CacaoNet Exploratory Consultation on Cacao Genetic Resources

Legal and policy aspects of germplasm exchange (access and benefit sharing)

31 March and 1 April 2015, Bioversity International, Maccarese, Rome, Italy

REPORT

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1. Introduction

Background to the CacaoNet Consultation

Conservation of cacao[1] genetic resources and what can be done to facilitate both their access and better sharing of derived benefits is a key issue in moving forwards with the implementation of the Global Strategy for the Conservation and Use of Cacao Genetic Resources (the Strategy hereafter). The Strategy was finalised at the end of 2012 by the Global Network for Cacao Genetic Resources (CacaoNet) and particularly the development of the Global Strategic Cacao Collection (GSCC). A summary and a long version of the Strategy is available to download at: www.cacaonet.org

There are 2 international cacao collections, one maintained at CATIE in Costa Rica and the other at the Cocoa Research Centre (CRC) in Trinidad and Tobago. The materials in the collections have been included under Article 15 of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) through a formal agreement signed in 2006 for CATIE and 2009 for CRC. The germplasm is distributed with an accompanying Standard Material Transfer Agreement (SMTA) (template from of the ITPGRFA. The SMTA includes an Access and Benefit-Sharing (ABS) agreement for the distribution and receipt of germplasm.

In addition to the 2 collections maintained at CATIE and CRC, the International Cocoa Quarantine Centre, Reading (ICQCR), UK ensures the safe movement of cacao germplasm between countries and regions. The materials maintained at the ICQCR mainly come from the 2 international collections but they also can manage materials provided to them by a national programme.

The rest of cacao genetic diversity is maintained in national collections and farmers' fields and in the wild, and is therefore outside the scope of the ITPGRFA because cacao is not an Annex 1 crop, which by definition is within the scope of the Convention on Biological Diversity (CBD) and the Nagoya Protocol and bilateral agreements. The FAO Commission on Genetic Resources for Food and Agriculture (CGRFA), including plants, animal, microbial and forests, is the overarching inter-governmental body discussing all aspects of genetic resources for food and agriculture.

The work of Bioversity International over the years in this area can provide guidance. It was therefore suggested that CacaoNet and Bioversity organise an exploratory consultation on cacao genetic resources access and benefit sharing policies and agreements, which took place in Rome 31 March and 1 April 2015.

Goal and Objectives

The goal of the CacaoNet consultation was to facilitate cacao germplasm exchange for research, crop improvement to enhance production and conservation.

The specific objectives were:

1. To analyse the current constraints in the system for the conservation and use of cacao genetic resources and what might be implied in providing facilitated access of germplasm.
2. To analyse past and present agreements on cacao germplasm exchange for research, including the SMTA, national bilateral agreements and other ABS agreements.
3. To identify incentives for partners to facilitate access to germplasm for further research collaboration for benefit-sharing.

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[1] *Although the term "cocoa" is generally used for the plant and its products in many English speaking countries, this document will refer to "cacao" for the plant and the unprocessed seeds of the species* Theobroma cacao. *Once the cacao seeds, commonly known as "beans", are harvested, fermented and dried, the product is known as cocoa.*

4. To propose options and innovative approaches for key partners managing cacao genetic resources for stimulating the use of cacao genetic resources for improving planting materials.
5. To identify possible next steps and decision-making processes towards the development of any instrument to facilitate access to cacao germplasm for research and crop improvement

Acknowledgements

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2. Summary of the Presentations and Discussions

Stephan Weise, Deputy Director General – Research, Bioversity International, welcomed all participants and provided background to the work of Bioversity and its engagement in cacao research.

The participants introduced themselves and expressed their expectations of the CacaoNet consultation. The list of participants is in ***Annex 1***.

Brigitte Laliberté presented the objectives of the CacaoNet consultation and the proposed sessions for the general approved of the participants.

The Programme was divided into the following 6 Sessions and the discussions are summarised below.

- Session 1 – Background on the key issues
- Session 2 – Current constraints and how to facilitate access
- Session 3 – Analysis past and present agreements
- Session 4 – Incentives and benefits to share germplasm
- Session 5 - Innovative solutions for stimulating use for improved materials
- Session 6 - Next steps and decision-making

The report is therefore structured according to the Programme sessions. Details of the Programme sessions are in ***Annex 2***.

Session 1 – Background on the key issues

PRESENTATION 1: Where we are today in conservation and use of cacao genetic diversity – and the movement of germplasm - Brigitte Laliberté

Brigitte Laliberté presented the current status of conservation and use of cacao genetic diversity which included the following points below.

Origins of Cacao Diversity

- Genus *Theobroma* originated millions of years ago in South America – 22 species
- 15 species are edible, and may have great importance as gene reservoirs for cacao improvement
- Cocoa was drunk by Maya traders as early as 400 BC.
- Christopher Columbus first outsider to drink cocoa after he reached Nicaragua in 1502.
- Hernan Cortés in 1528 bearing the Aztec recipe for Xocolat (cocoa drink) on his return to Spain

Cultivation around the World

- Late 17th and 18th centuries: farms were established throughout the Caribbean islands, Ecuador and new areas of Brazil, including Bahia, which later became the main area of cultivation.
- 17th century onwards: attempts to introduce cacao to other parts of the world. Criollo, Amelonado and Trinitario types were introduced:
    - *Mesoamerica, Trinidad, Venezuela → Philippines, Indonesia, Sri Lanka*
    - *Philippines, Indonesia and Sri Lanka→ Other parts of Asia, Indian Ocean region*
- Second half of 18th century: establishment of chocolate manufacturing in Europe and increase in consumption in North America
    - *Explosion in demand requiring more cacao to be cultivated*
- Cacao growing in West Africa spread rapidly following the introduction of Amelonado type from Brazil to Principe in 1822 and from Principe to:
    - *1830 - São Tomé* *1874 - Nigeria*
    - *1861 – Ghana* *1919 - Côte d'Ivoire*
- Cameroon: cacao growing was first recorded in 1876 with a shipment of 13 plants from the Royal Botanic Gardens Kew from Trinidad. Later on, different types of cacao were introduced from South and Central America, such that the country now produces a distinctive type of cocoa.
- Late 19th century: pods, seeds, plants of Trinitario populations reached Ecuador (from Venezuela).

Cacao Genetics

- Criollo (meaning native) - Cacao historically grown in Mesoamerica: central Mexico, Guatemala, Belize, Honduras, El Salvador and the Caribbean.
- Forastero (meaning foreign) - Amazonian types - quite different from Criollo and planted in new areas eastwards towards the mouth of the Amazon River.
- Amelonado (meaning melon-shape) - Forastero type most commonly cultivated until 1950.
- Hybrid populations - Where planting materials were exchanged between different areas, hybrid populations were developed, often with better growth and disease resistance than the rather weak Criollos but also had distinctive flavour characteristics.
- Trinitario - Originally hybrid populations between Criollo and Forastero occurring in Trinidad, used to describe types that are products of hybridization, known in the trade for their floral and fruity flavours.

Cacao genetic clusters

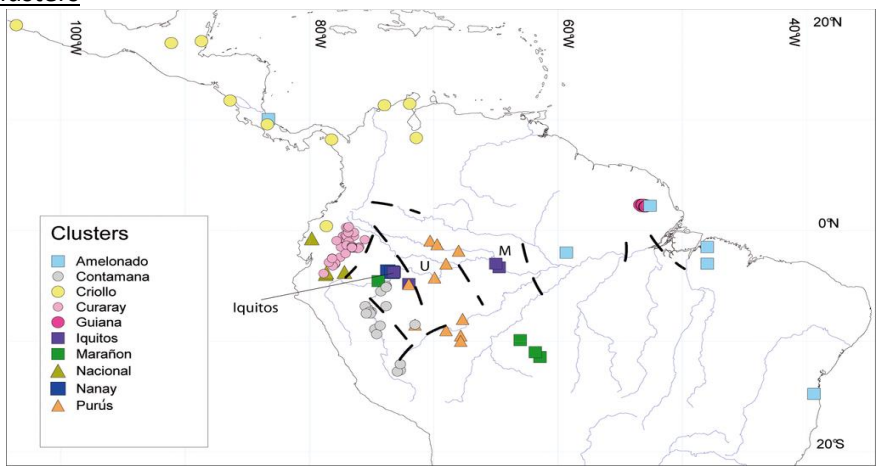

Figure 1: Cacao genetic clusters in Latin America

Ref: "Cacao Genetic Clusters" by J. C. Motamayor, P. Lachenaud, J. Wallace da Silva e Mota, R. Loor, D N. Kuhn, J. S. Brown, R. J. Schnell - Geographic and Genetic Population Differentiation of the Amazonian Chocolate Tree. 2008

Cocoa Production Today

- Cote d'Ivoire - 36% Ecuador – 5%
- Ghana - 21% Brazil – 5%
- Indonesia - 11% Nigeria – 6%
- West Africa accounts for 72% of total production.
- Traditional West African Amelonado and mixed hybrid types
- Forastero, also grown on a large scale in Indonesia and Brazil
- Despite a few more introductions:
    - much of the cacao grown in the rest of West Africa has a narrow genetic base
    - efforts to introduce a wider range of genetic diversity, especially from the Upper Amazon types, through breeding programmes are continuing.

Cacao Diversity - The Problem and Priority

PROBLEM:

- Lack of genetic diversity in cacao varieties
- Threats to the genetic resources that breeders rely on

PRIORITY:

- Good quality locally-adapted materials are required, regardless of country, region or farming system.
    - Development of and access to improved planting materials for both farm rehabilitation and productivity increases.
    - Substantially scaling-up effective and delivery of improved planting material to farmers.

Global Strategy for the Conservation and Use of Cacao Genetic Resources

- Finalised in October 2012
- Result of a consultation process, drawing upon the global cocoa community's expertise in all aspects of cacao genetic resources (over 75 individuals from 26 institutes contributed)
- Clear framework to secure funding for the most urgent needs to ensure that cacao diversity provides direct benefits to the millions of small-scale farmers around the world
- Long and summary versions available at: www.cacaonet.org

Assessing the Current Situation

- A survey collected detailed information on all *ex situ* collections, carried out by CacaoNet 2010-2012 to assess the current situation *vis a vis*:
    - Objective and mandate of collections
    - Content (in terms of diversity)
    - Long-term security of the collection
    - Management of information
    - Exchange of materials
    - Urgent needs and priorities to be addressed through a global collaborative strategy

Current situation on conservation and use

- Over 35 collections maintain about 24,000 samples of cacao diversity.
- Only 2 international collections managed by CRC, Trinidad and Tobago and CATIE, Costa Rica with an international agreement to maintain global collections of cacao genetic resources for the long term and to make this germplasm freely available to any bona fide user.
- The safe global movement of cacao germplasm is through the International Cocoa Quarantine Centre at the University of Reading UK, (ICQCR).
- The USDA/ARS in Miami offers quarantine facilities for regional transfers.

Table 1. Number of accessions in cacao ex situ *collections (Source: Data from the CacaoNet surveys 2008-2012).*

Country	Institute	Year the Collection was initiated	Number of accessions
Brazil	CEPLEC/CEPLAC/SUEPA/SUERO/ICA	1965	4,709
Trinidad and Tobago	CRU	1982	2,400
Ecuador	INIAP	1940	2,332
Malaysia	MCB	1992	2,263
Côte d'Ivoire	CNRA	1980	1,605
Ghana	CRIG	1943	1,366
Papua New Guinea	PNGCCI	1994	1,200
Costa Rica	CATIE	1944	1,146
Nigeria	CRIN	1948	1,100
Peru	ICT/ UNAS/CEPICAFE /	1987	1,038
Indonesia	ICCRI / Bah Lias	1978	1,019
Venezuela	INIA	1994	872
Colombia	CORPOICA		745
French Guiana	CIRAD	1980	508
Togo	CRAF	1968	217
United States of America	USDA	1930	200
India	CPCRI	1970	161
France	CIRAD-MPL	1985	138
Cuba	EIC-ECICC	1982	127
Dominican Republic	IDIAF	1974	115
Fiji	Dobuilevu		115
Solomon Islands	Black Post Cocoa Unit		95
Vanuatu	VARTC		85
Guyana	MHOCGA	1920	65
Nicaragua	UNAN	2009	51
Thailand	Chumphon	1979	34
Honduras	FHIA	1987	31
Benin	CRA-SB	1986	15

The Challenge:

- Wide variation for disease resistance and quality exists in ex situ collections and in farmers' fields but use of these traits is not optimised.
- Access is often restricted by lack of legal & policy framework.
- Movement of germplasm brings risk of transferring pests and diseases.

Factors limiting use of new germplasm into breeding

- Lack of information from characterization and evaluation (quality and performance).
- Narrow genetic base available.
- Lack of breeding programmes or of specialized staff.
- Pest and diseases affecting the germplasm and its safe movement.
- Quarantine requirements.
- Lack of a clear institutional legal and policy framework.

Safe movement of germplasm - Essential to the use of cacao genetic resources

- Global level - achieved through the International Cocoa Quarantine Centre at the University of Reading (ICQCR), UK.
- The USDA/ARS facility in Miami, USA, offers quarantine facilities for regional transfers.
- Movement of cacao germplasm brings risk of transferring pests and diseases, particularly from one major cacao-growing region to another.
- Viruses in collections can impact on genebanks' ability to distribute germplasm.
- Pests and diseases can reduce the vigour of trees and availability of suitable budwood/seed pods.
- ESSENTIAL - all those involved in handling cacao genetic resources must have access to information highlighting the risks associated with each pest or disease and recommendations on appropriate quarantine measures.

2014 Safe Movement Guidelines

The 2014 Technical Guidelines for the Safe Movement of Cacao available in English, French and Spanish. Includes information on:

- General advice regarding safe procedures to use when moving cacao.
- Geographical spread of significant pests and diseases of cacao.
- Descriptions of the key pests and diseases.
- Quarantine advice in relation to moving germplasm from a region where a specific pest or disease may be present.
- A summary table - overview of the geographical spread of pests and diseases of cacao and special precautions needed when moving particular plant parts.
- Table summarising pest and disease risks by country.
- Detailed descriptions of pests and diseases of cacao.
- Safe movement recommendations.

Global arrangement for the exchange of cacao genetic resources

- Relies mainly on the two international collections held by CATIE in Costa Rica and Cocoa Research Centre (CRC) in Trinidad and Tobago that have formally placed their cacao collection under the auspices of the International Treaty on Plant Genetic Resources for Food and Agriculture (IT-PGRFA).
- Other collections, such as CIRAD (Montpellier and French Guyana) and USDA (Puerto Rico), also make their materials available for international distribution.

- ICQCR uses the SMTA to distribute material received from CATIE and CRC. Also uses its own MTA for material received from other collections, requesting donor genebanks to agree for the material to be passed on to a third party.
- With the exception of exchanges between the International Collections, USDA and CIRAD, there is little international exchange of germplasm.
- Most national programmes operate under the Convention on Biological Diversity (CBD), usually without having specific Access and Benefit Sharing (ABS) legislation in place.
- This situation resulted in fragmented approaches, informal exchanges of germplasm and thus, the benefits generated not widely recognized or equitably shared.

Actual or potential benefits

- Several aspects of cacao germplasm exchange have been identified as actual or potential benefits for the world cocoa economy at large and particularly to countries contributing genetic resources to the global system.
- The main benefit is the actual continued and facilitated access to a broad range of cacao diversity for all bona fide users.
- This is the essential element in the production of new and improved cacao varieties to achieve sustainable and economical production and thus, contributing to the economy of cacao producing countries.

Benefits generated from global collaboration - Facilitated access to the following:

- Evaluated germplasm, i.e. material that can be directly included in national and local selection trials, as well as in breeding efforts.
- Enhanced breeding populations, i.e. with enhanced value for agronomic traits that were selected using the genetic variation available in international germplasm collections.
- Healthy germplasm and use of plant quarantine services, including the development of local and national quarantine facilities, reducing the spread of cacao pests and diseases.
- Information and knowledge on cacao genetic resources worldwide can be obtained from information management systems, including strengthening institutional and national systems.
- Technologies, procedures and methods to conserve, improve and breed cacao. Long-term germplasm conservation methodologies including cryopreservation, characterization standards, network of evaluation, diversity analysis, genetic tools, and somatic embryogenesis.

Strategic partnership & collaboration in research

- Clarifying the legal status of cacao collections, including formal roles and responsibilities of national cocoa research institutes in conserving and developing cacao germplasm collections.
- Key question: Who are the owners of the diversity maintained in the genebanks around the world?
    - The country of origin?
    - The country that maintains it?
    - The country that improves it?
    - Humanity and the future generations?
- Developing transparent ABS arrangements for cacao genetic resources.
    - If new products are developed from genetic material, how can the rights of the providers be recognized in the final product?
- New opportunities for funding and collaboration will emerge through participation in international commitments and collaboration.

What needs to be done

- Clarify and influence the legal situation regarding access to cacao genetic resources in individual countries.
- Improve awareness of existing conservation and research/breeding activities in countries.
- Share information regarding international and national policies and legislation regarding access and benefit-sharing.
- Facilitate the involvement of decision-makers in formalizing arrangements for the exchange of cacao genetic resources.
- Improve political understanding of the role of conservation and use of cacao genetic resources towards supporting the development of a sustainable (institutional) cacao industry in countries.
- Allow the exchange of accessions which were already in international collections but which have been lost. Examples of accessions lost from the CRC collection, i.e. ICS 55 and NA 33. Countries where these clones still exist might not have any problem in exchanging these.
- Allow the exchange of cacao germplasm that has disease and pest resistance, not including, for the time being germplasm noted for specific qualities, such as flavour attributes.
- CacaoNet to continue to collaborate with national collections, FAO and the International Treaty to promote the placing of cacao germplasm collections in the public domain through designation under the Treaty.

Follow-up discussion and comments

There was a question about the development of a Global Strategic Cacao Collection (GSCC), which is a key element of the Global Strategy. The GSCC concept is for a virtual collection consisting of unique and interesting materials that are currently available in the public domain. The materials in the CATIE and CRC collections will form the backbone of the GSCC, complemented with priority accessions from national collections available in the public domain such as materials maintained by CIRAD and USDA. The formation of the GSCC will result from a coordinated effort of characterization and rationalization of available cacao genetic resources. Agreed criteria such as genetic diversity, in the form of allelic richness and the uniqueness of each genotype, in combination with measures of agronomic value will be used to identify priority accessions. The specific criteria and boundary for each set of accessions would be agreed through a consultation process coordinated by CacaoNet. Partners will agree on how to share responsibilities for conserving and distributing material from the GSCC. CacaoNet organized a first consultation on the development of the GSCC, jointly with the Cocoa Research Centre of the University of the West Indies in Trinidad, on 22-24 October 2014.

Additional comments were the following:

- Bear in mind that not all materials at CATIE and CRC are under the ITPGRFA, for example breeding materials are not placed under the auspices of the IT. CATIE also has some materials conserved as “black box”, i.e. on behalf of another institution/country and can be used in breeding but not for further distribution.
- Some of the materials at the ICQCR have been there for more than 30 years but the materials do not constitute a collection for conservation purposes but for international distribution only.
- There is an increasing interdependency of countries on genetic resources.
- There is a question about informal exchange for research and how this complies with the national and international legal and policy frameworks.

PRESENTATION 2: International laws governing access to cacao genetic resources and sharing benefits derived from their use - Michael Halewood

Michael Halewood presented the current legal and policy frameworks which included the points below:

Outline

- International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)
- Convention on Biological Resources (CBD) and the Nagoya Protocol (GP)
- FAO Commission on Genetic Resources for Food and Agriculture (CGRFA) - Draft Elements to Facilitate Domestic Implementation of Access and Benefit-Sharing (ABS) for Different Subsectors of Genetic Resources for Food and Agriculture
- None of the above, or only partial implementation

International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)

- Multilateral System (MLS) of Access and Benefit Sharing (ABS)
    - Annex 1 crops only (cacao not included)
- Invitations to international institutions to sign agreements with the ITPGRFA governing body placing collections under ITPGRFA framework (Article 15 organizations)
    - Can include non-Annex 1 crops
    - CATIE (2006) and Univ. West Indies for Cocoa Research Unit (CRU) (2009)
        - Agreed to use the material transfer agreement as decided at 2nd meeting of the governing body = Standard Material Transfer Agreement (SMTA)
        - Exception: repatriation
- In exercise of their national sovereign rights to regulate access to their genetic resources, countries may decide to use the SMTA when supplying non-annex 1 crops, or allow natural and legal persons within their borders to do so.
    - e.g. A European Genebank Integrated System (AEGIS)
    - Netherlands CGN, others
    - France? CIRAD? For Cacao?
- Anyone who receives cacao germplasm under SMTA, (from Article 15 body, or other providers) must pass it on with the SMTA
    - e.g. International Cocoa Quarantine Centre (ICQCR), UK receiving from CRC, CATIE (any voluntary users of SMTA?)
- Materials voluntarily included/deposited in Article 15 collections would be moved from whatever ABS system is in place in the country of the provider/depositor to being managed under the ITPGRFA
    - When most of the international cacao collections were formed, no international laws explicitly addressed this, and few national laws
    - Currently, if the country concerned ratified and implemented the CBD and/ or the Nagoya Protocol (NP), then the rules in place to implement them would govern
    - Very little such movement currently

Multilateral System (MLS) of the ITPGRFA

- Between 4th session (2011) and 5th session (2013) of the ITPGRFA Governing Body, proactive work by Working Group on Funding Strategy.
    - Identified innovative options for increasing flow of financial benefits to the Benefit -sharing Fund (BSF). Report available at: http://www.planttreaty.org/sites/default/files/OWG-EFMLS_1-14-w4_en.pdf
- 5th Session created the Working Group to Enhance the Functioning of the MLS (WG-EFMLS)

- Develop a range of optional measures to: "(a) Increase user-based payments and contributions to the Benefit-sharing Fund In a sustainable and predictable long-term manner, and (b) Enhance the functioning of the Multilateral System by additional measures."
- One long-term option is to expand Annex 1 to include more crops or all PGRFA

Convention on Biological Diversity (CBD) and the Nagoya Protocol (NP)

- Most countries have ratified CBD by now.
  - Three basic principles: national sovereignty, Prior-Informed Consent (PIC), Mutually-Agreed Terms (MAT) (of national competent authority)
  - Country of origin. Where develop *in situ*.
  - *In situ* - GR: "in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties"
  - 25 years, only [33] countries report having institutionalized ABS measures, and many of them do not represent exhaustive, operational systems applicable to cacao access seekers (e.g. requirement to have proof of PIC in patent applications)
  - Nagoya Protocol came into force in November 2014. 57 member states so far. The number is growing.

Nagoya Protocol

Goes further than CBD by:

- Creating obligations on user states to put measures in place for monitoring and enforcement of agreements struck in other countries
- Creating international infrastructure - Clearing House Mechanism - as part of an enterprise, where countries send agreements
- Creation (highly qualified) obligations to put systems in place to require PIC and MAT from indigenous and local communities for genetic resources and traditional knowledge
- Art 4: relationship to other international agreements
  - No explicit mention of ITPGRFA, but clearly applies to it, creating obligation to recognize, and 'work around' the MLS (not applicable for cacao) and Article 15 agreements (CATIE, CRC)
  - '4.1. The provisions of this Protocol shall not affect the rights and obligations of any Party deriving from any existing international agreement, …
  - 4.3. This Protocol shall be implemented in a mutually supportive manner with other international instruments relevant to this Protocol.
  - 4.4. Where a specialized international access and benefit-sharing instrument applies that is consistent with, and does not run counter to the objectives of the Convention and this Protocol, this Protocol does not apply for the Party or Parties to the specialized instrument in respect of the specific genetic resource covered by and for the purpose of the specialized instrument.'
- Art 5: Benefit sharing …
- Art 6: Access to Genetic Resources
  - Promotes rule and process clarity for access seekers …
- Art 8: Special considerations
  - In the development and implementation of its access and benefit-sharing legislation or regulatory requirements, each Party shall
  - a) Create conditions to promote and encourage research which contributes to the conservation and sustainable use of biological diversity, particularly in developing countries,

including through simplified measures on access for non-commercial research purposes, taking into account the need to address a change of intent for such research;
    - c) Consider the importance of genetic resources for food and agriculture and their special role for food security.
- Article 23. Technology Transfer, Collaboration and Cooperation
    - … the Parties shall collaborate and cooperate in technical and scientific research and development programmes, including biotechnological research activities, as a means to achieve the objective of this Protocol. The Parties undertake to promote and encourage access to technology by, and transfer of technology to, developing country Parties, in particular the least-developed countries and small island developing States among them, … in order to enable the development and strengthening of a sound and viable technological and scientific base for the attainment of the objectives of the Convention and this Protocol. Where possible and appropriate such collaborative activities shall take place in and with a Party or the Parties providing genetic resources that is the country or are the countries of origin of such resources or a Party or Parties that have acquired the genetic resources in accordance with the Convention

<u>Convention on Biological Diversity (CBD) and the Nagoya Protocol (NP)</u>

- Assuming ratified and implemented …
- Access seekers must follow processes established by national law to:
    - Make application
    - Negotiate ABS agreements with entities identified by the law:
        - actual providers (e.g., individuals, organizations, genebanks, indigenous and local communities,), competent national authority
- No default right of facilitated access. If providers wants to say no, its no.
- While law may fix minimum BS conditions, de novo agreements will need to be worked out between provider and recipient, and approved by competent authority.
- Depends upon ability of the provider and receiver to strike mutually advantageous agreement
- In context of a larger research project with common goals, and research outcomes to be shared by all, it is easier to structure such arrangements than 'cold calling'

<u>FAO Commission on Genetic Resources for Food and Agriculture (CGRFA)</u>

- Draft Elements to Facilitate Domestic Implementation of Access and Benefit-Sharing for Different Subsectors of Genetic Resources for Food and Agriculture
    - Tool(s) to help countries develop measures, model agreements, re ABS for GRFA
    - Mainly in exercise of discretion under CBD and NP
    - Relevant for PGRFA not included in the MLS (including cacao)

<u>None of the above</u>

- ITPGRFA only provides rules for Article 15 organizations, recipients of materials from then under SMTA.
- The rest is under whatever international agreements countries concerned have both ratified and implemented through national law.
- Most countries have ratified, acceded to CBD. 57 for the Nagoya Protocol so far.
- But, still very low levels of CBD-ABS domestic implementation; no implementation yet of Nagoya Protocol.
- Difficult to know who to approach, and how
- Puts potential providers in a difficult position

- High level political commitments to protection + No explicit operational authorization = Disincentive to act
- Provider may want to get authorization from competent authority, but the latter is not yet appointed, or comfortable to decide
- Solutions depend upon providers and or authorities being willing to make deals on the basis of existing (or anticipated) authority/discretion
- So ultimately, a lot turns on trust, shared sense of purpose, clear case of national interest
    - Symptoms of long term research and development partnerships involving movements of materials and related information in furtherance of important objectives
- Full implementation, in mutually supportive ways of ITPGRFA, CBD/Nagoya protocol prerequisite to long term solutions
- In the meantime, need to build-up arrangements based trust, common purpose, shared benefits (directly with providers)
- Need to consider novel options for sharing with providers, including national programs and smallholder growers
- And possible extra comfort conditions – research only, no passing on, for consortia partners only, etc

Session 2 – Current constraints and how to facilitate access

PRESENTATION 3: Feedback from the interviews on the constraints of the current Access and Benefit-Sharing (ABS) tools used - Isabel Lapeña

Isabel Lapeña, Consultant on Genetic Resources Policy, made a presentation on the perceived constraints on the international exchange of cacao germplasm and how to facilitate access. Isabel carried out individual interviews with about 16 of the CacaoNet consultation participants between 25-30 March, representing international and national collections, the ICQCR and the industry. She asked the participants how access could be facilitated. The feedback received was analysed and each situations was described in terms of content of collections, agreements for exchange and major constraints. The key points of the presentation are summarised below.

For CATIE and CRC, the cacao germplasm is placed in the public domain under the Multilateral System (MLS) of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Facilitated exchange is through the Standard Material Transfer Agreement (SMTA). As mentioned, CATIE has materials under a "black-box" agreement for research but not available for distribution. The international distribution is done via the ICQCR. Most materials in national collections are under the CBD and therefore subject to bilateral agreements.

Constraints

- Access to cacao germplasm to become progressively more restrictive.
- Access to national collections materials: subject to authorization of the country of origin according to ABS rules.
- Complex/unknown CBD/ABS national regulations and intervention of different authorities with competence to authorize access.
- Plurality of institutions: CBD/ABS authorities in Ministries of Environment and of Agriculture:
    - Ministry of Environment level - lack of understanding of cacao research and its breeding context at
    - Ministry of Agriculture level - different institutions in charge – geographical distance.
    - Lack of coordination among both on access to genetic resources as a general rule.

- Scientists' lack of understanding of collection permits and ABS regulations.
- Different public and private nature of research and breeding institutes.
- Quarantine constraints:
    - Difficulties to introduce materials in countries due to quarantine issues.
    - Lack of harmonized quarantine requirements in internationally acceptable cacao quarantine certificates that would help to a more dynamic introduction of materials in the importer country.
    - Slow and long administrative procedures.
    - Lack of regional quarantine infrastructure leads to no exchange among countries.
    - Import constraints: Centralized authorizations - decentralized research stations.
- Industry - very involved in breeding and development of new varieties. Interest in new traits that are demanded by the market. No problem to put the results of their breeding programmes into the public domain. Need Agreements on intellectual property and research publishing. Long-term contributions for the maintenance of the international collections and support of research and conservation projects.

<u>How to facilitate access</u>

- Promote information and data exchange (standardization; avoid mislabelling, duplication)
- Identification of material that is not currently available in genebanks
- Creation of collaborative breeding programmes at regional and global level
- Continue with germplasm characterization in collaborative initiatives
- Centralize efforts in trustworthy international institutes
- Identify cases to show the importance of materials towards needs and interests in the market, industry, etc.
- Establish different types of access depending on:
    - Cacao material to be transferred (native varieties of economic importance for the country; wild relatives; introduced varieties)
    - Research activities involved (research; duplicates to avoid extinction; breeding)
- Explore new ways of cooperation between international collections and countries:
    - Black Box Status: germplasm of interest for the country, not to be distributed but allowed for research, evaluation, valuable information for the country; allow to duplicate and conserve valuable materials for the country.
    - Responds to new relationships between international collections and countries.
    - Allows for certain conditionality: for research/not for exploitation
    - Creates a mechanism for within-region sharing of breeding materials
    - Constructs relations based on trust
- Agreements that reward the release of material form countries through monetary and non-monetary benefits:
    - Get improved material back to benefit the country of origin of cacao genetic resources
    - Require a contribution in research
    - Support characterization activities
    - Conserve the best materials in national genebanks
    - Explore new efficient methodologies to conserve high yielding materials and towards increase in genetic diversity

Session 3 – Analysis past and present agreements

PRESENTATION 4: Current development in Brazil – new Access and Benefit Sharing (ABS) Legislation - Simone Nunes Ferreira

Simone Nunes Ferreira of CEPLAC, Brazil, made a presentation on the current Brazilian Access and Benefit Sharing system, which included the points below.

PM 2.186-16: main provisions

- Requires government authorization for access to genetic resources (GR) and traditional knowledge (TK) associated for the purpose of research, bio-prospecting and technology development.
- Requires Prior Informed Consent (PIC) from providers of GR and/or TK (including indigenous and local communities).
- Requires benefit sharing related to any economic use of product and process resulting from access to GR and TK to be paid to the providers.
- Requires Benefit Sharing contracts (Mutually Agreed Terms) and their submission to Cgen.
- Creates the Council for Genetic Heritage Management (Cgen).

Material transfer (shipment of samples)

- Article 19. Shipment of any sample of genetic heritage component from a Brazilian institution, public or private, to a foreign-based institution, shall be carried out based on material in ex situ conditions, and on receipt of information on the intended use and the prior authorization of the Management Council or an accredited institution.

Conditions:

- Deposit of a representative sub-sample of genetic heritage component in a collection maintained by an accredited institution;
- In the instances when the samples of a genetic heritage components accessed in *in situ* conditions before the enactment of this Provisional Act, the deposit referred to in the previous paragraph shall be carried out in the accessed form, if still available;
- Provide information obtained during the collection of samples of genetic heritage components;
- Prior signing of the Material Transfer Agreement.

Types of Authorization for access to Genetic Resources

- Authorization for access and shipment for purpose of scientific research, of bio-prospecting and of technological development.
- Special authorization for establishment of *ex situ* collection with economic potential.

New Brazilian ABS regulation - PLC 2, 2015

- Approved by House of Representatives (February, 2015)
- Discussing in Senate
- Must be voted until end of April
- Significant advances:
    - Facilitation of research: reduced transitions costs
    - Benefit Sharing: clearer regulation developed

New Brazilian ABS regulation - Significant advances

- One electronic registry for research and development.
- Registry of a Benefit Sharing Agreement for commercial use.
- Benefits: monetary (1%) or non monetary (conservation projects).
- Benefits shared with the Union and paid into a benefit-sharing fund.
- Only benefits from final product, not cumulate (agriculture final product: propagating material).

PRESENTATION 5: Analysis past and present agreements on cacao germplasm exchange for research including the SMTA, national bilateral agreements and other ABS agreements - Isabel Lapeña

Isabel Lapeña made a presentation on agreements used for cacao germplasm exchange, based on her individual interviews and materials sent by the participants in advance of the consultation. It included the points below.

What is a Material Transfer Agreement (MTA)?

- It is a contract that underlies the physical transfer of a genetic resource from the provider to a user.
- It will be used to specify terms and conditions attached to that physical transfer: (i.e. what the user will be able to do with the genetic resource obtained).
- It is not a *sales* contract, which calls for a change in ownership and allows the new owner to freely dispose of the genetic material.
- MTA may also form part of larger agreements for joint research and development (R&D).

Example from CATIE - Transfer Agreement for Plant Material Genetically Improved

- "CATIE will provide the material as part of its goal to maximize the use and dissemination of genetically improved germplasm, being products of its breeding and research activities. CATIE strives to ensure that this material will be of maximum public benefit, while ensuring that due credit is given to CATIE for developing it. For this purpose, CATIE, through this MTA seeks to ensure that third parties do not claim legal ownership over the material received nor seek any form of intellectual property protection over that material and related information".
- Main provisions include the following:
  1. Parties: Rights and obligations of the provider and recipient of the genetic resources
  2. Material: describes the type of materials (e.g. seeds, DNA etc)
  3. MTA Conditions
     1. Authorised Use of the Material
     2. Acknowledge the Source of the Cacao Germplasm
     3. Provide Access to the Results of R&D
     4. Duty to Inform
     5. Property of the results of R&D
  4. Third Party Transfer
  5. Intellectual Property Rights
  6. Benefit Sharing
  7. Duration and Termination of the Agreement
  8. Confidential Information
  9. Obligations of the provider
  10. Other Obligations of the Recipient

The Standard Material Transfer Agreement (SMTA) of the International Treaty of Plant Genetic resources for Food and Agriculture (ITPGRFA)

Obligations of the provider

- To make material under the multilateral system available expeditiously and free of charge.
- To do so under the SMTA.
- To list the material provided in the SMTA annex.
- To inform the Treaty's governing body about the SMTAs entered into.

Rights of the recipient

- Recipient can use the material for research, or for breeding or training.
- Recipient can develop new PGRFA products from the material and can protect them and commercialize them.
- Recipient cannot use materials for other purposes or for uses outside food and agriculture.

Obligations of the recipient

- Not to take out intellectual property rights (IPRs) over the material accessed from the multilateral system that restricts its availability to others.
- To make available to the multilateral system non-confidential information resulting from research and development on the material.
- To make a mandatory payment to the multilateral system if the recipient
    - develops a new PGRFA product derived from the material and
    - commercializes the new product and
    - restricts the availability of the new product to others for further research or breeding.
- If further availability is not restricted, then payments are voluntary

Types of restrictions that trigger mandatory payments

- Patents of the US type that restrict availability for research or breeding.
- Technological restrictions like genetic use restriction technologies (GURTs).
- Contractual or licence restrictions.
- Plant breeder's rights would not as a general rule trigger mandatory payments.

Types of payment schemes

- Normal payment scheme
    - 1.1% of gross sales less 30% (i.e., 0.77%)
- Alternative payment scheme
    - 0.5% of all sales of PGRFA of same crop

PGRFA under development

- Basically, breeders' lines in process of development.
- PGRFA under development to be available at discretion of developer during period of development.
- If PGRFA are made available, must be under the terms of the SMTA.
- Transfer can be subject to additional conditions, including payment of monetary consideration.
- Examples could include:
    - methods of making information available or
    - obligation to report information on material back to provider

Third-party beneficiary

- Benefits under SMTA flow to multilateral system not to individual providers.
- Multilateral system is the third-party beneficiary under the SMTA.
- SMTA gives FAO the right enforce third-party beneficiary rights.

Session 4 – Incentives and benefits to share germplasm

PRESENTATION 6: How to maximize and sustain the benefits though further collaboration - Looking at the bigger picture - Sélim Louafi

Sélim Louafi made a presentation (also on behalf of Eric Welch (ASU)) on how to maximize and sustain the benefits though further collaboration - looking at the bigger picture, which included the points below.

The puzzle

- Series of tensions surrounding exchange of genetic resources:
  - Public / private
  - North / South
  - Conservation / Use
  - *Ex situ / In situ*
  - Farmers Rights / Breeders Rights
- Not all actors exchange genetic resources the same way, value the same type of information, share the same policy culture, the same objectives.

…Yet, they are interdependent: no single set of actors is entirely self-sufficient with regard to their need for genetic resources

Tensions

- Formal *vs* informal relationships
- Close ties *vs* weak ties
- Material *vs* information exchange
- Local *vs* distant capacity development
- Concentration *vs* dispersion
- Commonly constructed rules *vs* ad hoc rules
- Efficiency *vs* equity values

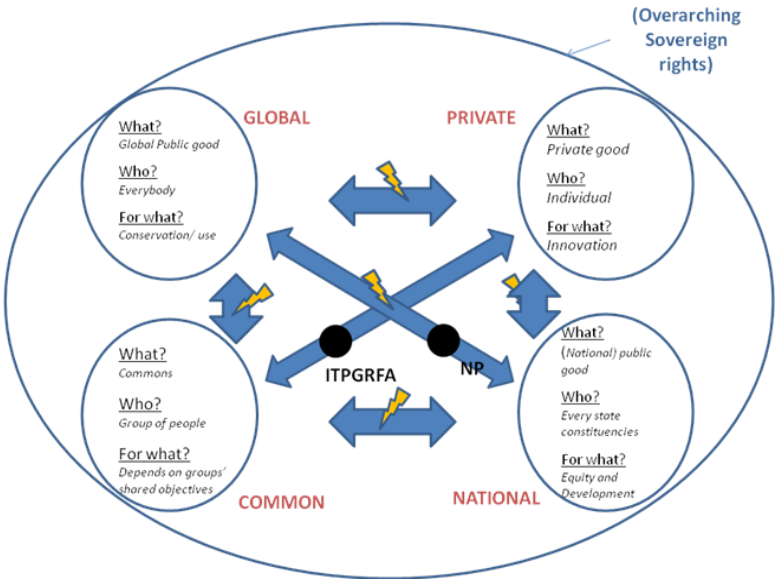

Figure 2: Tensions between the different groups

What expected benefits from collaboration?

- Conservation
    - Representativeness / Completeness
    - Security
    - Efficiency of resource use
    - Sustainability
    - Responsiveness to global or regional threats
- Availability
    - Proportion of conserved material available
    - Extent to which available to all users
    - Completeness of information systems
    - Accessibility of information to users and exchange of information
- Uses
    - Capacity for pre-breeding and breeding
    - Collaboration on crop improvement and use programmes

Research questions

To increase understanding about the dynamics among those groups that utilize common pool resources:

- What conditions facilitate collaboration/increase the cooperative capacities of actors?
- What factors hinder/enable exchange of genetic resources?
- How are benefits shared and what conditions lead to increasing the benefit returns? How to share collective-action outcomes in a context of intergroup inequality/wealth heterogeneity?
- How have global initiatives addressed competing objectives of partners through institutional structures and organizational designs?
- Why are some initiatives more successful than others in confronting these competing objectives?
- What is the basis for trust? What institutions could be most instrumental in fostering discussions and developing trust and trusting relationships?

An explanatory framework - The contested input framework (Welch, E., Louafi, S., 2015)

- Institutional context of exchange (Segger et al., 2013; Morgera et al., 2012) – some materials more regulated than others
    - *National and International Regulatory Barriers*
- Transactional context of exchange
    - *MTA*
    - *Compensation* (Wedajoo and Welch, 2013)
- Relational context of exchange
    - *Relational Closeness, Collegiality, Connections* (Wellman, 1999; Krackhardt, 1992; Shibayama and Baba, 2011)
    - *Trust, reputation*
- Individual Characteristics (Molloy, 2011; David, 2004)
    - *Open science attitude*
- Biophysical context of exchange (Kirk and Memon, 2010; Paavola and Ropke)
    - *Biophysical Value – some materials more valuable than others*

Various on-going projects

- Marie Curie project: Institutional Structures, Constraints and Outcomes of Bio-based research in Agriculture (ISCOBRA).
- NSF Proposal: Contested resource inputs to science: How institutional provisions on the access and use of materials and data affect research collaboration structures and outcomes.

- DivSeek Project: Institutional and Organizational Factors for Enabling Data Access, Exchange and Use Aims for DivSeek.
- Implementation of Nagoya Protocol in the research sector in Malaysia.
- + others

Case study approach

- Academic and grey literature review (knowledge sharing, social and professional networks and institutional design).
- exploratory interviews of potential cases.
- In-depth reviews that include:
    - Interviews of key actors – leads, collaborators, partners – in selected cases
    - Analysis of additional internal materials
    - Collection of transactional access, exchange and contribution data, as available
    - Analysis of bibliometrics to assess collaboration outcomes
    - Collection of survey data to assess the role(s) of social networks

Selection Criteria

- Resource characteristics: Programs in which scientists and others exchange and use both data and genetic materials.
- Goals: Programs that aim to integrate multiple goals such as fundamental research, innovation and conservation.
- Multidisciplinarity: Programmes that include representation from a wide range of disciplines and sub-disciplines of science.
- Transdisciplinarity (i.e. beyond academic sector) or multi-stakeholder: Programs that include a diversity of stakeholders and stakeholder institutions including those from public, non-profit and private sectors.
- Global equity dimension: Programs that are particularly engaged in global exchange and global issues, particularly those that have a developing country component.

Conclusion

- MTA, as any legal instrument, cannot accommodate all challenges related to collaboration => need to go beyond legal discussion.
- Importance of understanding what works and what does not work and how the various factors interact to lead (or not) to the desirable outcomes.
- Building on existing norms, values, institutions and practices increases the efficiency of any solution and reduces the mismatch between big and small policies.

Follow-up discussion and comments

The participants discussed the materials presented earlier and made comments summarised below:

- The group supported the development of a case study on cacao by Selim Louafi and his team.
- How to identify the benefits and how they can be shared.
- Improving trust requires transparency – it can help dealing with problems that will come later on.
- Important to identify the incentives so that all have a part in it and all can win.
- Despite all of the current agreements, why is exchange not happening?
- We need to start with the existing *ex situ* collections and stimulate further exchange step by step.
- Need to maximize the use of the 2 International Collections (CATIE and CRC), strengthen the characterization and re-introduce some clones that may have been lost.
- Need to develop a system that is sustainable and functions well.

- There are different streams with short, medium and long-term objectives.
- Need to support characterization at the national level to identify specific traits of interest and then develop agreements.
- Cacao planting material is less economically competitive than planting materials for other crops and the financial benefits may be less.
- The ITPGRFA was developed with a very pragmatic objective in mind – open and facilitated access to all crop genetic resources. But it may not yet adequately address all the needs.
- We may need to look at and focus on a few factors initially and develop the full range later on.
- Learn from cacao and other crops regarding the public-private partnerships arrangements for exchange.
- A step-wise approach may be to:
    1. use the existing international collections
    2. evaluate materials in national collections
    3. look at how the national diversity can benefit the global community and can be brought into the international collections. One way may be through pre-breeding.
- Need to understand what the benefits are and if they are specific or common to all. Are we talking about financial benefits? What other benefits might there be?
- And sharing the benefits with whom – national vs international, private vs public?
- We need to keep in mind that the diversity held at the national level is of 2 types (1) in *ex situ* collections and (2) at the community level in farmers' fields.
- Do we have enough information and knowledge to be ready to negotiate agreements with specific countries for specific materials? Or should we aim at developing a model or a broader framework?
- We need to have a clearer understanding of the issue of benefits.
- How to return the benefits at the community level is a key question.
- We need to look at different initiatives – what has worked well and not so well and what were the outcomes.

GROUP Discussions: identification of incentives for and benefits from cooperation that includes the exchange of cacao germplasm for research

The participants were divided into 7 small groups and discussed the key benefits of strengthening the exchange of cacao genetic diversity. The reports of the group discussions are summarised in the following points.

<u>Group A - Video-conference participants – notes captured by Brian Irish</u>

1. Prioritize actions on diversity in the existing in *ex situ* collections (international collections and the national collections). A lot of diversity there, many mislabelling, but disease resistance. Fund the management of these collections and then have a consistent system to access the non-improved material.
2. SCA background that is resistant to witches' broom and came originally from Peru. Can entities claim any rights if used in a breeding program 'retroactively'. Another example is the UF273 (parent to the CATIE R clones).
3. *In situ* is very difficult especially as Enrique Arevalo points out that cacao is competing with coca.

Group B – notes from Path Umaharan

- Between the communities, the governments and the end users growing and benefitting from the resources there are the companies also benefitting.
- The case of CSSV may be useful to estimate the loss to the industry and estimate the value of genetic resources.
- Between the genetic resources that we have and what is needed, there is conservation, technical assistance, support to the communities and repatriation of funds to ensure that no one is cheated
- Bilateral agreements, country-to-country, are difficult because of different values.
- The Cocoa Amazon Project may be a good example. It supported collecting and establishment of collections and there were benefits at the community and international levels.

Group C – notes from Andy Wetten

- Exploiting first what is in the collections is agreed and we also need to consider that collecting missions may not be that expensive and it is urgent to safeguard threatened diversity and a priority to secure it in *ex situ* collections.

Group D – notes captured by Judith Brown

- CacaoNet membership - members agree to collaborate, this also means they agree to share.
- Multilateral agreement – not bilateral agreement.
- Everyone contributes germplasm to the genebanks (native materials, genetic resources, hybrids, etc.).
- Define general benefit a member wants to receive.
- Define what each member has to share: valuable traits for the benefit of the industry. E.g. disease resistance – global benefit to the industry.
- Benefits to the 'inventor' encourage local community, national interests.
- Applies not only to genetic materials but also to information/IP about pathogens, disease, abiotic; genomicists intellectual property.
- Consortium inclusive of plant breeding, genomics, pathology, entomology, soil science contributions and expertise to the benefit of the membership.

Group E – notes from Pierre Broun

- Is it critical to identify the needs of the providing countries and find the appropriate benefits – putting countries ahead and prioritising productivity gains and disease resistance.
- The industry could act as a catalyst.
- The appropriate value can be returned back so that nobody is cheated.
- But what is the value of genetic resources? 1% of very little? Cacao is not a "sale" crop.

Group F – notes from Stephan Weise

- If diversity is a national heritage, we should be looking at protecting it for e.g. UNESCO.
- Perceived bad experiences on materials from one region to another so now countries are looking in rather than out.
- What does it mean to unlock cacao diversity?
- We may need to look at a multi-crop approach where the situation of several crops in one country is analysed – some native and some introduced.

Group G – notes from Andrew Daymond

- Look at the benefits of sharing data and information, e.g. the CFC/ICCO/Bioversity project shared data and germplasm – it was successful in getting genebanks to release germplasm.
- We need to consider Prior Informed Consent – PIC.
- Open the playing ground of negotiations not only with curators but with other partners along the value chain – new relations and win-win with the private sector.
- Some things are moving on with ABS and the key stakeholders are here in this CacaoNet consultation.
- How to ensure that it goes back to the communities? E.g. in Brazil with the new legislation.
- But is this CacaoNet's responsibility to oversee national responsibilities?
- In many situations the national system does not work and may lead to "leakages" – need to help countries to get their act together.

General discussions and comments

Following the small-group discussions and reports, the participants discussed in plenary and made the following comments:

- There are islands of best practices and we need to get these to work – it can be multi-country, multi-stakeholders.
- There are a lot of "personal" systems. Breeders need to start at the regional level with regional exchange first e.g. CEPLAC.
- The curators should start discussing and pushing the argument up so that exchange is promoted
- It is hard to share benefits when we do not know the origin of some of the materials.
- Pay first and take later – conserve and build the trust and then exchange – there are benefits when the material is conserved and the trust is built.
- Best practices – looking at the proposal developed for banana (Banana Boost) and the model for green marketing, pulling the benefits to be returned to the Pacific and proportion of sales to develop a trust fund.
- Benefits for the community could be to be involved in breeding trials and selecting promising materials.

Session 5 - Innovative solutions for stimulating use for improved materials

The participants discussed options and innovating approaches for key partners managing cacao genetic resources for stimulating the use of cacao genetic resources for improved planting materials.

The first suggestion was to carry out an inventory of the possible incentives to share cacao germplasm and carry out a case-study on why exchange is necessary. It may be useful to look at a few partners (1-3) and do a SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) and see how they can all complement each other.

It was agreed that a multi-lateral approach may be the best long-term option but that it will take time to build. And it would be useful to look at the best practices to build trust and relationships that would feed into a multilateral system.

There are several levels and types of exchange and these are pictured in ***Figure 3*** below.

Figure 3. Agreements between countries and *ex situ* collections.

The expectations and incentives will differ depending on whether the diversity comes from international genebanks, from countries of diversity, from producing countries and/or from specific individuals.

It is important to be clear on what problem the agreement is trying to resolve, why germplasm needs to be exchanged and why it requires a coordinated solution.

Another key issue is that scientists are often not the decision-makers and so how to make the links between the institutes at the national level is important.

It could be useful to look at examples of successful projects at the national level in other crops where materials were released in international genebanks. Examples were cited such as the UG99 for wheat in Uganda, of taro, and of banana with the International *Musa* Testing Programme (IMTP) and *Fusarium* Tropical Race 4. Another example was a project providing support for the regeneration of banana germplasm in India where materials was also sent to the international collection managed by Bioversity in Belgium (*in vitro* collection) and put in the public domain.

Rey Loor proposed that in the case of Ecuador, the steps to follow would be to first identify the genotypes required (wild or cultivated) and secondly contact the responsible institutes at the Ministry of Environment to establish a cooperation agreement with Bioversity International.

The group proposed looking more closely at the CFC/ICCO/Bioversity project as a good example of a global project that included the exchange of germplasm. And the following discussion focused on this.

GROUP Discussions: key benefits of the CFC/ICCO/Bioversity project and the lessons learnt

Brigitte Laliberté reminded the group about the main objectives and results the 2 phases of the CFC/ICCO/Bioversity Project. The first phase was carried out from 1998 to 2004 and the second phase from 2004 to 2010. Information is in ***Annex 3,*** which includes information on the projects' objectives, components, results and benefits and web reference to the final reports.

The participants divided into 3 groups and discussed the key benefits of the CFC/ICCO/Bioversity project. The reports from the groups' discussions are summarised in the following points.

Group A – notes from Martin Gilmour

- The main advantages of the CFC/ICCO/Bioversity projects were:
    - Sharing of information
    - Stimulated cacao breeders
    - Developed methodology for evaluation
    - Created the INGENIC group still active today
    - Promoted a less formal attitude to sharing - as a result there is exchange in Asia
    - Share genes against different pests and diseases – but did the partners share their best materials? They shared material that was not nationally sensitive
    - At the end there was a feeling of a global breeding community
- The project was an injection but the funding ran out.
- Now a follow-up project might look different and include collecting.
- There would be 2 main issues – sharing wild materials vs local varieties.
- Would be important to have wild materials in the international genebanks to have representatives of the genepool – in Bolivia, Brazil, Ecuador, Peru, etc.
- There are regions with good exchange in Asia and in Central America of materials from the breeding programmes.

Group B – notes from Michael Halewood

- There were 120 clones of which 105 came from CATIE and CRC and 10 from national programmes so if would be important to understand the incentives for sharing the national materials.
- Materials were selected based on diversity and traits.
- The project facilitated movement that initially was slow (possibly based on mistrust) but that later on was overcome.
- WCF is currently providing some support (5,000 USD per country) for the Asia-Pacific Cacao Breeders group for the sharing and revaluation of 40 clones.
- It may not be moving new diversity and there is a need to react to emergency and establish a system to increase the movement of diversity.

Group C – notes from Tony Lass

- The main advantages of the CFC/ICCO/Bioversity projects were:
    - Ambitious project that involved many countries
    - Led to INGENIC groups still active
    - Focused on the 2 international collections (CATIE and CRC)
    - Increased the movement from the ICQCR to countries
    - Increased the movement between countries
    - Supported the breeding programme in Trinidad
    - Collecting in Peru and Ecuador
    - In some countries the CFC project trials kept things going (e.g. CRIG)

    - The workshops improved the capacity of breeding and enhanced international understanding
    - 12 trials in 10 countries is quite an achievement
- Has the momentum died now?
- Not enough funds to continue recording the trials
- What about wild germplasm exchange?
- Do we need to develop a new "CFC-type" project and if so what would be the focus? Possibly climate change preparedness including drought tolerance to biotic and abiotic stresses

General discussions and comments

There was a question asked about what problem the CRC/ICCCO/Bioversity project was trying to solve, what triggered the development the project. Jan Engels provided background to the reasons why the projects were developed. It was mainly to strengthen the use of the 2 international collections and stimulate the exchange of the materials through clone trials and participation of breeding programmes. The leadership and coordination worked well, many people wanted to get something out of the project. But the part of exchange between regions and countries worked less, even in a less restrictive environment. But the exploration of the international collections worked well and this may have been the reason why there was less of a need to exchange between countries.

What may be needed is to construct a scenario, taking into consideration (1) the narrow genetic base of materials in West Africa, (2) the wealth of diversity in Latin America and the Caribbean (LAC) and the urgent need to increase productivity. There is therefore a need for more diversity to resolve current problems and new pests and diseases and where there is collaboration between LAC and West Africa.

It was suggested to take Cocoa Swollen Shoot Virus (CSSV) as a case-study for an urgent current issue in West Africa and a potential threat to spread globally. This would build on the current evaluation work for CSSV in Ghana (CRIG and Cote D'Ivoire (CNRA). It would be important to promote the exchange of materials between CRIG and CNRA to benefit the entire region. The situation with CSSV is urgent in West Africa at the moment and global collaboration is critical. There is an urgent need to bring in new materials in West Africa for testing as the current testing.

The first step would be to identify materials for screening and develop agreements for this purpose. It may therefore be easier to move these materials with some conditions. Then if specific materials are identified with potential resistance or tolerance, specific discussions and agreements could be formalised for these materials. The agreement on accessing materials for screening might involve movement to regions where the disease is present.

CATIE has already sent the parents of the breeding materials to the ICQCR and these are available for global distribution. CATIE would also be interested in getting data on the performance of some breeding materials for other pests and diseases in other regions. But the key issue is how to unlock some of the diversity in national collections by promoting its access and exchange.

Within the industry-led initiative CocoaAction, CSSV is a priority and it will happen, although stakeholders are still to decide on how best to implement such work. The first step will be the screening of the international collections, then field validation and providing a good flow of information and making faster progress.

The screening of diversity for different problems could be considered, keeping in mind the dependency of West Africa on the diversity from other regions. Therefore agreements between countries could include a number of additional activities such as collecting and support for the national collections.

The following are key questions to reflect on:

- What would be the conditions for consideration in a research consortium to make this happen?
- What is needed to unlock diversity for screening and pre-breeding and make the materials available?
- What would be needed to overcome the reluctance and provide incentives for LAC countries to share?
- What might be the needs of the consumers and the industry and how can LAC benefit?
- Diseases move across continents and this may be an incentive to share materials and research results and products? Although it was mentioned that it was not a priority for many countries, it may be in the future?

A starting point might be to discuss these important issues within the LAC Cacao Breeders Group.

GROUP Discussions: What are the conditions needed to include in a research consortium to unlock genetic diversity and make this happen?

The participants divided into 5 groups and discussed the key conditions and incentives required by partners in a research consortium to include access and exchange of diversity. The reports from the groups' discussions are summarised in the following points.

Group A – notes from Jan Engels

- The specific case of Peru was discussed in this group. An agreement would have to include collecting wild and unique germplasm and establish local collections. It would include making some arrangements with the International Collections and ICQCR for the exchange but as "black box" and with the information under the control of Peru.
- For West Africa, it would have to include screening methods for CSSV and test physiological traits.
- If West Africa would be interested in specific genotypes, agreements on the terms to make the material available would be developed.
- Information generated from the collaboration would be published.
- It would open up to other materials, not only from Peru.
- The specific steps for the example of Peru would be summarized as follows:
  1. Collect wild cacao in Peru with external funding
  2. Maintain in national genebank
  3. Send materials to ICQCR
  4. Screen for some physiological traits and CSSV
  5. Have the materials in the international collections as "black box" i.e. with restrictions on use
  6. International collections to provide advice and support to the national collection
  7. International collections to publish data on genes

Group B – notes from Thierry Leroy

The group used the example of looking at a specific disease and propose the following steps:

1. Information sharing
2. Aware of mutual interest for the problem and implement a shared strategy
3. Develop agreement to work on the specific disease resistance/tolerance
4. Know more about the procedures to get access and steps to follow, keeping it as simple as possible. To speed up the process, have local quarantine facilities
5. Perform analysis on the materials – share information – and propose exchange of materials for breeding

Group C – notes from Pierre Broun

- There is a need for risk assessment for the global diseases for sharing materials
- Need to put together a common platform for CSSV screening
- Need to complete the diversity to screen
- Getting access to materials that have resistance
- Screen in a neutral place such as the ICQCR
- Black pod as a focal point - global disease – more incentive to share – more pressing
- Common platform in West Africa to screen for CSSV and share materials
- For interesting resistance, the materials should be evaluated and information shared so that the resistance is not only on one strain of the virus
- Shared risk assessment – i.e. we need a platform to share the views and build a common understanding on these risks – possibly having a conference every 2 years

Group D – notes from Michael Halewood

- Bring together the regional Cacao Breeders groups – easier to talk to each other – build a discussion across regions. Need for a workshop to bring people together.
- Bring competent authorities from each country (although there are pros and cons for this).
- West Africa and LAC to exchange materials – from West Africa to LAC as a possible incentive.
- First use the materials at CATIE, CRC and ICQCR and require information on requests for other materials.

Group E – notes from Brian Irish

- Sharing may be perceived as a one-way and we need to think of it in a different way
- Reasons to share may be:
    - Provide funding back to the collections
    - Screen from LAC and elsewhere (WA, Asia)
    - New hybrids in WA and Asia to be shared with LAC
    - But there is a concern to introduce CSSV so would have to be clonal materials
    - Funding used to focus on problems in LAC for accessing materials
    - Funding for collecting and increase the diversity from the wild
- Work with countries willing to share first
- Productive clones screens for disease resistance in LAC and also CSSV as preventive measures
- Industry and countries interested in accessing materials should provide funding support
- The funding should be spread to share the benefits
- LAC may need other crop input from West Africa and Asia and could be a bargaining tool

Session 6 - Next steps and decision-making

The participants discussed the possible next steps and decision-making process towards the development an instrument to facilitate access to cacao germplasm for research.

There seem to be three main approaches for the development of agreements stimulating exchange:

1. Consortium approach including:
    - Shared research questions
    - Development of a project
    - Sharing genetic resources in support of the problems to be resolved
    - Involving INGENIC and the regional breeders groups
    - Mutual benefits developed
2. Bilateral agreement approach including:
    - Identification of specific needs
    - Arrangements for transfer of germplasm
3. Support to countries with the most diversity ensuring that:
    - Benefits are returned
    - Collaborative/capacity building approach with the provider country
    - They feel part of the process

These approaches are not mutually exclusive and they can all be part of a global project with elements under specific agreement. We need to be realistic and keep in mind that cacao is not an Annex 1 crop and is therefore under the CBD. It is important to develop a common understanding of the issues around the exchange of materials and the different interests but agree on a common goal for reciprocal benefits.

The first step would be to analyse the needs for each party and discuss which approach would be acceptable (e.g. for Brazil, Ecuador and Peru). The consortium approach would be perfectly adapted for the international collection material and it was indeed the one adopted for the CFC/ICCO/Bioversity project. Reflecting on the conditions needed for it to be applied to other material is one of the main challenges.

The Consortium approach could develop trials in each region and this could be discussed with the LAC breeders group. The LAC Regional Breeders Group may be meeting this year in El Salvador and would ensure link with the other regional groups by inviting representatives of the Africa and Asia/Pacific Breeders groups to attend.

It is important to further explore the consortium approach to continue building trust and test how concretely the sharing of the benefits and results could be implemented to satisfy all partners' expectations.

The example of CSSV as a potential good case for developing a consortium approach has been explored. An analysis of the willingness to share materials to solve the case of CSSV should be conducted but from initial discussion, it seems clear that we may need to look at multiple diseases at the same time and not focus on only CSSV if such consortium approach is to be privileged. Access and screen for 2 or 3 traits at the same time, then based on the information/data/knowledge, specific agreements could be developed.

We need to create a free space to move forward and be aligned with the national laws. This would include a diversity of options. Priorities proposed are to:

1. Ensure that diversity is available now and also for the future – need to collect, conserve and characterise. Funds are needed for the conservation/management and the industry can help to support these costs.
2. Focus on more specific problems (pest and diseases etc) and involve different schema of ABS
3. Develop a common consortium agreement for research and if something is useful, take the necessary steps to exchange the materials. Make it an attractive proposition to share as the easy option.

The approach 3 may be easier to accept, helping countries with diversity such as the Amazon collection. The example of CEPLAC and ICT, if you want results, you need to pay. There was a project developed between CEPLAC and ICT but it was not accepted. It may be the issue that ICT is private and CEPLAC is public.

There are 2 main types of exchange (1) wild materials and (2) breeding materials and we need to unlock the diversity not captured and safeguarded. And it is important to share materials as parents to ensure that the genepool is shared. Using a black box agreement, e.g. with CATIE/CRC/ICQCR would have the genes transferred to countries to carry out the crosses.

It was suggested that providing access to wild materials may be easier than to breeding materials but countries of diversity confirmed that it would be equally challenging. The issue is to be clear on why we should be sharing. In Peru for example, it is easier to share for commercial propagation than for conservation and use. Within West Africa, there are no problems about sharing germplasm as diseases are shared and all have a common interest.

There may be the need to agree in advance that if something is interesting, a payment would be made (e.g. 1% of sales) but the exact amount of payment would need to be discussed to get it right. So we may need to develop projects to value the materials and also estimate the value of germplasm. The value can be in the uniqueness of the diversity and in the characterisation information that brings more value.

There is an urgent need to ensure that representatives of the Motamayor *et al* 2008 genetic groups are safeguarded at the national level and available in the international collections and there is an urgency to collect and preserve these groups.

In the case of Peru, there is a small project from the government to fund the collection but these funds are running out in December 2015. The cost of maintaining a collection is high.

Characterisation is urgently needed but the task also needs to be shared and establish agreements for molecular and morphological characterisation.

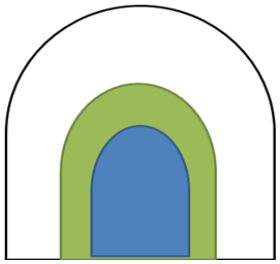

Figure 4: Different part of the cacao genetic diversity

Figure 4 above illustrates the different part of the cacao diversity where:

- The middle blue part is the material currently available, in the public domain – CATIE, CRC, CIRAD, USDA and the ICQCR. The exchange of this material is through using the SMTA or MTAs developed by CIRAD and USDA.
- The green part is the new diversity that would be critical to move forward with some of the pest and diseases and this would be subject to specific agreements. This material would be the focus of a consortium approach.
- The rest of the diversity is maintained in national collections and in farmers' fields and if access would be required, specific bilateral agreements would be developed between the interested parties.

It is recommended that the participants in this CacaoNet consultation be the main partners to move this forward together with the specific diversity countries. So the main task is for CacaoNet to map out the process and models and get feedback from the group. Carrying out an analysis the specific constraints and conditions would be part of the process. The regional interests will be critical and provide feedback to the process. We could develop a case-study for CSSV and materials from Peru and what would be the conditions to be included that would make it attractive to Peru.

The flow and materials from farmers' fields, communities, national and international genebanks and the possible agreements were summarised in the following diagram (***Figure 5***).

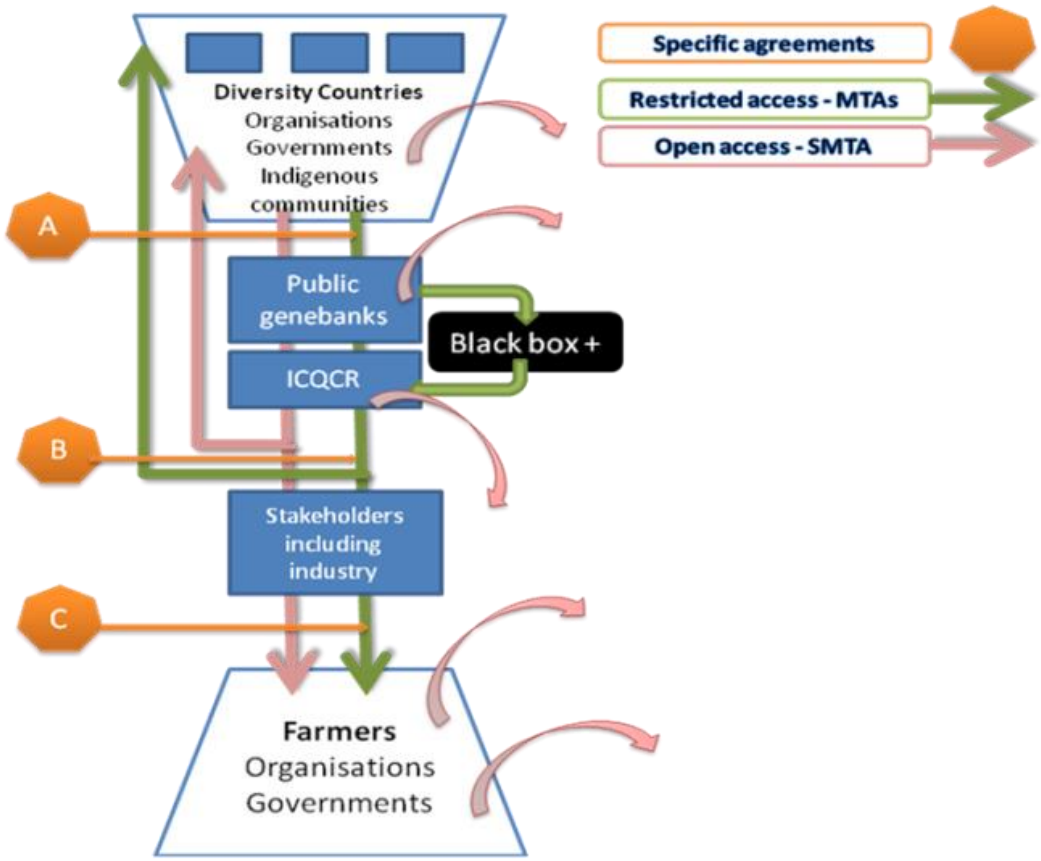

Figure 5: Diagram of the flow of materials

The last part of the meeting was taken as an opportunity for the participants to provide feedback on the CacaoNet consultation. The meeting ended with closing remarks from Stephan Weise expressing appreciations to all for their involvement and participation.

3. Summary, Recommendations and Next Steps

3.1 - CURRENT SITUATION of conservation and use of cacao genetic resources

The challenge:

- Lack of genetic diversity in cacao varieties and the threats to the genetic resources that breeders rely on.
- Priority to develop good quality locally-adapted materials required, whatever country, region or farming system.
- Increased interdependency of countries on genetic resources.
- Access to genetic diversity for the development of improved planting materials to farmers is the essential element to contributing to the economy of cocoa-producing countries.
- The development of a Global Strategic Cacao Collection (GSCC), a key element of the Global Strategy, will result from a coordinated effort of characterization of available cacao genetic resources.

Ex situ conservation:

- Over 35 *ex situ* collections worldwide maintain more than 24,000 samples of cacao diversity.
- Wide variation for disease resistance and quality exists in *ex situ* collections and in farmers' fields but its use it not optimised.
- There are only 2 international collections managed by CATIE, Costa Rica and CRC, Trinidad and Tobago with an international agreement under the ITPGRFA to maintain global collections of cacao genetic resources for the long term and to make this germplasm freely available to any *bona fide* user, with the SMTA.
- Long-term contributions from the industry for the maintenance of the international collections and support of research and conservation projects.
- Other collections, such as CIRAD (Montpellier and French Guyana) and USDA (Puerto Rico), also make their cacao germplasm available for international distribution.
- The rest of cacao diversity is in national collections and farmers' fields and in the wild often with restricted access and/or lack of a clear legal and policy framework.

The safe- movement of germplasm

- Movement of germplasm brings risk of transferring pests and diseases.
- The global safe movement of cacao germplasm is through the ICQCR with the use of the SMTA to distribute material received from CATIE and CRC or their own MTA for material received from other collections, requesting donor genebanks to agree for the material to be passed on to a third party.
- The USDA/ARS in Miami offers quarantine facilities for regional transfers.

Exchange of cacao germplasm:

- With the exception of the CATIE, CRC, USDA and CIRAD, there is little international exchange of germplasm.
- Asia/Pacific and West Africa regions open to exchange and more dependent on the diversity maintained in the LAC region.
- Lack of information from characterization and evaluation (quality and performance) is also an important factor limiting the use of new germplasm into breeding programmes.
- INGENIC breeders' groups active in exchanging information on genetic resources and new varieties during working group meetings.

- Most national programmes operate under the Convention on Biological Diversity (CBD), usually without having specific Access and Benefit Sharing (ABS) legislation in place.
- The situation has resulted in fragmented approaches, informal exchanges of germplasm and thus, the benefits generated not recognized.
- Danger of uninformed amateur direct movement of germplasm, outside of the normal system
- The industry is very involved in breeding and development of new varieties with traits demanded by the market. There are no problems in putting the results of breeding programmes into the public domain mainly based on agreements on intellectual property and research publishing.

<u>Constraints to the access of national collection materials</u>

- Key question: Who are the owners of the diversity maintained in the genebanks around the world?
    - The country of origin?
    - The country that maintains it?
    - The country that improves it?
    - Humanity and the future generations?
- Developing transparent ABS arrangements for cacao genetic resources.
    - If new products are developed from genetic material, how can the rights of the providers be recognized in the final product?
- Access to cacao germplasm to become progressively more restrictive.
- Restricted access subject to authorization of the country of origin according to countries ABS rules.
- Complex/unknown CBD/ABS national regulations and intervention of different authorities with competence to authorize access.
- Plurality of institutions involved: Lack of coordination between the Ministries (Environment and Agriculture) on access to genetic resources as a general rule. Lack of understanding of cacao research and its breeding context.
- Lack of understanding among scientists about collecting permits and ABS regulations.
- Different public and private nature of research and breeding institutes.
- Lack of regional quarantine infrastructure and national quarantine constrains lead to no exchange among countries.
- Difficulties to introduce materials due to quarantine issues. Lack of harmonized quarantine requirements, low and long administrative procedures.
- There are tensions surrounding the exchange of genetic resources:
    - Public vs private
    - North vs South
    - Conservation vs Use
    - *Ex situ vs In situ*
    - Farmers Rights vs Breeders Rights
    - Formal vs informal relationships
    - Close ties vs weak ties
    - Material vs information exchange
    - Local vs distant capacity development
    - Concentration vs dispersion
- Not all actors exchange genetic resources the same way, value the same type of information, share the same policy culture, the same objectives.
- Yet, they are interdependent: no single set of actors is entirely self-sufficient with regard to their need for genetic resources

3.2 - AGREEMENTS on cacao germplasm exchange for research

A Material Transfer Agreement (MTA) is:

- A contract that underlies the physical transfer of a genetic resource from the provider to a user.
- Used to specify terms and conditions attached to that physical transfer: (i.e. what the user will be able to do with the genetic resource obtained).
- Not a *sales* contract, which calls for a change in ownership and allows the new owner to freely dispose of the genetic material
- May also form part of larger agreements for joint research and development

The SMTA of the ITPGRFA – full text available here: http://www.planttreaty.org/content/what-smta

- Obligations of the provider:
    - make material available expeditiously and free of charge
    - list the material provided in the SMTA annex
    - inform the ITPGRFA's governing body about the SMTAs
- Conditions of the recipient:
    - can use the material for research, for breeding or training
    - can develop new PGRFA products from the material
    - can protect them and commercialize them
    - cannot use materials for other purposes or for uses outside food and agriculture
    - cannot to take out IPRs over the material accessed from the multilateral system that restricts its availability to others
- Obligations of the recipient:
    - make available the non-confidential information resulting from research and development on the material
    - make a mandatory payment to the multilateral system if the recipient
        - develops a new PGRFA product derived from the material
        - commercializes the new product
        - restricts the availability of the new product to others for further research or breeding
    - If further availability is not restricted, then payments are voluntary
    - If PGRFA are available it must be under the terms of the SMTA
    - PGRFA under development (breeders' lines in process of development) to be available at discretion of developer during period of development.
- Third-party beneficiary
    - Multilateral system is the third-party beneficiary under the SMTA
    - Benefits under SMTA flow to multilateral system and not to individual providers
    - SMTA gives FAO the right enforce third-party beneficiary rights

National bilateral agreements - Example from the Brazilian ABS system

- Material transfer (shipment of samples)
    - Article 19. Shipment of any sample of genetic heritage component from a Brazilian institution, public or private, to a foreign-based institution, shall be carried out based on material in ex situ conditions, and on receipt of information on the intended use and the prior authorization of the Management Council or an accredited institution.
- Conditions:
    - Deposit of a representative sub-sample of genetic heritage component in a collection maintained by an accredited institution

    - In the instances when the samples of a genetic heritage components accessed in *in situ* conditions before the enactment of this Provisional Act, the deposit referred to in the previous paragraph shall be carried out in the accessed form, if still available
    - Provide information obtained during the collection of samples of genetic heritage components
    - Prior signing of the Material Transfer Agreement.
- Types of Authorization for access to and shipment of genetic resources:
    - For purpose of scientific research, bio-prospecting and technological development.
    - Special authorization for establishment of *ex situ* collection with economic potential.
- New Brazilian ABS regulation - PLC 2, 2015
    - Approved by House of Representatives (February, 2015)
    - Discussing in Senate
    - Must be voted by the end of April
- Significant advances:
    - Facilitation of research: lower transaction costs
    - Benefit Sharing: clearly regulation

<u>Transfer Agreement for Genetically Improved Plant Material - Example from CATIE</u>

- "CATIE will provide the material as part of its goal to maximize the use and dissemination of genetically improved germplasm, being products of its breeding and research activities. CATIE strives to ensure that this material will be of maximum public benefit, while ensuring that due credit is given to CATIE for developing it. For this purpose, CATIE, through this MTA seeks to ensure that third parties do not claim legal ownership over the material received nor seek any form of intellectual property protection over that material and related information".
- Main provisions include:
    - Parties: Rights and obligations of the provider and recipient of the genetic resources
    - Material: describes the type of materials (e.g. seeds, DNA etc.)
    - MTA Conditions: Authorised use of the material, acknowledge the source of the cacao germplasm, provide access to the results of R&D, duty to Inform and property of the results of R&D
    - Third Party Transfer, Intellectual Property Rights, Benefit Sharing
    - Duration and termination of the agreement and confidential Information
    - Obligations of the provider and other obligations of the recipient

<u>Safety-duplication with use restrictions – definition of 'Black Box'</u>

Agreements of collaboration with international collections, for the management of materials under "Black Box" status, i.e. germplasm not to be distributed but can be used for research, evaluation and sharing of information back with the country. This constitutes a safety back-up and conserves valuable materials for the country at the same time as allowing some restricted use.

3.3 - BENEFITS and INCENTIVES from cooperation for the exchange of cacao germplasm

The diversity held at the national level are of 2 types (1) in *ex situ* collections and (2) at the community level in farmers' fields. It is critical to identify all the possible benefits of accessing genetic diversity and how these benefits can be shared with all involved, particularly how to return the benefits at the community level. But it is also important to acknowledge the difficulty of sharing benefits when the origin of materials may not be fully known, and when several countries may be sharing the same diversity.

The group stressed the importance of looking at different initiatives, what worked well and not so well and what were the outcomes. It was suggested the group drafts an inventory of possible incentives to share germplasm looking at a few partners (1-3) and do a SWOT analysis. The London Cocoa Trade Amazon Project may be a good example. It supported collecting and establishment of collections and benefits at the community and international levels. It could be useful to look at examples of successful projects in other crops where national materials were released in international genebanks (e.g. wheat, taro, and banana).

The CFC/ICCO/Bioversity project was a good example of a global collaborative project with the aim of stimulating the exchange and use of cacao germplasm. And the main benefits identified by the participants were the following:

- Ambitious project that involved many countries
- Sharing of information between all participants
- Facilitated movement of germplasm from the 2 international collections (CATIE and CRC) through the ICQCR to countries and between countries in the regions
- Strengthened the use of the 2 international collections through clone trials and participation of breeding programmes.
- A total of 120 clones, mainly from CATIE and CRC and a few from national programmes
- 12 trials in 10 countries is an important achievement
- Included collecting activities in some of the countries (Peru and Ecuador)
- Materials selected based on diversity and traits and genes shared against different pests and diseases
- Partners shared material that was not nationally sensitive
- Stimulated cacao breeders and created the INGENIC group still active today
- Fostered a global breeding community and improved capacity
- Enhanced understanding of the global issues to be solved
- Developed methodology for evaluation
- Promoted a less formal attitude to sharing
- In some countries the CFC project trials supported the national activities

The incentives to share germplasm will differ depending on whether the genetic diversity to be accessed comes from international genebanks, from countries of diversity, from producing countries and/or from specific individuals. They will be linked to the needs of the providing countries and ensuring that appropriate benefits are identified, putting countries first to productivity and disease resistance. Some of the key benefits may be access to the following:

- A broad range of cacao diversity and related information
- Healthy germplasm thought safe-movement and use of quarantine services
- Improved material back to benefit of the country of origin
- Evaluated germplasm that can be directly included in national and local selection trials
- Enhanced breeding populations

- Support for characterization activities
- Support for institutional information management systems
- Information on material that not currently available in genebanks – for gap filling
- Information on materials corresponding to the needs and interests in the market
- Support for conservation in national genebanks
- Technologies, procedures and methods to conserve, improve and breed cacao, including cryopreservation, characterization standards, diversity analysis, genetic tools, and somatic embryogenesis.
- Network of evaluation trials and standard methodologies
- Support for communities to be involved in breeding trials and selecting promising materials.
- Plant quarantine services, including development of local and national quarantine facilities, reducing the spread of cacao pests and diseases
- Germplasm characterization in collaborative initiatives
- Collaborative breeding programmes at regional and global level
- Collaborative responsiveness to global or regional threats
- New opportunities for funding and collaboration

3.4 - APPROACHES for global collaboration to stimulate exchange of germplasm

The pre-requisite for a long-term solution is the full implementation, in mutually supportive ways, of the ITPGRFA, the CBD and the Nagoya protocol. Ultimately a lot is based on trust (which requires transparency), on a shared sense of purpose (research and development partnerships involving movements of materials and related information in furtherance of shared objectives), on shared benefits (directly with providers) and on a clear understanding of the national interest. Novel options need to be considered for the sharing of germplasm with incentives for the providers, including national programmes and smallholder growers.

There are three main approaches proposed for the development of agreements stimulating exchange:

A. Consortium approach including:
    - Multilateral agreement
    - Mutual benefits
    - Development of a project
    - Involving INGENIC and the regional breeders groups
    - Sharing genetic resources in support of the problems to be resolved
    - Shared research questions
B. Bilateral agreement approach including:
    - Identification of specific needs between 2 parties
    - Arrangements for transfer of germplasm and conditions specific between the 2 parties
C. Support to countries with the most diversity ensuring that:
    - Benefits are returned to the country of origin
    - National programmes feel part of the process
    - Conserve, build trust and then exchange (pay first and take later)
    - Benefits are when the material is conserved and trust is built

These approached are not mutually exclusive and can all be part of a global project with different component under specific agreements. It was agreed however that a consortium approach with a multi-lateral agreement may be the best long-term option but that this may take time to build and that in the

case of an emergency, a bilateral approach may be quicker depending on the situation and level of urgency. However, bilateral agreements, country-to-country, may be difficult because of the different values and the approach to provide support to diversity countries may be easier to accept initially while building trust. It is important to keep in mind that cacao is not an Annex 1 crop of the ITPGRFA and is therefore under the CBD for all national collections. All efforts need to be aligned with national laws and this might include a diversity of options.

3.5 - CONDITIONS needed in a research consortium to unlock genetic diversity

It is proposed to construct a programme, taking into consideration the narrow genetic base of materials in West Africa, the wealth of diversity in Latin America and the Caribbean (LAC) and the urgent need to increase productivity. There is therefore a need to harness more diversity to resolve current problems and collaboration between LAC and West Africa.

The key questions to answer are therefore:

- What would be the conditions for participation in a research consortium?
- What is needed to unlock genetic diversity for screening and pre-breeding and make it available particularly for the LAC countries and share research results and products?
- What might be the needs of the consumers and the industry and how can LAC benefit?

Agreements to access genetic diversity would need to ensure the following benefits:

- Get improved material back to benefit of the country of origin of cacao genetic resources
- Require a contribution in research
- Support characterization activities
- Support to conservation in national genebanks
- Capacity for pre-breeding and breeding
- New opportunities for funding and collaboration

The steps to be taken to develop a research consortium for providing access to diversity could be the following (including conditions required by partners):

1. Carry out a global risk assessment of pests and diseases for sharing materials and establish a global platform to share views and build a common understanding on the risks (including conferences).
2. Agree on the pests and diseases to be targeted by a global consortium for urgent and preventive measures such as: Cocoa Swollen Shoot Virus (CSSV), Black Pod, Frosty Pod, climate change preparedness including drought tolerance to biotic and abiotic stresses etc.
3. Identify the materials and genotypes required for screening and the institutes where the materials are.
4. The first priority is to use the materials in the international collections at CATIE, CRC through the ICQCR and request information from collection managers for other materials.
5. Work with countries willing to share first and contact the responsible institutes (Min of Env. or Ag.) to establish a cooperation agreement with the global consortium.
6. Build on the current evaluation work for CSSV in Ghana (CRIG and Cote D'Ivoire (CNRA), planned by CocoaAction and partners.
7. Ensure the safeguard of wild and unique germplasm by collecting and conserving - materials from Bolivia, Brazil, Ecuador, Peru, etc. and have representatives in the international genebanks.
8. Provide funding support to national *ex situ* collections.
9. International collections to provide advice and support to national collections.
10. Develop agreements specifically for accessing materials for screening first. CIRAD has a model.

11. Develop agreements with the International Collections for the exchange (could be with restrictions on use).
12. Send materials to the ICQCR for exchange.
13. Develop screening methods.
14. Screen in a neutral place.
15. Publication of screening information.
16. Develop specific agreements for accessing specific materials with potential resistance-tolerance and genotypes for breeding.
17. Field evaluation trials of promising materials.
18. Publication of evaluation trials data.
19. Use of specific materials in breeding programme.

These different steps involve different types of commitments of the partners and different types of formalisation within the Consortium agreement. In all case, This steps would have to take place within an agreed governance framework that has to be set up from the outset and that would deal with the rules of participation, decision-making, communication, and would monitor the progress at all levels (legal, institutional, individual, scientific).

3.6 - NEXT STEPS and follow-up actions

The first step would be to analyse the needs for a number of parties (e.g. for Brazil, Ecuador and Peru) and discuss the potentially different approaches. It is important to be clear on what problem an agreement would be trying to resolve, why germplasm would need to be exchanged and why it would require a coordinated solution. Therefore taking the specific case of CSSV and potentially interesting materials from Brazil, Ecuador and Peru; this could provide a useful example, also representing the regional interests, to identify the conditions to be included in the different approaches and agreements. It would map out the flow of materials from farmers' fields, communities, national and international genebanks and the possible agreements that might be necessary to ensure that a global agreement is inclusive of these. A better idea of the economic value of cacao germplasm is also needed and the case of CSSV may be useful to estimate the loss to the industry (and to West Africa!) and therefore the potential value of genetic resources. The economic benefits to be made from accessing diversity and benefit-sharing may be better understood.

All approaches analysed would not only apply to genetic materials but also to information and intellectual property about pathogens, diseases, abiotic stresses, quality, and to genomicists. Therefore a Consortium approach should be inclusive of disciplines in plant breeding, genomics, pathology, entomology, soil science etc. It would open the playing field for negotiations not only to curators but also with other partners along the value chain and build new relationships and win-win with the private sector, with the industry acting as a catalyst.

Participation in a consortium approach might require looking at several pests and diseases (screening for 2-3 different things at the same time) and even possibly several crops – cacao as native and some introduced. So part of the process could also look at best practices, be it multi-crop and/or multi-stakeholder.

For this, it would be important to bring together the INGENIC Regional Cacao Breeders groups and build a discussion across regions. It may also be important to involve the competent authorities from each country. A starting point might be to discuss these important issues within the LAC Cacao Breeders Group.

A consortium approach should also ensure that diversity is available now and for the future and would ensure collecting (filling gaps), conserving and characterising. Funding support is needed for these activities and the industry and countries interested in accessing materials, and ensure that benefits are shared with all.

So the main task is for CacaoNet to map out the process and models and get feedback. It is recommended that the participants in this CacaoNet consultation be the main partners to move the concept forward together with the specific diversity countries.

It is important to keep in mind that the overall priority of the Global Strategy is to ensure the long-term conservation of the diversity in the existing in *ex situ* collections (international and national collections). These collections hold a lot of diversity with potential disease and pest resistance but there is much work to be done to document, reduce mislabelling, characterise, evaluate and share the information. Therefore exploiting first what is in these collections is agreed and carrying out collecting missions is urgent to safeguard threatened diversity and secure it in *ex situ* collections. Linked to this is the support to the characterization of materials in national collections to identify specific traits of interest. These collections require funding to support a global system of access to and exchange of cacao genetic diversity. And all players have a responsibility to support the essential services to the global community.

CacaoNet will also assist in the development of a case study on institutional structures and constraints for Cacao Genetic Resources in order to increase our understanding of the various factors that hinder/enable global collaboration on cacao genetic resources and of the range of options and models to reach to the desirable outcomes. This would allow building any future solutions on existing institutions and practices so that to ensure their actual and efficient implementation. Key research questions to increase understanding may be:

- What conditions facilitate collaboration/increase the cooperative capacities of actors?
- What factors hinder/enable exchange of genetic resources?
- How benefits are shared and what conditions lead to increasing the benefit returns? How to share collective action outcome in a context of intergroup inequality/wealth heterogeneity?
- How have global initiatives addressed competing objectives of partners through institutional structures and organizational designs?
- Why are some initiatives more successful than others in confronting these competing objectives?
- What trust means in this context? What basis for trust? What institutions could help building trust?

CacaoNet will continue to collaborate with national collections, FAO and the International Treaty to promote the placing of cacao germplasm collections in the public domain through designation under the Treaty. It will assist in clarifying the legal status of cacao collections, including formal roles and responsibilities of national cacao research institutes in conserving and developing cacao germplasm collections.

Annexes

Annex 1. Participants

Country	Full name	Institute full name	Acronym	City	Email or emails
1. Costa Rica	Wilbert Phillips-Mora	Centro Agronómico Tropical de Investigación y Enseñanza	CATIE	Turrialba	wphillip@catie.ac.cr
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Annex 2. Programme

Time	Tuesday 31 March 20915
09:00-09:30	**Welcome and Approval of Programme** • Welcome address - Stephan Weise • Introduction of participants and expectations of the consultation – All • Programme objectives and proposed agenda – Brigitte • Discussion and approval of programme • Logistic information
09:30-10:30	**Session 1 – Background on the key issues** • **PRESENTATION**: Where we are today in conservation and use of cacao genetic diversity – and the movement of germplasm – ***Brigitte Laliberte*** • General discussion • **PRESENTATION**: The current legal and policy frameworks explained – ***Michael Halewood*** o International Treaty on Plant Genetic Resources for Food and Agriculture (IT-PGRFA) and the Standard Material Transfer Agreement (SMTA) o The Convention on Biological Diversity (CBD) and Nagoya Protocol – including agreement of access for research o FAO Commission on Genetic Resources for Food and Agriculture (CGRFA) cross-cutting with Access and Benefit-Sharing (ABS) for special research exemption under the CBD • General discussion
10:30-11:00	***Coffee break***
11:00-12:30	Introduction of remote participants and summary of the earlier session - Brigitte **Session 2 – Current constraints and how to facilitate access** • **PRESENTATION**: Feedback from the interviews on the constraints of the current Access and Benefit-Sharing (ABS) tools used – ***Isabel Lapeña*** • Discussions on: o the analysis of the current constraints in the system for the conservation and use of cacao genetic resources o what might facilitate access of germplasm o identify all of the constraints – agree on the complete picture • General discussion
12:30-14:00	***Lunch break***
14:00-15:30	Introduction of remote participants and summary of morning session - Brigitte **Session 3 – Analysis past and present agreements** • **PRESENTATION**: Current development in Brazil – new Access and Benefit Sharing Legislation – *Simone Nunes Ferreira* • **PRESENTATION**: Analysis past and present agreements on cacao germplasm exchange for research including the SMTA, national bilateral agreements and other ABS agreements – *Isabel Lapeña* • GROUP discussion on the experience of the participants to complete the inventory of agreements
15:30-16:00	***Coffee break***
16:00-18:00	**Session 4 – Incentives and benefits to share germplasm** • **PRESENTATION**: How to maximize and sustain the benefits though further collaboration - Looking at the bigger picture – *Sélim Louafi* • Discussion and identification of the incentives for and benefits from cooperation that includes the exchange of cacao germplasm for research • GROUP discussion
20:00	**Social dinner:** Osteria Mavi, Via Enrico Fermi 71, Tel: 06-558-4801 – www.osteriamavi.it

Time	Wednesday 1 April
09:00-09:15	• Summary of DAY 1 discussions and key points – *Brigitte* • General discussion
09:15-10:30	**Session 5 - Innovative solutions for stimulating use for improved materials** • Discussion on options and innovating approaches for key partners managing cacao genetic resources for stimulating the use of cacao genetic resources for improved planting materials. • General discussion
10:30-11:00	***Coffee break***
11:00-12:30	Summary of the session before coffee break to remote participants - Brigitte **Session 5 - Innovative solutions for stimulating use for improved materials - *continued*** • Discussion on options and innovating approaches for key partners managing cacao genetic resources for stimulating the use of cacao genetic resources for improved planting materials. • General discussion
12:30-13:30	***Lunch break***
13:30-15:00	Summary of the morning session to remote participants - Brigitte **Session 6 - Next steps and decision-making** • Develop a road-map of the different steps in collaboration with key partners – *Selim Louafi* • Discussion on the possible next steps and decision-making process towards the development an instrument to facilitate access to cacao germplasm for research. • General discussion • Proposed recommendations
15:00-15:30	***Coffee break***
15:30-17:00	• Conclusions of the consultation and Next steps • Close of meeting

Annex 3. Extract from the CFC/ICCO/Bioversity project reports

CFC/ICCO/Bioversity projects - first project from 1998-2004 and second project from 2004-2010

CITATIONS and weblinks to the PDF reports:

- Eskes, A.B. and Y. Efron, editors. 2006. Global Approaches to Cocoa Germplasm Utilization and Conservation. Final report of the CFC/ICCO/IPGRI project on "Cocoa Germplasm Utilization and Conservation: a Global Approach" (1998-2004). CFC, Amsterdam, The Netherlands/ICCO, London, UK/IPGRI, Rome, Italy. http://www.bioversityinternational.org/uploads/tx_news/Global_approaches_to_cocoa_germplasm_utilization_and_conservation_1172.pdf
- Eskes AB, editor. 2011. Collaborative and Participatory Approaches to Cocoa Variety Improvement. Final report of the CFC/ICCO/Bioversity project on "Cocoa Productivity and Quality Improvement: a Participatory Approach" (2004-2010). CFC, Amsterdam,The Netherlands/ICCO, London, UK/Bioversity International, Rome, Italy. http://www.bioversityinternational.org/uploads/tx_news/Collaborative_and_participatory_approaches_to_cocoa_variety_improvement_1444.pdf

The objectives of the 2 projects (from 1998-2010) were:

- Selection of improved varieties with increased yield capacity, resistance to major diseases and pests and with good quality attributes,
- Reinforcement of regional and international collaboration in cocoa breeding,
- Reinforcement of local breeding programmes,
- Direct involvement of farmers in the selection of new varieties through a participatory approach,
- Use of diversity present in international cocoa genebanks to carry out germplasm enhancement for important diseases,
- Distribution of selected germplasm through intermediate quarantine to user countries and through exchange between partners,
- Exchange of information and capacity building.

Key benefits of the 2 projects were:

- Reinforcement of existing cocoa breeding programmes in six countries and re-initiation of breeding programmes in five other countries,
- Selection of new candidate varieties for distribution to farmers,
- Adoption of a farmers' participatory approach through use of farmers' knowledge in selecting promising trees in farmers' fields, and establishment of on-farm trials,
- Establishment of Regional Variety Trials in Africa and in the Americas, aiming at sharing germplasm with disease resistance,
- Evaluation of stability of selection traits through the International Clone Trial established in eight different countries,
- Insights gained in resistance testing methodologies,
- Use of the Trinidad collection to enhance germplasm for black pod and witches' broom resistance,
- Initiation of distribution of selected germplasm through intermediate quarantine (Reading University) to user countries,
- Sensory profiling and independent industry organoleptic evaluations of cocoa liquors made with clones of the International Clone Trial,
- Human capacity building through regular regional and international project workshops and use of project data to obtain university degrees,
- Unprecedented cooperation among research institutes in the cocoa-producing countries, regional and international cocoa research institutes as well as the private sector.

Summary description of the CFC/ICCO/Bioversity first project 1998-2004 - Cacao Germplasm Utilization and Conservation: a Global Approach

Between 1998 and 2004, the project was able to produce very tangible results, including:

- The creation of an effective informal research network;
- The revitalization of cacao breeding programmes in many of the participating countries;
- The implementation of collaborative approaches to cocoa breeding;
- The establishment of approximately 90 ha of new variety trials;
- The indirect support to germplasm collections by applying the concept of "conservation through use";
- The identification of the "Project Collection", combining genetic diversity and agronomic interest;
- The agreement on 31 standardized working procedures to evaluate germplasm for agronomic important traits; and
- The building of extra human capacity.

Component 1: International and local clone trials

- Multilocational clone trials were to be established in ten cocoa-producing countries, aiming at distributing and evaluating interesting new cocoa clones, selecting superior clonal varieties and assessing the genetic stability of economically important traits. Twenty cocoa clones, supplied by intermediate quarantine centres, were to be compared with 20 local clones in ten different countries for all economically important traits, including disease and pest resistance. For the Ppr and witches' broom diseases, "ring tests" were to be carried out, applying standardized early screening methods, to study stability of these clones to fungal isolates from different geographical origins. In addition, 100-150 interesting trees were to be selected in each country by applying early screening methods. These trees were to be planted in field observation plots.

Component 2: Internationally coordinated hybrid trials

- Approximately 40 hybrid progenies were to be produced in each of five countries by making crosses between locally selected superior clones, which are part of the clone trials of Component 1. This would permit the selection of superior hybrid varieties, comparison of the value of the parental clones with their progenies, and selection of individual trees within these hybrids to be used in further breeding. The use of crossing designs would permit genetic analysis of the results to advance knowledge on inheritance of traits.

Component 3: Population breeding

- Population breeding programmes were to be initiated or reinforced in four major cocoa-producing countries, aiming at long-term improvement of economically important traits, including disease resistance. The available knowledge about the local germplasm was to be used to identify base populations for initiation of recurrent selection procedures. Exchange of basic breeding material (parental genotypes or seed progenies) was to be promoted between countries which face similar production constraints, thus stimulating regional/international approaches to cocoa breeding.

Component 4: Germplasm enhancement

- More heritable economic traits were to be evaluated at the International Cocoa Genebank maintained by CRU in Trinidad (ICG,T), especially resistance to Ppr and witches' broom diseases. Germplasm enhancement consists of identifying more resistant seedlings within crosses between selected resistant clones. This approach was intended to explore the large genetic variation present in this collection to create improved populations. During the project life, a start was to be made on transferring selected clones or populations to user countries.

Component 5: Germplasm conservation, characterization and preliminary evaluation

- This component aimed to coordinate and intensify characterization and evaluation of germplasm by identifying genotypes of interest to breeders in international and local collections, with a view to establishing "core collections". Selected material in the ICG,T was to be characterized to evaluate the genetic diversity present in such a core collection (called the "CFC/ICCO/IPGRI Project Collection").Existing and newly obtained characterization and evaluation results were to be incorporated in the national and international databases. Furthermore, opportunities for collection and conservation of material from interesting new areas were to be explored. These activities were to be funded by existing or complementary counterpart and co-financing contributions.

Component 6: Distribution and quarantine of interesting genotypes

- This component aimed to distribute to participating countries a range of interesting genotypes identified in the project, following the internationally agreed Technical Guidelines for the Safe Movement of Cocoa Germplasm, published by FAO and IBPGR (Frison and Feliu 1989).This included specifically the accessions of the International Clone Trial, of the project core collection to be identified at CRU, and of improved populations. Exchange of cocoa germplasm between the participating institutions was to be stimulated by mutual interests and agreements.

Component 7: Exchange of information and workshops

- Exchange of information between project partners was to be achieved through exchange of working documents and through preparation of information sheets, including photographs, on clones to be included in the International Clone Trial and on other widely distributed clones. All the data collected on genotypes were to be entered into the International Cocoa Germplasm Database. Notes on project development and achievements were to be published in newsletters and presented at international conferences, and relevant data introduced into existing databases. A compendium of the results was to be published as a final project publication. Two project workshops were scheduled: one at the beginning of the project and one at the end of the project. During the first workshop, standardized procedures for evaluation and selection of cocoa genotypes in project trials were to be discussed and adopted and the planned collaborative activities between participants established. During the closing workshop, project results were to be presented and possibilities for project continuation discussed. Regional technical meetings were proposed to be held in the third year of the project.

Component 8: Coordination and scientific/technical backstopping

- This component provided the participating institutions with the means and procedures to communicate with each other and cooperate in the various activities. A Project Coordinating Unit was to be established at the headquarters of IPGRI's banana research network (in Montpellier, France), to deal with technical and administrative matters. This Unit was to carry out the liaison between the project partners, needed for efficient implementation of the activities, and to ensure that results are internationally comparable. Working visits of the Project Coordinator to all project sites were to be carried out at regular intervals. Through the exchange of information, through technology transfer, through the visits of the Coordinator to project sites, through the workshops and regional technical meetings, inputs would be made into the strengthening of human capacity in the various disciplinary areas of cocoa breeding and conservation.

Component 9: Management, supervision and evaluation

- Day-to-day management of the project was the responsibility of IPGRI, the Project Executing Agency, whereas ICCO was the Supervisory Body. Project evaluation was to be based on 6-month Progress and Financial Reports. A general Mid-term Evaluation would be organized in the third project year.

Project partners - National agricultural research institutions

- Cocoa and Coconut Research Institute (CCRI, now CCI), Papua New Guinea
- Cocoa Research Institute of Nigeria (CRIN), Nigeria
- Cocoa Research Institute (CRIG), Ghana
- Comissão Executiva do Plano da Lavoura Cacaueira (CEPLAC), Brazil
- Centre National de Recherches Agronomiques (CNRA), Côte d'Ivoire
- Fundación para el Desarrollo de la Ciencia y la Tecnología del Estado de Aragua (FUNDACITE-Aragua) and Fondo Nacional de Investigaciones Agropecuarias (FONAIAP, now Instituto Nacional de Investigaciones Agropecuarias, INIA), Venezuela
- Institut de Recherche Agricole pourle Développement (IRAD), Cameroon
- Instituto Nacional de Investigaciones Agropecuarias (INIAP), Ecuador
- Malaysian Cocoa Board (MCB), Malaysia
- Ministry of Agriculture, Land and Marine Resources (MALMR), Trinidad and Tobago

Project partners - International agricultural research institutes

- Centre de Coopération Internationale en Recherche Agronomique pour le Développement/Département des Cultures Pérennes (CIRAD-CP), France
- Cocoa Research Unit (CRU) of the University of the West Indies, Trinidad and Tobago
- University of Reading, United Kingdom

Co-financing organizations

- American Cocoa Research Institute (ACRI, now World Cocoa Foundation or WCF), USA
- Biscuit, Cake, Chocolate and Confectionery Alliance (BCCCA), United Kingdom
- CIRAD, France
- International Plant Genetic Resources Institute (IPGRI), Italy

Supervisory Body

- International Cocoa Organization (ICCO), United Kingdom

Project Executing Agency

- IPGRI, Italy

Main financing institution

- Common Fund for Commodities (CFC), The Netherlands

Objectives and Benefits of the CFC/ICCO/Bioversity second project 2004-2010 - Cocoa Productivity and Quality Improvement: a Participatory Approach

This Final Report summarizes the outcomes of the Closing Workshop of the CFC/ICCO/Bioversity project on "Cocoa Productivity and Quality Improvement: a Participatory Approach", convened at the end of May 2010 in Accra, Ghana. The workshop formally marked the conclusion of the project that was launched in June 2004, but which was building on the achievements of the CFC/ICCO/IPGRI[2] project on "Cocoa Germplasm Utilization and Conservation: a Global Approach" implemented between 1998 and 2004. Thus many of the results presented here reflect the work done over a long period of time.

Cocoa breeding during the 1990s had suffered seriously from low cocoa prices. Breeding programmes were underfunded and therefore had reduced their activities or, in some cases, had to cease their activities completely. When the first CFC/ICCO/IPGRI project started, cocoa breeding had come to a virtual stop in five out of the ten countries participating in the project. Meanwhile, destructive diseases and pests had spread, and continued to spread afterwards, to new cocoa-growing areas: witches' broom in Brazil (Bahia), moniliasis in Central and South America, Phytophthora megakaryain West Africa (Ghana and Côte d'Ivoire) and pod borer in Indonesia and Papua New Guinea. To find resistant or tolerant planting materials with regard to these pests and diseases was one of the major challenges of both projects.

The second project continued and intensified the on-station selection activities initiated in the first project, and at the same time initiated a farmers' participatory approach. This approach included a farm survey and the direct involvement of farmers in selection of outstanding trees on their farms and in the on-farm trials established between the second and fourth years of the project. The project focused clearly on further capacity building of researchers by linking the research institutes with one another, and through the organization of two project workshops each in the Americas and in Africa in the second and fourth years of the project.

The project's general objectives included:

1. To validate promising cocoa varieties in farmers' fields through participatory approaches, involving farmers directly in the evaluation and selection process;
2. To increase sustainability in cocoa crop improvement programmes through validation and dissemination of selected cocoa varieties between project partners, through enhanced regional and international collaborative research and development activities, and through capacity building;
3. To exchange information and disseminate results among all project partners and also outside the project;
4. To establish and maintain functional linkages between national cocoa breeding programmes, international cocoa genebanks and quarantine centres, and international cocoa research and development efforts.

[2] *Since 1 December 2006, IPGRI and INIBAP operate under the name "Bioversity International", Bioversity for short.*

Promising cocoa varieties have been validated, R&D collaboration enhanced, information generated and exchanged, and networks established. At all project sites, numerous clone and hybrid varieties have been selected for further use in breeding. In five countries new candidate varieties were selected that can be recommended for distribution to farmers. Rapid and/or early resistance screening methods have been validated and successfully adopted for Phytophthora pod rot, while screening for resistance to other diseases and pests continues to rely mainly on field evaluations. The International Clone Trial (ICT), planted at eight sites, has yielded important information on stability of agronomic, disease resistance, physiological and quality traits. The relative stability of these traits over sites suggests that evaluations made at one site will be of value also at other sites. This underpins the value of collaborative approaches in cocoa breeding, such as the germplasm evaluation and enhancement programmes carried out in Trinidad and in Costa Rica.

The work has demonstrated the feasibility of collaborating in cocoa breeding through using similar approaches and exchange of information. The farmers' participatory approach has allowed the farmers to be involved directly in selecting new varieties. In on-farm trials, breeders' selections are being compared to farm selections. This way it is hoped that the farmers adopt materials best suited to their own conditions.

The results of the project were presented in detail during the Project's Closing Workshop (see programme of the workshop, Appendix II) and were described also in the Final Individual Institutes' Reports (see Annexes of the Final Completion Report2). The presentations made during the Closing Workshop were included on a CD-ROM and distributed to all participants in July 2010. The detailed presentation of conclusions and recommendations at the end of the workshop are included here as Appendix I.

Several of the activities initiated in the project are still ongoing. Such is the case for the on-farm trials and for the Regional Variety Trials. It is expected that these trials can be continued within the local breeding programmes. However, new collaborative initiatives are required to continue with the pre-breeding programmes and with the distribution of selected materials. The distribution of accessions with resistance to moniliasis and to witches' broom to Africa should continue to be a major objective. Major constraints in cocoa production, such as destructive diseases and pests, vary between the regions (continents). Therefore, continued regional cooperation would be of great value in overcoming these constraints

SUMMARY OF PROJECT RESULTS AND BENEFITS

Component 1. Participatory approaches to cocoa selection and breeding

Approximately 2000 farms were surveyed in ten different countries. The knowledge of the farmers on their planting materials was documented and results were presented at international cocoa meetings (e.g. INGENIC 2006 Workshop). As planned, approximately 2000 trees were identified as interesting for yield or for low disease or pest incidence. Early screening for Phytophthora pod rot (Ppr) resistance carried out in Africa and in Trinidad showed that several of the farmers' selections were highly resistant to the disease. This was in agreement with farmers' knowledge on trees that were identified as less susceptible in farmers' fields. Approximately 1500 farm selections were established in on-station observation plots or in on-farm trial plots in eight countries. Evaluation of these farm selections has been initiated. Some farm selections appear to be as good as, or better than the local control varieties. Through a co-financing agreement, including with the International Institute of Tropical Agriculture (IITA), the genetic diversity of approximately 2000 farm selections in Africa was analysed using simple sequence repeat (SSR) markers. The results show large genetic variation in the farm population, which is mainly of hybrid origin, with important contributions of the Amelonado, Trinitario and Upper Amazon parental genomes. Approximately 240 on-farm selection plots were established with support of the project (originally 200 were planned). In most of these plots, varieties selected by breeders are being compared to farm selections (clones or seedling progenies). This activity suffered from drought in Africa and from neglect of some of the farmers. Consequently, the total number of plots that are still actively being observed has been reduced to approximately 120 plots.

Component 2. Collaborative approaches in cocoa breeding Evaluation and selection of variety trials established in the "Germplasm" project

Approximately 85 ha of variety trials established in the Germplasm project (ICCO/02) have been evaluated throughout the current project. In several countries (e.g. Brazil, Ghana, Nigeria, Papua New Guinea and Trinidad and Tobago) several new varieties were selected or confirmed for commercial distribution to farmers. Numerous

promising individual trees or hybrid varieties were selected to be used in further confirmation trials in several other places (e.g. Brazil, Ecuador, Côte d'Ivoire and Venezuela). New variety trials with promising selections were established in Brazil, Côte d'Ivoire, Ecuador, Malaysia and Papua New Guinea. The International Clone Trial, established in eight countries, has also been evaluated throughout the second project. Although some clones yielded quite well, in general the average of the local control clones evaluated in the Local Clone Trial yielded substantially more than the average of the International Clones. This shows the low level of adaptation of many of the International Clones, which were not previously selected for yield potential.

However, some of the International Clones out-yielded the local control clones at a few sites. Evaluation of sensory quality was carried out for the International Clones during 2007-09. Cocoa liquors of approximately 200 cocoa bean samples were prepared and distributed by Guittard Chocolate Co. to three panels (Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), France; Cocoa Research Unit (CRU), Trinidad and Tobago; and Guittard/Mars Inc., USA). Data analyses showed significant environmental effects for cocoa flavour, acidity and astringency and clone effects for floral flavour. Interactions between environment and clones estimated over 2 years of evaluations were not significant, whereas significant effects were obtained for individual years. Significant differences between clones were also observed for agronomic traits at all sites. Yield data appeared to be significantly correlated over a large number of sites, while vigour was less well correlated between sites. Physiological traits varied over sites and clones reacted variably, suggesting that different genotypes require different management practices (such as pruning) to optimize yield performance.

Regional Variety Trials (RVTs)

The project supported the establishment, between 2005 and 2006, of an RVT in the Americas (six countries) and of another RVT in Africa (four countries). The objective was to exchange hybrid varieties with good yield potential and with resistance to diseases (Ppr, moniliasis and witches' broom). The first results in Costa Rica show significant variation in resistance to moniliasis (10-50% infection), with two hybrids having very low infection levels.

Germplasm enhancement for disease resistance

A large Germplasm Enhancement programme for resistance to Ppr has been implemented at CRU already from 1998 onwards. Interesting results were observed for the Ppr resistance enhancement, obtaining approximately 70% of resistant (R) or moderately resistant (MR) trees after one cycle of selection of crosses among selected parental accessions of the International Cocoa Genebank, Trinidad and Tobago (ICG,T). The original population only contained 30% of MR or R trees. CRU already initiated the second cycle, i.e. selection of seedlings from crosses between first-cycle selections. A similar enhancement programme for resistance to witches' broom was initiated in 2004. Approximately 5000 seedlings were evaluated and 200 selected seedlings (also tested for resistance to Ppr) were planted in the field for further observations.

Quarantine and distribution of selected accessions

The so-called "CFC/ICCO/Bioversity Collection" was selected as part of the first project activities. This collection contains 112 accessions mainly selected from the ICG,T for resistance to Ppr, but it also contains selections with resistance to witches' broom and to moniliasis. During the current project, this collection was sent to the Reading University intermediate quarantine facility, where it underwent virus indexing for a 2-year period. At the end of the project, 80 clones had completed quarantine. Distribution of this collection has been initiated, especially to African countries.

Resistance testing methods

The use of the leaf disc and pod tests for Ppr resistance screening was validated during the second project in Côte d'Ivoire and in Cameroon. Screening for resistance to witches' broom with the traditional spray method had shown low consistency at individual plant level. In Trinidad, good results were reported by using the agar-droplet method, aiming at high infection level and evaluation of the broom base diameter as the main selection trait. This method was since adopted for individual seedling selection in the germplasm enhancement programme. Pod inoculations were tried but infection levels were low or inconsistent. More work will be required to improve this method. Early screening for resistance to moniliasis by inoculation of seeds or young seedlings failed to produce symptoms. The pod inoculation method in the field proved to be reliable, and this was used successfully in Costa Rica as well as in Ecuador. Testing of antixenosis (choice of insect to feed on twigs from different cocoa genotypes), tolerance and

antibiosis (capacity to survive on different host tissues) to cocoa mirids showed often inconsistent results and the implementation of these methods is laborious. However, antixenosis appeared to be related to long-term damage of mirids observed in Côte d'Ivoire. Lasiodiplodia was easily isolated from young and old mirid wounds, showing a possible association with mirid damage. Screening methods for Lasiodiplodia resistance were tested using Lasiodiplodia inoculations of wounded seedlings and detached twigs. Results were inconsistent, including when artificial wounding was used as a method to facilitate natural infection with Lasiodiplodia.

Main benefits

- Reinforcement of existing cocoa breeding programmes in 11 countries.
- Selection of 55 new candidate varieties for distribution to farmers in Brazil, Ecuador, Nigeria, Papua New Guinea and Trinidad and Tobago.
- Selection of numerous varieties to be used in further breeding (all cocoa-producing countries).
- Adoption of a farmers' participatory approach in cocoa breeding through capturing farmers' knowledge on their planting materials, selection of interesting trees and establishment of on-farm trial plots.
- Establishment of two Regional Variety Trials in six countries in the Americas and in four countries in Africa, aiming at sharing of varieties with disease resistance.
- Evaluation of stability of cocoa traits through the International Clone Trial, using similar evaluation methods.
- Insight has been gained into resistance testing methods. Positive results were obtained with testing for Ppr resistance methods, whereas less consistent results were obtained with methods used for other diseases and pests.
- Use of the Trinidad germplasm collection to carry out pre-breeding for resistance to Phytophthora pod rot and to witches' broom disease.
- Initiation of distribution of germplasm selected in the project through quarantine at the Reading University to user countries, especially African countries.
- Unprecedented cooperation was achieved among research institutions in the cocoa-producing countries, regional and international institutions, and the private sector.
- The project has positively impacted on cocoa breeding programmes, through reinforcement of ongoing breeding programmes.
- A total of 1500 promising trees were identified by using a farmers' participatory approach.
- More than 100 selected genotypes were quarantined and distribution to user countries was initiated.
- Human capacity building was achieved through the organization of four regional workshops and exchange of results (publications, project reports).
- The data generated in the project were used to obtain three PhD degrees in Africa, and several MSc and undergraduate degrees elsewhere.
- As a spin-off of the project, institutes have managed to obtain new projects in cocoa breeding and also in other cocoa research areas.

Annex 4. ABS Regulation in Brazil: some answers to CacaoNet members

Access and Benefit Sharing (ABS) regulation in Brazil: some answers to CacaoNet members
Simone Nunes Ferreira and Maria José A. Sampaio – 20/04/2015

Brazil was one of the first countries to regulate access and benefit sharing. In force since 2000, Provisional Measure 2186-16 establish rules for the access to genetic resources (GR) and to traditional knowledge associated (TK) for the purpose of research, bioprospecting and technology development.

Brazil has unique characteristics. It's the 5th largest country in the world with 8.514.876 km² and more than 4.5 million km² in costal marine area. It's also a multiethnic country that includes immigrants from all continents and 220 indigenous peoples with 180 different languages. It's a Federation comprising 26 States, a Federal District and 5,565 municipalities encompassing a population of more than 200 million people. Biodiversity in Brazil is composed by 6 biomes: Amazon, Caatinga, Cerrado, Pantanal, Atlantic Forest, Pampas. Almost 35% of the country is still covered by native vegetation. Brazil concentrates 15% of know species (possibly 25% of all species). Brazilian researchers are responsible for 6% of the scientific production on biodiversity. There are also significant genomics and biotechnology programs. On the other hand, Brazil is also the 2nd largest food exporter and biofuels producer in the world. These characteristics result in significant conflicts of interests on ABS issues among different stakeholder groups (research, conservation, agriculture, indigenous, industry). In this context, Provisional Measure 2.186-16 and its regulations try to accommodate major interests and concerns although with some obvious difficulties. In summary: access and benefit sharing are sensitive and complex issues, with different interests or point of view and serious consequences on research and innovation processes.

Provisional Measure 2.186-16 created the Genetic Heritage Management Commission – CGEN recognized as the National Authority. It is a Federal administrative body with legislative and deliberative functions. It is composed by representatives of 19 Government entities, including research institutions as Embrapa.

Although created in 2000, CGEN was effectively established only in June 2002. The first access authorizations were issued in 2003. Until the end of 2014 more than 1,300 authorizations were issued, but only 136 Benefit Sharing Agreements were signed. At this moment, Brazil is the country with the biggest number known of ABS authorizations; however these numbers need to be improved to include most of the Brazilian scientific production on native biodiversity. Provisional Measure 2,186-16's main legal provisions are:

- The need for previous government authorization for access to native genetic resources (GR) and traditional knowledge associated (TK) for the purpose of research, bioprospecting and technology development;
- The need for prior Informed consent (PIC) from providers of GR and/or TK (including indigenous and local communities);
- The need for benefit arising from any economic use of product and process resulting from access to GR and/or TK to be shared with the providers;
- The need for Benefit Sharing contracts including (Mutual Agreed Terms - MAT) to be submitted to CGEN for approval.

Material transfer for the purpose of research, bioprospecting and technology also needs CGEN´s authorization. The conditions to transfer any native material include the deposit of a representative sub-sample in a collection maintained by an accredited institution government authorization for access to native genetic resources and signature of a Material Transfer Agreement whose model was approved under CGEN's Resolution n. 20.

Since 2002, CGEN has approved some norms to clarify and to regulate specific cases and to promote the implementation of ABS framework: 40 Resolutions; 9 Technical Orientations; 12 Regulatory Deliberations.

Some lessons learned from 15 years of ABS regulation:

- Excessive bureaucratic requirements are a disincentive to applied research and development for both academia and industry;
- Facilitation of research will increase benefit sharing;
- ABS regulation must be clear and provide legal certainty to users.

Annex 5. Web information resources

CacaoNet - Global Network for Cacao Genetic Resources

- Global Strategy for the Conservation and Use of Cacao Genetic Resources: www.cacaonet.org

ITPGRFA - International Treaty of Plant Genetic Resources for Food and Agriculture

- General information: http://www.planttreaty.org/
- Multilateral system of access and benefit sharing (MLS): http://www.planttreaty.org/content/multilateral-system
- Article 15 text: http://www.planttreaty.org/content/agreements-concluded-under-article-15
- All International Collections' agreements: http://www.planttreaty.org/inclusions?field_mls_noti_inclu_type_owner_value_many_to_one=International+Center
- CATIE agreement : http://www.planttreaty.org/sites/default/files/CATIE.pdf
- CRC/UWI agreement : http://www.planttreaty.org/sites/default/files/trinidad.pdf
- SMTA - The Standard Material Transfer Agreement - text available in English, French, Spanish, Arabic, Chinese and Russian: http://www.planttreaty.org/content/what-smta
- The Benefit-Sharing Fund: http://www.planttreaty.org/content/benefit-sharing-fund
- Report of the First meeting of the Working Group to Enhance the Functioning of the MLS (WG-EFMLS) May 2014: http://www.planttreaty.org/sites/default/files/OWG-EFMLS_1-14-w4_en.pdf
- Frequently Asked Questions about the ITPGRFA: http://www.planttreaty.org/faq

CBD - Convention on Biological Diversity

- Nagoya Protocol: http://www.cbd.int/abs/
- Nagoya Protocol - text available in English, French, Spanish, Arabic, Chinese and Russian : http://www.cbd.int/abs/text/default.shtml

CGRFA - FAO Commission on Genetic Resources for Food and Agriculture

- General information: http://www.fao.org/nr/cgrfa/cgrfa-home/it/
- Plant Genetic Resources: http://www.fao.org/nr/cgrfa/cthemes/plants/it/

Annex 6. Acronyms

ABS	Access and Benefit-Sharing
AEGIS	European Genebank Integrated System
ASU	Arizona State University, USA
BSF	Benefit-sharing Fund
CacaoNet	Global Network for Cacao Genetic Resources
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica
CBD	Convention on Biological Diversity
CEPEC/CEPLAC	Centro de Pesquisas do Cacau da Comissão Executiva do Plano da Lavoura Cacaueira, Brazil
Cgen	Council for Genetic Heritage Management, Brazil
CGIAR	Consultative Group on International Agricultural Research
CGN	Centre for Genetic Resources, The Netherlands
CGRFA	FAO Commission on Genetic Resources for Food and Agriculture
CIRAD	Centre International en Recherche Agronomique pour le Développement, France
CNRA	Centre National de Recherche Agronomique, Côte d'Ivoire
CORPOICA	Corporación Colombiana de Investigación Agropecuaria, Colombia
CRA	Cocoa Research Association Ltd, UK
CRC	Cocoa Research Centre of the University of the West Indies, Trinidad and Tobago
CRIG	Cocoa Research Institute of Ghana
CRP-FTA	CGIAR Research Programme on Forests, Trees and Agroforestry
CRU	Cocoa Research Unit, now Cocoa Research Centre (see CRC)
CSSV	Cocoa Swollen Shoot Virus
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária, Ministério da Agricultura, Pecuária e Abastecimento, Brazil
FAO	Food and Agricultural Organisation of the United Nations
FEDECACAO	Federación Nacional de Cacaoteros, Colombia
GR	Genetic Resources
GRFA	Genetic Resources for Food and Agriculture
GSCC	Global Strategic Cacao Collection – component of the Global Strategy for the Conservation and Use of Cacao Genetic Resources
GURTs	Genetic Use Restriction Technologies
ICQCR	International Cocoa Quarantine Centre, Reading, UK
ICT	Instituto de Cultivos Tropicales, Peru
INIAP	Instituto Nacional Autónomo de Investigaciones Agropecuarias, Ecuador
IPRs	Intellectual property rights
ISCOBRA	Institutional Structures, Constraints and Outcomes of Bio-based research in Agriculture
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
LAC	Latin America and Caribbean
MAT	Mutually-Agreed Terms
MCB	Malaysia Cocoa Board
MLS	Multilateral System of Access and Benefit Sharing of the ITPGRFA
MTA	Material Transfer Agreement
NP	Nagoya Protocol of the Convention on Biological Diversity
PGRFA	Plant Genetic Resources for Food and Agriculture
PIC	Prior-Informed Consent
R&D	Research and Development
SMTA	Standard Material Transfer of the ITPGRFA
USDA/ARS	United States Department of Agriculture, Agriculture Research Service
WCF	World Cocoa Foundation
WG-EFMLS	Working Group to Enhance the Functioning of the Multilateral System