Towards reviving the International Coconut Genetic Resources Network

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Abstract

Created in 1992, the International Coconut Genetic Resources (COGENT) aims to strengthen international collaboration in conservation and use of coconut genetic resources; to promote improving coconut production on a sustainable basis, and to boost livelihoods and incomes of coconut stakeholders in developing countries. Currently, membership is open only to coconut-producing countries. COGENT now comprises 39 country members. Two regional coordinators from each of the five regional networks constitute its Steering Committee, which is the decision-making body of the network. COGENT had its peak of activities during the period 1997 to 2006. In 2012, various initiatives were launched to revive the network. New communications tools were developed. Country members were asked to designate an alternative COGENT representative in charge of technical tasks, and to update data relating to genebanks. Lists of COGENT representatives and associated experts, databases, comprehensive lists of germplasm, and guidelines regarding coconut nomenclature were made available online on the COGENT website. Two surveys were organized to refine COGENT's organization and to share information about coconut research. The first Steering Committee meeting for 6 years will be held in Kochi, India, from 8th to 10 July 2012. Attendees are not only members of the Steering Committee, but representatives of 6 other COGENT countries, of private companies, of NGOs, and of Bioversity International, the Asian and Pacific Coconut Community and the Global Crop Diversity Trust. The main immediate challenges are to update the global coconut Conservation Strategy and to secure germplasm conservation. *Ex situ* coconut conservation is facing a critical situation. Presently 24 genebanks are conserving 725 unique populations with 1374 living accessions. 447 of these accessions, collected during the 1980s, are becoming very tall without being rejuvenated. At least 16 genebanks, including three out of the five international genebanks, do not have sufficient capability, laboratories, equipment, manpower and/or budget needed to make reliable controlled pollinations. Taking in account this huge need of capacity building, a large project should be launched to safeguard this germplasm.

Keywords:
COGENT network, network organization, Coconut research, germplasm, coconut

1 Introduction

Coconut remains one of the crops most neglected by scientists, with regards to its economic value and cultural importance. Despite the enormous potential of the crop, coconut farmers often scrape a living below the poverty line. About 96% of coconut farmers, growing coconuts on 12 million hectares worldwide, are smallholders tending less than four hectares (Frison, 2006). Coconut farmers are marginalized. Many do not own the land they work, lack the resources to invest in technologies that would improve production, and are considered non-bankable by the formal banking sector. Many traditional varieties of coconut palms are presently disappearing and there is a huge and urgent need to safeguard the remaining diversity.

At an international workshop in Cipanas, Indonesia in October 1991, acting on the suggestion of the Consultative Group on International Agricultural Research (CGIAR) and its Technical Advisory Committee, representatives of 15 coconut-producing countries recommended establishing an international coconut genetic resources network. In 1992, endorsed by the CGIAR and its donors, Bioversity International (Bioversity), established the International Coconut Genetic Resources Network (COGENT) to promote an international collaborative programme on genetic resources conservation and use.

Based on the results of this consultation process, the CGIAR decided to include coconut in its research portfolio in 1992, after studies indicated that international support and global coordination of research in coconut is essential to make the crop more productive and beneficial to smallholder coconut farmers. Coconut-producing countries lack both human and material resources to conduct expensive and time-consuming research that could solve these problems. Concervation and improvement of genetic resources have been identified as the most urgent and strategic area to increase productivity and yield security.

2 COGENT’s mission

COGENT's goal is to strengthen international collaboration in conservation and use of coconut genetic resources, to improve coconut production on a sustainable basis and to boost livelihoods and incomes of coconut stakeholders in developing countries.

COGENT continues to develop and implement an international mechanism to coordinate research activities of national, regional and global significance, particularly in germplasm exploration, collecting, conservation and enhancement. It also establishes a basis for collaboration on the broader aspects of coconut research and development. The network functions at the national, regional and global levels to strengthen the capacity of national programmes to conserve and utilize coconut genetic resources. Specifically, COGENT:

1. Establishes and maintains an international database on existing and future collections;
2. Encourages the protection and use of existing germplasm collections;
3. Identifies and secures additional threatened diversity by developing and adopting suitable technologies and conservation strategies;
4. Promotes greater collaboration among research groups in producer countries and advanced technology sources in the exchange of germplasm and the development of new techniques;
5. Conducts appropriate training,

6. Disseminates relevant information dissemination and
7. Facilitates securing necessary funding for network activities.

3 Previous organization and achievements

3.1 Organization of the network

The International Coconut Genetic Resources Network (COGENT) includes 39 country members and is organized into 5 regional sub-networks: Africa and the Indian Ocean; Latin America and the Caribbean; South Asia and Middle East; Southeast and East Asia; and the South Pacific. Table 1 gives a list of the member countries.

Table.1
Composition of the COGENT by regional networks in 2012

South Asia and Middle East	Southeast East Asia	South Pacific	Africa and Indian Ocean	Latin America and Caribbean
Bangladesh	China	Cook Islands	Benin	***Brazil***
India	***Indonesia***	Fiji	***Ivory Coast***	Colombia
Pakistan	Malaysia	Kiribati	Ghana	Costa Rica
Sri Lanka	Myanmar	***Papua New Guinea***	Kenya	Cuba
Sultanate of Oman	**Philippines**	Samoa	Madagascar	Guyana
	Thailand	Solomon Islands	Mozambique	Haiti
	Vietnam	Tonga	Nigeria	Honduras
		Vanuatu	Seychelles	Jamaica
			Tanzania	**Mexico**
				Trinidad and Tobago

In ***Bold and Italic***: International Genebanks.
In **Bold**: country members of the COGENT Steering Committee in 2012.

Only a country can become a member of the network. At the present stage, membership is open only to coconut producing countries. There is no membership fee. To apply for membership, an authorized government official should write to the COGENT secretariat and provides dedicated information. To be eligible for COGENT membership, a country must meet certain criteria that have recently been articulated[1].

Until 2011, each country member was represented in COGENT by a national Official representative, chosen by the country concerned. Currently two regional coordinators from each of the five regional networks constitute the Steering Committee. The COGENT Coordinator is an ex-officio member and serves as the Secretary. The Asian and Pacific Coconut Community (APCC) is a non-voting member. The Chair and Vice-Chair of the Steering Committee are elected for a 2-year term and each must come from a different regional network. The members are also elected for a 2-year term. COGENT programme

[1] See on the FAQ section of the COGENT website:" How a country can become a member of Cogent?" at: http://www.cogentnetwork.org/index.php/faq/34-membership

priorities and activities are decided by members of the Steering Committee, and reviewed by Bioversity to enhance complementarity and effectiveness. The COGENT Coordinator coordinates the planning, implementation, monitoring and evaluation of COGENT's programme, projects and activities, and establishes linkages with collaborating institutions, programmes and donors.

Table 2 provides the list of the Coordinators, Chairman and Vice-Chairman of the network. . Dr Gabrielle Persley, then working with the Australian Centre for International Agricultural Research (ACIAR), and later with the Doyle Foundation, is credited with making a major contribution to COGENT for supporting case studies and organizing efforts to convince the CGIAR that coconut research needed international support; in commissioning external reviews to evaluate the progress of COGENT and in developing its strategic plan; and in organizing the CGIAR Coconut Support Group to generate support for COGENT priority activities. To organize COGENT, IPGRI engaged Dr Hugh Harries as a Consultant in 1991 who helped develop the first five-year work plan and who eventually suggested the acronym 'COGENT' for the network. Mr Gerardo Santos served as the Acting Coordinator of COGENT for a few months in early 1993. Dr Michel de Nuce followed briefly as Coordinator for the rest of 1993. Some data regarding Chairman and Vice-Chairman are still missing and any contribution will be welcome to help us to fill the gaps.

Table 2.: Coordinators, Chairman and Vice-Chairman of the COGENT Network

Years	Location of the Steering Committee meeting	Coordinators and initial consultancy	Chairman	Vice-Chairman
1991	N.A	Dr H. Harries	N.A	N.A
1992	N.A		N.A	N.A
1993	N.A	Dr G. Santos and Michel de Nuce de Lamothe	N.A	N.A
1994	N.A	Dr P. Batugal	N.A	N.A
1995	N.A		N.A	N.A
1996	N.A		N.A	N.A
1997	Côte d'Ivoire		B. Been	S. M. Hazelman
1998	Papua NG		S. M. Hazelman	A.Sangare
1999	Vietnam		T. Osborn	P. Yavo N'Cho
2000	India		P. Yavo N'Cho	C.Carpio
2001	N.A		P. Yavo N'Cho	C.Carpio
2002	Thailand		C. Carpio	A. Kullaya
2003	-		C. Carpio	A. Kullaya
2004	Malaysia		C. Carpio	C. Oropeza
2005	India		C.Carpio	C. Oropeza
2006	France		C.Oropeza	C.Jayasekara
2007	Philippines	Dr M. L. George	C. Oropeza	C.Jayasekara
2008	-		C.Jayasekara	J.L. Konan
2009	-		C.Jayasekara	J.L. Konan

2010	-	Dr S. Weise	J.L. Konan	N.A
2011	-		J.L. Konan	N.A
2012	India	Dr R. Bourdeix	K. Allou	C. Carpio

3.2 Past achievements

COGENT has established collaborative linkages with partner research and development institutions working on coconut which presently include the *Centre de Coopération Internationale en Recherche Agronomique pour le Développement* (CIRAD), France; the Asian and Pacific Coconut Commission (APCC), Indonesia; *l'Institut de Recherche pour le Developpement* (IRD – previously known as ORSTOM), France; the Inter-American Institute for Cooperation on Agriculture (IICA), USA; Long Ashton Research Station (LARS), UK, and research agencies in the 39 member countries.

COGENT has received funding support from donors which include the Asian Development Bank (ADB), the International Fund for Agricultural Development (IFAD), the Department for International Development (DFID), the Common Fund for Commodities (CFC), the French government, the Global Crop Diversity Trust (Trust) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Germany. A CGIAR Coconut Support Group, consisting of donor agencies and partner institutions was formed to foster international support for coconut research. The Group facilitates the financing of priority activities identified by the Steering Committee.

Thanks to Dr Pons Batugal, the period from 1994 to 2006 is well documented regarding COGENT activities. The following six major project proposals generated funding from various donors (Batugal, 2005):

1. *Regional technical assistance for the establishment of a coconut genetic resources network for Asia and the Pacific Region.* This 3-year Project (1994-1997), involving 13 countries, was funded by a US$800,000 grant from Asian Development Bank (ADB).
2. *Regional technical assistance for a coconut genetic resources and human resource strengthening for Asia and the Pacific Region.* This 3-year project (1998-2000), involving 20 countries, was funded by a grant of US$ 1,200,000 by ADB.
3. *Developing sustainable coconut-based income generating technologies in poor rural communities.* This 3-year project (1998-2000) involving eight Asia Pacific countries is funded by a US$1,000,000 grant from ADB
4. *Sustainable use of coconut genetic resources to enhance incomes and nutrition of smallholders in the Asia-Pacific Region.* This 3-year project (1997-2000), involving 14 countries, is funded by a grant of US$907,000 by the International Fund for Agricultural Development (IFAD).
5. *Coconut germplasm utilization and conservation to promote sustainable coconut production.* This 5-year project (1997-2002), involving 3 African and 3 Latin American countries in variety/ hybrid multi-location trials and technology transfer worldwide, is funded by a US$1,198,778 grant from the Common Fund for Commodities.
6. *Regeneration of Accessions in the International Coconut Genebank for Africa and the Indian Ocean*. This 8-year project (2004-2011)

conducted in Côte d'Ivoire was funded by a technical assistance grant of US$236,940 from the Global Crop Diversity Trust

7. *Overcoming poverty in coconut growing communities.* This 3-year project (2005-2008) involving 19 countries was funded by a technical assistance grant of US$ 1000,000 from IFAD.
8. *Coconut-based product diversification to reduce poverty in coconut-growing communities*. This 5-year project (2005-2009) conducted in the Philippines was funded by a technical assistance grant of US$ 62,400 from the Philippines government.

To support regional and global projects, COGENT and IPGRI provided funds and technical backstopping to national programs and partner institutions in 30 countries. This enabled them to conduct 288 research projects, trainings, meetings and workshop activities in support of research with regional and global significance.

Thanks to Dr Maria Luz George and S. Weise, the following projects were launched during the period 2006 to 2011:

9. *Validation of a coconut embryo culture protocol for the international exchange of germplasm*. This 4-year project (2009-2012) involving 4 countries was funded by a technical assistance grant of U$ 295,666 from the Global Crop Diversity Trust.
10. *Establishment of the International Coconut Gene Bank for South America and the Caribbean*. This 4-year project (2006-2011) located in Brazil was funded by a technical assistance grant of U$ 200, 000 from Embrapa.

Dr Bourdeix worked as main technical expert in projects 6 and 10, when Dr Kristi Queto (Philippines) did the same for the embryo culture project (9).

4 Recent evolution and activities of the network

In late 2011 and early 2012 respectively, two short projects were launched:

11. *Upgrading international coconut genebanks and evaluating accessions*. This 6-month project was funded by a technical assistance grant of U$ 35,000 from the Global Crop Diversity Trust. It involved 5 main countries, but the management and analysis of the data included all COGENT genebanks.
12. *Organization of the 16th Steering Committee Meeting of the International Coconut Genetic Resources Network (COGENT), Kochi, Kerala, India*. This project was funded by a grant of U$18,877 from the Global Crop Diversity Trust and an additional U$20,000 funding from the CRP6 GGIAR budget[2].

4.1 Organizational aspects

The latest country to join the network was the Sultanate of Oman in early 2012. Then, the 39 COGENT country members were contacted to confirm their official COGENT representatives. We introduced a new organisational tool, by asking the country members to

[2] CGIAR Research Programme (CRP) "Forest, trees and agroforestry"

designate also an alternative COGENT representative in charge of technical tasks. Engaging two people (one official and one alternative representative) in COGENT for each member-country is real progress, because it makes communication much more efficient and sustained. The list of COGENT representatives is now available on the COGENT website, together with the list of the 24 ex situ genebanks[3].

Two students in communication and international negotiation[4] and the COGENT coordinator were involved in this process which required extensive communications by email, 'phone and Skype. The process also was used to update the Coconut Genetic Resources Databases (CGRD). Table 3 gives a summary of the communication process.

Table 3. Balance of communications with COGENT country members to upgrade the CGRD

	COGENT countries (39)	Africa & the Indian Ocean	South Asia	Southeast & East Asia	South Pacific	Latin America & the Caribbean
# emails	276	78	29	37	57	75
# phone calls	56	19	5	8	13	11
# Skype communications	5	1	0	2	2	0
% countries appointing 2 COGENT Reps	74,35%	77,7%	100%	87,5%	87,5%	40%
% countries which appointed almost 1 COGENT Rep.	100%	100%	100%	100%	100%	100%
% countries owning a Skype account	%	77,7%	100%	71,4%	87,5%	20%
% countries which set up Skype software and used it at least once	%	11,1%	0%	28,5%	25%	0%
% countries which have linked to the CGRD	%	66,6%	80%	71,4%	37,5%	10%
% countries which started inputting data	%	66,6%	80%	71,4%	37,5%	10%

As shown in table 2, no Steering Committee meetings were organized between 2008 and 2011. Decision was taken to organize in 2012 a steering Committee Meeting in Kochi, from 8th to 10 July 2012, just after the 45th Cocotech Meeting and Coconut Festival. Piggy-backing the two meetings in the same location will generate an economy of both time and financial resources. It will be also more environmentally friendly, because the number of international flights will be reduced. In order to prepare this meeting, 2 international surveys have been launched.

The first survey provides for an organizational assessment and is open to all stakeholders concerned by COGENT's activities. The survey aims to better assess the most efficient

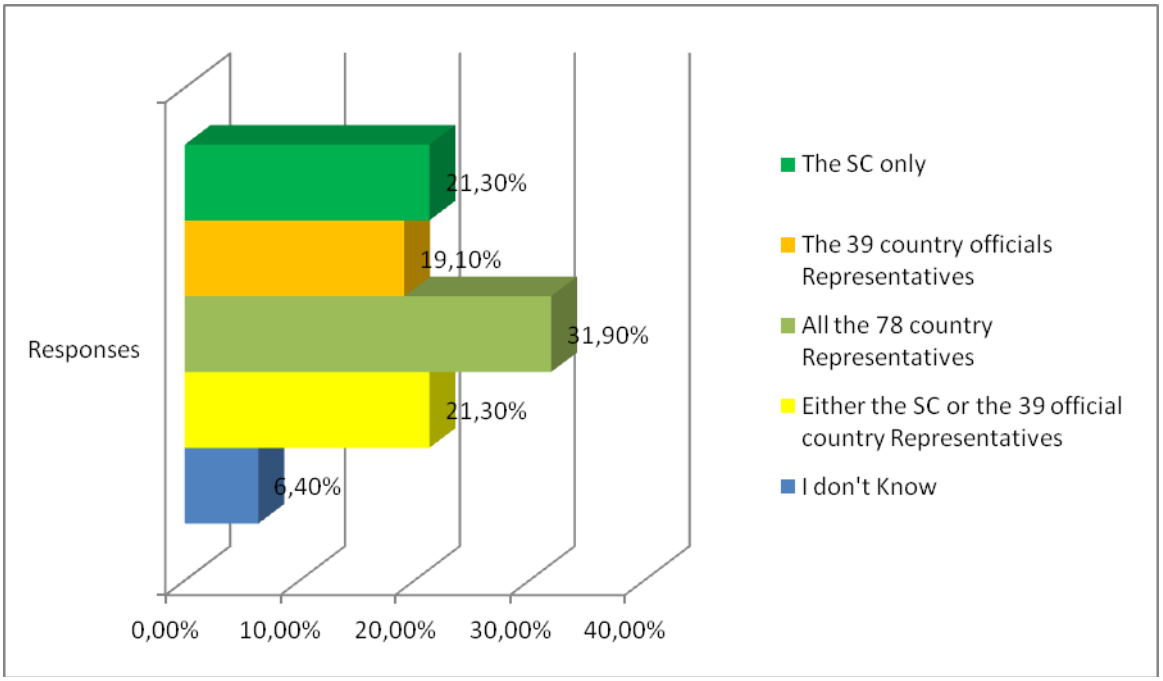
[3] See: List of COGENT representative: http://www.cogentnetwork.org/index.php/contact/country-representatives List of genebanks: http://www.cogentnetwork.org/index.php/faq/139-exsitu

[4] Dorine Martinez and Ramon Sepulveda, based in Bioversity Montpellier.

organizational structure for the COGENT network. Using Survey Monkey online software, 37 seven questions divided into 5 main thematic areas were developed: 1) Steering Committee (SC) composition; 2) Steering Committee representation and renewal; 3) Decision-making process; 4) the COGENT Secretariat's capacity, and 5) Free comments. At the time of redaction of this communication, the survey is still open to respondents. However, the first results indicate that the sample group wish to move towards a more participative and collective organizational structure for COGENT, as illustrated in the example given in figure 1:

Figure 1:
Decision making process of Steering Committee and the whole network

Question 27: Making decisions at distance voting should be requested to:



The second survey is being conducted in the framework of the preparation of regional reports. It comprises 20 questions divided into 5 thematic areas: 1) information about researchers and students; 2) information about genebanks; 3) information about breeding programmes; 4) COGENT membership activities; 5) Thematic groups and 6-Free comments. Contrary to the first organizational assessment, the sample group of this survey is limited to COGENT representatives. Results will be discussed collectively during the meeting.

In discussion with donors and other international agencies, it is clear that the most important matter is that COGENT fulfils its mission, rather than the way COGENT is organized. The main objectives of the Steering Committee are then the following:

- To refine the Global Coconut Conservation Strategy, an essential tool for the future of Coconut Genetic Resources at the global level.
- To provide a balanced review of the research activities of the COGENT country members in the field of Coconut Genetic Resources and Breeding.
- To interact with other countries in order to develop new international research projects in the field of Coconut Genetic Resources and Breeding.

4.2 Coconut Genetic Resources Databases

The need to update the current Global Coconut Conservation Strategy was highlighted in 2009 during a COGENT meeting held in Korea. One of the main limiting factors of this updating process was identified as *"making decisions with incomplete or obsolete information"*. Over the last decade, not enough information has been shared between COGENT members. It is not possible to work efficiently on the strategy without knowing the current status of the germplasm conserved in the 24 ex situ genebanks of the network.

Thanks to a short project funded by the Global Crop Diversity Trust[5], we undertook an update of the data regarding Coconut conservation at the global level.

The coconut genetic resources database version 5.1. (CGRD5.1) was made available on the COGENT website. Member-countries were asked to visit the COGENT website, to download the software for updating their data. Skype accounts were created to facilitate the communication between the COGENT Secretariat and country representatives and to help the countries process their data. Researchers and students in charge of updating the data in the COGENT countries were identified and distance training was provided. Training of researchers was also conducted in Brazil, Côte d'Ivoire, India, Indonesia, Sri Lanka and Malaysia.

Six comprehensive lists of conserved coconut germplasm were released on the COGENT website in the frequently asked questions (FAQ) section:

- 419 cultivars or varieties ranked by names of cultivars
- 419 cultivars or varieties ranked by countries of origin
- 855 populations ranked by names of cultivars and populations
- 855 populations ranked by countries of origin
- 1680 accessions ranked by names of cultivars and populations
- 1680 accessions ranked by sites of conservation (genebanks)

The CGRD software has been updated to comply with international standards, and especially with regard to the nomenclature aspects, as described in the new guidelines. An important improvement was to separate the cultivar name from the population name; this is very important, because it allows easy generation of a list of coconut cultivars rather than just lists of accessions and populations. We also developed two important guidelines[6] in the FAQ section of the COGENT website:

- How an international name is given to a new coconut variety?
- What is the meaning of the terms: 'Variety', 'Cultivar', 'Population' and 'Accession' and how do they differ?

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[5] Project entitled "Upgrading international coconut genebanks and evaluating accessions", implemented from January to May 2012, led by Bioversity International and in partnership with the Central Plantation Crops Research Institute (India), the Centre International de Recherche Agronomique pour le développement (France), the Centre National De Recherche Agronomique (Côte d'Ivoire), the Coconut Research Institute (Sri Lanka), the Embrapa Tabuleiros Costeiros (Brazil), the Indonesian Palm Research Institute, and the Malaysian Agricultural Research and Development Institute (Malaysia)

[6] http://www.cogentnetwork.org/index.php/faq/140-how-is-named-a-coconut-variety
http://www.cogentnetwork.org/index.php/faq/141-faq-accession-cultivar

The updated CGRD data was used to develop a comparative evaluation of the COGENT genebank. This analysis and the development of decision-making tools will be crucial for upgrading the Global Coconut Conservation Strategy and for identifying the germplasm at risk.

In 1999, the COGENT Steering Committee took the decision to release the coconut genetic resources database (CGRD) into the public domain, in order to make accessible and disseminate this useful information, and to create public awareness about coconut genetic resources[7]. We developed a FAQ about this topic on the COGENT website[8], together with a draft proposal for Data Sharing Agreement and a CGRD Portal Terms and Conditions of Use. Although the CGRD is now fully available on the COGENT website, it is planned to draft a signed data-sharing agreement (DSA) between each COGENT country-member, as the data provider, and Bioversity, as the data receiver, to increase the level of legal protection of the data and to acknowledge the stake of individual COGENT country members. This will be done only on the individual demand of country members, as some countries may consider that their data are enough protected with the present system.

A Data Sharing Agreement (DSA) comprises a number of regulations for managing shared data between the Data-provider and the Receiver in several specific domains and contexts. This is an official accord between the parties that distinctly establishes which type of data is being shared, the obligations involved, the permissions required and how the data can be used. It ensures the protection of the Data-provider and the Receiver, by establishing regulations and agreed terms and conditions of use in diffusion to third parties.

Targeted end-users concerning this DSA include genebank managers, plant breeders, taxonomists, policy-makers, educators, and students, as well as the broader scientific community, in addition to wide array of general users. Sharing data encourages researchers, provides vital input and support for academic research, and renders the data available to other investigators.

The new version 6 of the CGRD database software, together with a new and more user-friendly web interface named COCOGIS (Coconut Germplasm Information System) will be available on the COGENT website before the end of June 2012.

5 Opportunities and challenges

Presently the main opportunity and challenge facing COGENT is to update the global coconut conservation strategy. Indeed, this is an opportunity because the message from donors and international agencies is clear: a comprehensive and workable Global Conservation Strategy covering the next 10 year period is needed before developing new initiatives and funding. It is also a great challenge because coconut research and coconut stakeholders are facing urgent, complex and stimulating issues.

The components of the conservation strategy, as published in the 2008 version, are the following:

- conservation in national field collections;

[7] source: minutes of the 8th COGENT Steering Committee held in Ho Chi Minh City, Vietnam 20-22 September 1999

[8] See http://www.cogentnetwork.org/index.php/faq/137-what-is

- conservation in the multi-site International Coconut Genebank (ICG);
- in vitro embryo culture, somatic embryogenesis and cryopreservation;
- in situ and on-farm conservation;
- promoting conservation through use by:
    - developing and implementing a globally coordinated coconut breeding programme,
    - establishing farmer community-managed coconut seedling nurseries,
    - linking germplasm conservation and use with the broader areas of research and development in partnership with CIRAD (agro-physiology and crop protection), APCC (processing and marketing) and other organizations;
    - developing and disseminating catalogues of conserved germplasm and farmers' varieties, and
    - upgrading and supporting the wide use of the International Coconut Genetic Resources Database (CGRD).

Hereunder are some of the points that will be discussed during the next Steering Committee Meeting.

- *Ex situ conservation*

An immediate concern is the critical situation of *ex situ* coconut conservation. In classical coconut genebanks, coconut cultivars are conserved as accessions, generally planted close together in the same fields. Each accession generally counts 75 to 100 coconut palms from the same cultivar. The lifespan of such accessions is only 25 to 30 years. After this period, most non-dwarf coconut varieties reach 15 m high or more. At this stage, it becomes difficult to make the requested controlled pollinations. It is therefore necessary to rejuvenate the accessions before the inflorescences become inaccessible. For reproducing these accessions, the technique of controlled pollination with bagging of the inflorescence must be used (Konan & al., 2008). Presently 24 genebanks are conserving 725 unique populations with 1374 living accessions. The analysis of CGRD data shows that 447 of these accessions, collected during the 1980s, are becoming very tall without being rejuvenated. At least 16 genebanks, including three out of the five international genebanks, do not have sufficient capability, laboratories, equipment, manpower and/or budget needed to make reliable controlled pollinations. In some of the genebanks where controlled pollinations are conducted, DNA analysis shows that the pollinations are not fully reliable. Taking in account this huge need of capacity building, a large project should be launched to safeguard this germplasm. At list one controlled pollination lab should receive an ISO certification during the next 10 years.

- *Germplasm collecting missions*

There is a huge need of collecting additional germplasm, not only for keeping this germplasm in *ex situ* genebanks, but also for organizing the *in situ* conservation in a more sustainable and efficient way. The needs in collecting germplasm will be prioritized during the next meeting:

    - Collecting endangered germplasm with special fruit characteristics such as Sweet husk or tasty kernel, which will be precious for developing new markets;
    - Collecting the numerous and amazing compact dwarf varieties existing in Polynesia
    - Collecting germplasm for disease resistance
    - Collecting germplasm in areas strongly endangered by climate change and sea rising, such as low coral atolls and river deltas.

- *In situ conservation*

Regarding in situ conservation, it seems important to better understand the biological, social and historical dynamics which are shaping the coconut biodiversity and its uses. Such a diachronic approach was recently developed for the Pacific Region (Bourdeix & al, 2009c); data regarding Africa and Latin America seems well documented. The same kind of studies should be conducted in Asia.

In many islands of the Pacific region, the same kind of dynamics occurred. In the 1800s, Islanders' families had each a limited number of coconut palms, but there existed many coconut landraces serving very different purposes including for: food and drink; making ropes and containers; medicine; building houses, and braiding. From 1800 to 1930, coconut and copra became a huge colonial business. The number of coconut palms in the Pacific region was multiplied by 60 to 100. Coconut landraces that had been created over thousands of years by the islanders were diluted in the mass of coconut palms selected only to produce copra. During colonial times, planting techniques on the atolls consisted, in most cases, clearing all the natural vegetation, letting it dry for a month and then burning everything. These planting techniques were indeed harmful to the biodiversity of endemic species. They were also damaging for the coconut palms, especially from the point of view of conservation of genetic diversity. During this period, the agricultural landscapes and practices were profoundly and brutally modified. Many islanders were forced to work in coconut plantations and in the ovens for drying copra. In many islands, the population was decimated by diseases imported by Europeans, such as measles. The cataclysmic socio-economic changes that affected these islands exacerbated the erosion of both traditional knowledge and biological resources. We estimate that at least 50% of the coconut varieties created by Pacific Islanders over centuries are already lost.

Some recent studies conducted in French Polynesia (R. Bourdeix, unpublished data) indicate that more than 80% of coconut farmers do not have the key technical knowledge about the reproduction mode of the coconut palm; they do not know, for instance, how to identify the male and the female flowers in a coconut inflorescence. More than 60% of the farmers do not know anymore how to use the simple genetic markers, such as seedling sprout-colour at the nursery stage. Such markers allow differentiating within progenies from natural pollination. If generalized, the shortage of knowledge may limit farmers' capacities to breed and disseminate good quality coconut varieties.

Local stakeholders (men and women farmers, private enterprise, NGOs and CBOs) should become more involved in supplying and using quality germplasm. Farmers' knowledge regarding the reproduction mode of the coconut palm should be assessed at the global level using a standardized method. Then, farmers' knowledge should be improved using appropriate communication tools. If the COGENT network finds a way for 50% of the coconut farmers to acquire this knowledge, it will be a great indicator of success.

- *The balance between in situ and ex situ conservation*

The optimal balance between *ex situ* and *in situ* conservation must be studied, together with some new approaches which do not fit with the classical delineation between *ex situ* and *in situ*, such as the concepts of *Polymotu* and *Virtual collection (*Bourdeix & al, 2009b*)*. According to the Poly*motu* concept, coconut palms could be planted in geographical and reproductive isolation. In this way, some of the conservation constraints linked to the height and ages of the palms are shifted. Instead of climbing the palms for making controlled

pollination, people only have to wait for the coconut to fall naturally to the ground. Open-pollination will provide true-to-type and cheap seednuts. Thus, the same accession can be kept as long as a sufficient number of palms remain alive in the field. In most cases, the duration of a coconut accession will then be extended to 75 to 100 years. Even if some of the palms die, there is no need to remove the remainder, as is done in a classical genebank. Dead palms can be replaced by new ones, without removing the old palms remaining alive. Extending the lifespan of a coconut accession from 25-30 years to 75-100 years represents a huge saving of time, manpower and money. Some of the in situ designs allow farmers to conserve in the same site both Tall and Dwarf varieties, and also to produce their own Dwarf x Tall hybrid seedlings.

The attempt to create a globally coordinated coconut breeding programme, as stated in the previous version of the strategy, was not successful. In is presently envisioned to launch dedicated international experiments at the regional or sub-regional level. Discussions regarding two large experiments have been initiated in 2012. The first one gathers Latin America, Africa and the Indian Ocean for studying dwarfs varieties and their progenies. The second one is envisioned in South East Asia. It compares Dwarf x Tall hybrids, progenies of Dwarf x Dwarf Hybrids, and Tall populations, and it will test a special technique of growing coconuts from the Mekong Delta. A very important point is to understand the inheritance of the two kinds of dwarfism existing in the coconut palm. This is open the door for using the positive characteristics of the Dwarf (slow vertical growth, precocity in nut-bearing) in populations of tall type having a broader genetic variability.

The “conservation through use” approach should be broadened in a more ambitious and commercial way. What we need could be a kind of “marketing of genetic resources”. The role of genebanks is not only to conserve but also to ensure that the available germplasm is used by stakeholders. Many stakeholders have some interest that can be linked to the conservation of coconut genetic resources, and most of these stakeholders do not know it: municipalities, tourist centres, university campuses, research institute sites, golf courses, and of course farmers. Respect for tradition can foster economic competitiveness. The plantation of some traditional varieties could generate lucrative niche-markets. For the tourism industry evolving in a very competitive environment, it becomes more and more important to stand out from the standard fare that tourism offers. The coconut palms should no longer serve as symbols of anonymous and counterfeit exoticism: they tell true stories, specifically related to local cultures in an ecotourism approach.

The results of the project “Validation of a coconut embryo culture protocol” funded by the Global Crop Diversity Trust show that exchanging germplasm using embryo culture is potentially feasible. Project work has substantially refined the protocol. However, to ensure the effective implementation of the protocol, we need to ensure appropriate skills development for both providers and recipients of the embryos. We also need to ensure the availability of the required equipment in good working order that fully respects the revised protocol. The Steering Committee should discuss how this research should be followed up, and also review the opportunity for building a new cryo-genebank for conservation of coconut embryos frozen in liquid nitrogen.

Last but not least, the research area of genomics and sequencing of the Coconut genome needs to be further considered. It is envisioned to sequence and document the genome of the coconut palm within the 10 next years.

6 Conclusion

The process for reviving COGENT is ongoing. The improvement of COGENT's organization was initiated in 2012 by developing new tools and organizational assessments. During the next Steering Committee meeting, it seems essential not to devote too much time to COGENT organization, but to focus on developing the new Coconut Global Conservation Strategy; and to start preparing research projects in the framework of this strategy. From the donors point of view, the most important is not *how COGENT is organized*, but *what results COGENT produces*. A key issue will be the ability of the network to organize and animate international thematic working groups in each of the research areas covered by COGENT mandate. Another important issue will be to involve more national researchers and PhD students in global thematic studies linked to the strategy, such as for instance comparing data on germplasm at the global level with the national level.

The success will also depend on the ability of the steering committee and other COGENT members to act effectively as a proactive group. The Steering Committee should steer the regional network programmes in collaboration with the COGENT Coordinator. The SC members are designated by the Government of each country. If the designated member does not have the capacity to lead, the ability to conceptualize, plan and put ideas into motion, and/or if they do not have the time and commitment to undertake the above role, then the network revival will not be sustainable.

A significant outcome will be the safe conservation of the representative biodiversity of coconuts (*Cocos nucifera*), and the availability of certified coconut seednuts for farmers. Men and women farmers will cultivate more diversified, adapted, profitable coconut varieties. Beneficiaries will be all those stakeholders who rely on coconuts for their livelihoods. A main impact will be enhanced livelihood for coconut stakeholders.

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