lower middle-income countries received 1 508 495 samples (42.7 percent; annual average of 188 561.9);
those in upper middle-income countries received 1 011 792 samples (28.6 percent; annual average of

660 126 474); those in high-income countries received 585 515 (16.7 percent; annual average of 73 689.4); and

those in low-income countries received 424 547 samples (12 percent; annual average of 53 068.4).

662 *3.5 Distributions to Specific Recipient Types*

663 3.5.1 Distributions to recipient organizational types

The *WIEWS dataset* records 793 850 accessions distributed with specific information on recipient type (62.5 percent of all accessions distributed) and 2 788 604 samples distributed with specific information on recipient type (66.7 percent of the all samples distributed). Note that indicating the amounts distributed to the different categories of recipient was optional for those reporting on Indicators 28 and 29. Analyses of these data is based on the premise that the categories NARC, Private Sector, Farmer or NGO, Others and Unknown all represent domestic distributions, with the category Foreign Stakeholders representing international distributions.

The numbers of accessions received by the different recipient types (**Figure 13**) were as follows (in descending order):

NARC – 480 266 (60.5 percent of designated accessions; 37.8 percent of the total accessions; annual
 average of 60 033.3 accessions);

• others – 139 973 (17.6 percent of designated; 11 percent of the total; annual average of 17 496.6);

676 • farmers or NGOs – 62 272 (7.8 percent of designated; 4.9 percent of the total; annual average of
 677 7 784);

• private sector – 46 405 (5.8 percent of designed; 3.7 percent of the total; annual average of 5 800.6);

• foreign stakeholders – 46 299 (5.8 percent of designated; 3.6 percent of the total; annual average of

680 5 787.4); and

• unknown – 18 635 (2.3 percent of designated; 1.5 percent of the total; annual average of 2 329.4).

682 The figures for 2012 to 2014 were as follows:

683	•	NARC - 95 570 (53 percent of designated accessions; 37 percent of the total accessions; annual
684	averaş	ge of 38 228 accessions);

• others – 45 944 (25.5 percent of designated; 17.8 percent of the total; annual average of 18 377.6);

foreign stakeholders – 14 912 (6.1 percent of designated; 5.8 percent of the total; annual average of
 5 964.8);

• private sector – 11 938 (6.6 percent of designed; 4.6 percent of the total; annual average of 4 775.2);

farmers or NGOs - 7 797 (4.3 percent of designated; 3 percent of the total; annual average of
 3 118.8); and

692 The figures for 2014 to 2019 were as follows:

NARC – 384 696 (62.7 percent of designated accessions; 38 percent of the total accessions; annual
 average of 69 944.7 accessions),

• others – 94 029 (15.3 percent of designated; 9.3 percent of the total; annual average of 17 096.2);

farmers or NGOs – 54 475 (8.9 percent of designated; 5.4 percent of the total; annual average of
9 904.5);

• private sector – 34 467 (5.6 percent of designed; 3.4 percent of the total; annual average of 6 266.7);

foreign stakeholders – 31 387 (4.4 percent of designated; 3.1 percent of the total; annual average of
 5 706.7); and

701 •

• unknown – 14 460 (2.4 percent of designated; 1.4 percent of the total; annual average of 2 629.1).





702

705	The numbers of samples received by the different recipient types (Table 1, Figure 14) were as follows (in			
706	descen	ding order):		
707	•	private sector - 1 047 760 (36.6 percent of designated samples; 25.1 percent of the total samples;		
708	annual	average of 130 970);		
709	•	NARC - 864 478 (31 percent of designated; 20.7 percent of the total; annual average of 108 059.8);		
710	•	farmers or NGOs – 550 427 (19.7 percent of designated; 13.2 percent of the total; annual average		
711	of 68 8	303.4);		
712	•	others – 211 485 (7.6 percent of designed; 5.1 percent of the total; annual average of 26 435.6);		
713	•	foreign stakeholders - 64 365 (2.1 percent of designated; 1.5 percent of the total; annual average of		
714	8 045.0	b); and		
715	•	unknown – 50 089 (1.8 percent of designated; 1.2 percent of the total; annual average of 6 261.1).		
716	The fig	gures for 2012 to 2014 were as follows:		
717	•	NARC - 279 029 (58.4 percent of designated samples; 33.6 percent of the total samples; annual		
718	average	e of 111 611.6 samples);		
719	•	farmers or NGOs - 71 321 (14.9 percent of designated; 8.6 percent of the total; annual average of		
720	28 528	.4);		
721	•	others – 54 049 (11.3 percent of designated; 6.5 percent of the total; annual average of 21 619.6);		
722	•	private sector – 45 256 (9.5 percent of designed; 5.5 percent of the total; annual average of 18 102.4);		
723	•	foreign stakeholders - 23 304 (3.5 percent of designated; 2.8 percent of the total; annual average of		
724	9 321.0	5); and		
725	•	unknown – 5 189 (1.1 percent of designated; 0.6 percent of the total; annual average of 2 075.6).		
726	The fig	gures for 2014 to 2019 were as follows:		
727	•	Private Sector - 1 002 504 samples (43.4 percent of designated samples; 29.9 percent of the total		
728	sample	es; annual average of 182 273.5 samples per year);		
729	•	NARC - 585 499 (25.3 percent of designated; 17.9 percent of the total; annual average of 106 445.3);		
730	•	farmers or NGOs - 479 106 (20.7 percent of designated; 14.3 percent of the total; annual average		
731	of 87 1	10.2);		
732	•	others - 157 436 (6.8 percent of designed; 4.7 percent of the total; annual average of 28 624.7);		
733	•	unknown - 44 900 (1.9 percent of designated; 1.3 percent of the total; annual average of 8 163.6);		
734	and			
735	•	foreign stakeholders - 41 061 (1.5 percent of designated; 1.2 percent of the total; annual average of		
736	7 465.0	b).		





740 3.5.2 Number of farmers' varieties/landraces distributed by national or local genebanks to

741 farmers (either directly or through intermediaries)

737

The *WIEWS dataset* records a total of 58 324 farmers' varieties/landraces distributed by national or local genebanks to farmers (either directly or through intermediaries) over the eight-year period (average of 744 7 290.5 per year). From the beginning of 2012 to mid-2014, 6 917 farmers' varieties/landraces were reported 745 distributed (average of 2 766.8 per year). Between mid-2014 and the end of 2019, 51 407 farmers' 746 varieties/landraces were reported distributed (average of 9 346.7 per year).

These data were reported by 70 countries, which include most of the 86 countries reporting on Indicators 28 and 29 (Number of accessions and Number of samples distributed by genebanks to users of germplasm), and include in addition contributions from Benin, the Democratic Republic of the Congo, Guatemala and Guinea. The countries that reported distributing the most farmers' varieties/landraces to farmers included Bangladesh, Brazil, Mexico, Peru and Spain, all of which distributed over 1 000 farmers' varieties/landraces during the entire period (**Figure 15**).



Figure 15. Provider-country totals for distributions of farmers' varieties/landraces by national or local genebanks to farmers
 (either directly or through intermediaries) between 2012 and 2019 (WIEWS dataset).

- 756 The numbers of farmers' varieties/landraces distributed to farmers by organizations in the various regions 757 of the world were as follows:
- Americas 36 067 varieties/landraces (61.8 percent of the total; annual average of 4 508.4),
 especially South America;
- Europe 11 102 (19 percent; annual average of 1 387.8), especially Southern Europe;
- Asia 7 887 (13.5 percent; annual average of 985.9), especially Southern Asia;
- Africa 3 213 (5.5 percent; annual average of 401.6), especially Eastern Africa; and
- Oceania 55 (0.1 percent; annual average of 6.9), entirely by organizations in Australia.
- 764 Sixteen countries identified by the United Nations as LDCs¹⁵ reported distributing 7 899 farmers'
- varieties/landraces (13.5 percent of the total; annual average of 987.4); 15 LLDCs¹⁶ reported distributing
- 766 3 165 farmers' varieties/landraces (5.4 percent of the total; annual average of 395.6); and one SIDS (Guyana)
- reported distributing 150 farmers' varieties/landraces (0.3 percent of the total; annual average of 18.8). Note
- that countries can be assigned to more than one of these categories.

¹⁵ In descending order of samples distributed, these were Bangladesh, Nepal, Guinea, Uganda, Ethiopia, Niger, Zambia, Mali, United Republic of Tanzania, Benin, Bhutan, Madagascar, Malawi, Senegal, Democratic Republic of the Congo and Eritrea.

¹⁶ In descending order of samples distributed, these were Zimbabwe, Nepal, Uganda, Ethiopia, Niger, Azerbaijan, Zambia, Botswana, Mali, Kyrgyzstan, Armenia, Bhutan, Uzbekistan, Tajikistan and Malawi.

769 The figures for the various World Bank income categories were as follows (in descending order):

- upper middle-income countries distributed between 37 092 and 37 164 farmers' varieties/landraces
 (63.6–63.7 percent), depending on whether the country classification was based on the first (2012 or 2014)
 or final (2014 or 2019) year of the reporting period, with an average of 37 128 (63.7 percent);
- high-income countries distributed between 10 798 and 10 826 farmers' varieties/landraces (18.5–
 18.6 percent), with an average of 10 812 (18.5 percent);
- lower middle-income countries distributed between 7 232 and 8 509 farmers' varieties/landraces
 (12.4–14.6 percent), with an average of 7 870.5 (13.5 percent), and
- low-income countries distributed between 1 825 and 3 202 farmers' varieties/landraces (3.1–
 5.5 percent), with an average of 2 513.5 (4.3 percent).

779 Farmers' varieties/landraces belonging to a total of 250 crops or general crop categories were distributed to farmers during the eight-year period. Many of the data were not specifically attributed to crops but were 780 781 rather categorized as multiple crops (18 022 varieties/landraces; 30.9 percent of the total), vegetables (9 845; 16.9 percent), cereals (1 222; 2.1 percent), pulses (1 184; 2 percent) or fruits (910; 1.6 percent). The crops 782 that were specifically reported included maize (3 592; 6.2 percent), cassava (3 568; 6.1 percent), common 783 784 bean (1 418; 2.4 percent), sweet potato (1 296; 2.2 percent), rice (1 295; 2.2 percent) and groundnut (982; 785 1.7 percent). The numbers of farmers' varieties/landraces belonging to the various crop groups distributed 786 to farmers were as follows (in descending order): multiple crops - 18 002 (30.9 percent of the total); vegetables - 13 690 (23.5 percent); cereals - 8 808 (15.1 percent), roots and tubers - 7 291 (12.5 percent); 787 788 legumes $-5\,826$ (10 percent); and nuts, fruits and berries $-2\,770$ (4.7 percent). The remaining categories 789 (fibre plants; forages; industrial and ornamental plants; medicinal plants, aromatic plants, spices and 790 stimulant plants; not specified; oil plants; and sugar plants) each comprised 1 percent or less of total 791 distributions.

792 3.5.3 Transfers made to international and regional genebank recipients

The *WIEWS dataset* does not contain a recipient organizational type permitting clear identification of international and regional genebanks as recipients. It offers only the categories NARC, Private Sector, Farmer or NGO, Others, Foreign Stakeholders and Unknown. It is possible that distributions made to Others or Foreign Stakeholders represent some distributions to international and regional genebanks. A total 139 973 accessions and 211 485 samples were distributed to Others, and 46 299 accessions and 64 365 samples to Foreign Stakeholders (Table 1). The *Treaty dataset* did not contain information on recipient organizational types, only on recipient countries.

Information from the *Online Reporting Tool (ORT)* for CGIAR centres maintained by the Crop Trust indicates that during the period 2010 to 2019 (inclusive), the CGIAR genebanks acquired about 90 000 samples for inclusion in Article 15 collections (Halewood *et al.*, 2020; Lusty *et al.*, 2021). Approximately 35 percent of the samples came from the centres' own breeding programmes. As these are internal transfers, they would not be reported by the centres to the Governing Body of the Treaty as transfers using the SMTA, and therefore would not be counted in the statistics on such transfers cited in this paper. Most of the 806 germplasm acquired by the centres – approximately 65 percent – came from providers in 142 different 807 countries; 84 percent of those countries are developing countries or countries with economies in transition.

808 Where the period focused on in the present study is concerned, the CGIAR genebanks received almost 14 000 samples in 2012. The numbers dropped thereafter, with fewer than 5 000 samples received in 2019. 809 The peak period of acquisition (generally from 2010 to 2014) was at least partly the result of an 810 internationally funded project coordinated by the Crop Trust that assisted national genebanks to regenerate 811 and safety-duplicate unique and threatened PGRFA. Many of the national genebanks collaborating in this 812 project elected to send samples of the respective materials to CGIAR genebanks. All the samples were either 813 received under the SMTA or under other agreements whereby the providers gave the CGIAR centres 814 815 permission to subsequently distribute the material under the SMTA; such permission includes material 816 provided by countries that are not currently Contracting Parties to the Treaty (Halewood et al., 2020; Lusty 817 et al., 2021).

818 3.5.4 Inter-genebank exchanges or safety duplications

Neither the WIEWS nor the Treaty datasets analysed here offer clear information regarding inter-genebank exchanges or safety duplications. The *ORT* for CGIAR centres maintained by the Crop Trust likewise does not specifically track inter-genebank exchanges, but it does indicate that approximately 25 000 to 50 000 accessions are typically safety duplicated at the Svalbard Global Seed Vault annually and that approximately 5 000 to 50 000 accessions are safety duplicated at other CGIAR or other regional or national genebanks annually (Halewood *et al.*, 2020; Lusty *et al.*, 2021). These safety duplications are not included in the Treaty dataset, as they are not transferred under the SMTA.

826 3.6 Distributions by Contracting-Party Status of the Country in which Provider or Recipient is Located

- 827 3.6.1 Distributions and receipts by providers and recipients located in countries that are
- 828 Contracting Parties to the Treaty and in those that are not

The WIEWS dataset in combination with information on Treaty Contracting Party status indicates that 829 830 between 880 501 and 894 937 accessions (69.3-70.5 percent of the total) were distributed by providers located in countries that are Contracting Parties to the Treaty, the figure depending on whether the 831 832 Contracting Party status is assigned based on the first (2012 or 2014) or final (2014 or 2019) year of the reporting period. Taking averages between the two alternative sets of figures provides the following results: : 833 887 719 accessions; 69.9 percent of the total; average of 110 964.9 accessions per year across the period. 834 835 Thus the number of accessions distributed by providers located in countries that were not Contracting 836 Parties was between 374 881 and 389 317 (29.5-30.7 percent of the total). Taking averages between the two 837 alternative sets of figures provides the following results: 382 099 accessions; 30.1 percent of the total; average of 47 762.4 accessions per year (Figure 16). The WIEWS dataset does not contain information on 838 839 the recipient country, and thus it is not possible to determine the Treaty Contracting Party status of the

840 recipients of these germplasm distributions.





Figure 16. Proportion of accessions distributed by providers located in Treaty Contracting Parties and non-Parties between
2012 and 2019 (WIEWS dataset).

844 During the 2012 to 2014 period, the number of accessions distributed by Contracting Parties to the Treaty 845 (based on the country location of the provider) was 238 209 or 248 902 (92.2 percent or 96.4 percent of the 846 total), depending on whether Contracting Party status is assigned based on the first (2012) or final (2014) 847 year of the reporting period. Taking averages between the two alternative sets of figures provides the following results:: 243 555.5 accessions; 94.3 percent of the total; annual average of 97 422.2 accessions per 848 849 year across the period. The number of accessions distributed by providers located in non-Contracting Party countries was thus 9 386 or 20 079 accessions (3.6 percent or 7.8 percent of the total) depending on the year 850 851 for which Contracting Party status is assigned. Taking averages between the two alternative sets of figures 852 provides the following results: 14 732.5 accessions; 5.7 percent of the total; average of 5 893 accessions per 853 year across the period.

854 During the 2014 to 2019 period, the number of accessions distributed by Contracting Parties to the Treaty (based on the country location of the provider) was 642 292 or 646 035 (63.5 percent or 63.9 percent of the 855 856 total), depending on whether Contracting Party status is assigned based on the first (2014) or final (2019) year of the reporting period. Taking averages between the two alternative sets of figures provides the 857 858 following results: 644 163.5 accessions; 63.7 percent of the total; average of 117 120.6 accessions per year across the period. The number of accessions distributed by providers located in non-Contracting Party 859 860 countries was thus 365 495 or 369 238 (36.1 percent or 36.5 percent of the total). Taking averages between the two alternative sets of figures provides the following results: 367 366.5 accessions; 36.3 percent of the 861 total; average of 66 793.9 accessions per year across the period. 862

863 Where samples are concerned, the WIEWS dataset in combination with information on Treaty Contracting 864 Party status indicates that between 3 557 533 and 3 642 055 samples (85.1–87.1 percent of the total), were 865 distributed by Contracting Parties to the Treaty (based on the country location of the provider), depending

866 on whether Contracting Party status is assigned based on the first (2012 or 2014) or final (2014 or 2019)
year of the reporting period. Taking averages between the two alternative sets of figures provides the following results: 3 599 794 samples; 86.1 percent of the total; average of 449 974.3 samples per year across the period.. The number of samples distributed by providers located in non-Contracting Party countries was thus between 540 527 and 625 049 samples (12.9–14.9 percent of the total). Taking averages between the two alternative sets of figures provides the following results: 582 788 samples; 13.9 percent of the total; average of 72 848.5 samples per year across the period (**Figure 17**).



Figure 17. Proportions of samples distributed by providers located in Treaty Contracting Parties and non-Parties between
 2012 and 2019 (WIEWS dataset).

876 During the 2012 to 2014 period, the number of samples distributed by Contracting Parties to the Treaty (based on the country location of the provider) was 768 880 or 789 217 (92.6 percent or 95.1 percent of the 877 total), depending on whether Contracting Party status is assigned based on the first (2012) or final (2014) 878 879 year of the reporting period. Taking averages between the two alternative sets of figures provides the following results: 779 048 samples; 93.9 percent of the total; average of 311 619.4 samples per year across 880 the period. The number of samples distributed by providers located in non-Contracting Party countries was 881 thus 40 722 or 61 059 samples (4.9 percent or 7.4 percent of the total). Taking averages between the two 882 alternative sets of figures provides the following results:50 890.5 samples; 6.1 percent of the total; average 883 884 of 20 356.2 samples per year across the period.

During the 2014 to 2019 period, the number of samples distributed by Contracting Parties to the Treaty (based on the country location of the provider) was 2 788 653 or 2 852 838 (83.2 percent or 85.1 percent of the total), depending on whether Contracting Party status is assigned based on the first (2014) or final (2019) year of the reporting period. Taking averages between the two alternative sets of figures provides the following results: 2 820 745.5 samples; 84.1 percent of the total; average of 512 862.8 samples per year across the period. The number of samples distributed by providers located in non-Contracting Party countries was

thus 499 805 or 563 990 (14.9 percent or 16.8 percent of the total). Taking averages between the two

alternative sets of figures provides the following results: 531 897.5 samples; 15.9 percent of the total; average
of 96 708.6 samples per year across the period.

894 The Treaty dataset in combination with information on Treaty Contracting Party status indicates that 2 114 348 samples (53.2 percent of the total; average of 264 293.5 samples per year across the period) were 895 distributed using the SMTA by organizations located in countries that were Contracting Parties to the Treaty, 896 and 1 861 361 (46.8 percent; annual average of 232 670.1) samples were distributed by organizations located 897 in countries that were not Contracting Parties (Figure 18). Given that a) the Treaty dataset overwhelmingly 898 comprises CGIAR distribution data (88.9 percent of total distributions were by international centres), b) 899 germplasm maintained by CGIAR centres is made available in the Multilateral System according to the 900 901 agreements concluded under the provisions of Article 15 of the Treaty, and c) various CGIAR centres are located in countries that are not currently Contracting Parties to the Treaty (e.g. Colombia, Mexico and 902 903 Nigeria), it is very likely that these statistics based solely on country location of providers drastically 904 underestimate the total distributions made under the terms and conditions of the Treaty.



Figure 18. Proportions of samples distributed by providers located in Contracting Parties and non-Parties to the Treaty
 between 2012 and 2019 (Treaty dataset).

The Treaty dataset in combination with information on Treaty Contracting Party status indicates that 3 194 162 samples (80.3 percent of the total; average of 399 270.3 samples per year across the whole period) that were distributed using the SMTA were received by organizations located in countries that were Contracting Parties to the Treaty, and that 781 547 (19.7 percent; annual average of 97 693.4) were received by organizations located in countries that were non-Contracting Parties (**Figure 19**). The proportion of

912 samples received by recipients in non-Contracting Parties declined in general over the eight-year period.





914 **Figure 19.** Proportions of samples distributed to recipients located in Contracting Parties and non-Parties to the Treaty

915 between 2012 and 2019 (Treaty dataset).

916 3.6.2 Distributions by providers and receipts by recipients located in countries that are Parties to

917 the Nagoya Protocol and those that are not

918 The WIEWS dataset in combination with information on Nagoya Protocol Contracting Party status 919 indicates that between 178 222 and 769 389 accessions (14-60.6 percent of the total), were distributed by 920 providers located in countries that were Contracting Parties to the Nagoya Protocol, depending on whether 921 Contracting Party status was assigned based on the first (2012 or 2014) or final (2014 or 2019) year of the 922 reporting period. Taking averages between the two alternative sets of figures provides the following results: 923 473 805.5 accessions; 37.3 percent of the total; average of 59 225.7 accessions per year. The number of 924 accessions distributed by non-Contracting parties was thus between 500 429 and 1 091 596 accessions (39.4-925 86 percent of the total). Taking averages between the two alternative sets of figures provides the following 926 results: 796 012.5 accessions; 62.7 percent of the total; average of 99 501.6 accessions per year (Figure 20). The WIEWS dataset does not contain information on recipient countries, and thus it is not possible to 927 928 determine the Contracting Party status of the recipients of these distributions with respect to the Nagoya 929 Protocol.

- 930 During the 2012 to 2014 period, the number of accessions distributed by providers located in countries that
- 931 were Contracting Parties to the Nagoya Protocol was zero or 39 946 (0 percent or 15.5 percent of the total),
- 932 depending on whether status is assigned based on the situation in 2012 or 2014. Taking averages between
- 933 the two alternative sets of figures provides the following results: 19 973 accessions; 7.7 percent of the total;
- 934 average of 7 989.2 accessions per year. The number of accessions distributed by providers located in non-
- 935 Contracting Party countries was thus 218 342 or 258 288 (84.5–100 percent of the total), depending on the
- 936 year of assignment. Taking averages between the two alternative sets of figures provides the following results:
- 937 238 315 accessions; 92.3 percent of the total; annual average of 95 326 accessions per year.

938 During the 2014 to 2019 period, the number of accessions distributed by providers located in countries that were Contracting Parties to the Nagoya Protocol was 178 222 or 729 443 (17.6 percent or 72.1 percent of 939 the total), depending on whether Contracting Party status is assigned based on the situation in 2014 or 2019. 940 Taking averages between the two alternative sets of figures provides the following results: 453 832.5 941 942 accessions; 44.9 percent of the total; average of 82 515 accessions per year. The number of accessions distributed by providers located in non-Contracting Party countries was thus 282 087 or 833 308 (27.9-943 82.4 percent of the total). Taking averages between the two alternative sets of figures provides the following 944 945 results: 557 697.5 accessions; 55.1 percent of the total; average of 101 399.5 accessions per year.



Figure 20. Proportions of accessions distributed by providers located in Nagoya Protocol Contracting Parties and non-Parties
 between 2012 and 2019 (WIEWS dataset).

948 Where samples are concerned, the WIEWS dataset in combination with information on Nagoya Protocol 949 Contracting Party status indicates that the number of samples distributed by providers located in countries that were Contracting Parties to the Nagoya Protocol was between 771 523 and 2 196 858 (18.4-950 52.5 percent of the total), depending whether Contracting Party status is assigned based on the first (2012 951 952 or 2014) or final (2014 or 2019) year of the reporting period. Taking averages between the two alternative 953 sets of figures provides the following results: 1 484 190.5 samples; 35.5 percent of the total; average of 954 185 523.8 samples per year. The number of samples distributed by non-Contracting Parties was thus between 1 985 724 and 3 411 059 samples (47.5-81.6 percent of the total). Taking averages between the two 955 956 alternative sets of figures provides the following results: 2 698 391.5 samples; 64.5 percent of the total; 957 average of 337 298.9 samples per year (Figure 21).

During the 2012 to 2014 period, the number of samples distributed by providers in countries that were Contracting Parties to the Nagoya Protocol was 0 or 296 046 samples (0 percent or 35.7 percent of the total), depending on whether Contracting Party status is assigned based on the situation in 2012 or 2014. Taking averages between the two alternative sets of figures provides the following results: 148 023 samples; 17.8 percent of the total; average of 59 209.2 samples per year. The number of samples distributed by providers located in non-Contracting Party countries was thus 533 893 or 829 939 (64.3 percent or 100 percent of the total). Taking averages between the two alternative sets of figures provides the following
results: 681 916 samples; 82.2 percent of the total; average of 272 766.4 samples per year.

During the 2014 to 2019 period, the number of samples distributed by providers in countries that were 966 Contracting Parties to the Nagoya Protocol was 771 523 or 1 900 812 (23 percent or 56.7 percent of the 967 total), depending on whether contracting party status was assigned based on the situation in 2014 or 2019. 968 Taking averages between the two alternative sets of figures provides the following results: 1 336 167.5 969 970 samples; 39.9 percent of the total; average of 242 939.5 samples per year. The number of samples distributed by providers located in non-Contracting Party countries was thus 1 451 831 or 2 581 120 (43.3 percent or 971 972 77 percent of the total). Taking averages between the two alternative sets of figures provides the following 973 results: 2 016 475.5 samples; 60.1 percent of the total; average of 366 631.9 samples per year.

The *Plant Treaty dataset* in combination with information on Nagoya Protocol Contracting Party status indicates that 2 076 603 samples (52.2 percent of the total; average of 259 575.4 samples per year across the whole period) were distributed under the SMTA by providers located in countries that were Contracting Parties to the Nagoya Protocol. Conversely, 1 899 106 samples (47.8 percent of the total; average of 237 388.3 samples per year across the whole period) were provided by organizations located in countries that were non-Contracting Parties (**Figure 22**). Note that the Treaty dataset is overwhelmingly composed of distributions by CGIAR providers.



Figure 21. Proportions of samples distributed by providers located in Nagoya Protocol Contracting Parties and non- Parties between 2012 and 2019 (WIEWS dataset).

- 986 The Treaty dataset indicates that 1 643 252 samples (41.3 percent of the total; annual average of 205 406.5
- 987 samples) were distributed under the SMTA to receiving organizations located in countries that were
- 988 Contracting Parties to the Nagoya Protocol. Conversely, 2 332 457 samples (58.7 percent of the total; annual
- 989 average of 291 557.1 samples) were received by organizations located in countries that were not Contracting
- 990 Parties (Figure 23). The relative proportion of samples received by recipients in non-Contracting Parties
- 991 declined in general over the eight-year period.



- 992 Figure 22. Proportions of samples distributed by providers located in Contracting Parties and non-Parties to the Nagoya
- 993 Protocol between 2012 and 2019 (Treaty dataset).



994 Figure 23. Proportions of samples distributed to recipients located in Contracting Parties and non-Parties to the Nagoya

995 Protocol between 2012 and 2019 (Treaty dataset).

996 *3.7 Distributions by Crops and Crop Types*

997 3.7.1 Distributions by crops

998 The *WIEWS dataset* contained over 1 750 crop names or combinations. These were standardized to 843 999 distinct crops or (when it was not possible to identify specific crop) crop groups. The number of reported 1000 distributions per crop ranged from as low as one accession or sample to as high as 177 808 accessions or 1001 371 107 samples over the eight-year period.

Where accessions are concerned, the dataset shows that more than 100 000 accessions of each of three 1002 1003 crops (wheat, rice and soybean) were distributed, between 10 000 and 100 000 accessions of each of 22 1004 crops, between 1 000 and 10 000 accessions of each of 72 crops, between 100 and 1 000 of each of 98 crops, 1005 and fewer than 100 accessions of each of 643 crops (Figure 24). The crops or crop groups with the highest 1006 total numbers of accessions distributed over the full period, in descending order, were wheat, rice, soybean, barley, multiple crops, cereal crops, unspecified crops, common bean, chickpea, Brassica crops, maize, fruit 1007 1008 crops, vegetable crops, oat, sorghum, pea, cotton, citrus, potato, oil crops, pulse crops, tomato, broad bean 1009 and vetch, tobacco and lentil, all with over 10 000 accessions distributed (and all with more than 1 250 1010 accessions distributed on average annually); these 25 crops or crop groups represent over three-quarters 1011 (76.8 percent) of all accessions distributed.

741 crops @ between 1 and 1 000 accessions

72 crops @

between 1 000

and 10 000 accessions

3 crops @
accessions

Number of accessions

Wheat 177 808 Barley 76 180 Capsicum 9 6 4 6 Tectona 991 Rice 135 566 48 655 Rubber Multiple Forages 8 8 18 950 Soybean 100 089 Cereals 40 276 Finger millet 8 812 Yams 936 Total 413 436 Not specified 34 132 8 132 Radish 917 Acacla Common bean 30 279 Pear 7 595 False sesame 875 29 839 7 355 Chicpea Stylosanthes 866 OII crops Brassica 29 246 Sesame 7 277 Bitter gourd 826 Malze 28 569 Cocoa 7 198 Millet 825 Fruits 27 711 Cowpea 7 071 Ulluco 781 Vegetables 24 940 Okra 7 067 Guizotia 773 Oat 23 096 Teff 6 794 Castor bean 759 Sorghum 20 489 740 Flax 6 6 6 2 Corlander Peas 20 466 Tea 6 6 4 4 Buckwheat 733 Cotton 17 847 6 0 3 9 Raintree 730 Reta Citrus 17 792 5 277 Nigella 706 Apple Potato 16 052 Cucumbers and melon 5 2 2 4 Camellina 628 Olls 15 854 Grapes 4914 Bambara groundnut 608 Pulses 14 406 4812 597 Vigna Nuts Tomato 13 277 Eggplant 4 722 Poa 577 Broad bean 11 379 Jute mailow 4 471 Terminalia 574 Tobacco 10 889 +52 others (118 226) +721 others (26 522) 10 311 TOTAL 252 756 TOTAL 41 914 Lentil TOTAL 561 685

1012

1013 Figure 24. Numbers of accessions distributed per crop or crop group (when specific crops were not listed) between 2012 and 1014 2019 (WIEWS dataset).

1015 During the 2012 to 2014 period, the crops or crop groups with the largest numbers of accessions distributed 1016 included wheat, multiple crops, cereal crops, unspecified crops, rice, oil crops, barley, vegetable crops, pulse crops, Acacia, sorghum, Brassica crops, potato, chickpea, forage crops, common bean and Capsicum crops, all 1017 1018 with over 1 000 accessions distributed on average annually. During the 2014 to 2019 period, the crops or crop groups with the largest numbers of accessions distributed included wheat, rice, soybean, barley, 1019 1020 common bean, fruit crops, maize, chickpea, multiple crops, Brassica crops, unspecified crops, oat, citrus 1021 crops, cotton, cereal crops, pea, vegetable crops, sorghum, tomato, potato, tobacco, broad bean and vetch, 1022 lentil, finger millet, pear, oil crops, Capsicum crops, cocoa, tea, okra, sesame and oil crops, all with over 1 000 1023 accessions distributed on average annually.

1024 Where samples are concerned, more than 100 000 samples were distributed of each of 10 crops, between

10 000 and 100 000 samples of 48 crops, between 1 000 and 10 000 samples of 126 crops, between 100 and 1025

- 1026 1 000 samples of 133 crops, and fewer than 100 samples of 526 crops (Figure 25). The crops or crop groups
- 1027 with the highest total numbers of samples distributed over the full period, in descending order, were dragon
- 1028 fruit, rice, wheat, citrus crops, pistachio, soybean, cocoa, avocado, barley and coffee, all with over 100 000
- 1029 samples distributed (and over 13 000 samples distributed on average annually); these ten crops or crop
- 1030 groups represent 49 percent of all samples distributed.

126 crops @ between 1 000 and 10 000 accessions			os @ 000 ions	48crop etween 10 000 access	10 crops @ 100 000 accessions be and 100		
rop n 1 a	659 c betweer						
essi	1 000 acc					-	er of crops
N.							
99	Neem	9 704	Beta	99 034	Not specified	371 107	Dragon fruit
97	Bitter gourd	9 576	Eggplant	88 188	Cereals	364 842	Rice
95	Buckwheat	9 256	Alltum	86 100	Vegetables	254 799	Wheat
95	Celosia	9 076	Sesame	82 358	Multiple	207 902	Citrus
94	Plums	8 744	Vigna	74 807	Maize	200 021	Pistachios
93	Walnut	8 682	Agave	74 334	Mango	169 776	Soybean
92	Saivia	8 584	Teff	64 433	Arabidopsis	151 591	Cocoa
90	Stylosanthes	8 305	Nuts, fruits and berries	59 359	Rubber	114 635	Avocado
87	Corlander	8 142	Acerola	56 823	Brassica	109 449	Barley
84	Ornamentals	7 500	Loquat	55 665	Cassava	107 125	Cofee
84	Arracacha	7 355	Oll crops	54 411	Tomato	2 051 247	Total
83	Protium	6 909	Syzyglum	47 862	Acacla		
81	Castor bean	6 846	Spinach	47 306	Potato		
80	Bambara groundnut	6 6 4 4	Tea	46 936	Sorghum		
80	Echeverla	6 579	Terminalla	46 108	Common bean		
79	Aquilaria	6 451	Amaranth	45 531	Grapes		
79	Moringa	6 424	Lupine	37 673	Annona		
73	Raintree	6 072	Pearó millet	36 363	Coconut		
72	Poppies	5 971	Cucurbita	35 170	Caspicum		
(43	+640 others	(255 244)	+107 other	(531 108)	+29 others		
EO	TOTAL	402 064	TOTAL	1 669 569	TOTAL		

1031

- 1032 Figure 25. Number of samples distributed per crop or crop group (when specific crops were not listed) between 2012 and
 1033 2019 (WIEWS dataset).
- 1034 During the 2012 to 2014 period, the crops or crop groups with the largest numbers of samples distributed
- 1035 included rice, wheat, Arabidopsis, multiple crops, cereal crops, unspecified crops, fig, sorghum, potato,
- 1036 vegetable crops, pulse crops, barley, maize and tomato, all with an average of more than 5 000 samples
- 1037 distributed annually. During the 2014 to 2019 period, the crops or crop groups with the largest numbers of
- 1038 samples distributed included dragon fruit, rice, pistachio, citrus crops, wheat, soybean, cocoa, coffee,
- 1039 avocado, barley, mango, vegetable crops, rubber, unspecified crops, maize, cassava, Brassica crops, grape,
- 1040 Acacia, tomato, common bean, coconut, Annona, sugar cane, cereal crops and chickpea, all with an average
- 1041 of more than 5 000 samples distributed annually.

The Treaty dataset contained over 560 crop names or combinations, which were standardized to 270 1042 distinct crops and (when not possible to identify the specific crop) crop groups. As few as one to as many 1043 1044 as 1 874 121 samples were distributed per crop over the eight-year period. For the full dataset, more than 1045 1 000 000 samples were distributed of one crop (wheat), between 100 000 and 1 000 000 samples of four crops, between 10 000 and 100 000 samples of 16 crops, between 1 000 and 10 000 samples of 30 crops, 1046 1047 between 100 and 1 000 samples of 38 crops and between one and 100 samples of 181 crops (Figure 26). The crops or crop groups with the highest total numbers of samples distributed over the eight-year period, 1048 1049 in descending order, were wheat, maize, rice, barley, chickpea, unspecified crops, lentil, bean, sorghum, pearl 1050 millet, Brassicaceae crops, broad bean and vetch, pigeon pea, cowpea, potato, groundnut, oat, lettuce, grass 1051 pea and other Lathyrus, soybean and pea, all with over 10 000 samples distributed (and over 1 250 samples 1052 distributed on average annually). These 21 crops or crop groups account for 96.5 percent of all samples 1053 distributed. Annual distributions per crop varied from year to year, but there was no discernible trend across



Number of samples							
1 (F							
1 crops @ >100 000 accessions	4 crops @ between 10 000 and 100 000 accessions			16 crops @ between 1 000 and 10 000 accessions 249 crops			
Number of crops					1 000 acce	ession	
		C		2		Ŷ	
Wheat 1 874 121	Malze	526 609	Not specified	84 948	Forages (unspecified)	99	
the second s	Rice	492 424	Lentils	74 405	Cassava	97	
	Barley	206 260	Beans	57 338	Capsicum	79	
	Chickpeas	189 389	Sorghum	43 754	Tomato	73	
	TOTAL	1 419 823	Pearl millet	41 728	Clovers	71	
			Brassicaceae	41 158	Flax	6 9	
		Broad Bean and vetch Pigeonpeas			Finger millet	63	
					Triticale	60	
			Cowpeas	22 357	Banans and plantains	5 9	
			Potato	22 062	Spinach	54	
			Groundnuts	21 316	Beets	53	
			Oats	14 868	Egoplant	5 1	
			Lettuce	12 330	Alfalfa	4 9	
			Grasspea	10 232	Carrots	46	
			Soybeans	10 185	Rye	3 5	
			Peas	10 128	Sunflowers	33	
			TOTAL	540 642	Bambara bean	33	
					Lupins	28	
					Swettpotatoes	28	
					+230 others	(32	
					ΤΟΤΑΙ	14	

1056 Figure 26. Number of samples distributed per crop or crop group (when specific crops were not listed) between 2012 and

1057 **2019** (Treaty dataset).

1058 3.7.2 Distributions by crop types

In the *WIEWS dataset*, crops that are primarily used for food comprised by far the largest numbers of accessions (1 098 101 accessions; 86.5 percent of the total; annual average of 137 262.6) and samples (3 673 632 samples; 87.8 percent of the total; annual average of 459 204) distributed over the eight-year period. Note that crops can have more than one use and information on specific purposes of germplasm use/crop breeding for each distribution was not available in the WIEWS dataset. Other categories of clearly designated crop types included, in descending order in terms of distributions of accessions, industrial crops, fibre crops, forage crops and medicinal crops.

1066 Following the system of crop type categories utilized in the Second Report (FAO, 2010), 11 clearly identified 1067 crop types, as well as three unspecified categories, were represented in the WIEWS dataset. In terms of 1068 accessions, distributions by crop type ranged from as low as 2 093 (other plants) to as high as 536 360 1069 (cereals) over the full period. The crop types with the highest total numbers of accessions distributed, in 1070 descending order, were cereals, oil plants, food legumes and vegetables, each with over 100 000 accessions 1071 distributed (and an average of more than 12 000 accessions distributed per year). These were followed by 1072 nuts, fruits and berries; multiple crops; medicinal plants, aromatic plants, spices and stimulant plants; 1073 unspecified crops; forages; roots and tubers, fibre plants; industrial and ornamental plants; sugar plants; and 1074 other plants (Figure 27).

During the 2012 to 2014 period, the crop types with the largest numbers of accessions distributed included cereals, food legumes, vegetables, multiple crops, oil plants, industrial and ornamental plants, unspecified crops and forages, each with over 10 000 accessions distributed in total (and an average of more than 4 000 accessions distributed per year). During the 2014 to 2019 period, the crop types with the largest numbers of accessions distributed included cereals; oil plants; food legumes; nuts, fruits and berries; vegetables; medicinal plants, aromatic plants, spices and stimulant plants; multiple crops; and forages, each with over 22 000 accessions distributed in total (and an average of more than 4 000 accessions distributed per year).

1082





1085 Figure 27. Numbers of accessions distributed per crop type between 2012 and 2019 (WIEWS dataset).

Where samples are concerned, the number of distributions per crop type recorded in the WIEWS dataset ranged from 2 097 (other plants) to 1 333 733 (nuts, fruits and berries) over the eight-year period. The crop types with the highest total numbers of samples distributed were, in descending order, nuts, fruits and berries; cereals; medicinal plants, aromatic plants, spices and stimulant plants; vegetables; oil plants; industrial and ornamental plants; and food legumes, each with a total of more than 225 000 samples distributed (and an average of more than 25 000 samples distributed per year). These were followed by roots and tubers; unspecified crops; multiple crops; forages; sugar plants; fibre plants; and other plants (**Figure 28**).

During the 2012 to 2014 period, the crop types with the largest numbers of samples distributed included cereals; vegetables; nuts, fruits and berries; industrial and ornamental plants; and food legumes, each with a total of more than 50 000 samples distributed (and an average of more than 20 000 samples distributed per year). During the 2014 to 2019 period, the crop types with the largest numbers of samples distributed included nuts, fruits and berries; cereals; medicinal plants, aromatic plants, spices and stimulant plants; vegetables; oil plants; food legumes; industrial and ornamental plants; and roots and tubers, each with more than 100 000 samples distributed in total (and an average of more than 20 000 samples distributed per year).

Like the WIEWS dataset, the *Treaty dataset* indicates that crops used primarily for food comprised by far the largest number of samples distributed over the eight-year period (3 861 441 samples; 97.1 percent of the total; annual average of 482 680.1). Note that crops can have more than one use and information on specific purposes of germplasm use/crop breeding for each sample distributed was not available in the Treaty dataset. After food crops, other categories of clearly designated crop types, in descending order in terms of distributions of samples, included forage crops, industrial (including forestry and ornamental purposes) crops, fibre crops and medicinal crops. Following the system of crop type categories utilized in the Second Report (FAO, 2010), ten clearly identified crop types, as well as one unspecified category, were represented in the Treaty dataset. Distributions by crop type ranged from as few as 285 samples over the full period (fibre plants, with an annual average of 35.6) to as many as 3 226 629 samples (cereals, with an annual average of 403 328.6).



1111

1112 Figure 28. Number of samples distributed per crop type between 2012 and 2019 (WIEWS dataset).

The crop types with the highest total numbers of samples distributed were, in descending order, cereals, food legumes, vegetables, unspecified crops, roots and tubers, forages and oil plants, each with over 20 000 samples distributed between 2012 and 2019 and an annual average of at least 2 500 samples distributed. These were followed by medicinal plants, aromatic plants, spices and stimulant plants; nuts, fruits and berries; industrial and ornamental plants; and fibre plants (**Figure 29**). Annual distributions per crop type varied from year to year, but there was no discernible trend over time.



1121 Figure 29. Numbers of samples distributed per crop type between 2012 and 2019 (Treaty dataset).

1122 3.7.3 Distributions by crop improvement types (wild versus cultivated germplasm)

1123 Neither the WIEWS nor the Treaty datasets contain specific information on the improvement type (i.e. wild, 1124 weedy, landrace, breeding material, cultivar, etc.) of the germplasm distributed. Nonetheless, based on 1125 notations in the original data and from the taxonomic name, it was possible to roughly estimate the 1126 proportions of wild relative versus domesticated crop germplasm among the materials distributed.

- 1127 For the WIEWS dataset, it is estimated that at least 15 561 crop wild relative accessions (1.2 percent of the 1128 total; annual average of 1 945.1) and 27 500 crop wild relative samples (0.7 percent of the total; annual 1129 average of 3 437.5) were distributed over the eight-year period. The remaining 1 254 257 accessions (98.8 percent of the total; annual average of 156 782.1) and 4 155 082 samples (99.3 percent of the total; 1130 1131 annual average of 519 385.3) distributed are estimated to have been domesticated crop germplasm. Proportions of wild versus domesticated germplasm distributed in the two periods (2012 to 2014, and 2014 1132 to 2019) were similar to those for the eight-year period. As the WIEWS dataset does not specifically record 1133 1134 whether germplasm belongs to a cultivated taxon or to a wild relative, the numbers of distributions of wild 1135 relatives or other wild taxa may have been considerably larger than the numbers reported here. Wild relatives 1136 of oat, lettuce, rice, wheat, barley, potato, tomato, cowpea, beet, jute mallow, tree tomato, pearl millet, 1137 spinach, groundnut, apple, unspecified Solanum crops, grape and carrot were the most distributed in terms 1138 of accessions, each with over 100 accessions distributed. In the case of samples, the same crops top the list.
- For the *Treaty dataset*, it is estimated that at least 3 013 crop wild relative samples (0.1 percent of the total; annual average of 376.6 samples) of were distributed, with the remaining 3 972 696 samples (99.9 percent of the total; annual average of 496 587 samples) comprising domesticated crop germplasm. The proportions of wild relative and crop germplasm among the materials distributed varied from year to year, but there was no discernible trend across the years. As the Treaty dataset does not specifically record whether germplasm belongs to a cultivated taxon or a wild relative, the numbers of distributions of wild relatives or other wild

1145 taxa may be considerably higher than those reported here. Wild relatives of cowpea, lettuce, carrot, wheat, 1146 oat, barley, lentil and grass pea were the most distributed, each with more than ten samples distributed.

Information from the ORT for CGIAR centres maintained by the Crop Trust indicates that for the period2017 to 2019 approximately 50 percent of samples distributed were traditional varieties/landraces,

1149 24 percent were breeding materials, 13 percent were wild relatives, 8 percent were "other" and 6 percent

2) percent were breeding matchais, is percent were wild relatives, o percent were blief and o percent

- 1150 were advanced/improved cultivars (Halewood *et al.*, 2020).
- 1151 3.7.4 Distributions by crop germplasm and storage behaviour types
- 1152 Germplasm is typically distributed either as seed (sexually reproductive propagules) or as a clonal/vegetative
- 1153 (asexually reproductive) propagules, such as a tubers or cuttings. Many crops are commonly distributed using
- 1154 only one of these techniques, although some can be distributed in both ways.
- 1155 Based on a rapid assessment of germplasm types, the WIEWS dataset indicates that at least 1 030 245 accessions (81.1 percent of the total; annual average of 128 780.6) were probably distributed by seed, and 1156 1157 111 609 accessions (8.8 percent of the total; annual average of 13 951.1) were probably distributed 1158 clonally/vegetatively, with a further 127 964 accessions (10.1 percent of the total) not readily attributable to 1159 germplasm type. Proportions of seed versus clonal/vegetative germplasm distributed in the two periods 1160 (2012 to 2014, and 2014 to 2019) were fairly similar to each other and to the eight-year period statistics, 1161 ranging between 75 percent and 82.7 percent for seed, and between 4.4 percent and 9.9 percent for 1162 clonal/vegetative germplasm.

In terms of samples, at least 2 170 424 samples (51.9 percent of the total; annual average of 271 303) were 1163 1164 probably distributed as seed, and 1 645 711 samples (39.3 percent of the total; annual average of 205 713.9) 1165 were probably distributed clonally/vegetatively, with 366 417 samples (8.8 percent of the total) not readily 1166 attributable to germplasm type. Proportions of seed versus clonal/vegetative germplasm distributed in the two periods (2012 to 2014, and 2014 to 2019) varied considerably: 72 percent seed and 16.3 percent clonal 1167 in the first period reporting, and 46.9 percent seed and 45 percent clonal in the second. The relatively high 1168 1169 proportion of clonal/vegetative germplasm distributed in the second period (and reflected in the eight-year 1170 period statistics) was due to very large distributions reported for dragon fruit, citrus, pistachio, cocoa, 1171 avocado, mango, cassava, potato, grape and other crops.

- Based on a rapid assessment of germplasm types, the *Treaty dataset* indicates that at least 3 846 574 samples (96.8 percent of the total; annual average of 480 821.8) were probably distributed as seed, and 44 187 (1.1 percent of the total; annual average of 5 523.4) clonally/vegetatively, with the remaining 84 948 (2.1 percent of the total) not readily attributable to germplasm type. Annual distributions of seed versus clonal/vegetative germplasm varied by year, but there was no discernible trend over the years.
- 1177 For seed-producing plants, germplasm can also be classified according to its storage behaviour, i.e.
- 1178 according to its ability to tolerate the low-humidity and low-temperature conditions typically employed in
- 1179 ex situ conservation. Orthodox seeds tolerate drying and cooling well and can be stored in cool, dry

- 1180 conditions. Recalcitrant seeds do not tolerate such conditions. Intermediate seeds tolerate cool, dry
- 1181 conditions to a limited or variable extent.

1182 Based on a rapid assessment of seed storage behaviour, drawing on information mainly from the Kew Seed Information Database, the WIEWS dataset indicates that at least 1 024 047 distributed accessions 1183 (80.6 percent of the total; annual average of 128 005.9) belonged to crops with orthodox or probably 1184 orthodox seeds. At least 28 174 (2.2 percent of the total; annual average of 3 521.8) belonged to crops with 1185 intermediate or probably intermediate seeds. At least 9 427 accessions (0.7 percent of the total; annual 1186 average of 1 178.4) belonged to crops with recalcitrant or probably recalcitrant seeds. Finally, 208 170 1187 1188 accessions (16.4 percent of the total) were listed as uncertain or were not readily attributable to any seed 1189 storage type. Proportions of orthodox, intermediate and recalcitrant types distributed in the two reporting periods (2012 to 2014, and 2014 to 2019) were fairly similar to each other and to the eight-year period 1190 1191 statistics, ranging between 68.1 percent and 83.9 percent for orthodox, 0 percent and 2.8 percent for 1192 intermediate, and 0.4 percent and 0.8 percent for recalcitrant seeds.

- 1193 In terms of samples, at least 2 331 343 of those distributed (55.7 percent of the total; annual average of 1194 291 417.9) belonged to crops with orthodox or probably orthodox seeds. At least 365 696 (8.7 percent of 1195 the total; annual average of 45 712) belonged to crops with intermediate or probably intermediate seeds. At 1196 least 455 654 (10.9 percent of the total; annual average of 56 956.8) belonged to crops with recalcitrant or 1197 probably recalcitrant seeds. Finally, 1 029 889 (24.6 percent of the total) were listed as uncertain or were not 1198 readily attributable to any seed storage type. Proportions of orthodox, intermediate and recalcitrant types distributed in the two periods (2012 to 2014, and 2014 to 2019) varied considerably: 63.6 percent orthodox, 1199 1200 1.1 percent intermediate and 1.7 percent recalcitrant in the first reporting period, and 53.8 percent orthodox, 1201 10.6 percent intermediate and 13.2 percent recalcitrant in the second reporting period.
- 1202 Based on a rapid assessment of seed storage behaviour, the *Treaty dataset* indicates that at least 3 868 537 1203 distributed samples (97.3 percent of the total; annual average of 483 567.1) belonged to crops with orthodox 1204 or probably orthodox seeds. At least 7 123 (0.2 percent of the total; annual average of 890.4) belonged to crops with intermediate or probably intermediate seeds. At least 55 (0.001 percent of the total; annual 1205 1206 average of 6.9) belonged to crops with recalcitrant or probably recalcitrant seeds, and 99 994 samples 1207 (2.5 percent of the total) were listed as uncertain or were not readily attributable to seed storage type. Annual 1208 distributions of orthodox, intermediate and recalcitrant types varied from year to year, but there was no 1209 discernible trend over the years.
- 1210 3.7.5 Distributions of crops in the context of their global use

Approximately 210 crops in the *WIEWS dataset* (24.9 percent of all crops in the dataset, but representing 65.5 percent of all accessions and 56.5 percent of all samples distributed) are tracked by FAOSTAT in terms of production and/or food-supply metrics, either specifically (e.g. pineapple or potato) or within general

- 1214 commodity groupings (e.g. pigeon pea, which is included under "Pulses, Other", or passionfruit, which is
- 1215 included under "Fruits, Other").

- An analysis of alignment between estimated global production metrics including total production (tonnes), harvested area (hectares) and production value (gross constant thousand USD) – and numbers of accessions and samples distributed, as reported in the WIEWS dataset, indicated a generally positive correlation, with cereal crops such as wheat and rice having especially high production and germplasm distribution values (**Figures 30, 31**). Some crops, for example sugar cane, oil palm, beet, cassava and soybean, stood out as having very high global production but relatively low reported germplasm distributions.
- 1222 A parallel analysis of alignment between global food-supply metrics - measured in terms of the contribution of crops to global calories (kcal/capita/day), protein (g/capita/day), fat (g/capita/day) and food weight 1223 (g/capita/day) - and numbers of accessions and samples distributed indicated similar trends in three metrics 1224 1225 (calories, protein and food weight). Wheat, rice, maize, soybean, and potato had the highest food-supply values and the highest numbers of accessions and samples distributed (Figures 30, 31). Cassava, banana 1226 1227 and plantain, grape and yam stood out as crops making a considerable contribution to food supplies 1228 (especially in terms of food weight) but having relatively low reported germplasm distributions. For fat, such 1229 outliers were even more evident, and included soybean, oil palm, sunflower, coconut, groundnut and olive, 1230 all with a very high contributions to fat in food supplies but a relatively small number of accessions and 1231 samples distributed. At the crop-type level, cereals and legumes showed the strongest correlation in terms 1232 of global production or food-supply values and the numbers of accessions/samples distributed, while sugar 1233 plants, oil plants, and roots and tubers had the smallest numbers of reported distributions relative to their 1234 global production levels or contributions to food supplies.



Figure 30. Numbers of accessions distributed per crop between 2012 and 2019 (WIEWS dataset) and contributions of crops
 to global production and food supplies (FAOSTAT)

- 1238 Approximately 119 of the crops in the Treaty dataset (44.1 percent of all crops in the dataset but
- 1239 representing 97 percent of all samples distributed) are tracked by FAOSTAT in terms of production and/or
- 1240 food-supply metrics. An analysis of alignment between global production metrics and the numbers of

samples distributed revealed a correlation generally similar to that seen in the WIEWS dataset, with wheat, 1241 maize and rice standing out in terms of very large production levels and a high number of germplasm 1242 samples distributed (Figure 32). This general trend was also evident in global food-supply metrics 1243 (Figure 33). For production metrics, outlier crops with very high production values but relatively low 1244 numbers of samples distributed included cassava, soybean and potato. These same crops showed similar 1245 trends in terms of contribution to calories, protein and food weight in global food supplies. Tomato, banana 1246 and plantain were similar, especially regarding their contribution to food weight. Soybean, sunflower, 1247 groundnut and olive stood out in terms of making large contributions to global supplies of fat but having 1248 1249 relatively low numbers of samples distributed. At the crop-type level, cereals showed the strongest correlation between global production or food-supply values and numbers of germplasm samples distributed, 1250 1251 while roots and tubers, oil plants, vegetables and fibre plants had the smallest numbers of distributions 1252 relative to their production or food-supply values.



1254 **Figure 31.** Numbers of samples distributed per crop between 2012 and 2019 (WIEWS dataset) and contributions of crops to

1253

¹²⁵⁵ global production and food supplies (FAOSTAT)



- 1257 Figure 32. Numbers of samples distributed per crop between 2012 and 2019 (Treaty dataset) and contributions of crops to
- 1258 global production (FAOSTAT).

1256

1259



Figure 33. Numbers of samples distributed per crop between 2012 and 2019 (Treaty dataset) and contributions of crops toglobal food supplies (FAOSTAT).

1262 3.7.6 Distributions by the Treaty Multilateral System of Access and benefit-sharing (Annex 1)

- 1263 status of crops
- 1264 According to the WIEWS dataset, distributions of crops clearly listed under the Multilateral System of the
- 1265 Treaty (i.e. listed in Annex 1) amounted to 714 471 accessions (56.3 percent of the total; annual average of
- 1266 89 308.9) over the eight-year period (Figure 34). The figures for the 2012 to 2014 period were 111 024
- 1267 accessions (43 percent of the total; annual average of 44 409.6), and those for the 2014 to 2019 period were
- 1268 603 447 accessions (59.7 percent of the total; annual average of 109 717.6).

1269 Note that this analysis was based on the crops distributed, not the provider. Some Contracting Party 1270 providers include public crop germplasm within the Multilateral System and distribute it under the SMTA 1271 even if the particular crops are not listed in Annex 1. Conversely providers located in countries that are not 1272 Contracting Parties to the Treaty may distribute crops listed in Annex 1 without their being part of the 1273 Multilateral System. Also note that many distributions in the dataset could not be attributed to specific crops 1274 but only to crop groups (e.g. multiple crops, cereal crops, unspecified crops, fruit crops, vegetable crops, oil 1275 crops and pulse crops). For this analysis, the crop groups were considered not to be specifically listed in 1276 Annex 1.

- 1277 In terms of samples, distributions of Annex 1 crops amounted to 1 587 666 samples (38 percent of the total;
- 1278 annual average of 198 458.3) over the eight-year period. During the 2012 to 2014 period, such distributions
- totalled 362 574 samples (43.7 percent of the total; annual average of 145 029.6). During the 2014 to 2019
- 1280 period, they totalled 1 225 092 samples (36.5 percent of the total; annual average of 222 744).





Figure 34. Numbers of accessions and samples distributed between 2012 and 2019 per crop type with and without Annex 1
 status (WIEWS dataset).

Distributions of crops not specifically listed in Annex 1 amounted to 555 347 accessions (43.7 percent of the total; annual average of 69 418.4) over the full period. During the 2012 to 2014 period, distributions of crops not specifically listed in Annex 1 of the Treaty totalled 147 264 accessions (57 percent of the total; annual average of 58 905.6). During the 2014 to 2019 period, such distributions totalled 408 083 accessions (40.3 percent of the total; annual average of 74 196.9). Note that, as mentioned above, accessions that could not be attributed to specific crops but only to crop groups were not considered to be included in Annex 1. This explains, in part, the relatively high numbers of non-Annex 1 distributions. Specific non-Annex 1 crops with the largest numbers of accessions distributed during the full period included soybean, cotton, tomato, tobacco, *Capsicum* crops, *Acacia*, pear, sesame, cocoa, okra, teff, flax, tea, beet, and cucumber and melons, each with over 5 000 accessions distributed.

1294 Crop types with the largest germplasm distributions during the eight-year period in terms of absolute 1295 numbers of accessions of non-Annex 1 crops included oil plants; vegetables; cereals; nuts, fruits and berries; 1296 medicinal plants, aromatic plants, spices and stimulant plants; fibre plants; food legumes; industrial and ornamental plants; and forages, all with over 15 000 accessions distributed. The leading crop types in terms 1297 1298 of the proportions of their total germplasm distributions (accessions) belonging to crops that are not listed 1299 in Annex 1 included fibre plants (100 percent); sugar plants (100 percent); other plants (100 percent); industrial and ornamental plants (99.9 percent); medicinal plants, aromatic plants, spices and stimulant plants 1300 1301 (91.5 percent); oil plants (90 percent); vegetables (79.5 percent); and forages (49.1 percent).

1302 Where samples are concerned, non-Annex 1 crops comprised 2 594 916 of those distributed over the eightyear period (62 percent of the total; annual average of 324 364.5). During the 2012 to 2014 period, such 1303 1304 distributions totalled 467 365 (56.3 percent of the total; annual average of 186 946). During the 2014 to 2019 1305 period, they totalled 2 127 551 (63.5 percent of the total; annual average of 386 827.5). Specific non-Annex 1306 1 crops with the largest numbers of samples distributed included dragon fruit, pistachio, soybean, cocoa, 1307 avocado, coffee, mango, Arabidopsis, rubber, tomato, Acacia, grape, Annona crops, coconut, Capsicum crops, 1308 sugar cane, fig, pear, cotton, cucumber and melons, lettuce, guava, tobacco, okra, flax, sapote and papava, each with over 10 000 samples distributed. 1309

1310 The crop types that had the largest germplasm distributions during the full period in terms of absolute 1311 numbers of samples of non-Annex 1 crops included nuts, fruits and berries; medicinal plants, aromatic 1312 plants, spices and stimulant plants; vegetables; industrial and ornamental plants; oil plants; and cereals (all 1313 with over 100 000 samples distributed). The leading crop types in terms of the proportions of their total 1314 germplasm distributions (samples) belonging to crops not listed in Annex 1 included fibre plants (100 percent); sugar plants (100 percent); other plants (100 percent); industrial and ornamental plants 1315 1316 (99.9 percent); medicinal plants, aromatic plants, spices and stimulant plants (98 percent); oil plants 1317 (90.5 percent); vegetables (84.6 percent); nuts, fruits and berries (81.1 percent); and forages (44.4 percent).

1318 According to the *Treaty dataset*, the distribution of crops listed in Annex 1 amounted to 3 787 498 samples 1319 (95.3 percent of the total; annual average of 473 437.3), while that of crops not specifically listed in Annex 1320 1 amounted to 188 211 samples (4.7 percent of the total; annual average of 23 526.4) (Figure 35). Relative 1321 proportions of Annex 1 and non-Annex 1 crop samples distributed per year were fairly consistent across 1322 the eight-year period. As in the case of the WIEWS dataset, there were considerable distributions of 1323 germplasm of crops that could only be attributed to crop groups (e.g. unspecified crops and unspecified 1324 forages), and these were again considered not to be listed in Annex 1 for the purposes of the analysis. 1325 Specific non-Annex 1 crops with the largest quantities of germplasm distributed over the eight-year period 1326 included groundnut, lettuce, soybean, Capsicum crops, tomato, flax and spinach, each with over 5 000

included within them the largest numbers of samples of non-Annex 1 crops, included unspecified crops, 1328 1329 vegetables, food legumes and oil plants, all with over 15 000 samples distributed. The leading crop types in

- terms of the proportions of their total germplasm distributions belonging to crops that are not listed in 1330
- 1331 Annex 1 included fibre plants (100 percent); industrial and ornamental plants (100 percent); medicinal plants,
- 1332 aromatic plants, spices and stimulant plants (100 percent); unspecified crops (100 percent); oil plants
- (83.6 percent); vegetables (37.2 percent); and forages (31.2 percent). 1333





Note:

1327

1335 Figure 35. Numbers of Annex 1 and non-Annex 1 samples distributed per crop type between 2012 and 2019 (Treaty database).

3.8. Change over Time in Distributions within and beyond the Study Period 1336

- The WIEWS dataset contained two reporting periods: January 2012 to June 2014 (2.5 years), during which 1337
- 1338 258 288 accessions and 829 939 samples were distributed by 63 countries (in terms of accessions) or 65 (in

terms of samples); and July 2014 to December 2019 (5.5 years), during which 1 011 530 accessions and33 52 643 samples were distributed by 79 countries.

1341 Annual averages amounted to 103 315.2 accessions distributed per year during the first period, 183 914.5 per year during the second period and 158 727.3 per year during the full eight years. In the case of samples, 1342 the figures were 331 975.6 per year during the first period, 609 571.5 per year during the second period and 1343 522 822.8 per year across the full eight years. There were thus 78 percent (accessions) and 83.6 percent 1344 (samples) more distributions per year on average during the second period than during the first period. 1345 These larger reported distributions are explained, at least in part, by the additional countries reporting in the 1346 second period, some of which were among those with the largest numbers of reported distributions, 1347 1348 especially in terms of samples (e.g. China, Nicaragua and Togo, and to a lesser degree, Hungary, Italy, the Philippines and Sri Lanka). Analysing change in distributions solely for the 57 countries reporting for both 1349 1350 time periods, the annual average number of accessions distributed increased from 94 116.4 in the first period 1351 to 110 921.1 in the second period (an increase of 17.9 percent), while the annual average number of samples 1352 distributed increased from 310 948.4 to 317 701.5 (+2.2 percent). Annual average distributions of accessions 1353 and samples varied considerably across the 57 countries, with some reporting increasing annual average 1354 distributions, others reporting decreasing distributions, and a very few reporting a steady number of 1355 distributions. No trend was discernible across countries or in terms of accessions versus samples.

Total annual distributions recorded in the *Treaty dataset* varied from year to year, but there was no discernible trend across the eight-year period. This included a low of 407 512 samples distributed in 2019 and a high of 602 521 samples distributed in 2018. Reporting of distributions to the Treaty generally takes several years to complete, and thus it is possible that year 2019 distributions are not yet fully accounted for.

The Second Report offered examples of germplasm distributions by national genebanks from the mid-1990s to the late 2010s, with the exact time period depending on the specific country report (FAO, 2010). While direct comparisons of those statistics with the WIEWS dataset for 2012 to 2019 is confounded by variation in reporting style and period covered, as well as uncertainty regarding the consistency of use of the terms "accessions" and "samples", examples from China, Ethiopia, Germany, India, Japan, Kenya, Malawi, Pakistan, Poland and Switzerland generally indicate that distributions by most national genebanks in the recent reporting period were similar to or larger than those in the period covered by the Second Report.

1367 The Second Report also documented more than 1.1 million samples distributed by the CGIAR centres and 1368 the World Vegetable Center (formerly Asian Vegetable Research and Development Center, AVRDC) during 1369 the respective reporting period, 615 000 of which (about 50 000 per year) were sent to external recipients 1370 (FAO, 2010). The Second Report states that total distributions by international centres remained more or 1371 less steady over the period from 1996 to 2007 at about 100 000 accessions each year, and notes that these 1372 annual numbers were similar to those reported in the First Report for the period 1993 to 1995 (FAO, 2010). 1373 The Treaty dataset filtered only for distributions made by the CGIAR centres indicates that a total of 1374 3 534 349 samples were distributed between 2012 and 2019, amounting to an average of 441 793.6 samples 1375 distributed per year. Thus, it appears that CGIAR centres may have distributed more germplasm in the

1376 current reporting period than in the periods covered by the First Report and Second Report. However, it 1377 should be noted that the comparison is confounded by uncertainty regarding extent to which the figures for 1378 the different reporting periods cover only genebank distributions or also include distributions of material 1379 from breeding programmes.

1380

4 **DISCUSSION**

1381 4.1. Key Findings and Implications

The analysis presented in this study covers the distribution of over 1.2 million accessions (circa 159 000 per 1382 1383 year on average) and over 4.1 million samples (circa 523 000 per year) made primarily by national genebanks between 2012 and 2019, as recorded in the WIEWS dataset. It also covers the distribution of over 1384 1385 3.9 million samples (circa 497 000 per year) from genebanks, breeding programmes and other organizational 1386 types using the SMTA, as recorded in the Treaty dataset, during the same period. These distributions are 1387 considerably larger than those indicated by information on germplasm distributions synthesized from the 1388 First Report (FAO, 1998) and the Second Report (FAO, 2010) for previous periods. However, the true 1389 extent of any increase in distribution since the earlier studies is hard to assess, as the post-2012 data are far 1390 more comprehensive.

1391 The WIEWS dataset essentially documents domestic genetic resource exchange activities, with well over 1392 90 percent of distributions in the dataset made within the respective country. In terms of accessions 1393 distributed, the dataset indicates that NARCs were the foremost in-country recipients, followed by recipients 1394 classed as Others, Farmers or NGOs, Private Sector and Unknown. In terms of samples, the Private Sector and NARCs were the foremost recipient categories, followed by Farmers or NGOs, Others and Unknown. 1395 1396 The relatively small proportion of material that is distributed internationally from national genebanks may 1397 reflect a reluctance to send material abroad (e.g. in the case of genebanks in countries that are not members 1398 of the Treaty or material that is not in Annex 1 of the Treaty), inability to do so (e.g. because of limited 1399 germplasm availability) or an absence of external demand. The latter may, in turn, reflect a relative lack of 1400 access to information on what is available or, alternatively, greater ease in obtaining material from other 1401 national or international genebanks.

The *Treaty dataset* documents a very different germplasm distribution pattern, with three-quarters (76.5 percent) of distributions occurring across international borders, and one-quarter (23.5 percent) within the respective country. This dataset primarily reflects CGIAR distributions (88.9 percent of the total) and shows that 80.8 percent of these were made to recipients outside the country in which the CGIAR centre was located. This kind of distribution pattern is to be expected given the widespread importance of the crops the CGIAR curates, the size and comprehensiveness of the collections, and the relative ease with which they can be accessed.

The *WIEWS dataset* records the distribution of germplasm by 87 countries or territories, more than half of which distributed more than 1 000 accessions each over the eight-year period. Asian and European providers were the main contributors, with Asia accounting for almost half of the total accessions distributed

and Europe almost a quarter. The Oceania, Americas and Africa regions each provided around 10 percent. 1412 High-income countries distributed 39.4 percent of all accessions, upper middle-income countries 1413 1414 35.7 percent, lower middle-income 18.9 percent and low-income countries 6 percent. LDCs distributed 1415 8.5 percent of total accessions, LLDCs distributed 5.2 percent, and SIDS distributed 0.9 percent. 1416 Assessments at the sample level paint a similar picture, although they may be confounded by relatively large 1417 numbers of samples reported for a few crops from a few countries. In terms of samples, almost half the 1418 reporting countries distributed more than 10 000 each over the eight-year period. Providers in the Americas (29 percent), Europe (28.8 percent) and Asia (25.7 percent) distributed the most samples, followed by Africa 1419 1420 (13.4 percent) and Oceania (3.1 percent). Lower middle-income countries distributed 38.3 percent of all samples, high-income counties 33.3 percent, upper middle-income countries 18.8 percent and low-income 1421 1422 countries 9.6 percent. LDCs distributed 12.8 percent of total samples, LLDCs 3.1 percent and SIDS 1423 3.2 percent. Approximately 69.9 percent of total accessions and 86.1 percent of total samples were 1424 distributed by providers located in countries that were Contracting Parties to the Treaty. Approximately 1425 37.3 percent of total accessions and 35.5 percent of total samples were distributed by providers located in 1426 countries that were Contracting Parties to the Nagoya Protocol. It is interesting to note that providers in 1427 countries that were not Contracting Parties to the Nagoya Protocol were active in distributing germplasm internationally, providing approximately half of the international distributions. This was not the case for 1428 1429 providers in countries that were not Contracting Parties to the Treaty, which distributed relatively few 1430 accessions and samples internationally.

1431 The Treaty dataset contains information on the distribution of germplasm from providers located in 48 countries, with more than 1 000 samples distributed by providers in each of 34 of those countries. Analysis 1432 1433 by region shows that providers located in the Americas accounted for 47.9 percent of total distributions, those in Asia for 29.5 percent, those in Africa for 14.1 percent, those in Europe for 8.4 percent and those 1434 1435 in Oceania for 0.2 percent. Providers located in upper middle-income countries accounted for 59.7 percent 1436 of total samples distributed, followed by those in lower middle-income countries (27 percent), high-income 1437 countries (10.5 percent) and low-income countries (2.9 percent). Approximately 53.2 percent and 52.2 percent of total samples distributed using the SMTA were provided by organizations located in 1438 1439 countries that were Contracting Parties to the Treaty and to the Nagoya Protocol, respectively. However, it should be remembered that CGIAR centres were the providers of almost 90 percent of total distributions 1440 1441 in the Treaty dataset and thus the terms and conditions under which international centres distribute 1442 germplasm are more pertinent to understanding these exchange patterns.

1443 The *Treaty dataset* records the distribution of samples to recipients in 179 countries, with over 1 000 1444 samples received in each of 131 countries between 2012 and 2019. The countries where recipients received 1445 the largest numbers of samples were India, Kenya, Mexico, Türkiye, the United States of America, Germany, 1446 Canada, China, Pakistan and the Islamic Republic of Iran, each receiving over 100 000 samples under the 1447 SMTA. Recipients in Asia received 42.1 percent of total samples, Africa 22.5 percent, the Americas 1448 21.2 percent, Europe 13.2 percent and Oceania 1 percent. Recipients in lower middle-income countries 1449 received 38.6 percent of total samples, upper middle-income countries 26.7 percent, high-income countries 1450 23.8 percent, and low-income countries 10.8 percent. Recipients in LDCs received 11 percent of total

samples, those in LLDCs 12.5 percent and those in SIDS 0.3 percent. Approximately 80.3 percent of total 1451 samples distributed using the SMTA were received by organizations located in countries that were 1452 1453 Contracting Parties to the Treaty, and 41.3 percent by organizations located in countries that were 1454 Contracting Parties to the Nagoya Protocol. The relatively small distribution of material to low-income 1455 countries and LDCs is almost certainly a reflection of relative lack of demand due to capacity gaps in these 1456 countries' plant breeding and other agricultural research institutions. If this situation is to be improved and 1457 such countries are to benefit more from access to genetic resources, capacity building needs to be given 1458 greater attention.

1459 The WIEWS dataset records the distribution of germplasm for 843 crops or crop groups. However, 1460 generalized reporting within the dataset means that the actual number of crops and species distributed may be considerably higher. For one crop (wheat), as many as 177 808 accessions and 371 107 samples were 1461 1462 distributed over the eight-year period. More than 100 000 accessions of each of three crops (wheat, rice and 1463 soybean) were distributed, between 10 000 and 100 000 accessions of each of 22 crops, between 1 000 and 1464 10 000 accessions of each of 72 crops, between 100 and 1 000 of each of 98 crops, and fewer than 100 1465 accessions of each of 643 crops. Crops with the highest numbers of accessions distributed included wheat, 1466 rice, soybean, barley, multiple crops, cereal crops, unspecified crops, common bean, chickpea, Brassica crops, 1467 maize, fruit crops, vegetable crops, oat, sorghum, pea, cotton, citrus, potato, oil crops, pulse crops, tomato, 1468 broad bean and vetch, tobacco and lentil, each with over 10 000 accessions distributed; these 25 crops or 1469 crop groups represent over three-quarters (76.8 percent) of all accessions distributed. More than 100 000 1470 samples were distributed of each of 10 crops (see below), between 10 000 and 100 000 samples of 48 crops, between 1 000 and 10 000 samples of 126 crops, between 100 and 1 000 samples of 133 crops, and between 1471 1472 1 and 100 samples of 526 crops. The crops or crop groups with the highest total numbers of samples 1473 distributed were dragon fruit, rice, wheat, citrus crops, pistachio, soybean, cocoa, avocado, barley and coffee, 1474 all with over 100 000 samples distributed. These ten crops or crop groups represent 49 percent of all samples 1475 distributed. While the distribution of accessions largely reflects the importance of the crop concerned at the global level, including those handled by the CGIAR centres, the distribution of samples appears to be 1476 skewed by a high, and possibly anomalous, demand during the reporting period for a few crops of lesser 1477 1478 global importance, such as dragon fruit and pistachio. It will be interesting to see if this remains the case in 1479 the future, and with the growing impact of climate change it will be important to continue to monitor the 1480 changing distribution of different crops over time, in particular those that are more heat and drought 1481 resistant.

At the crop-type level, food crop germplasm comprised 86.5 percent of total accessions and 87.8 percent of total samples documented in the WIEWS dataset, with cereals, oil plants, food legumes and vegetables being the most distributed in terms of accessions, and nuts, fruits and berries; cereals; medicinal plants, aromatic plants, spices and stimulant plants; vegetables; oil plants; industrial and ornamental plants; and food legumes in terms of samples. Approximately 81.1 percent of total accessions and 51.9 percent of samples were distributed by seed, while 8.8 percent of accessions and 39.3 percent of samples were distributed vegetatively. The quantities of germplasm distributed generally aligned well with global production metrics for crops and

1489 with their contributions to global food supplies. However, on certain metrics, some crops - for example,

sugar cane, oil palm, beet, cassava, soybean, banana and plantain, grape, yam, sunflower, coconut, groundnut
 and olive – stood out as making very large contributions to global production or food-supply but having
 relatively few reported germplasm distributions.

1493 According to the WIEWS dataset, approximately 56.3 percent of total accessions and 38 percent of 1494 samples distributed belonged to crops listed in Annex 1 of the Treaty. The non-Annex 1 crops that comprised the other 43.7 percent of accessions distributed included soybean, cotton, tomato, tobacco, 1495 1496 Capsicum crops, Acacia, pear, sesame, cocoa, okra, teff, flax, tea, beet, and cucumber and melon, each with 1497 over 5 000 accessions distributed. The non-Annex 1 crops that comprised the other 62 percent of samples 1498 distributed included dragon fruit, pistachio, soybean, cocoa, avocado, coffee, mango, Arabidopsis, rubber, 1499 tomato, Acacia, grape, Annona crops, coconut, Capsicum crops, sugar cane, fig, pear, cotton, cucumber and 1500 melon, lettuce, guava, tobacco, okra, flax, sapote and papaya, each with over 10 000 samples distributed. 1501 This high level of demand for germplasm of non-Annex 1 crops underscores the importance of prioritizing ways and means of further facilitating access to such germplasm, while also ensuring the fair and equitable 1502 1503 sharing of any benefits arising from such access.

1504 The Treaty dataset records the distribution of over 270 crops or crop groups, with up to 1 874 121 samples 1505 per crop distributed over the eight-year period. One crop had more than 1 000 000 samples (wheat) 1506 distributed, 4 crops between 100 000 and 1 000 000 samples, 16 crops between 10 000 and 100 000 samples, 1507 30 crops between 1 000 and 10 000 samples, 38 crops between 100 and 1 000 samples, and 181 crops between 1 and 100 samples. Crops with the highest total numbers of samples distributed included wheat, 1508 maize, rice, barley, chickpea, unspecified crops, lentil, bean, sorghum, pearl millet, Brassicareae crops, broad 1509 1510 bean and vetch, pigeon pea, cowpea, potato, groundnut, oat, lettuce, grass pea and other Lathyrus, soybean 1511 and pea, all with over 10 000 samples distributed. These 21 crops or crop groups represent 96.5 percent of 1512 all samples distributed. Again, the data primarily reflect the crops handled by the CGIAR centres. Given the 1513 high demand for germplasm of non-CGIAR crops that is evident in the WIEWS dataset, it is important that 1514 consideration be given to ways of developing and/or strengthening international mechanisms for the 1515 conservation and distribution of such crops.

1516 At the crop-type level, the *Treaty dataset* indicates that food crop germplasm comprised 97.1 percent of 1517 the samples distributed, with cereals, food legumes, vegetables, unspecified crops, roots and tubers, forages, 1518 and oil plants comprising the largest shares. It is likely that at least 96.8 percent of the samples were 1519 distributed as seed and 1.1 percent vegetatively. The numbers of samples distributed generally aligned well 1520 with global production metrics and with the crops' contributions to global food supplies. However, for 1521 certain metrics, some crops - for example, cassava, soybean, potato, tomato, banana and plantain, sunflower, 1522 groundnut and olive stood – out as having high production or food-supply values relative to the amount of 1523 germplasm distributed. This probably reflects the difficulty of conserving and distributing certain crops (e.g. cassava, potato, and banana and plantain), exclusion of some of from Annex 1 (e.g. soybean, tomato and 1524 1525 groundnut) and/or the relative paucity of major breeding programmes worldwide for some (e.g. sunflower, 1526 olive).

Approximately 95.3 percent of samples in the *Treaty dataset* belonged to crops listed in Annex 1 of the Treaty. The non-Annex 1 crops that comprised the other 4.7 percent of the samples distributed included groundnut, lettuce, soybean, *Capsicum* crops, tomato, flax and spinach, each with over 5 000 samples distributed.

1531 4.2 Caveats and Information Gaps

The distributions documented in this study are clearly substantial, and they are also diverse in terms of the location, income and political status of the provider and recipient countries, as well as in terms of the organizational types and the crops and crop types involved. The two main datasets record germplasm flows largely from different providers and are thus complementary. With some notable exceptions, the distributions appear generally to be in alignment with the use of the respective crops as measured by global production and food-supply statistics.

1538 Whether the distributions are in proportion to investments made in ex situ conservation or relate to present 1539 and future crop improvement and other research priorities is much more difficult to assess based on the 1540 data analysed. Whether they even need to be in alignment is itself a worthwhile question. As noted in the 1541 First Report, "The primary purpose of many base collections is long-term conservation, and, therefore, the 1542 rate of "utilization" may be expected to be low. In addition, the utilization of a relatively small part of a 1543 genebank's collection can lead to large benefits, proportionally far greater than the quantity of accessions 1544 used" (FAO, 1998). Over the two decades since the publication of the First Report, based on the limited 1545 comparable information available, global germplasm distribution appears to have increased considerably, as 1546 have ex situ collections.

1547 What is clearer is that while the two datasets used in this analysis represent a major leap forward in 1548 documenting and quantifying global germplasm exchange, neither dataset is fully comprehensive in terms 1549 of the distributions made during the eight-year period by providers of plant genetic resources. A number of countries - some with very large ex situ collections - did not contribute to the relevant indicators in WIEWS 1550 1551 (Figure 5 and Figure 7). Data provided in the annual reports on technology transfer published by the 1552 United States Department of Agriculture indicate that in the period covered by this study (USDA, 2012-1553 2019) the 21 repositories and units included in the National Genetic Resources Program (NGRP) of the 1554 USDA sent more than 2 million samples to foreign genebanks, international agricultural research centres, domestic and foreign commercial companies, and domestic and foreign research organizations and 1555 1556 universities, with an average of 260 000 samples distributed per year. An average of 150 000 accessions were 1557 distributed per year during the period 2015 to 2019 (reports of previous years do not provide information 1558 about the number of accessions that were transferred, only samples). These USDA statistics indicate that 1559 the true volume of national and international distributions worldwide may be considerably larger than that 1560 documented in the WIEWS indicators. Further, the lack of information on the geographic location of 1561 germplasm recipients in this dataset, and the current sporadic reporting of distributions in terms of recipient 1562 types, impede a fuller understanding of users of plant germplasm.

Likewise, the Treaty dataset encompasses only international institutions that signed Article 15 agreements 1563 1564 with the Treaty's Governing Body and organizations in countries that were Contracting Parties to the Treaty, 1565 which were under obligation to use the SMTA for distributions during the eight-year period. The genebanks, breeding programmes and other providers of germplasm in many countries in Latin America (most of 1566 1567 Central America, as well as the southern cone and various Andean countries, among others), Africa (most of Northern, Middle, and Southern Africa), Europe (most of Eastern Europe), Asia (most of Central and 1568 Western Asia, South-eastern Asia and parts of the Pacific region) are not included in these data (Figure 9). 1569 1570 Other countries are only represented for the period in which they were a Contracting Party to the Treaty 1571 (e.g. the United States of America became a Contracting Party in 2016). Furthermore, Contracting Parties 1572 have various options as to whether they use the SMTA for domestic transfers, and most internal transfers 1573 (e.g. from genebanks to breeding programmes in the same institution) are not reported. Known delays in reporting also mean that the data available for recent years may not be complete. While all further additions 1574 1575 of Contracting Parties to the Treaty will increase the comprehensiveness of the dataset, additional methods of quantifying germplasm exchange (especially beyond the national genebanks reported in WIEWS) will be 1576

1577 needed if a truly global picture is to be obtained.

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1746 Annexes

1747 Annex 1: Extended Methodology and Data Sources

1748 **A1.1 Study timeframe**

1749 In accordance with the scope of the Third Report, this study covers the period 2012 to 2019, with 1750 supplementary information covering longer periods for additional context.

1751 A1.2 Data sources

1752 This study is based on two main information sources:

1753 A1.2.1 The World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture

1754 (WIEWS) Reporting Tool on Indicators 6, 28 and 29 of the Second GPA monitoring framework.

1755 This dataset includes two main indicators as outlined in FAO (2020):

Indicators 28, Number of accessions distributed by genebanks to users of germplasm, and 29,
 Number of samples distributed by genebanks to users of germplasm (Question: 8.4 Indicate for each crop,
 crop group or preferably for each taxon, the number of accessions and the number of samples distributed
 during the reporting period by the national genebank[s] Optionally, indicate the amounts distributed to the
 different categories of recipients).

Indicator 6, Number of farmers' varieties/landraces distributed by national or local genebanks to
 farmers (either directly or through intermediaries) (Question: 2.3 Indicate for each crop or crop group, the
 number of farmers' varieties/landraces distributed during the reporting period by national or local
 genebanks to farmers (either directly or through intermediaries).

For both indicators, data were provided by stakeholders for two periods: 1 January 2012 to 30 June 2014,¹⁷ and 1 July 2014 to 31 December 2019. Data were received for this analysis directly from FAO in March 2022, with updates for specific providers received in June and July 2022. These data are limited to National Focal Point (NFP) contributions; distributions from the CGIAR centres were not included, as they are assumed to be well tracked in the Treaty dataset (below). The WIEWS dataset thus mainly covers national and subnational genebank distributions.

For Indicators 28 and 29, the data provide summary counts of accessions and samples distributed per crop or taxon, per stakeholder (institution) and per reporting period. These are presented in total count format as well (optionally) by recipient category. These categories include National Agricultural Research Centres (NARCs), Private Sector, Farmer or Non-Governmental Organization (NGO), Others, Foreign Stakeholders and Unknown. It is understood that all categories refer to within-country distributions, aside

¹⁷ A limited number of distributions were reported for a timeframe of 2009 to 2013 for the first reporting period, by one data provider. These distributions were reported only for samples (not accessions), and total 162 753 samples.
1776 from the Foreign Stakeholders category, which is not further disaggregated in terms of recipient 1777 organizational types. Recipient countries or institutions are not identified in these data.

For Indicator 6, the data provide summary counts of farmers' varieties/landraces distributed by national or local genebanks to farmers, per crop or taxon, per stakeholder (institution) and per reporting period. Recipient countries or institutions are not identified in these data; it is assumed that distributions are mainly within-country.

A1.2.2 Data Store of the Multilateral System of Access and Benefit Sharing of the International Treaty on Plant Genetic
 Resources for Food and Agriculture (Treaty)

The Data Store includes all reported distributions made with the Standard Material Transfer Agreement 1784 1785 (SMTA). The dataset used in the study was provided by the Secretariat of the Treaty and comprises the data contained in the Data Store (Easy-SMTA, https://mls.planttreaty.org) as of 17 February 2022, with 1786 1787 additional data from one provider - the International Center for Tropical Agriculture (CIAT) - received in 1788 June 2022. The SMTA obliges the provider to report to the Governing Body of the Treaty (Article 5.3). The 1789 reporting is done for each transfer at the sample level at least once every two years. Thie dataset covers the 1790 period 2012-2019, and thus includes four two-year datasets (2012-2013, 2014-2015, 2016-2017 and 2018-1791 2019). Data were provided both for all transfers and only for those from CGIAR centres, the latter including 1792 data from the Africa Rice Center (AfricaRice), Bioversity International, the International Center for Tropical 1793 Agriculture (CIAT), the International Maize and Wheat Improvement Center (CIMMYT), the International 1794 Potato Center (CIP), the International Center for Agricultural Research in the Dry Areas (ICARDA), the 1795 World Agroforestry Center (ICRAF), the International Crops Research Institute for the Semi-arid Tropics 1796 (ICRISAT), the International Institute of Tropical Agriculture (IITA), the International Livestock Research 1797 Institute (ILRI) and the International Rice Research Institute (IRRI).

The dataset provides summary counts of samples distributed per crop or taxon, per distributing country, per recipient country and per year. Specific distributor or recipient stakeholder names, institutions or categories/types are not specified; only the distributor or recipient country is. As the dataset covers all germplasm transfers under the SMTA, it offers information not solely on the distribution of genebank samples but also on materials derived from these samples and other sources, for example materials from breeding programmes.

1804 A1.3 Data processing and analysis

Processing of the two main datasets for analysis followed as standardized a process as possible to maximize the potential for comparability between the two. This mainly included cleaning of existing data and adding supplementary data of use for analysis. These were processed using both manual methods and automated processes in the Python programming language. The programming code for the automated processing steps is available at: https://github.com/CIAT-DAPA/fao_sow. 1811 Crop names were as far as possible standardized to enable comparative analyses; some names were 1812 generalized for this purpose. Names were typically standardized to the most common name for the crop in 1813 English or a Latin (generally the genus) name.

1814 A1.3.2 Designation and standardization of crop categories

WIEWS data included two crop category formats: a) crop groupings as standardized and reported in Appendix 2 of the Second Report; and b) plant groupings further checked and processed by FAO WIEWS staff. These fields were checked for consistency and updated per row in communication with FAO. The Treaty dataset did not include information on crop categories. The two crop category formats from the WIEWS dataset were added to the Treaty dataset by assigning crops on the basis of how the same or similar crops were assigned in the WIEWS dataset.

1821 To supplement the WIEWS crop categories, an additional crop grouping format was added. This category 1822 derives from a current Treaty project (The Plants That Feed the World: baseline data and metrics to inform strategies for the conservation and use of plant genetic resources for food and agriculture) led by the International Center for Tropical 1823 1824 Agriculture (CIAT) (Khoury et al., 2023), which compiles and provides standardized information on the use 1825 of more than 350 crops globally, including data on interdependence, demand, supply, and security of their 1826 genetic resources. The project's crop list offers crop grouping information at both general/primary and 1827 specific levels; both fields were added to both datasets analysed here, with crops not on the 350-crop list 1828 assigned to appropriate categories manually.

1829 A1.3.3 Addition of information on whether crops are listed in Annex 1 of the Treaty

A field was added to each dataset marking whether the crop was listed in Annex 1 of the Treaty (FAO, 2009). This was accomplished by aligning the respective information from the project *The Plants That Feed the World: baseline data and metrics to inform strategies for the conservation and use of plant genetic resources for food and*

- 1833 agriculture (Khoury et al., 2023) to crops in the current datasets whose names matched, and then reviewing
- 1834 Annex 1 and manually assigning the crops not on the 350-crop list.
- 1835 A1.3.4 Addition of information on crop use

1836 To provide additional context regarding crop use globally, information was compiled from FAOSTAT global food-supply data (for calories [kcal/capita/day], protein [g/capita/day], fat [g/capita/day] and food 1837 1838 weight [g/capita/day]) and for global production (for production quantity [tonnes], harvested area [ha], and 1839 production value [gross constant thousand USD]). An annual average for these metrics was calculated across 1840 the years 2015 to 2018, representing the most recent years for these metrics in FAOSTAT at the time of analysis. These data were brought in from the project The Plants That Feed the World: baseline data and metrics to 1841 1842 inform strategies for the conservation and use of plant genetic resources for food and agriculture (Khoury et al., 2023), matching by crop names. The 350 crops on the crop list from this project are inclusive of all crops reported 1843 1844 in FAOSTAT, thus crops in the current analysis not on the 350-crop list do not contain this supplementary

1845 information.

While FAOSTAT data contain statistical information on the use of many crops (food-supply data contains 1846 approximately 54 relevant crop plant commodities ["items"], with data from 173 countries; production data 1847 1848 contain approximately 142 relevant crop plant commodities, with data from 205 countries; value of 1849 production data contain approximately 140 relevant crop plant commodities, with data from 205 countries), 1850 many crops are not specifically listed (especially in food-supply data) but are instead grouped within general 1851 commodities (i.e. "Cereals, Other", "Fruits, Other", "Nuts', "Oilcrops, Other", "Pulses, Other", "Roots, Other", "Spices, Other", "Tea and Mate" and "Vegetables, Other" in food-supply data). Applying the full 1852 1853 reported values for these general commodities to each crop listed under the respective item would lead to 1854 clear overestimations of each crop's value and to a distorted understanding of their value compared to other 1855 crops that are included individually in the data (i.e. not within a general commodity).

1856 To resolve this while attempting to provide FAOSTAT data for as many crops as possible, production 1857 information for each crop (production quantity metric) was used as a factor by which to disaggregate the 1858 general food-supply values. As a simple example, the "Tea and Mate" food-supply commodity comprises 1859 two crops - tea and mate. Global production of these crops in terms of production quantity consists of 1860 approximately 85.8 percent tea and 14.2 percent mate, based on 2018 data. Thus, in order to obtain separate 1861 food-supply values for tea and mate the respective values for the general commodity (e.g. kcal/capita/day 1862 in the case of calories) was assigned proportionally, i.e. 85.8 percent of the total to tea and 14.2 percent to mate. Note this disaggregation was not possible for the various crops in the "Beans" and "Millets" food-1863 1864 supply commodities because production data for crops pertinent to the commodities were also aggregated and thus were not specific to the individual crops. In these cases, all crops were given the full value of the 1865 respective commodity, which it should be noted leads to an overestimation of each crop's individual use, 1866 1867 especially the minor bean and millet crops (an alternative could have been to equally divide the general 1868 commodity value across the crops comprising these commodities, but this would have led to much smaller 1869 values than are likely to be accurate for many of the crops).

1870 Following this disaggregation of food-supply values, the results were judged to be more accurate, except 1871 that many of the minor crops that are listed in production metrics as components of general commodities (i.e. "Agave fibres nes", "Berries, nes", "Cereals, nes", "Fibre crops nes", "Fruit, fresh nes", "Fruit, tropical 1872 fresh nes", "Nuts, nes", "Oilseeds nes", "Pulses, nes", "Roots and tubers, nes", "Spices, nes", "Sugar crops, 1873 1874 nes", "Vegetables, fresh nes") were judged to have food-supply values that were too high relative to crops that are specifically listed in the production metrics. To address this issue, the values for these general 1875 1876 production commodities were divided equally among their component crops (e.g. bay leaf, dill, fenugreek, 1877 saffron, thyme and turmeric - the six crops listed within the production commodity "Spices, nes" - were all assigned the same production value, i.e. 1/6 of the total value of "Spices, nes"). Following this 1878 1879 transformation of the production data, the food-supply transformation described above was redone and 1880 new food-supply values assigned to these crops.

1881 A1.3.5 Addition of information on germplasm storage type and storage behaviour type

- A field was added to each dataset marking the typical germplasm storage type of each crop (seed, clonal, or unknown). For crops that may be stored in multiple formats, the most common format was assigned. This information was drawn from Khoury *et al.* (2021), with designations made manually for crops not listed in the supplementary information of that resource.
- A field was also added to each dataset marking the seed storage behaviour type for the crop as listed in the Royal Botanic Gardens, Kew Seed Information Database (SID) (SER, INSBR and RBG Kew, 2023). Seed storage behaviour as listed in the SID is categorized as orthodox, recalcitrant or intermediate, with some species listed as possibly in a category. These were standardized in this analysis. As described in the SID:
- 1890 "Orthodox seeds can be dried, without damage, to low moisture contents, usually much lower than those 1891 they would normally achieve in nature. Over a wide range of storage environments their longevity increases 1892 with reductions in both moisture content and temperature, in a quantifiable and predictable way.
- 1893 Recalcitrant seeds do not survive drying to any large degree, and are thus not amenable to long term storage,
 1894 although the critical moisture level for survival varies among species. In this database this category includes
 1895 those seeds, of some aquatic species in particular, described as viviparous.
- 1896 Intermediate seeds are more tolerant of desiccation than recalcitrants, though that tolerance is much more 1897 limited than is the case with orthodox seeds, and they generally lose viability more rapidly at low temperature. 1898 They do not conform to all the criteria defining orthodox seeds, especially in respect of the quantification 1899 and predictability of the relations between longevity and both drying and cooling." (SER, 2023).
- 1900 A1.3.6 Designation of providers and recipients in terms of world region classifications
- Information from the UNSTATS m49 classification system of world regions and regional classifications
 (UNSTATS, 2022) was added for each country reported in the datasets. The WIEWS dataset contains
 country information only for providers; the Treaty dataset contains country information both for providers
 and recipients.
- 1905 A1.3.7 Designation of providers and recipients in terms of country income level
- Information from the World Bank Country and Lending Groups classification system (World Bank, 2022)
 was added for each country included in the datasets. The WIEWS dataset contains country information only
 for providers; the Treaty dataset contains country information for both providers and recipients.
- This World Bank information is available by year and may change between years. For the Treaty dataset, where germplasm distribution information is available by year, countries were associated with their respective World Bank income levels for each reported year. Three recipient countries (Cook Islands, Nauru and Niue) were either not listed in the World Bank dataset or were not assigned an income level for relevant years and are thus not attributable in the analysis; these cases account for an extremely small number of
- 1914 samples (65 in total).

- 1915 For the WIEWS dataset, where germplasm distribution information is provided for only two periods (2012–
- 1916 2014 and 2014–2019), countries were associated with their respective World Bank income levels as assigned
- 1917 by the World Bank at both the first (2012 or 2014) and the final (2014 or 2019) years of the reporting periods;
- 1918 total counts/percentages for each income category are provided based on the country assignments in the
- 1919 first and the final year of the respective period and an average between the two.
- 1920 A1.3.8 Designation of providers' and recipients' locations in terms of country status as Contracting Parties to the Treaty
- 1921 Information regarding whether providers and recipients were located in countries that were Contracting1922 Parties to the Treaty at the time of germplasm distribution was added to the datasets based on data provided
- 1923 directly to the authors from the Treaty in February 2022. The WIEWS dataset contains country information
- 1924 only for providers; the Treaty dataset contains country information for both providers and recipients.
- 1925 The Treaty Contracting Party data contained year of entry into force for each country. For the analysis, if the year of entry into force was the same as or earlier than the year of the germplasm distribution, the 1926 country was marked as a Contracting Party to the Treaty at the time of the distribution. For the Treaty 1927 1928 germplasm distributions dataset, where distribution information is available by year, countries were 1929 associated with their Contracting Party status in the respective year. For the WIEWS dataset, where 1930 distributions are assigned only to multiyear periods (2012-2014 and 2014-2019), countries were associated 1931 with their Treaty Contracting Party status as recorded for the first (2012 or 2014) and for final (2014 or 2019) 1932 years of the reporting period; total counts/percentages for both alternatives (assignment based on the first and last years of the respective period) as well as averages between respective figures were calculated. 1933
- A1.3.9 Designation of providers' and recipients' locations in terms of status as Contracting Parties to the Nagoya Protocol of
 the Convention on Biological Diversity
- Information regarding status as Contracting Parties to the Nagoya Protocol was added to the datasets based
 on data obtained from the Convention on Biological Diversity (CBD, 2022). The WIEWS dataset contains
 country information only for providers; the Treaty dataset contains country information for both providers
 and recipients.
- 1940 The Nagoya Protocol Contracting Party data contained the year of ratification for each country. For the purposes of the analysis, if the year of ratification was the same as, or earlier than, the year of the germplasm 1941 1942 distribution, the country was marked as a Contracting Party to the Nagoya Protocol at the time of the 1943 distribution. For the Treaty dataset, where distribution information is available by year, countries were 1944 associated with their Contracting Party status in the respective year. For the WIEWS dataset, where 1945 distribution information is provided in only for multivear periods (2012-2014 and 2014-2019), countries 1946 were associated with their Nagoya Contracting Party status as recorded in both the first (2012 or 2014) and 1947 the final (2014 or 2019) years of the reporting period; total counts/percentages for both alternatives 1948 (assignment based on the first and last years of the respective period) as well as averages between respective 1949 figures were calculated.

1950 A1.4. Additional sources of information

1951 The eleven CGIAR centres hosting international PGRFA collections pursuant to their 1994 in-trust agreements with FAO and their 2006 Article 15 agreements with the Governing Body of the Treaty maintain 1952 1953 records of their genebanks' acquisitions and distributions of PGRFA, on the Online Reporting Tool (ORT) 1954 maintained by the Global Crop Diversity Trust as coordinator of the CGIAR Genebank Reseach 1955 Programme (2012 to 2016) and Genebank Platform (2017 to 2021). The ORT includes data on the types of materials transferred by the genebanks as well as the types of recipients to whom it was transferred. 1956 1957 Unfortunately, no such centralized, aggregate data exist for CGIAR breeding programmes. The ORT data 1958 are used by the Crop Trust and CGIAR to develop reports to relevant international fora (FAO, 2017a, b, 1959 2019a, b) and other publications (Halewood et al., 2020; Lusty et al., 2021).

1960 A1.5 Data availability

1961 Compiled and processed datasets for the two main data sources are accessible in WIEWS (link TBD), and

1962 their data dictionaries are provided as Annex 2 and 3 of this report. Data from the additional sources of

- 1963 information are available in Halewood et al. (2020) and Lusty et al. (2021).
- 1964 References for Annex 1

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 Food and Agriculture. Rome. https://www.fao.org/3/ng622en/ng622en.pdf
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- 1991 Lusty, C., Sackville Hamilton, R., Guarino, L., Richards, C., Jamora, N. & Hawtin, G. 2021.
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- 1995 Restoration) & RBG Kew (Royal Botanic Gardens Kew). 2023. Seed Information Database Seed Storage
 1996 Behaviour. [Cited 26 September 2023]. https://ser-sid.org/definitions/storage
- 1997 **UNSTATS (United Nations Statistical Division)**. 2022. *Standard country or area codes for statistical use* 1998 *(M49)*. [Cited 31 July 2022]. https://unstats.un.org/unsd/methodology/m49/overview/
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 datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

2001 ANNEX 2: WIEWS Germplasm Distribution Dataset Dictionary

- 2002 Dictionary/notes on FAO WIEWS dataset fields:
- 2003 Dataset: Denotes which WIEWS data indicator. Data complete.
- Germplasm_distributions FAO WIEWS indicators 28 and 29 (8.4 Indicate for each crop, crop 2005 group or preferably for each taxon, the number of accessions and the number of samples distributed during 2006 the reporting period by the national genebank(s). Optionally, indicate the amounts distributed to the 2007 different categories of recipients)
- landraces_to_farmers FAO WIEWS indicator 6 (2.3 Indicate for each crop or crop group, the
 number of farmers' varieties/landraces distributed during the reporting period by national or local
 genebanks to farmers (either directly or through intermediaries).
- Answer_id Unique code for each report. Original data. Data complete aside from a very small number
 of records.
- 2013 Iteration Reporting time period. Either 2012-2014 or 2014-2019. Original data. Data complete.
- Provider_iso3_cleaned Origin country of distribution. Data fixed for Romania (ROU instead of ROM).
 Data complete.
- 2016 Provider_stakeholder Institution. Original data. Data complete.
- Provider_instcode Code for institution. Original data. Data complete aside from a very small number
 of records.
- 2019 Crop_original Original crop name(s). Original data. Data not complete.
- 2020 Crop_cleaned Processed/cleaned crop names. New data. Data complete.
- SOW2_grouping Crop type as per SOWII categorization. Original data. Data complete aside from a very small number of records.
- SOW2_grouping_cleaned Cleaned/processed crop type as per SOWII categorization. New data. Data
 complete.
- 2025 ▶ PL_group Plant group categorization. Original data. Data complete aside from a very small number of
 2026 records.
- PL_group_cleaned Cleaned/processed crop type as per PL_group categorization. New data. Data complete.
- 2029 Taxon Scientific name. Original data. Data complete aside from a very small number of records.
- 2030 Genus Genus. Original data. Data complete aside from a very small number of records.
- 2031 Species Species. Original data. Data not complete.

- 2032 Wild_relative Y/N if the sample is a wild relative based on taxonomy and crop names. New data.
- 2033 Completed to the extent possible.
- 2034 Farmer_varieties Data from landraces_to_farmers dataset. Original data.
- 2035 D Total_Accs Data from germplasm_distributions dataset. Original data. Refers to accession level (# of accessions distributed).
- 2037 Accs_to_NARC Data from germplasm_distributions dataset. Original data. Refers to within country distributions
- Accs_to_FarmerOrNGO Data from germplasm_distributions dataset. Original data. Refers to within
 country distributions.
- Accs_to_Others Data from germplasm_distributions dataset. Original data. Refers to within country distributions.
- 2043 Accs_to_ForeignStakeholders Data from germplasm_distributions dataset. Original data.
- Accs_to_Unknown Data from germplasm_distributions dataset. Original data. Refers to within country
 distributions
- 2046 Total_Samples Data from germplasm_distributions dataset. Original data. Refers to samples level (# of
 2047 samples distributed).
- 2048 Samples_to_NARC Data from germplasm_distributions dataset. Original data. Refers to within country
 2049 distributions.
- 2050 Samples_to_FarmerOrNGO data from germplasm_distributions dataset. Original data. Refers to within
 2051 country distributions.
- 2052 Samples_to_Others Data from germplasm_distributions dataset. Original data. Refers to within country distributions.
- 2054 Samples_to_ForeignStakeholders Data from germplasm_distributions dataset. Original data.
- Samples_to_Unknown Data from germplasm_distributions dataset. Original data. Refers to within
 country distributions.
- 2057 CropList_equivalent Name of crop in Crop List (Treaty Crop Indicator project) for those crops
 2058 matching. All other crops listed here as None. New data. Data complete.
- 2059 CropList_Use_primary General crop type category. Field from Crop List (Treaty Crop Indicator project). Field further filled manually for crops not matching to Crop List. Data complete.
- 2061 CropList_Use_detailed Specific crop type category. Field from Crop List (Treaty Crop Indicator project). Field further filled manually for crops not matching to Crop List. Data complete.
- CropList_MLS_Annex1_crop Y/N. lists if crop in Annex 1 of Plant Treaty MLS (only based on crop, not on provider or country). Field from Crop List (Treaty Crop Indicator project). Field further filled manually for crops not matching to Crop List. Data complete.
- 2066 CropList_Seed_storage_behaviour Orthodox/recalcitrant info, from Kew SID. Field from Crop List
 2067 (Treaty Crop Indicator project). Field only filled for crops matching to Crop List. Data not complete.
- CropList_seed_storage_behaviour_cleaned Orthodox/recalcitrant info, from Kew SID. Field from
 Crop List (Treaty Crop Indicator project). Field further filled manually for crops not matching to Crop List,
 as possible. Data not complete.
- Provider_iso3 Origin country of distribution. Original data, data complete (but error existing for Romania iso3).
- 2073 Germplasm_storage_type Seed/clonal/unknown. Refers to main likely way germplasm distributed for
 2074 crop. Data from Khoury *et al.* 2021 and further filled manually as possible. Data complete.
- 2075 Provider_region_name Region of provider country. Data from UNSTATs (2022). Data complete.

- 2076 Provider_subregion_name Subregion of origin country. Data from UNSTATs (2022). Data complete.
- 2077 Provider_intermediate_region_name Intermediate region of origin country. Data from UNSTATs
- 2078 (2022). Data complete.
- 2079 Provider_country_or_area Country name. Data from UNSTATs (2022). Data complete.
- 2080 Provider_iso2 Iso2 code of provider country. Data from UNSTATs (2022). Data complete.
- 2081 Provider_least_developed_countries_ldc Y/N. Data from UNSTATs (2022). Data complete.
- 2082 Provider_land_locked_developing_countries_lldc Y/N. Data from UNSTATs (2022). Data complete.
- 2083 Provider_small_island_developing_states_sids Y/N. Data from UNSTATs (2022). Data complete.
- 2084 Reporting_year_startyear Earliest year from Iteration field.
- 2085 Reporting_year_endyear Latest year from Iteration field.
- 2086 Analysis_year_startyear Earliest year from Iteration field.
- Provider_income_category_startyear Income level of provider country. Data from World Bank. World
 Bank income level data are per year; for this field, year is based on earliest year in Iteration field. Data
 complete.
- 2090 Analysis_year_endyear Latest year from Iteration field.
- Provider_income_category_endyear Income level of provider country. Data from World Bank. World
 Bank income level data is per year; for this field, year is based on latest year in Iteration field. Data complete.
- 2093 Crop use (FAOSTAT food supplies and production)
- ▶ FAOSTAT_Fat_supply_quantity_g_capita_day Data on contribution of crop to global food supplies in terms of fat, based on FAOSTAT data, averaged across years 2015–2018. Data for each row are total global data for crop, thus not summable across rows. Data only for crops in Crop List (Treaty Crop Indicator project).
- ▶ FAOSTAT_Food_supply_kcal_capita_day Data on contribution of crop to global food supplies in terms of calories, based on FAOSTAT data, averaged across years 2015–2018. Data for each row are total global data for crop, thus not summable across rows. Data only for crops in Crop List (Treaty Crop Indicator project).
- ▶ FAOSTAT_Food_supply_quantity_kg_capita_yr Data on contribution of crop to global food supplies
 in terms of food weight, based on FAOSTAT data, averaged across years 2015–2018. Data for each row are
 total global data for crop, thus not summable across rows. Data only for crops in Crop List (Treaty Crop
 Indicator project).
- ▶ FAOSTAT_Protein_supply_quantity_g_capita_day Data on contribution of crop to global food
 supplies in terms of protein, based on FAOSTAT data, averaged across years 2015–2018. Data for each row
 are total global data for crop, thus not summable across rows. Data only for crops in Crop List (Treaty Crop
 Indicator project).
- FAOSTAT_Production_area_harvested Data on contribution of crop to global production in terms of harvested area, based on FAOSTAT data, averaged across years 2015–2018. Data for each row are total global data for crop, thus not summable across rows. Data only for crops in Crop List (Treaty Crop Indicator project).
- ▶ FAOSTAT_Production_quantity Data on contribution of crop to global production in terms of production quantity, based on FAOSTAT data, averaged across years 2015–2018. Data for each row are total global data for crop, thus not summable across rows. Data only for crops in Crop List (Treaty Crop Indicator project).
- 2118 ▶ FAOSTAT_Production_value_cnst_2014-16_us Data on contribution of crop to global production in 2119 terms of production value, based on FAOSTAT data, averaged across years 2015–2018. Data for each row

- are total global data for crop, thus not summable across rows. Data only for crops in Crop List (Treaty CropIndicator project).
- 2121 Indicator project).
- 2122 Political contracting party status:
- 2123 Nagoya Protocol:

Provider_Nagoya_party_cleaned – Y/N if the provider country is currently Contracting Party to Nagoya
 Protocol (from Nagoya dataset). Data complete.

- Provider_Nagoya_party_year_cleaned Year of provider country joining as a Contracting Party (for provider countries Contracting Party to Nagoya Protocol) or blank (for provider countries not Contracting Party to Nagoya Protocol).
- Provider_Nagoya_party_during_transfer_startyear TRUE (provider country is Contracting Party to Nagoya Protocol) or FALSE (provider country is not Contracting Party to Nagoya Protocol) during year of germplasm distribution. Data based on field "Provider_Nagoya_Party_year_cleaned" (if that year is same or previous to distribution year (field "analysis_year_startyear"), then TRUE, if more recent or blank, then FALSE). Data complete.
- Provider_Nagoya_party_during_transfer_endyear TRUE (provider country is Contracting Party to Nagoya Protocol) or FALSE (provider country is not Contracting Party to Nagoya Protocol) during year of germplasm distribution. Data based on field "Provider_Nagoya_Party_year_cleaned" (if that year is same or previous to distribution year (field "analysis_year_endyear"), then TRUE, if more recent or blank, then
- 2138 FALSE). Data complete.
- 2139 The Treaty:
- Provider_Treaty_contracting_party_cleaned Yes/No if the provider country is currently Contracting
 Party to the Plant Treaty (from Plant Treaty contracting party dataset). Data complete.
- Provider_Treaty_entry_into_force_cleaned Year of provider country joining as a Contracting Party (for
- provider countries Contracting Party to Plant Treaty) or blank (for provider countries not Contracting Partyto Plant Treaty)
- Provider_Treaty_party_during_transfer_startyear TRUE (provider country is Contracting Party to Plant Treaty) or FALSE (provider country is not Contracting Party to Plant Treaty) during year of germplasm distribution. Data based on field "Provider_Treaty_entry_into_force_cleaned" (if that year is same or previous to distribution year (field "analysis_year_startyear"), then TRUE, if more recent or blank, then FALSE). Data complete.
- Provider_Treaty_party_during_transfer_endyear TRUE (provider country is Contracting Party to Plant Treaty) or FALSE (provider country is not Contracting Party to Plant Treaty) during year of germplasm distribution. Data based on field "Provider_Treaty_entry_into_force_cleaned" (if that year is same or previous to distribution year (field "analysis_year_endyear"), then TRUE, if more recent or blank, then FALSE). Data complete.

2155 ANNEX 3: The Treaty Germplasm Distribution Dataset Dictionary

- 2156 Dictionary/notes on Treaty dataset fields:
- 2157 Dataset: Denotes which the Treaty dataset. Original data. Data complete.
- CGIAR only International centres as provider (note provider_iso3 and provider_country list country where CGIAR center is located.
- Total transfers Full dataset (including CGIAR as well as all other transfers).
- 2161 Provider_iso3 Origin country code of distribution. Original data. Data complete.
- 2162 Provider_country Origin country of distribution. Original data. Data complete.
- 2163 Crop_original original crop name(s). Original data. Data complete.

- 2164 Crop_cleaned Processed/cleaned crop names. New data. Data complete.
- 2165 Taxonomic_name Scientific name. New data. Data not complete.
- Wild_relative Y/N if the sample is a wild relative based on taxonomy and crop names. New data.
 Completed to the extent possible.

2168 CropList_equivalent – Name of crop in Crop List (Treaty Crop Indicator project) for those crops
 2169 matching. All other crops listed here as None. New data. Data complete.

- 2170 Vear Year of germplasm distribution. Original data. Data complete.
- 2171 Number of samples Number of samples distributed. Original data. Data complete.
- 2172 Recipient_iso3 Recipient country code of distribution. Original data. Data complete.
- 2173 Recipient_country Recipient country of distribution. Original data. Data complete.
- SOW2_grouping_cleaned Cleaned/processed crop type as per SOWII categorization. New data. Data
 complete.
- PL_group_cleaned cleaned/processed crop type as per PL_group categorization. New data. Data
 complete.
- 2178 CropList_seed_storage_behaviour_cleaned Orthodox/recalcitrant info, from Kew SID. Field from
 2179 Crop List (Treaty Crop Indicator project). Field further filled manually for crops not matching to Crop List,
 2180 as possible. Data not complete.
- 2181 Germplasm storage type Seed/clonal/unknown. Refers to the main likely way germplasm distributed
 2182 for crop. Data from Khoury *et al.* (2021) and further filled manually as possible. Data complete.
- 2183 CropList_seed_storage_behavior Orthodox/recalcitrant info, from Kew SID. Field from Crop List
 2184 (Treaty Crop Indicator project). Field only filled for crops matching to Crop List. Data not complete.
- 2185 CropList_Use_detailed Specific use category. Field from Crop List (Treaty Crop Indicator project).
 2186 Field further filled manually for crops not matching to Crop List. Data complete.
- 2187 Description CropList_Use_primary General use category. Field from Crop List (Treaty Crop Indicator project).
 2188 Field further filled manually for crops not matching to Crop List. Data complete.
- CropList_MLS_Annex1_crop Y/N. lists if crop in Annex 1 of Treaty MLS (only based on crop, not on provider or country). Field from Crop List (Treaty Crop Indicator project). Field further filled manually for crops not matching to Crop List. Data complete.
- 2192 Provider_region_name Region of provider country. Data from UNSTATs (2022). Data complete.
- 2193 Provider_subregion_name Subregion of provider country. Data from UNSTATs (2022). Data complete.
- Provider_intermediate_region_name Intermediate region of provider country. Data from UNSTATs
 (2022). Data complete.
- 2196 Provider_country_or_area Provider country name. Data from UNSTATs (2022). Data complete.
- Provider_iso2 Iso2 code of provider country of distribution. Data from UNSTATs (2022). Data complete.
- 2199 Provider_least_developed_countries_ldc. Y/N. Data from UNSTATs (2022). Data complete.
- 2200 Provider_land_locked_developing_countries_lldc. Y/N. Data from UNSTATs (2022). Data complete.
- 2201 Provider_small_island_developing_states_sids. Y/N. Data from UNSTATs (2022). Data complete.
- 2202 Recipient_region_name Region of recipient country. Data from UNSTATs (2022). Data complete.
- 2203 Recipient_subregion_name Subregion of recipient country. Data from UNSTATs (2022). Data complete.

- 2205 Recipient_intermediate_region_name Intermediate region of recipient country. Data from UNSTATs
 2206 (2022). Data complete.
- 2207 Recipient_country_or_area Recipient country name. Data from UNSTATs (2022). Data complete.
- 2208 Recipient_iso2 iso2 code of recipient country of distribution. Data from UNSTATs (2022). Data complete.
- 2210 Recipient_least_developed_countries_ldc. Y/N. Data from UNSTATs (2022). Data complete.
- 2211 Recipient_land_locked_developing_countries_lldc. Y/N. Data from UNSTATs (2022). Data complete.
- 2212 Recipient_small_island_developing_states_sids. Y/N. Data from UNSTATs (2022). Data complete.
- Provider_income_category Income level of provider country. Data from World Bank. Based on year
 of distribution, as income levels can change year to year. Data complete.
- 2215 Recipient_income_category Income level of recipient country. Data from World Bank. Based on year
 2216 of distribution, as income levels can change year to year. Data complete.
- 2217 Crop importance (food supplies and production)
- FAOSTAT_Fat_supply_quantity_g_capita_day Data on contribution of crop to global food supplies
 in terms of fat, based on FAOSTAT data, averaged across years 2015–2018. Data for each row are total
 global data for crop, thus not summable across rows. Data only for crops in Crop List (Treaty Crop Indicator
 project).
- FAOSTAT_Food_supply_kcal_capita_day Ddata on contribution of crop to global food supplies in terms of calories, based on FAOSTAT data, averaged across years 2015–2018. Data for each row are total global data for crop, thus not summable across rows. Data only for crops in Crop List (Treaty Crop Indicator project).
- ▶ FAOSTAT_Food_supply_quantity_kg_capita_yr Data on contribution of crop to global food supplies
 in terms of food weight, based on FAOSTAT data, averaged across years 2015–2018. Data for each row are
 total global data for crop, thus not summable across rows. Data only for crops in Crop List (Treaty Crop
 Indicator project).
- FAOSTAT_Protein_supply_quantity_g_capita_day Data on contribution of crop to global food
 supplies in terms of protein, based on FAOSTAT data, averaged across years 2015–2018. Data for each row
 are total global data for crop, thus not summable across rows. Data only for crops in Crop List (Treaty Crop
 Indicator project).
- FAOSTAT_Production_area_harvested Data on contribution of crop to global production in terms of harvested area, based on FAOSTAT data, averaged across years 2015–2018. Data for each row are total global data for crop, thus not summable across rows. Data only for crops in Crop List (Treaty Crop Indicator project).
- FAOSTAT_Production_quantity Data on contribution of crop to global production in terms of production quantity, based on FAOSTAT data, averaged across years 2015–2018. Data for each row are total global data for crop, thus not summable across rows. Data only for crops in Crop List (Treaty Crop Indicator project).
- PAOSTAT_Production_value_cnst_2014-16_us Data on contribution of crop to global production in terms of production value, based on FAOSTAT data, averaged across years 2015–2018. Data for each row are total global data for crop, thus not summable across rows. Data only for crops in Crop List (Treaty Crop Indicator project).
- 2246 Political contracting party status:
- 2247 Nagoya Protocol:

Provider_Nagoya_Party_cleaned – Y/N if the provider country is currently a Contracting Party to
 Nagoya Protocol (from Nagoya dataset). Data complete.

- 2250 Provider_Nagoya_party_year_cleaned – year of provider country joining as a Contracting Party (for provider countries Contracting Party to Nagoya Protocol) or blank (for provider countries not Contracting 2251 Party to Nagoya) 2252
- 2253 Recipient_Nagoya_Party_cleaned – Y/N if the recipient country is currently Contracting Party to Nagoya 2254 Protocol (from Nagoya dataset). Data complete.
- 2255 Recipient_Nagoya_party_year_cleaned - year of joining (for recipient countries Contracting Party to Nagoya Protocol) or blank (for recipient countries not Contracting Party to Nagoya) 2256
- Provider_Nagoya_party_during_transfer TRUE (provider country is Contracting Party to Nagoya 2257 2258 protocol) or FALSE (provider country is not Contracting Party to Nagoya Protocol) during year of germplasm distribution. Data based on field "Provider_Nagoya_party_year_cleaned" (if that year is same or 2259 previous to distribution year, then TRUE, if more recent or blank, then FALSE). Data complete. 2260
- 2261 • Recipient_Nagoya_party_during_transfer - TRUE (recipient country is Contracting Party to Nagoya 2262 Protocol) or FALSE (recipient country is not Contracting Party to Nagoya protocol) during year of germplasm distribution. Data based on field "Recipient_Nagoya_party_year_cleaned" (if that year is the 2263 2264 same or previous to the distribution year, then TRUE, if more recent or blank, then FALSE). Data complete.
- 2265 The Treaty:
- ▶ Provider_Treaty_contracting_party_cleaned Y/N if the provider country is currently Contracting Party 2266 to the Plant Treaty (from Plant Treaty contracting party dataset). Data complete. 2267
- 2268 ▶ Provider_Treaty_entry_into_force_cleaned - Year of joining (for provider countries Contracting Party 2269 to Plant Treaty) or blank (for provider countries not Contracting Party to Plant Treaty)
- 2270 ▶ Recipient_Treaty_contracting_party_cleaned – Y/N if the recipient country is currently a Contracting 2271 Party to the Plant Treaty (from Plant Treaty contracting party dataset). Data complete.
- 2272 Recipient_Treaty_entry_into_force_cleaned - Year of joining (for recipient countries Contracting Party 2273 to ITPGRFA) or blank (for recipient countries not Contracting Party to ITPGRFA)
- 2274 ▶ Provider_Treaty_party_during_transfer – TRUE (provider country is Contracting Party to Plant Treaty) or FALSE (provider country is not Contracting Party to Plant Treaty) during year of germplasm distribution. 2275 2276 Data based on field "Provider_Treaty_entry_into_force_cleaned" (if that year is same or previous to the
- 2277 distribution year, then TRUE, if more recent or blank, then FALSE). Data complete.
- 2278 ▶ Recipient_Treaty_party_during_transfer – TRUE (recipient country is Contracting Party to Plant Treaty)
- 2279 or FALSE (recipient country is not Contracting Party to Plant Treaty) during year of germplasm distribution. Data based on field "Recipient_Treaty_entry_into_force_cleaned" (if that year is same or previous to the 2280 distribution year, then TRUE, if more recent or blank, then FALSE). Data complete. 2281
- 2282 References for Annex 3
- 2283 UNSTATS (United Nations Statistical Division). 2022. Standard country or area codes for statistical use

(M49). [Cited 31 July 2022]. https://unstats.un.org/unsd/methodology/m49/overview/ 2284