

Securing Our Future: *Why Cocoa Diversity Matters*

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CacaoNet & Bioversity International

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Cacao diversity in CATIE, Costa Rica. Credit: A. Mata/ W. Phillips

Cocoa diversity is necessary

- We cannot grow the same varieties everywhere
- There are different
 - Pest and disease pressures
 - Environmental conditions
 - Cultivation practices: organic, shade, inputs, etc.
 - Markets: quality bulk, fine flavour, single origin, etc.
 - Flavours
 - Farmer preferences
- There isn't a perfect cocoa plant for everybody!

Why diversity matters?

- Demand is increasing rapidly with emerging countries consumption
- We need to increase production in an environmentally sustainable way (reduced inputs).
- New and improved planting material is an important part of the solution, optimized by good agricultural practices.
- Good quality, locally adapted planting material are continuously required, whatever country, region or farming system.

So...

- Access to a wide range of genetic diversity is critical to the success of breeding programs.
- It provides the variability needed to find solutions for:
 - Pests and diseases
 - Changing markets requirements
 - Adaptation to climate change
 - Need for environmental responsibilities
- The “Green Revolution” demonstrated the tremendous impact that genetic resources can have on increasing crop production.
- Breeding accounted for 50% of yield gain in the world’s major crops since the 1930’s (OTA 1987)

We don't know the future

- What will be the characteristics required for the next generations of planting material?
- What will be the future concerns of the demand?



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- What will be the future concerns of the demand?



The future...

Pests and diseases will continue to evolve and spread...

- Affecting new cocoa growing areas
- With more aggressive strains
- New species will appear



Health safety will continue to put pressure...

- Residue levels
- Heavy metal uptake



Climate change



- Climate change
 - Current growing areas are already experiencing:
 - Droughts
 - Flooding
 - Higher temperatures
 - Higher CO₂ levels
 - Growing regions will vary
- Agricultural practices will change, such as uptake of modern / mechanized methods
- Cocoa diversity is crucial for developing the future varieties needed for all and different cocoa production systems

Where is the diversity?

In the wild - *the Amazon basin is the centre of diversity*



Where is this diversity?

In farmers' fields - *landraces and populations selected by farmers over generations for specific properties*



Where is this diversity?

In the many genebanks around the world:

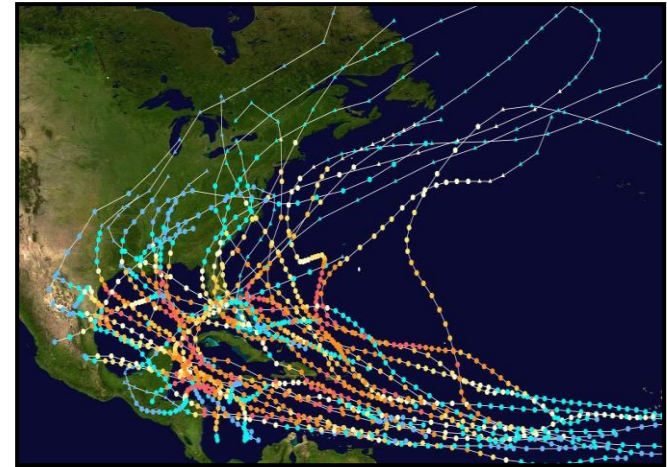
- Seeds of cacao cannot be dried and frozen like most other crops.
- Individual trees need to be maintained as living collections



E. Arevalo, Peru

Cocoa diversity is threatened

- Destruction of the Amazonian rainforests - the centre of unique diversity
- Spread of pests and diseases
- Changing patterns of land use
- Climate changes causing shifts in production (areas and crops)
- Natural disasters and extreme weather
- Forest fires
- Civil unrest
- Vandalism

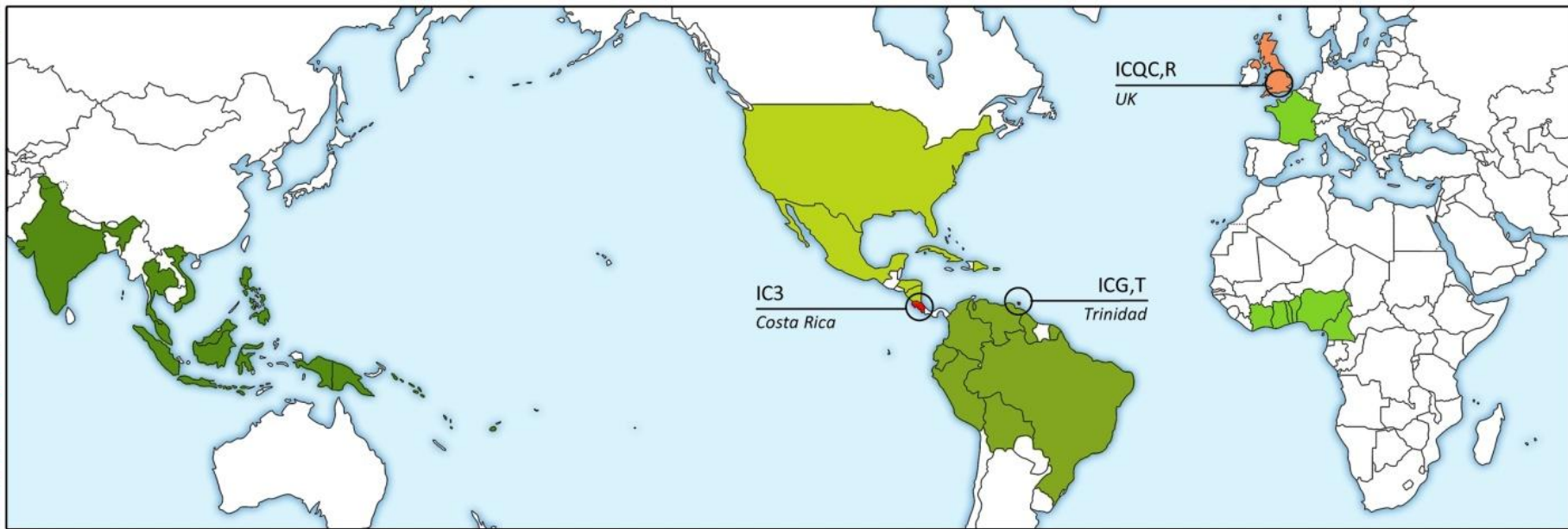


Urgency

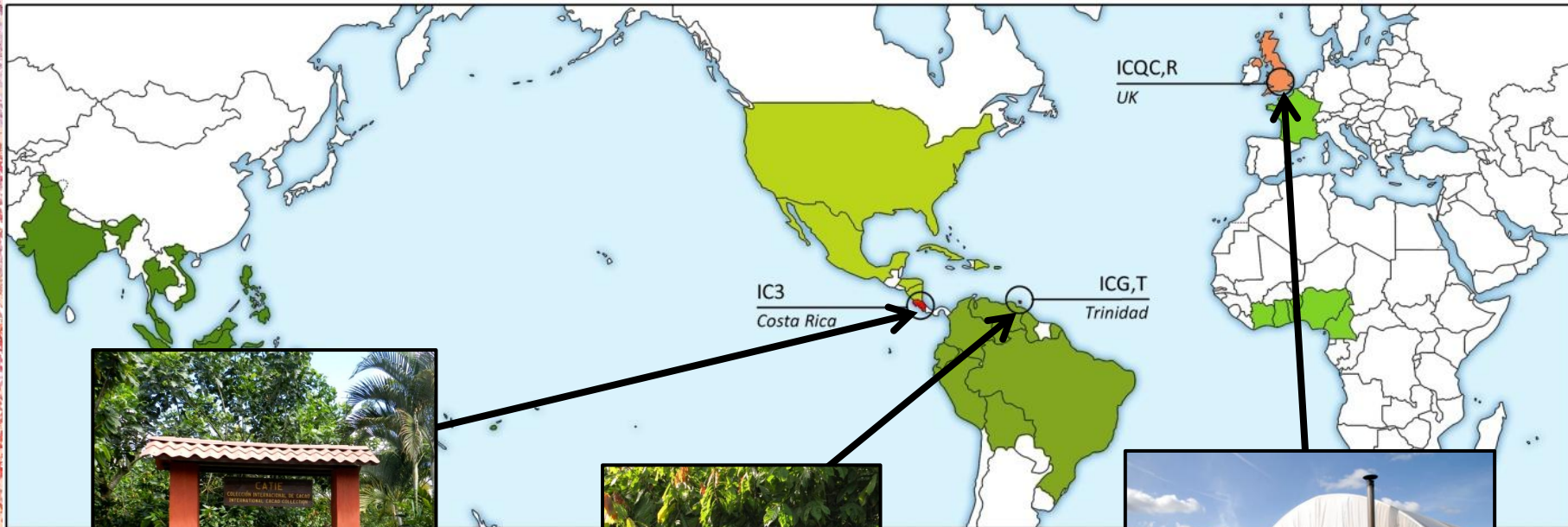
- Every year we lose materials
- Collections in developing countries are at risk
- Lack of funding for adequate management standards
- Long-term funding basis for the management of the international collections is not secured, including the safe movement of germplasm, evaluation and use in breeding.
- Local varieties replacement is happening at a fast pace, in Ecuador, Peru for example.
- Little investment in research to improve cocoa compared to many crops.
- What if the well-known disease resistant clones (e.g. SCA 6) had been lost?
- Where will the next SCA 6 come from?

Where are we today?

- Over 35 collections 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



■ Fiji	Dobuilevu	■ Costa Rica	IC3 (International)	■ Bolivia	El Ceibo Cooperative	■ Benin	CRA-SB
■ India	CPCRI	■ Cuba	EIC-ECICC	■ Brazil	CEPEC SUEPA SUERO ICA	■ Cameroon	IRAD
■ Indonesia	Bah Lias ICCRI	■ Dominican Republic	IDIAF	■ Colombia	ICA CORPOICA	■ Côte d'Ivoire	CNRA
■ Malaysia	MCB	■ Honduras	FHIA	■ Ecuador	INIAP	■ Ghana	CRIG
■ Papua New Guinea	PNGCCI	■ Mexico	INIFAP	■ French Guiana	CIRAD	■ Nigeria	CRIN
■ Philippines	USMARC/PICRI	■ Nicaragua	UNAN	■ Guyana	MHOCGA	■ Togo	CRAF
■ Solomon Islands	BPCU	■ Trinidad & Tobago	ICG,T (International)	■ Peru	CEPICAFA ICT UNAS UNSA	■ France	CIRAD
■ Thailand	Chumphon	■ USA	USDA	■ Venezuela	INIA	■ UK	ICQC,R (Quarantine)
■ Vanuatu	VARTC						
■ Vietnam	Nong Lam University						



Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Costa Rica (*W. Philipps*)



Cocoa Research Centre of the University of the West Indies (CRC/UWI), Trinidad and Tobago (*M. Gilmour*)



International Cocoa Quarantine Centre (ICQC), UK (*A. Daymond*)

But...

- Conservation is not secured
- Few collections have safety duplication of unique materials
- Use is not always optimized
- Access is often restricted by lack of legal & policy framework
- Most collections have duplications internally and with other collections
- Misidentification of trees within collections can be as high as 30%
- No targeted *in situ* and on farm conservation plans

Securing diversity for all, forever

All countries involved in the improvement and production of cocoa are highly dependent on genes and varieties conserved and evaluated in other countries and regions.

The efforts necessary to ensure the:

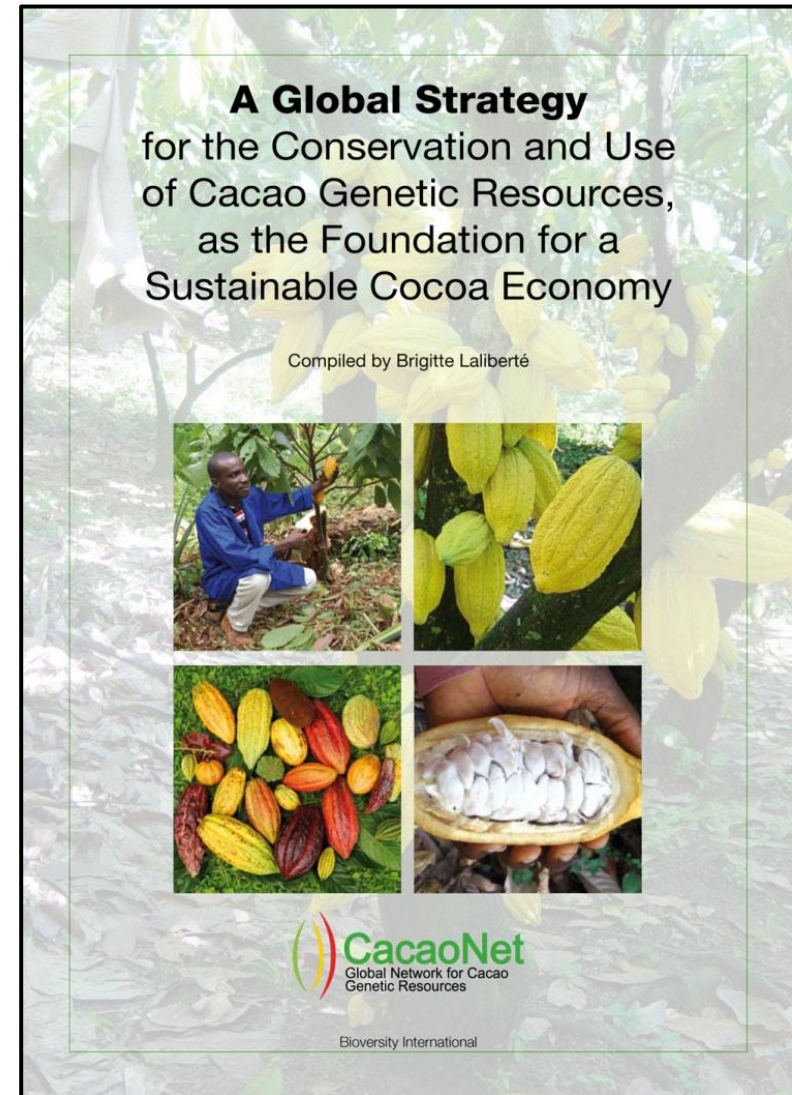
- effective conservation of the entire range of cacao diversity *in situ* and *ex situ* for the long term
- global system for the safe exchange of germplasm
- optimised use of diversity in improvement programmes

... can only be achieved and carried out:

- through international (inter-regional) collaboration
- by bringing together players in public and private sectors

A Global Strategy

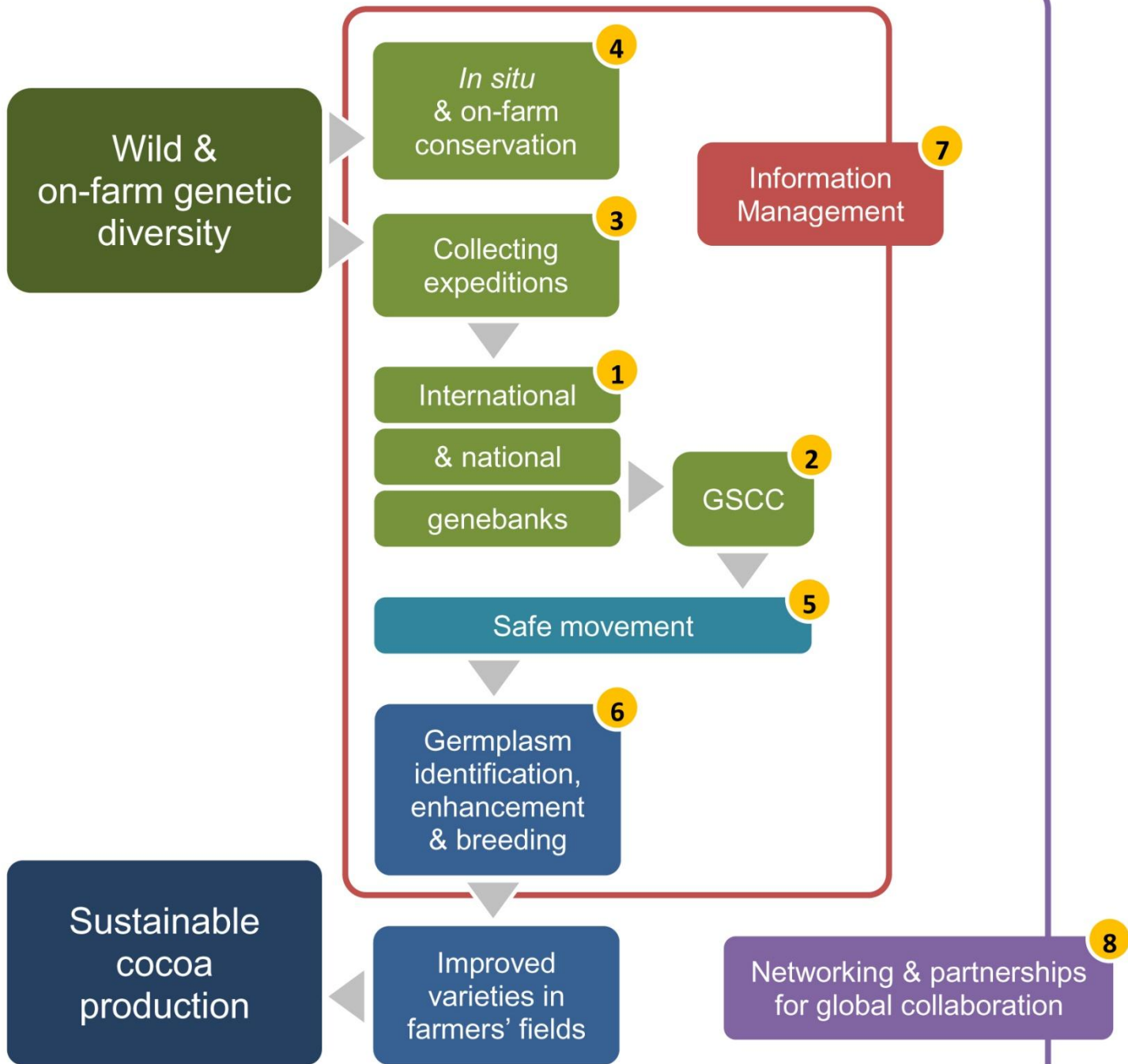
- Developed by CacaoNet (Global Network for Cacao Genetic Resources)
- Result of a consultation process, drawing upon the global cocoa community's expertise in all aspects of cacao genetic resources (*over 75 individuals from 26 institutes contributed*)
- Provides a clear framework to secure funding for the most urgent needs to ensure that cacao diversity is conserved, used and provides direct benefits to the millions of small-scale farmers around the world



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Wild & on-farm genetic diversity

4
In situ & on-farm conservation

3
Collecting expeditions

1
International & national genebanks

Securing existing *ex situ* cacao genetic resources, particularly those held in the public domain, and their distribution

5
Safe movement

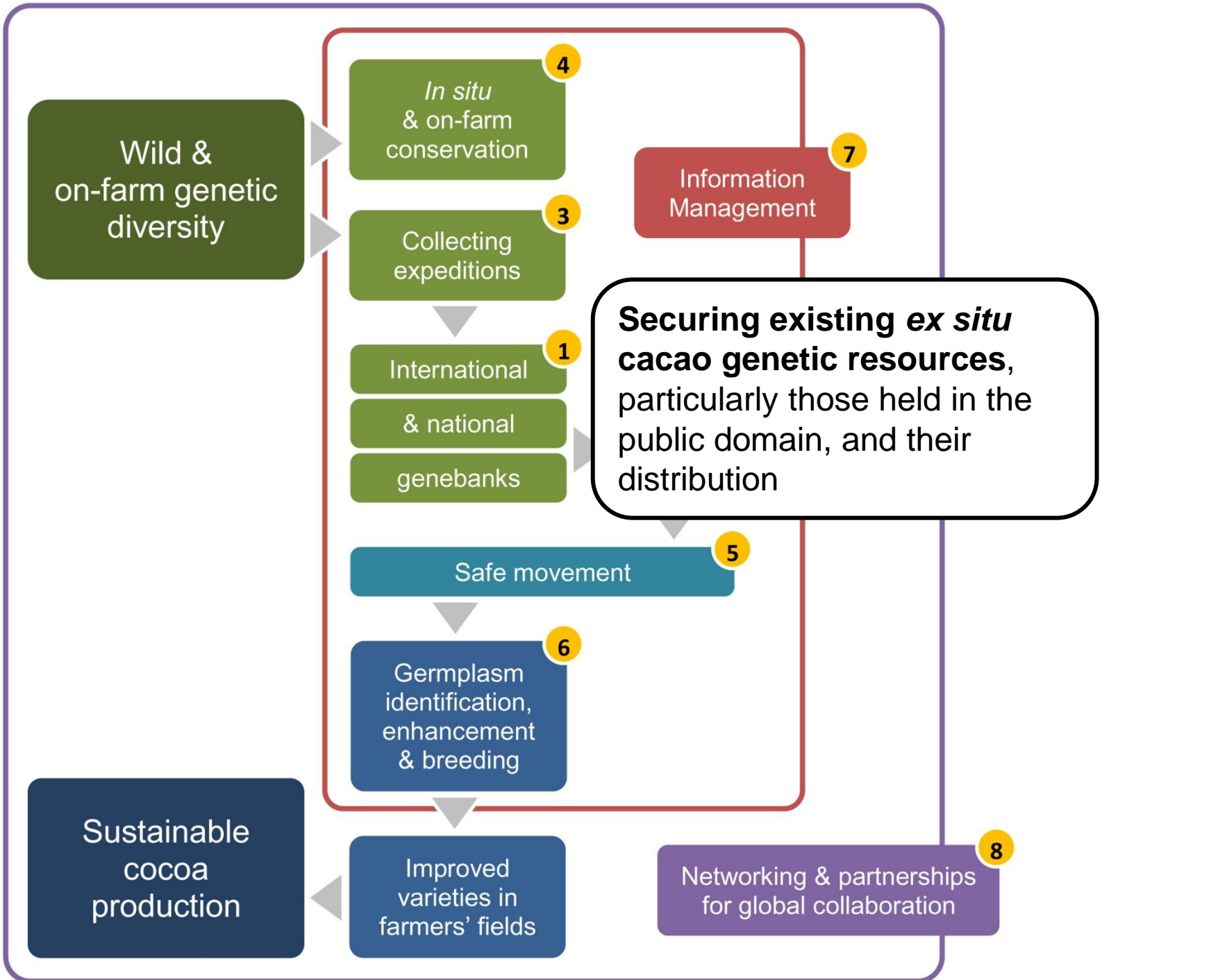
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Germplasm identification, enhancement & breeding

7
Information Management

Sustainable cocoa production

Improved varieties in farmers' fields

8
Networking & partnerships for global collaboration



Wild & on-farm genetic diversity

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& on-farm
conservation

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Collecting
expeditions

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International

& national

genebanks

2
GSCC

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Safe movement

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identification,
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Management

Developing a **Global
Strategic Cacao
Collection**

Sustainable
cocoa
production

Improved
varieties in
farmers' fields

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Networking & partnerships
for global collaboration

Wild & on-farm genetic diversity

In situ & on-farm conservation **4**

Collecting expeditions **3**

International **1**

& national

genebanks

Genetic diversity gap filling
in *ex situ* collections and
collecting

GSCC **2**

Safe movement **5**

Germplasm
identification,
enhancement
& breeding **6**

Sustainable
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production

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farmers' fields

Networking & partnerships
for global collaboration **8**

Wild & on-farm genetic diversity



Ensuring the *in situ* and on-farm conservation of important genetic diversity

Management

Sustainable cocoa production

Improved varieties in farmers' fields

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Strengthening the
distribution mechanism
and **safe movement** of
germplasm

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for global collaboration

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identification,
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Strengthening the use of the cacao genetic resources by providing support to breeders and key users through **improved characterization, evaluation** within collections and supporting population enhancement programmes

for global collaboration

Sustainable
cocoa
production

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Improving the
**documentation
and sharing of
information** on
germplasm

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Strengthening the
**networking and
partnerships** for
global collaboration

8
Networking & partnerships
for global collaboration

We are not starting from scratch

Many components are present:

- 2 international collections part of the multilateral system of exchange (International Treaty):
 - More than 3,500 accessions freely available for use in research, breeding and training
 - Long-term commitment to conservation and use
 - Benefits arising from their use shared in a fair and equitable way



G. Lockwood

But... not complete, securely funded or linked to all the other key collections around the world.

Success stories

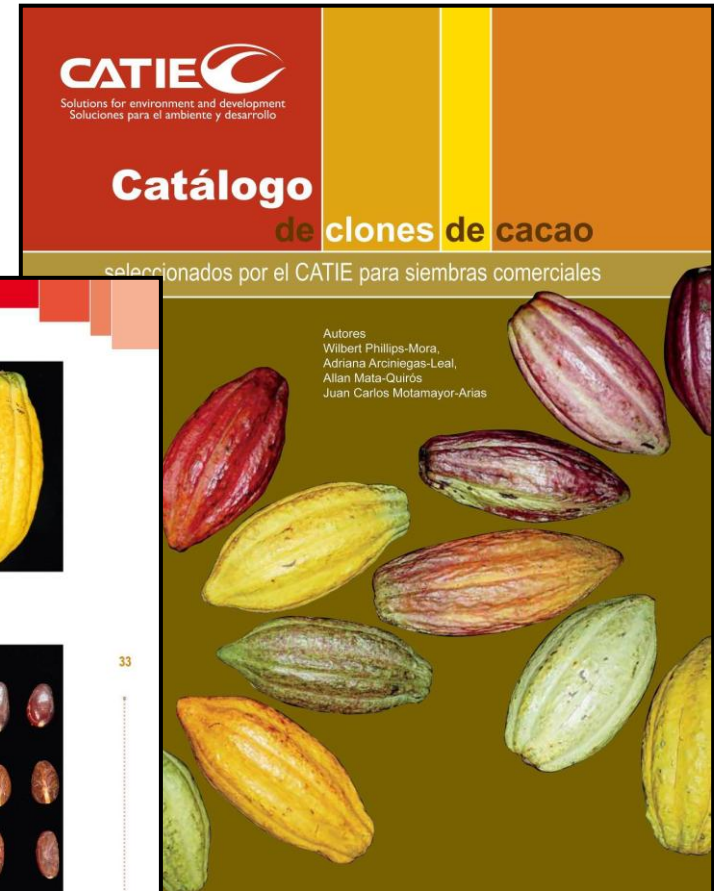
- In 2008, a storm damaged an important part of the international collection maintained by CRC/UWI
- Although some material was lost, the majority was safely duplicated (locally or internationally) and most of the varieties were recovered




D. Sukha, Trinidad

Success stories

- Genetic resources used for variety releases
 - CATIE
 - CRC/UWI
 - Cote d'Ivoire
 - Nigeria
 - Brazil
 - Peru
 - Ecuador
 - India
 - Indonesia

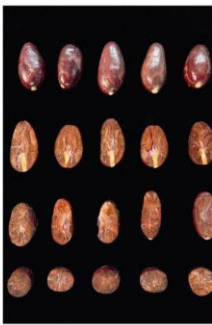


FRUTOS CATIE-R4



Color	Immature: Verde pálido con tonalidades muy suaves de rojo
	Mature: Anarjado con amarillado y eventuales pecas rojas
Forma	Fruto: Cordonado
	Clavo: Abundante
	Constricción basal: 5
	Rugosidad ^a : 5
	Dureza ^b : 3
Cáscara	
	Peso (g): 573.7 ± 19.8
	Longitud (cm): 18.7 ± 0.26
	Diámetro (cm): 1.83 ± 0.13
	Relación L/D (cm): 1.9 ± 0.02
Otras	Peso fresco por fruto (g): 144.7 ± 5.70
Semillas	Numero semillas por fruto: 35 ± 1.30
	Catálisis: Espesor (cm): 1.5 ± 0.04
	Surco: Profundidad (cm): 1.1 ± 0.02
	*Constricción basal: 0 = ausente, 3 = suave, 5 = intermedia, 7 = fuerte.
	*Rugosidad: 0 = asenta, 3 = suave, 5 = intermedia, 7 = áspera
	*Dureza: 3 = suave, 5 = intermedia, 7 = dura

SEMILLAS CATIE-R4



Color colisión:	Púrpura
Forma:	Ovalada
Forma del corte transversal:	Redondeada
Longitud (cm):	2.5 ± 0.08
Diámetro (cm):	1.0 ± 0.01
Espesor (cm):	1.3 ± 0.03

33

Success stories



Wild cocoa collected in
Peru between 2008 and
2012, held in the ICT
collection (*E. Arevalo*)

N°	River	N° wild cacao collected
1	Aypena	22
2	Marañon - Charupa	22
3	Ungurahui	38
4	Pastaza	24
5	Ungumayo	26
6	Nucuray	25
7	Urituyacu	33
8	Santiago	38
9	Morona	50
10	Chambira	20
11	Tigre	22
12	Napo	22
13	Urubamba	22
14	Ucayali	55
15	Madre de Dios	34
Total		453

What next?

- The diversity in the collections is critical to the world's cocoa production.
- Conservation serves no purpose if the material is not accessible, or its potential evaluated and documented for use.
- Ownership must be resolved to ensure global access to these critical resources.
- The global effort to assemble, document and use this diversity is essential.



C. Motagnon

We have come a long way!

- We have collections, services and research



Cocoa farmer in Venezuela (A. Eskes).



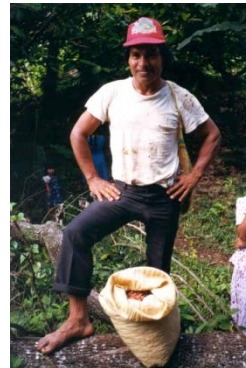
Cocoa farmer in Côte d'Ivoire (D. Pokou,).

We still have some way to go but we cannot afford to wait and must move quickly and effectively

Global Network for Cacao Genetic Resources



Aims to optimize the conservation and use of cacao genetic resources as the foundation of a sustainable cocoa economy,
by coordinating and strengthening the research efforts of a worldwide network of public and private sector stakeholders,
with member representatives from cocoa research institutes and organizations that support cocoa research.



**MERCI
GRACIAS
THANK YOU!**

