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COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Item 8.1 of the Provisional Agenda

Seventeenth Regular Session

Rome, 18–22 February 2019

REPORT OF THE FIRST MEETING OF THE EXPERT GROUP ON MICRO-ORGANISM AND INVERTEBRATE GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Note by the Secretariat

The Commission, at its last session, agreed to produce non-prescriptive explanatory notes describing, within the context of the *Elements to Facilitate Domestic Implementation of Access and Benefit-sharing for Different Subsectors of Genetic Resources for Food and Agriculture* (ABS Elements), the distinctive features and specific practices of different subsectors of genetic resources for food and agriculture (GRFA), to complement the ABS Elements.

The Commission requested the Secretariat to invite seven regionally representative experts from the subsectors of micro-organism and invertebrate GRFA, designated by the Secretary in consultation with the Bureau, to attend the International Workshop on Access and Benefit-sharing for Genetic Resources for Food and Agriculture. Experts nominated by their regions attended the Workshop, held from 10 to 13 January 2018.

The Commission also requested the Secretariat to convene the experts to (i) review the draft explanatory notes for their subsectors and (ii) review and provide inputs to the draft exploratory fact-finding scoping study on "digital sequence information" on GRFA. The Expert Group on Micro-organism and Invertebrate Genetic Resources for Food and Agriculture (Expert Group) met from 3 to 5 October 2018. On this occasion, the Expert Group also reviewed the *Draft Work Plan for the Sustainable Use and Conservation of Micro-organism and Invertebrate Genetic Resources for Food and Agriculture*.

The report of the Expert Group is contained in this document, for the information of the Commission.

Food and Agriculture Organization of the United Nations

COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

CGRFA/EG-MIGR-1/18/Report

First Meeting of the Expert Group on Micro-organism and Invertebrate Genetic Resources for Food and Agriculture

Rome, Italy, 3 – 5 October 2018

CGRFA/EG-MIGR-1/18/Report

COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

REPORT OF THE FIRST MEETING OF THE EXPERT GROUP ON MICRO-ORGANISM AND INVERTEBRATE GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Rome, Italy, 3 – 5 October 2018

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Rome, 2018

The documents prepared for the First Meeting of the Expert Group on Micro-organism and Invertebrate Genetic Resources for Food and Agriculture of the Commission on Genetic Resources for Food and Agriculture are available on the Internet at the following address:

http://www.fao.org/cgrfa/meetings/ttle-abs/en/

TABLE OF CONTENTS

I. OPENING OF THE MEETING

1. The First Meeting of the Expert Group on Micro-organism and Invertebrate Genetic Resources for Food and Agriculture (Expert Group) met in Rome, Italy, from 3 to 5 October 2018. The list of experts attending the meeting is given in *Appendix A* to this report.

2. Mr Dan Leskien, Senior Liaison Officer, Commission on Genetic Resources for Food and Agriculture (the Commission) Secretariat, welcomed all participants to the meeting. He noted that the Commission requested the Secretariat to convene a meeting of the Expert Group to review draft explanatory notes describing, within the context of the ABS Elements,[1] the distinctive features of micro-organism and invertebrate genetic resources for food and agriculture (MIGR) and to review and provide inputs to the draft exploratory fact-finding scoping study on "digital sequence information" on genetic resources for food and agriculture (GRFA). In addition, the Expert Group would also be consulted on the Commission's draft work plan for the sustainable use and conservation of MIGR. He then provided a brief introduction to the work of the Commission.

II. ELECTION OF CHAIR AND *RAPPORTEUR*

3. The Expert Group elected Ms Johannette Klapwijk (The Netherlands) as Chair of the Expert Group. Mr Scott Miller (United States of America) was elected *Rapporteur*.

III. ADOPTION OF THE AGENDA

4. The Expert Group adopted the agenda as given in *Appendix B* to this report.

IV. DRAFT EXPLANATORY NOTES DESCRIBING, WITHIN THE CONTEXT OF THE ABS ELEMENTS, THE DISTINCTIVE FEATURES OF MICRO-ORGANISM AND INVERTEBRATE GENETIC RESOURCES FOR FOOD AND AGRICULTURE

5. The Expert Group considered the document *Draft explanatory notes describing, within the context of the ABS Elements, the distinctive features of micro-organism and invertebrate genetic resources for* food *and agriculture*[2] and took note of *Inputs by Members and Observers on Access and Benefit-sharing for Genetic Resources for Food and Agriculture*[3] and the *Outputs of the International Workshop on Access and Benefit-sharing for Genetic Resources for Food and Agriculture.*[4] The Expert Group took also note of the document *Access and Benefit-sharing for Genetic Resources for Food and Agriculture: Survey Findings*[5] and the *Proceedings of the International Workshop on Access and Benefit-Sharing for Genetic Resources for Food and Agriculture.*[6]

6. The Expert Group reviewed and revised the relevance of distinctive features of GRFA to MIGR, as indicated in *Appendix C* to this report.

7. The Expert Group reviewed and revised the draft explanatory notes, as given in *Appendix D* to this report, for further consideration by the Team of Technical and Legal Experts on Access and Benefit-sharing and the Commission, at their next sessions. It recommended that MIGR be duly considered in their deliberations.

[1] Elements to Facilitate Domestic. Implementation of Access and Benefit-Sharing for Different Subsectors of Genetic Resources: http://www.fao.org/3/a-i5033e.pdf
[2] CGRFA/EG-MIGR-1/18/2.
[3] CGRFA/EG-MIGR-1/18/Inf.2
[4] CGRFA/EG-MIGR-1/18/Inf.3.
[5] CGRFA/EG-MIGR-1/18/Inf.4.
[6] http://www.fao.org/3/CA0099EN/ca0099en.pdf

V. DRAFT EXPLORATORY FACT-FINDING SCOPING STUDY ON "DIGITAL SEQUENCE INFORMATION" ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

8. The Expert Group considered the document *Draft Exploratory Fact-Finding Scoping Study on "Digital Sequence Information" on Genetic Resources for Food and Agriculture.*[7]

9. The Expert Group welcomed the draft exploratory fact-finding scoping study and noted that it was a comprehensive, informative and useful report.

10. The Expert Group endorsed the comments received in writing from some of its Members. It stressed the importance of public databases, such as GenBank, European Molecular Biology Laboratory (EMBL) and the DNA Data Bank of Japan (DDBJ), to support identification and diagnostic tools, such as DNA barcoding. The Expert Group noted that digital sequence information (DSI) is particularly important for MIGR in terms of characterization. It recommended that the study, in the sections on characterization of GRFA (in the executive summary and section 3.1), include references to the importance of open data to reproducibility in science in light of the ongoing progress in this field.[8]

11. The Expert Group recommended to specify on p. 62, the important role of DSI for the identification and characterization of traits and for the improvement of GRFA through breeding.

12. The Expert Group also recommended that the study highlight the importance of using DSI in genetic resources research and development.

13. The Expert Group recommended that the study include a reference to a case study on a Salmonella outbreak that demonstrates how global sharing of whole genome sequence (WGS) data can enhance the response to international food-borne outbreaks.[9]

VI. DRAFT WORK PLAN FOR THE SUSTAINABLE USE AND CONSERVATION OF MICRO-ORGANISM AND INVERTEBRATE GENETIC RESOURCES FOR FOOD AND AGRICULTURE

14. The Expert Group considered the document *Draft Work Plan for the Sustainable Use and Conservation of Micro-organism and Invertebrate Genetic Resources for Food and Agriculture.*[10]

15. The Expert Group reviewed the draft work plan for the sustainable use and conservation of micro-organism and invertebrate genetic resources for food and agriculture, in particular the list of functional groups identified and the order in which they should be considered by the Commission. The Expert Group recommended that in view of the recent publication of *The assessment report on pollinators, pollination and food production*[11] of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the Commission address pollinators, including honey bees, at its 18th Regular Session. Its work could build upon, complement and supplement the findings of the IPBES report from a food and agriculture perspective to assist countries to strengthen the conservation and use of pollinators.

16. The Expert Group recommended that the Commission address at its 19th, 20th and 21st Regular Sessions, in no particular order: biological control agents and pests and diseases, including invasive species; beneficial soil micro-organisms and invertebrates, including biostimulants and plant growth promoters; and organisms used as dietary components of food/feed, including edible fungi, insects and

[7] CGRFA/EG-MIGR-1/18/3.
[8] McNutt, M. 2014. Reproducibility. *Science*. 343(6168): 229 and *Nature* journal special collection *Challenges in irreproducible research* (available at www.nature.com/collections/prbfkwmwvz).
[9] FAO. 2016. Technical paper on the applications of whole genome sequencing in food safety management (available at http://www.fao.org/3/a-i5619e.pdf).
[10] CGRFA/EG-MIGR-1/18/4.
[11] Potts, S. G., *et al*., 2016. The assessment report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services on pollinators, pollination and food production (available at: https://www.ipbes.net/assessment-reports/pollinators).

algae. It noted that these functional groups made important contributions to sustainable food and agriculture, food security and nutrition. The Expert Group recommended that the Commission address food processing and agro-industrial processes at its 22nd Regular Session and micro-organisms of relevance to animal digestion at its 23nd Regular Session.

17. The Expert Group recommended that the Commission consider addressing endosymbionts as an additional functional group of micro-organisms in its work plan. It also stressed the importance of taxonomic work for the micro-organism and invertebrate sector, which is vital to monitoring agricultural pests and diseases, including invasive alien species.

18. The Expert Group recommended that the future work of the Commission on MIGR be reviewed by a specific group with expertise on micro-organisms and invertebrates rather than by the different working groups of the Commission.

VII. CLOSING REMARKS

19. Mr Dan Leskien thanked all experts for having attended the meeting. He stressed the importance of MIGR and that the outputs of this meeting would be very valuable in moving forward the Commission's work in this area. In addition, he noted the relevance for the experts to attend the Commission meetings to allow for increased visibility and understanding of this sector. The Expert Group thanked the Secretariat and other support staff for the preparation of the meeting documents and the support during the meeting.

APPENDIX A
LIST OF EXPERTS

Asia

Mr Eldrin De Los Reyes ARGUELLES
Specialist Microbiologist (PAM)
Curator of Microalgae and Cyanobacteria
University Researcher
Philippine National Collection of Microorganisms
National Institute of Molecular Biology (BIOTECH)
University of the Philippines
Los Baños College, Laguna 403
Los Baños
Philippines
Email: edarguelles@up.edu.ph

Europe

Ms Johannette KLAPWIJK
Regulatory Affairs Specialist Entomology
Koppert Biological Systems
P.O. Box 155
2650 AD Berkel en Rodenrijs
The Netherlands
Email: jklapwijk@koppert.nl

Latin America and the Caribbean

Mr Andrés FRANCE IGLESIAS
Ingeniero Agrónomo/Investigador
Instituto de Investigaciones Agropecuarias (INIA)
Ministerio de Agricultura
Director – Colección Chilena de
Recursos Genéticos Microbianos
Av. Vicente Méndez 515
Chillán
Chile
Email: afrance@inia.cl

Near East and North Africa

Mr Hussain AL-JUMAILI
Adviser for Animal Resources
Ministry of Agriculture
Baghdad
Iraq
Email: hussain.soaud@hotmail.com

North America

Mr Scott MILLER
Deputy Under Secretary, Science and Collections
Office of the Provost
Under Secretary for Museums and Research
Smithsonian Institution
P.O.Box 37012, MRC 009
Washington, DC 20013-7012
United States of America
Email: MillerS@si.edu

APPENDIX B

AGENDA OF THE FIRST MEETING OF THE EXPERT GROUP ON MICRO-ORGANISM AND INVERTEBRATE GENETIC RESOURCES FOR FOOD AND AGRICULTURE

1. Election of Co-Chair(s) and *Rapporteur*
2. Adoption of the agenda and time-table
3. Draft explanatory notes describing, within the context of the ABS Elements, the distinctive features of micro-organism and invertebrate genetic resources for food and agriculture
4. “Digital sequence information” on genetic resources for food and agriculture
5. Draft work plan for future work on sustainable use and conservation of micro-organism and invertebrate genetic resources for food and agriculture
6. Any other matters
7. Adoption of the Report

APPENDIX C

DISTINCTIVE FEATURES OF MICRO-ORGANISM AND INVERTEBRATE[12] GENETIC RESOURCES FOR FOOD AND AGRICULTURE

		MGR	IGR
A. Role of GFA for food security	A.1 GRFA are an integral part of agricultural and food production systems and play an essential role for achieving food security and the sustainable development of the food and agriculture sector.	+	+
	A.2 Plant, animal, invertebrate and micro-organism GRFA form an interdependent network of genetic diversity in agricultural and aquatic ecosystems.	+	+
B. Role of human management	B.1 (a) The existence of most GRFA is closely linked to human activity. (b) Many GRFA can be regarded as human-modified forms of genetic resources.	(a): - (b): +/-	-
	B.2 The maintenance and evolution of many GRFA depend on continued human intervention, and their sustainable utilization in research, development and production is an important instrument to ensure conservation.	-	-
C. International exchange and interdependence	C.1 Historically, GRFA have been widely exchanged across communities, countries and regions over often long periods of time, and a relevant part of the genetic diversity used in food and agriculture today is of exotic origin.	-	+
	C.2 Countries are interdependent with regard to GRFA and act both as providers of some GRFA and as recipients of others.	+	+
	C.3 The international exchange of GRFA is essential to the functioning of the sector, and its importance is likely to increase in future.	+	+
D. Nature of the innovation process	D.1 The innovation process for GRFA is usually of incremental nature and the result of contributions made by many different people, including indigenous and local communities, farmers, researchers and breeders, in different places and at different points in time.	-	-
	D.2 Many GRFA products are not developed out of an individual genetic resource, but with the contributions of several GRFA at different stages in the innovation process.	-	-
	D.3 Most products developed with the use of GRFA can in turn be used as genetic resources for further research and development, which makes it difficult to draw a clear line between providers and recipients of GRFA.	+	+
	D.4 Many agricultural products reach the market place in a form in which they may be used both as biological resources and as genetic resources.	+	+
E. Holders and users of GRFA	E.1 (a) GRFA are held and used by a broad range of very diverse stakeholders. (b) There are distinct communities of providers and users with respect to the different subsectors of GRFA.	(a): + (b): +	(a): - (b): +
	E.2 The different stakeholders managing and using GRFA are interdependent.	-	-
	E.3 A significant amount of GRFA is privately held.	-	-
	E.4 An important part of GRFA is held and can be accessed *ex situ*.	+	-
	E.5 An important part of GRFA is conserved *in situ* and on farm under different financial, technical and legal conditions.	+	+
	F.1 The exchange of GRFA takes place in the context of customary practices and existing communities of providers and users.	+	+

[12] This report considers under the term IGR primarily invertebrate BC agents. Invertebrate pollinators are considered animal genetic resources. Aquatic invertebrates used for food are considered aquatic genetic resources. IGR used for other purposes of relevance to agriculture could be addressed in future work.

F. GRFA exchange practices	F.2 An extensive transfer of genetic material between different stakeholders along the value chain occurs in research and development.	-	-
G. Benefits generated with the use of GRFA	G.1 (a) While the overall benefits of GRFA are very high, (b) it is difficult to estimate at the time of the transaction the expected benefits of an individual sample of GRFA.	(a): +/- (b): +	(a): - (b): +
	G.2 The use of GRFA may also generate important non-monetary benefits.	+	+
	G.3 The use of GRFA may lead to external effects going far beyond the individual provider and recipient.	+	+

APPENDIX D

EXPLANATORY NOTES DESCRIBING, WITHIN THE CONTEXT OF THE ABS ELEMENTS, THE DISTINCTIVE FEATURES OF MICRO-ORGANISM AND INVERTEBRATE GENETIC RESOURCES FOR FOOD AND AGRICULTURE[13]

The following draft explanatory notes aim to (i) provide relevant background information on MIGR to policy-makers developing, adapting or implementing ABS measures and (ii) clarify some of the issues raised in the ABS Elements as they are relevant to MIGR.

Background information on micro-organism and invertebrate genetic resources for food and agriculture

1. ABS policy-makers may find it useful to receive some background information on the use and exchange of MIGR. Explanatory notes should therefore explain that:

Micro-organism genetic resources (MGR) and invertebrate genetic resources (IGR) have been used as food and as tools for agricultural production for millennia.

Micro-organism genetic resources[14]

The number of MGR currently used for food or agriculture applications is small relative to the huge number of species potentially useful, in part because of technical limitations to the culturing of many living micro-organisms. Agriculture applications of MGR are nevertheless quite diverse: soil fertility improvement and plant growth promoting agents; biological control; beneficial symbiosis in the digestive tracts of livestock; production of chemicals of direct benefit to agriculture; catalysts in agro-industrial processes; understanding and surveillance of microbial plant and animal (including fish) pathogens. Food applications are also quite varied: traditional fermentation (fermented foods); industrial fermentation of alcohol and wines; dairy production; probiotics; feed additives; production of chemicals of benefit to food production, including vitamins and organic acids; environmental damage remediation and purification of soils and water; and understanding and surveillance of health-hazardous micro-organisms such as food toxins and food-borne pathogens.

Use of MGR is mainly carried out by screening large quantities of naturally occurring micro-organisms or microbial resources conserved in purified form in *ex situ* collections. Synthetic biology may involve genetic improvement, but this remains a marginal phenomenon although it may grow in the future.

Microbial culture collections (MCCs) are at the heart of the sector. All known culture collections with major holdings in food and agriculture belong to the public sector or are non-profit organizations with major governmental funding. They fulfil several objectives: procurement of cultures and *ex situ* conservation of micro-organisms; provision of authentic microbial cultures to industries and academic and research institutes; provision of identification, freeze-drying and other microbiology-related services; depository of cultures deposited for patent purposes; and research on microbial diversity, taxonomy and related areas. Many large MCCs are situated in OECD countries. Many countries are actively involved in collecting and exchanging micro-organisms internationally, and microbial collections from non-OECD countries represent an important and growing subset in the overall network of culture collections. MGR currently used in agriculture and food systems have been collected both from tropical and subtropical species-rich agro-ecosystems and from non-tropical areas.[15]

[13] This report considers under the term IGR primarily invertebrate BC agents. Invertebrate pollinators are considered animal genetic resources. Aquatic invertebrates used for food are considered aquatic genetic resources. IGR used for other purposes of relevance to agriculture could be addressed in future work.
[14] This section draws on Background Study Paper No. 59, p.9–10.
[15] Background Study Paper No. 46, chapter II.

Because each MCC contains an important set of unique strains (an average of 40 percent of the strains in each collection are unique), collaboration and exchange among MCCs is common.[16] These exchanges, as well as flows from *in situ* to *ex situ*, occur in all geographical directions. Whereas historically these exchanges were quite informal, there has been a noticeable evolution towards formalization in recent decades.[17] In particular, MCCs are moving increasingly towards the use of legal instruments: acquisition agreements when acquiring materials and Material Transfer Agreements (MTAs) when distributing them. Some important limitations, especially on further distribution to third parties, generally apply even for non-commercial research purposes, mainly for quality management purposes and to address biosecurity issues. When commercial development is involved, additional agreements with the MCC, the initial depositor and/or the country of origin may be required, with the general understanding that recipients of materials hold the responsibility to take all steps necessary for compliance with ABS measures as they may apply to the material, including with regard to prior informed consent from the country of origin. Exchange between qualified MCCs may involve simplified procedures. Both OECD and non-OECD collections include clauses related to legitimate/legal exchange in their MTAs, which allow public culture collections that comply with strict quality-management criteria to further distribute microbial research material that they have received from other public MCCs (so-called legitimate exchange). The European Biological Resource Centres Network (EBRCN) and the Asian Consortium of Microbiological Resources (ACM) are making efforts to make the cultures available within the networks with few restrictions. However, in response to growing commercial opportunities and to financial restrictions on government spending on culture collections in some countries in the 1990s, this club model is threatened. Some MCCs have departed from the sharing and collaborating practices and have introduced restrictive MTAs even for exchange between MCCs.[18]

The culture collection community has developed a distinct body of codes of conduct, standards for best practices and model documents addressing specific aspects of access and benefit-sharing.[19]

Invertebrate genetic resources used for biological control[20]

Invertebrates play a key role for agricultural systems. They participate in essential soil processes, provide biological control (BC) of crop pests, are used for silk, food or feed production or provide pollination from which many of the world's most important crops benefit in terms of yield and/or quality.[21]

These Explanatory Notes consider under the term IGR primarily invertebrate BC agents. Invertebrate pollinators are covered by the notes relating to animal genetic resources. Aquatic invertebrates used for food are covered by the notes relating to aquatic genetic resources. IGR used for other purposes of relevance in agriculture could be addressed in future work.

The BC of pests plays an important role in integrated pest management approaches in the food and agriculture sector. It is based on the use of natural enemies of pests, often referred to as BC agents. These are predators, parasitoids of invertebrate pests and entomopathogenic nematodes, and herbivores that attack weed pests.

There are two main categories of BC. Classical BC is the introduction of one or more BC agents, usually from a pest's area of origin, to control the pest in an area it has invaded. Once introduced, the BC agent becomes established, reproduces and spreads. The BC agent then continues to

[16] Ibid.
[17] Ibid.
[18] Ibid.
[19] For an overview: McCluskey, K., *et al.* 2017. The U.S. Culture Collection Network responding to the requirements of the Nagoya Protocol on Access and Benefit Sharing. mBio 8, Table 1. DOI: 10.1128/mBio.00982-17.
[20] This chapter draws on Background Study Paper. No. 59, p. 9–12.
[21] Cock, M.J.W., *et al.* 2012. The positive contribution of invertebrates to sustainable agriculture and food security. CAB Reviews. 7(043): 1–27. DOI: 10.1079/PAVSNNR20127043.

have its effect on the target pest without the need for any further interventions. Augmentative BC involves the production and release of BC agents – indigenous or exotic – into specific crop situations, where they control the target pest, but are not expected to persist from one cropping cycle to the next.[22]

The research and development process leading to the use of a new BC agent involves various steps that require access to genetic resources. The largest number of exchanges of genetic material takes place in the early stages of research and development, when it is necessary to study the target pest and its natural enemies. Preliminary surveys of the target pest and its natural enemies will often need to be carried out in several countries, and specimens of pests and natural enemies normally need to be exported for identification and taxonomic studies. Detailed studies on natural enemies to assess their potential as BC agents can, in part, be carried out in the source country, while host-specificity studies involving plants or animals not naturally occurring in the source country are best carried out in quarantine in the target country or in a third country. Overall, only a small fraction of all the species found and studied will actually be recommended for use and released as BC agents. Once a specific BC agent has been identified and is being applied for BC purposes, there is little need for further exchange of genetic material.[23]

The type of genetic material used in BC consists primarily of living organisms used as BC agents. Organisms are mostly collected *in situ* and exported as live specimens. Product development does not normally include genetic improvement of the BC agent as such. Usually at most, it entails discrimination between populations in terms of biological characteristics that affect their adaptation to the target country or target pest. As a consequence most of the genetic diversity used in BC can be regarded as wild.

A particular feature of classical BC is the public good nature of its activities. As classical BC agents establish and reproduce themselves in the target environment and from that point on are freely available, it is not possible to make continuous profit from their production and release. Consequently, classical BC is run by the public sector, mainly through national and international research institutions paid by governments or development agencies. Augmentative BC, in turn, is a relatively recently developed activity. The history of commercial mass production and sale of natural enemies spans less than 50 years. It is carried out by a relatively small number of companies worldwide, of which most are located in developed countries and the majority are medium- or small-sized. Even though augmentative BC agents are mainly produced for high-value crops such as greenhouse vegetables and ornamentals, the average profit margin is usually quite low. While the development of rearing, distribution and release methods is mainly carried out by commercial producers, public research institutions and universities sometimes play an important role in the early stages of research and development.

The international exchange of genetic resources relevant for BC plays a critical role in the functioning of the sector. The introduction of BC agents especially in classical BC is often linked to the use of exotic genetic material, as it follows the movement of target crops and pests around the world. In fact, the great majority of classical BC transfers are intercontinental, which is to be expected as the target pests are themselves introduced species, often of intercontinental origin. Once a BC agent has been used successfully in one country, the opportunity is often taken to repeat the success in other countries through redistribution of the agent. Consequently, the international flow of genetic resources related to BC has been quite significant, involving several thousand BC agent species from more than a hundred countries, and introductions into an even higher number of countries.[24]

As the BC sector is composed of a small number of actors, exchanges of genetic material have essentially been regulated through informal means, mainly by professional networks, which may be institutionalized or simply operate at a personal level. However, the informal character of exchange practices does not necessarily mean that no terms and conditions apply. Established

[22] Background Study Paper No. 47.
[23] Ibid.
[24] Ibid.

> "customary" practices for use and exchange may, for example, foresee the sharing of results obtained from the use of the material or, in the case of research, the joint publication of results. In addition, in the augmentative BC sector, exchange practices are also regulated through classical commercial practices such as licensing production (i.e. larger augmentative BC companies license production to smaller companies as a way of facilitating the establishment of new companies in new countries to supply new markets).[25]

Identification and consultation of relevant governmental entities and non-governmental stakeholders holding, providing or using GRFA

2. The ABS Elements recommend consulting government entities and non-governmental stakeholders holding, providing or using GRFA.[26] Explanatory notes should explain that:

> It is important to note that research and development on MIGR lies in most countries in the hands of very different stakeholders. These include academic researchers, the private sector, and business associations representing specific stakeholders. All these stakeholders should be consulted in the development and implementation of ABS for MIGR. Their involvement will be important to allow policy-makers and regulators to gain insight into the diversity and specificities of MIGR and related research and development activities. Existing use and exchange practices should be taken into account as well as best practices that are either already in use or have been proposed by stakeholders.
>
> MIGR play an important role for sustainable agriculture: as plant growth promoting agents; for biological control; in the digestive tracts of livestock; for the production of biopesticides of direct benefit to agriculture; as catalysts in agro-industrial processes; for understanding and surveillance of microbial plant and animal (including fish) pathogens; and environmental damage remediation and purification of soils and water. MGR may also be used for food processing, such as traditional or industrial fermentation, the production of alcohols, dairy products, probiotics and feed additives; the production of biological components of benefit to food and feed production (vitamins, organic acids, enzymes, etc.) and understanding and surveillance of health-hazardous micro-organisms, such as food toxins and food-borne pathogens. MIGR are essential for important soil processes and provide BC of crop and animal (including fish) pests.

Integration of ABS measures with broader food security and sustainable agricultural development policies and strategies

3. The ABS Elements recommend considering ABS for GRFA in the wider context of sustainable agricultural development and food security.[27] Explanatory notes should therefore explicitly refer to policies and legislation in the areas of, for example, food security and biological control, which could either integrate or refer to relevant provisions for ABS for MIGR:

> In many countries ABS measures have been or are being developed as stand-alone legislation or policy. It is, however, important to develop ABS measures in harmony with other related policies and to integrate them with these policies, such as regulatory frameworks for biological control, pesticides and food safety and policies, such as food security strategies. The integration of approval procedures should on the other hand not lead to delays or unnecessary bureaucracy in the process of development of products. It is likewise important to involve from the outset the different communities behind the different functional groups of MIGR in the development and implementation of ABS measures to ensure that policy-makers have a full understanding of the taxonomic complexity and multiplicity of functions of the sector, of its current use and exchange practices and of potential effects ABS measures may have on research and development of MIGR.

[25] Ibid.
[26] ABS Elements, paragraph 15.II.
[27] ABS Elements, paragraph 15.III.

Integration of implementation of ABS measures into the institutional landscape

4. The ABS Elements recommend "using and adapting, as appropriate, existing structure administrative procedures and sectoral practices [as they] may facilitate the smooth identifying existing operationalization and implementation of ABS measures.[28] Explanatory notes should explain that:

> Historically, in most countries the agricultural sector has been a primary regulator of micro-organisms and invertebrates. As the regulatory environment gets more complex, the integration with wildlife and biodiversity regulatory frameworks is causing confusion for stakeholders. While in many countries one single competent authority is responsible for ABS for all genetic resources, several specialized authorities could share the responsibility for ABS. Whether such sharing of ABS competences is useful will depend on the institutional landscape and other country-specific circumstances.

Communication of, and awareness-raising regarding, ABS measures for potential providers and users of GRFA

5. The ABS Elements stress the importance of communicating ABS measures to potential providers, holders and users of GRFA.[29] Explanatory notes should explain that:

> The global distribution and exchange of micro-organisms that are publicly available for research is mainly in the hands of MCCs. Various initiatives of MCCs, such as Micro-Organisms Sustainable use and Access regulation International Code of Conduct (MOSAICC),[30] have led to an increased awareness of MCCs of the potential implications of access and benefit-sharing for the distribution and use of MGR.
>
> MTAs, nowadays used by most MCCs, usually impose the responsibility for complying with applicable ABS measures on the recipient of materials. In other words, receiving material from an MCC does usually not imply that the material can be freely used. Commercial uses of the material are often prohibited, unless explicitly authorised. It is furthermore the recipient's sole responsibility to obtain necessary intellectual property licenses and ABS permits, as applicable.[31]
>
> Raising the awareness and improving relevant knowledge of recipients of materials from MCCs, for example on the occasion of scientific conferences and workshops, might nonetheless be useful to increase the awareness of ABS measures. More specifically, it will be important to guide and possibly assist stakeholders as to how they may obtain the information necessary to initiate the necessary approval procedures.
>
> The BC community has also made serious progress in formulating best practices for ABS for IGR.[32]

[28] ABS Elements, paragraph 15.V.
[29] ABS Elements, 3.VI.
[30] http://bccm.belspo.be/projects/mosaicc
[31] See, for example, the BCCM Material Transfer Agreement.
[32] Mason, P.G., *et al.* 2018. Best practices for the use and exchange of invertebrate biological control genetic resources relevant for food and agriculture. *BioControl*., 63(1): 149–154. DOI: 10.1007/s10526-017-9810-3 and Smith, D., *et al.* 2018. Biological control and the Nagoya Protocol on access and benefit-sharing – a case of effective due diligence. *Biocontrol Science and Technology*. DOI: 10.1080/09583157.2018.1460317

Access and benefit-sharing for genetic resources for food and agriculture: the international legal framework

6. The ABS Elements refer to three international instruments, which are part of the global framework for ABS for genetic resources: the CBD, the Nagoya Protocol and the Treaty.[33] Explanatory notes should explain that:

> In addition to the Treaty, the Convention and the Protocol, other instruments relevant to certain MIGR should be taken into account in the development, adaptation and implementation of ABS measures. The International Plant Protection Convention (IPPC) has a broad overlap into biodiversity issues. The Glossary of phytosanitary terms defines pests as "[a]ny species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products" and defines plants as "[l]iving plants and parts thereof, including seeds and germplasm."[34] The IPPC obliges National Plant Protection Organizations to carry out surveillance of growing plants, including both areas under cultivation and wild flora for pests[35] with the object of reporting the occurrence, outbreak and spread of pests, and of controlling those pests.[36] ABS measures for MIGR should be aligned with obligations under the IPPC. Other regulatory frameworks in the biomedical and veterinary sectors are relevant to disease causing micro-organisms and invertebrates as vectors of diseases.

Rationale of access and benefit-sharing measures for genetic resources for food and agriculture

7. According to the ABS Elements, "ABS measures may be instrumental in furthering the achievement of food security and improving nutrition. (…) Therefore, ABS measures aimed at achieving food security and the conservation of GRFA should aim to facilitate and actively encourage the continued use and exchange of GRFA for research and development and benefit-sharing".[37] Explanatory notes should explain that:

> While the importance of access to plant and animal genetic resources is obviously indispensable for the improvement and adaptation of crops and livestock and, thus, for food security, the importance of MIGR for food security may be less obvious to some. The reason might be that for a long time the service of soil micro-organisms and natural enemies of pests, to name just a few, has been taken for granted and therefore received little attention in agricultural management. ABS measures aimed at achieving food security and the conservation of MIGR could therefore, as an objective, also mention the facilitation of exchange, sustainable use and conservation of MIGR as an important contribution to food security.

Flows of germplasm, including international flows and possible gaps in ABS measures

8. The ABS Elements recommend that in developing, adapting and implementing ABS measures, the relevance of germplasm flows should be considered.[38] Explanatory notes should explain that:

> *Micro-organism genetic resources*
> Most micro-organisms can easily be spread by host organisms, wind and water, or attached to any organic material. However, the "ubiquity" of micro-organisms does not mean that every strain can be found everywhere. There is growing recognition that micro-organism can exhibit biogeographical patterns in spite of their widespread availability. This means that certain micro-organisms are only available in specific habitats and cannot be found elsewhere.[39]

[33] ABS Elements, Chapter I.
[34] Glossary of phytosanitary terms. ISPM 5.
[35] IPPC Convention, Article IV.2
[36] IPPC Convention, Article VIII.1
[37] ABS Elements, Chapter 5.
[38] ABS Elements. paragraph 15 I.e.
[39] Background Study Paper No. 46, p. 31.

> Besides this interdependence in access to *in situ* MGR, there is interdependence with regard to material stored *ex situ* in MCCs. The largest MCC, with approximately 25 000 strains, holds less than 2 percent of the total number of strain holdings in the collections united under the World Federation of Culture Collections (WFCC) and only an estimated 1.5 percent of the total biodiversity of unique strain holdings in the WFCC. Many collections have specialized in various areas of microbial research and it is this specialization and the resulting creation of internationally recognized reference culture collections used and referred to in most follow-up research that has led to close international collaboration and exchange of materials and, thus, to a situation that has been considered "*functional interdependency in access to ex situ strains on a global scale*."[40]
>
> *Invertebrate genetic resources for biological control*
>
> Similarly, throughout the history of BC, BC agents that proved effective in one country have been forwarded to other countries effected by the same pest problem. The international exchange of genetic resources relevant for BC plays, thus, a critical role in the functioning of the BC sector. The great majority of classical BC transfers are intercontinental, which is to be expected as the target pests are themselves introduced species, often of invasive alien species. The international flow of genetic resources related to BC has therefore been quite significant, involving several thousand BC agent species from more than a hundred countries, and introductions into an even higher number of countries.[41]

Categories of genetic resources use covered by ABS measures

9. The ABS Elements stress that ABS measures need to be clear as to which GRFA are covered by relevant access provisions and which are not.[42] This consideration applies likewise to the temporal and the subject-matter scope of ABS measures. Explanatory notes should explain that:

> As with commodity crops there are some micro-organisms and invertebrates that are treated as a commodity for food or fibre for use. Some have raised a concern that although originally accessed for direct use, these commodities could end up being used for research and development. IGR, such as insects and snails, made available for direct use, e.g. for trade, consumption or multiplication, can often also be used for research and development, including breeding. A micro-organism requested as reference culture may be used for bioprospecting studies. However, regulating access to MIGR for direct use may have an unwanted impact on trade. If ABS measures refrain from regulating access to MIGR that may be directly used, they could still require PIC and benefit-sharing where the intention of the recipient changes and MIGR originally intended for direct use are being used for research and development.
>
> It also needs to be recognised that invertebrates and micro-organisms regularly cross international borders unintentionally through commodity trade.
>
> Most MCC require nowadays depositors to indicate the country of origin of materials they wish to deposit. It appears that most MCC also require information regarding the prior informed consent of the country of origin of the material.[43] Many MCC also require recipients of material to comply with the relevant ABS provisions of the country of origin, often irrespective of whether or not the material has been collected and deposited prior to or after the entry into force of the Nagoya Protocol. This means that MTAs of MCC might at times require PIC (prior informed consent) and MAT (mutually agreed terms) for materials which are excluded from the scope of ABS measures under the jurisdiction under which the MCC operates. ABS measures and MCC MTAs should therefore be clear as to whether PIC and MAT are required for research and development on pre-Nagoya MGR.

[40] Background Study Paper No. 46, p. 32.
[41] Background Study Paper No. 47, Annex I.
[42] ABS Elements, paragraph 36.
[43] Background Study Paper No. 46, p. 49.

MIGR provided by countries of origin/ countries that acquired them in accordance with the CBD

10. Under the Nagoya Protocol, "[…] access to genetic resources for their utilization shall be subject to the prior informed consent of the Party providing such resources that is the country of origin of such resources or a Party that has acquired the genetic resources in accordance with the Convention […]." The ABS Elements refer to difficulties "to determine with certainty the country of origin" of GRFA as many GRFA have been widely exchanged across regions countries and communities and often over long period of time.[44] Explanatory notes could suggest:

> The Nagoya Protocol requires PIC of the Party providing genetic resources "that is the country of origin of such resources or a Party that has acquired the genetic resources in accordance with the Convention." ABS measures should clarify whether PIC (and MAT) are also required where genetic resources have been received from a country other than the country of origin and have been collected prior to the entry into force of the Nagoya Protocol ("indirect acquisition of genetic resources"). ABS measures could point out that irrespective of national ABS laws recipients of genetic resources have to comply with conditions they accepted under bilateral agreements, such as MTAs.
>
> It will sometimes be difficult if not impossible to determine with certainty the country of origin of MIGR, and especially of those occurring *in situ*. Genetic resources, in particular MIGR, may have several countries of origin.

Utilization of micro-organism and invertebrate genetic resources

11. "Access to genetic resources for their utilization", is subject to prior informed consent under the Nagoya Protocol. "Utilization" means "to conduct research and development on the genetic and/or biochemical composition of genetic resources, including through the use of biotechnology".[45] The ABS Elements point out that it may be difficult in some cases to decide whether a GRFA is utilized within the meaning of the Nagoya Protocol.[46] Explanatory notes should explain that:

> There is a need to clearly identify activities related to MIGR that are considered "utilization" and those that are not. It is important to note that there are certain 'upstream' activities which are related to (or carried out in support of) research on MIGR but are as such not "utilization", e.g. the maintenance and management of collections for conservation purposes, including storage, rearing, multiplication, identification and evaluation of MIGR. Similarly, the mere description of genetic resources in phenotype-based research, such as morphological analysis or the diagnostic use of a well-known gene sequence for identification, might normally not qualify as utilization. Therefore not every study of an MIGR may be considered as utilization.[47]

Research and development for food and agriculture

12. The ABS Elements refer to Article 8(c) of the Nagoya Protocol, which calls upon Parties to consider the importance of GRFA and their special role for food security in the development of ABS legislation or regulatory requirements. Explanatory notes should explain that:

> To acknowledge the special role of MIGR for food security, governments could consider, in line with Article 8(c) of the Nagoya Protocol, treating access to and utilization of them differently if they are intended to contribute to food and agricultural research and development. It is important to note that no country is under an obligation to restrict access to genetic resources within its jurisdiction.

[44] ABS Elements, pargraph 35.
[45] Nagoya Protocol, Article 2.
[46] ABS Elements, paragraph 46–48.
[47] See Table 1 in Smith, D., *et al.* 2018. Biological control and the Nagoya Protocol on access and benefit-sharing – a case of effective due diligence. *Biocontrol Science and Technology*. DOI: 10.1080/09583157.2018.1460317 for an overview of activities and their possible qualification.

Commercial/non-commercial research and development

13. ABS measures sometimes distinguish between commercial and non-commercial utilization of genetic resources.[48] Explanatory notes should explain that:

> Many activities related to MIGR for food and agriculture ultimately aim at the development of a product and might therefore be considered "commercial". Depending on the definition of the term "commercial" the sectors using MIGR for research and development might not greatly benefit from a distinction between commercial and non-commercial activities and simplifications granted by ABS measures for the latter. However, policy-makers could consider, in line with Article 8(a) of the Nagoya Protocol, to exclude certain research and development activities from the application of ABS measures.

Standard and fast-track procedures

14. The ABS Elements recognize that governments may wish to establish fast-track procedures for certain situations, e.g. for access to certain materials or materials to be used for certain purposes. Explanatory notes should explain:

> Fast-track procedures could be foreseen in ABS legislation (as well as MTA and material acquisition agreements, MAAs) for cases of emergency, for example for MIGR required for biocontrol or plant and animal health (see Article 8(b) of the Nagoya Protocol).[49]

Standardization of PIC and MAT

15. The ABS Elements encourage governments to consider the different options of authorization procedures, including the option of standardizing procedures, terms and conditions. The ABS Elements explicitly refer to the Standard Material Transfer Agreement of the Treaty, as a "fully functioning precedent" for standardization of PIC and MAT.[50] Explanatory notes should explain:

> Best practices, model MTAs and MAAs have been developed for various subsectors of MIGR.[51] These models may inspire the development of MTAs and MAAs stakeholders of the relevant sub-sectors may agree on with a view to facilitate access and benefit-sharing and avoid the need to conclude bi-lateral agreements on a case-by-case basis. ABS measures could allow for and, in fact, encourage the use of MTA and MAAs for MIGR.

Benefit-sharing through cooperation agreements

16. The ABS Elements stress the importance of sharing monetary and non-monetary benefits and note that the terms and conditions of such benefit-sharing will often depend on the particularities and specificities of the subsector, the species, the concrete intended use, etc.[52] The ABS Elements note that GRFA are often exchanged in the framework of working collaborations and partnerships. ABS measures could therefore allow for benefit-sharing arrangements tailor-made to the subsector's collaboration and partnership practices.[53] Explanatory notes should explain that:

> ABS measures could encourage stakeholders to address ABS issues, where possible and appropriate, as part of scientific partnership agreements and within existing informal and formal

[48] ABS Elements paragraph 50.
[49] See, for example, MOSAICC, section I.2.
[50] ABS Elements, paragraph 57.
[51] For an overview: McCluskey, K., *et.al.* 2017. The U.S. Culture Collection Network responding to the requirements of the Nagoya Protocol on Access and Benefit Sharing. mBio 8, Table, DOI: 10.1128/mBio.00982-17 ; Mason, G. *et al.* 2018. Best practices for the use and exchange of invertebrate biological control genetic resources relevant for food and agriculture. *Biocontrol,* 63: 149–154. DOI: 10.1007/s10526-017-9810-3, Supplementary information.
[52] ABS Elements, paragraph 73.
[53] ABS Elements, paragraph 74.

networks. It has been argued that "informal cooperative networks of biological control practitioners around the world, involving scientists working with government agencies, intergovernmental organizations, international agricultural research centres, universities, industries, etc, are best suited to assist biological control practitioners for the free multilateral exchange of invertebrate biological control agents."[54] The difficulty of working with micro-organisms and invertebrates and the special skills required may make the sharing of non-monetary benefits, including capacity building, particularly relevant.

[54] Mason, G., *et al.* 2018. Best practices for the use and exchange of invertebrate biological control genetic resources relevant for food and agriculture. *Biocontrol*, 63: 151, DOI: 10.1007/s10526-017-9810-3.