

Supplementary Table S1: A Glossary of Key Terms Used in the International Agreements

Biotechnology	Defined in the Convention to mean “any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use” and derivative is defined for this purpose as “a naturally occurring biochemical compound resulting from the genetic expression or metabolism of biological or genetic resources, even if it does not contain functional units of heredity.”
Digital sequence information (DSI)	There is not yet international agreement concerning the definition of ‘Digital Sequence Information’ or DSI. So DSI is a ‘placeholder’ term that negotiators have agreed to use under the aegis of the Convention, Plant Treaty, and other international agreements until such time as they can agree on a definition. The Convention Secretariat has published a generally highly regarded framework for negotiators to consider when assessing the scope of information that should be included in the definition, setting out options that include successively broader layers of information that can be derived from underlying genetic material, e.g. DNA and RNA only, DNA, RNA and proteins, DNA, RNA, proteins and metabolites, DNA, RNA, proteins, metabolites and all other associated information including traditional knowledge ⁵ . There is currently a contentious debate about whether access to and use of digital sequence information (DSI) derived from genetic resources should be subject to ABS regulations, including one or more of the Convention, Nagoya Protocol and or Plant Treaty, or even some new international instrument. This debate is discussed further in Section III.
Functional unit of heredity (as used in the definition of “genetic material”)	Not defined in the agreements. The term is generally understood to mean “heritable material” or “any genes, nucleic acids, or other molecules from the organism that can, without human intervention, replicate in a biological system and transfer a character or trait to another organism or to subsequent generations of the organism”.
Genetic material	Defined in the Convention (and therefore in the Nagoya Protocol) as “any material of plant, animal, microbial or other origin containing functional units of heredity”, and in the Plant Treaty as “any material of plant origin, including reproductive and vegetative propagating material, containing functional units of heredity .”
Plant genetic resources (PGR)	Not specifically defined in the Plant Treaty, Convention or Nagoya Protocol. The Convention (and therefore the Nagoya Protocol) define the broader term “Genetic Resources” as “ genetic material of actual or potential value.” The Plant Treaty defines a subset of genetic resources by both its origin and use: plant genetic resources for food and agriculture (see below).

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Plant genetic resources for food and agriculture (PGRFA)	Defined as “ genetic material of plant origin of actual or potential value for food and agriculture.”
Utilization of genetic resources	Defined in the Nagoya Protocol to mean “to conduct research and development on the genetic and/or biochemical composition of genetic resources, including through the application of biotechnology.”

Supplementary Table S2

International Treaty on Plant Genetic Resources for Food and Agriculture Annex 1

List of crops covered under the Multilateral System

Food crops

Crop	Genus	Observations
Breadfruit	<i>Artocarpus</i>	Breadfruit only.
Asparagus	<i>Asparagus</i>	
Oat	<i>Avena</i>	
Beet	<i>Beta</i>	
Brassica complex.	<i>Brassica</i> et al	Genera included are: <i>Brassica</i> , <i>A Armoracia</i> , <i>Barbarea</i> , <i>Camelina</i> , <i>Crambe</i> , <i>Diplotaxis</i> , <i>Eruca</i> , <i>Isatis</i> , <i>Lepidium</i> , <i>Raphanobrassica</i> , <i>Raphanus</i> , <i>Rorippa</i> , and <i>Sinapis</i> . This comprises oilseed and vegetable crops such as cabbage, rapeseed, mustard, cress, rocket, radish, and turnip. The species <i>Lepidium meyenii</i> (maca) is excluded.
Pigeon Pea	<i>Cajanus</i>	
Chickpea	<i>Cicer</i>	
Citrus	<i>Citrus</i>	Genera <i>Poncirus</i> and <i>Fortunella</i> are included as root stock.
Coconut	<i>Cocos</i>	
Major aroids	<i>Colocasia</i> , <i>Xanthosoma</i>	Major aroids include taro, cocoyam, dasheen and tannia.
Carrot	<i>Daucus</i>	
Yams	<i>Dioscorea</i>	
Finger Millet	<i>Eleusine</i>	
Strawberry	<i>Fragaria</i>	
Sunflower	<i>Helianthus</i>	
Barley	<i>Hordeum</i>	
Sweet Potato	<i>Ipomoea</i>	
Grass pea	<i>Lathyrus</i>	
Lentil	<i>Lens</i>	
Apple	<i>Malus</i>	
Cassava	<i>Manihot</i>	<i>Manihot esculenta</i> only.
Banana/Plantain	<i>Musa</i>	Except <i>Musa textilis</i> .
Rice	<i>Oryza</i>	
Pearl Millet	<i>Pennisetum</i>	
Beans	<i>Phaseolus</i>	Except <i>Phaseolus polyanthus</i> .
Pea	<i>Pisum</i>	
Rye	<i>Secale</i>	
Potato	<i>Solanum</i>	Section <i>tuberosa</i> included, except <i>Solanum phureja</i> .
Eggplant	<i>Solanum</i>	Section <i>melongena</i> included.

Sorghum	<i>Sorghum</i>	
Triticale	<i>Triticosecale</i>	
Wheat	<i>Triticum et al.</i>	Including <i>Agropyron</i> , <i>Elymus</i> , and <i>Secale</i> .
Faba Bean/Vetch	<i>Vicia</i>	
Cowpea <i>et al.</i>	<i>Vigna</i>	
Maize	<i>Zea</i>	Excluding <i>Zea perennis</i> , <i>Zea diploperennis</i> , and <i>Zea luxurians</i>

Forages

Genera	Species
LEGUME FORAGES	
<i>Astragalus</i>	<i>chinensis, cicer, arenarius</i>
<i>Canavalia</i>	<i>ensifomis</i>
<i>Coronilla</i>	<i>varia</i>
<i>Hedysarum</i>	<i>coronarium</i>
<i>Lathyrus</i>	<i>cicera, ciliolatus, hirsutus, ochrus, odoratus, sativus</i>
<i>Lespedeza</i>	<i>cuneata, striata, stipulacea</i>
<i>Lotus</i>	<i>corniculatus, subbiflorus, uliginosus</i>
<i>Lupinus</i>	<i>albus, angustifolius, luteus</i>
<i>Medicago</i>	<i>arborea, falcata, sativa, scutellata, rigidula, truncatula</i>
<i>Melilotus</i>	<i>albus, officinalis</i>
<i>Onobrychis</i>	<i>viciifolia</i>
<i>Ornithopus</i>	<i>sativus</i>
<i>Prosopis</i>	<i>affinis, alba, chilensis, nigra, pallida</i>
<i>Pueraria</i>	<i>phaseoloides</i>
<i>Trifolium</i>	<i>alexandrinum, alpestre, ambiguum, angustifolium, arvense, agrocicerum, hybridum, incarnatum, pratense, repens, resupinatum, rueppellianum, semipilosum, subterraneum, vesiculosum</i>
GRASS FORAGES	
<i>Andropogon</i>	<i>gayanus</i>
<i>Agropyron</i>	<i>cristatum, desertorum</i>
<i>Agrostis</i>	<i>stolonifera, tenuis</i>
<i>Alopecurus</i>	<i>pratensis</i>
<i>Arrhenatherum</i>	<i>elatius</i>
<i>Dactylis</i>	<i>glomerata</i>
<i>Festuca</i>	<i>arundinacea, gigantea, heterophylla, ovina, pratensis, rubra</i>
<i>Lolium</i>	<i>hybridum, multiflorum, perenne, rigidum, temulentum</i>
<i>Phalaris</i>	<i>aquatica, arundinacea</i>
<i>Phleum</i>	<i>pratense</i>

<i>Poa</i>	<i>alpina, annua, pratensis</i>
<i>Tripsacum</i>	<i>laxum</i>
OTHER FORAGES	
<i>Atriplex</i>	<i>halimus, nummularia</i>
<i>Salsola</i>	<i>vermiculata</i>

Supplementary Table S3. Forms of Benefit-Sharing under the Nagoya Protocol

<i>Monetary benefits may include, but not be limited to:</i>	<i>Non-monetary benefits may include, but not be limited to:</i>
<p>(a) Access fees/fee per sample collected or otherwise acquired;</p> <p>(b) Up-front payments;</p> <p>(c) Milestone payments;</p> <p>(d) Payment of royalties;</p> <p>(e) Licence fees in case of commercialization;</p> <p>(f) Special fees to be paid to trust funds supporting conservation and sustainable use of biodiversity;</p> <p>(g) Salaries and preferential terms where mutually agreed;</p> <p>(h) Research funding;</p> <p>(i) Joint ventures;</p> <p>(j) Joint ownership of relevant intellectual property rights.</p>	<p>(a) Sharing of research and development results;</p> <p>(b) Collaboration, cooperation and contribution in scientific research and development programmes, particularly biotechnological research activities, where possible in the Party providing genetic resources;</p> <p>(c) Participation in product development;</p> <p>(d) Collaboration, cooperation and contribution in education and training;</p> <p>(e) Admittance to ex situ facilities of genetic resources and to databases;</p> <p>(f) Transfer to the provider of the genetic resources of knowledge and technology under fair and most favourable terms, including on concessional and preferential terms where agreed, in particular, knowledge and technology that make use of genetic resources, including biotechnology, or that are relevant to the conservation and sustainable utilization of biological diversity;</p> <p>(g) Strengthening capacities for technology transfer;</p> <p>(h) Institutional capacity-building;</p> <p>(i) Human and material resources to strengthen the capacities for the administration and enforcement of access regulations;</p> <p>(j) Training related to genetic resources with the full participation of countries providing genetic resources, and where possible, in such countries;</p> <p>(k) Access to scientific information relevant to conservation and sustainable use of biological diversity, including biological inventories and taxonomic studies;</p> <p>(l) Contributions to the local economy;</p> <p>(m) Research directed towards priority needs, such as health and food security, taking into account domestic uses of genetic resources in the Party providing genetic resources;</p> <p>(n) Institutional and professional relationships that can arise from an access and benefit-sharing agreement and subsequent collaborative activities;</p> <p>(o) Food and livelihood security benefits;</p> <p>(p) Social recognition;</p> <p>(q) Joint ownership of relevant intellectual property rights</p>

Supplementary Table S4

Key Terms of the Standard Material Transfer Agreement, International Treaty on Plant Genetic Resources for Food and Agriculture

Section	Text	Key Points
6.1	<i>The Recipient undertakes that the Material shall be used or conserved only for the purposes of research, breeding and training for food and agriculture. Such purposes shall not include chemical, pharmaceutical and/or other non-food/feed industrial uses.</i>	The terms, “research, breeding and training for food and agriculture,” are not further defined in the Plant Treaty and therefore have their commonly understood meaning. When users access PGR and sign the SMTA, they agree to this term. The Plant Treaty allows research and breeding for commercial purposes in food and agriculture. However, if a user intends to use the PGR for an industrial, pharmaceutical purpose, they could not agree to this term. Note, however, that PGR accessed for other purposes may be subject to the Convention and Nagoya Protocol, as discussed below.
6.2	The Recipient shall not claim any intellectual property or other rights that limit the facilitated access to the Material provided under this Agreement, or its genetic parts or components, in the form received from the Multilateral System.	This term is intended to ensure that PGR in the Multilateral System remain available for future users and are not tied up by patents or other forms of intellectual property protection. Importantly, however, this limitation applies only to the PGR “in the form received.” Therefore, users cannot patent or pursue plant variety protection on PGR that they receive from the multilateral system (or on PGR that is propagated in ways that preserve its genetic identity) but they can develop new plant varieties and subject those to intellectual property protection. However, this term does not prevent users from seeking patent, plant variety protection or other intellectual property protections on a form of PGR that they derive or breed using the PGR they accessed from the multilateral system, provided the claim does not seek to restrict access to the original material.
6.3	In the case that the Recipient conserves the Material supplied, the Recipient shall make the Material and related information	Taken together, Sections 6.3 and 6.4 mean that users can make further transfers of the PGRFA that they receive under the SMTA,

	referred to in Article 5b, available to the Multilateral System using the SMTA.	but they must make those transfers under a new SMTA and notify the Governing Body that they have done so in accordance with the reporting instructions determined by the Governing Body. This information should be submitted directly to the Plant Treaty Secretariat, which has provided simple tools for online reporting (https://mls.planttreaty.org/).
6.4	In the case that the Recipient transfers the Material supplied under this Agreement to another person or entity (hereinafter referred to as “the subsequent recipient”), the Recipient shall a) do so under the terms and conditions of the SMTA, through a new material transfer agreement; and b) notify the Governing Body, in accordance with Article 5e.	
6.5	In the case that the Recipient transfers a PGRFA Under Development to another person or entity, the Recipient shall: a) do so under the terms and conditions of the SMTA, through a new material transfer agreement, provided that Article 5a of the SMTA shall not apply; b) identify, in Annex 1 to the new material transfer agreement, the Material received from the Multilateral System, and specify that the PGRFA under Development being transferred are derived from the Material; c) notify the Governing Body, in accordance with Article 5e; and d) have no further obligations regarding the actions of any subsequent recipient.	These terms provide an obligation on users who have signed the SMTA with respect to PGRFA Under Development to ensure that a material transfer agreement also applies if the user passes on the material to a subsequent user. Notably, for PGRFA Under Development, one article of the SMTA (5a) does not apply, and the provider and recipient can attach to the SMTA additional conditions (6.6) relating to product development.
6.6	Entering into a material transfer agreement under paragraph 6.5 shall be without prejudice to the right of the parties to attach additional conditions, relating to further product development, including, as appropriate, the payment of monetary consideration.	
6.7	In the case that the Recipient commercializes a Product that is a PGRFA and that incorporates Material as referred to in Article 3 of this Agreement, and where such Product is not available without restriction to others for further research and breeding, the Recipient shall pay a fixed percentage of the Sales of the commercialized Product into the mechanism established by the Governing	These terms (and 6.11 which presents an alternative form of monetary benefit-sharing) together define the benefit sharing obligation under the SMTA. Monetary benefit-sharing obligations are triggered if the party commercializing the product that incorporates PGR from the multilateral system restricts use of that product for further research and breeding. If there are such restrictions, then the party

	Body for this purpose, in accordance with Annex 2 to this Agreement.	commercializing the product is obligated to pay a fixed percentage of profit, which has been determined by the Plant Treaty coming from commercial sales to the Benefit Sharing Fund. If, however, a party commercializes a product that “incorporates” PGR from the multilateral system but allows that commercialized product to be made available to others for research or breeding without restriction, then the monetary benefit sharing obligations do not apply. [SMTA Article 6.8] Note that the SMTA encourages voluntary payments to the Benefit-Sharing Fund in such cases.
6.8	In the case that the Recipient commercializes a Product that is a PGRFA and that incorporates Material as referred to in Article 3 of this Agreement and where that Product is available without restriction to others for further research and breeding, the Recipient is encouraged to make voluntary payments into the mechanism established by the Governing Body for this purpose in accordance with Annex 2 to this Agreement	
6.9	The Recipient shall make available to the Multilateral System, through the information system provided for in Article 17 of the Treaty, all non-confidential information that results from research and development carried out on the Material, and is encouraged to share through the Multilateral System non-monetary benefits expressly identified in Article 13.2 of the Treaty that result from such research and development. After the expiry or abandonment of the protection period of an intellectual property right on a Product that incorporates the Material, the Recipient is encouraged to place a sample of this Product into a collection that is part of the Multilateral System for research and breeding	<p>This provision obligates the user of PGRFA from the Multilateral System to contribute “non-confidential information that results from research and development” to a Global Information System, or GLIS, per Article 17 of the Plant Treaty. The Plant Treaty is in the process of building this GLIS based on integration of existing systems. The aim is to facilitate exchange of scientific, technical and environmental information on PGRFA.</p> <p>The Plant Treaty started issuing DOIs in October 2017 to accurately and permanently identify PGRFA. Assigning and using GLIS DOIs for PGRFA is currently the only routine way of complying with article 6.9. The GLIS extends to all PGRFA, not only those in Annex 1 of the Plant Treaty. In addition, the Plant Treaty will assign DOIs to any PGRFA, regardless of whether it is included in the Multilateral System.</p>