Global Conservation Strategy for *Cocos nucifera*

A framework for promoting the effective conservation and use of coconut genetic resources developed in consultation with COGENT members and partners

Bioversity International

COGENT

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DISCLAIMER

This document, developed with the input of a large number of experts, aims to provide a framework for the efficient and effective *ex situ* conservation of globally important collections of coconut.

The Global Crop Diversity Trust (the Trust) provided support for this initiative and considers this document to be an important framework for guiding the allocation of its resources. However the Trust does not take responsibility for the relevance, accuracy or completeness of the information in this document and does not commit to funding any of the priorities identified.

This strategy document (dated January 2008) is expected to continue to evolve and be updated as and when circumstances change or new information becomes available.

In case of specific questions and/or comments, please direct them to the COGENT coordinator mentioned in the document.

Global Coconut Genetic Resources Conservation Strategy and Priority Activities for 2005-2015

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1. Introduction

In 1992, at the request of the Consultative Group on International Agricultural Research (CGIAR), the International Coconut Genetic Resources Network (COGENT) was launched by Bioversity International (previously known as IPGRI, the International Plant Genetic Resources Institute). Starting with 15 countries, COGENT developed into a global network currently involving 38 coconut producing countries (Table 1).

Table 1. COGENT member countries

	Southeast and East Asia	South Asia	South Pacific	Africa/Indian Ocean	Latin America/ Caribbean
1.	China	Bangladesh	Cook Islands	Benin	Brazil
2.	Indonesia	India	Fiji Islands	Côte d'Ivoire	Colombia
3.	Malaysia	Pakistan	Kiribati	Ghana	Costa Rica
4.	Myanmar	Sri Lanka	Papua New Guinea	Kenya	Cuba
5.	Philippines		Solomon Island	Madagascar	Guyana
6.	Thailand		Tonga	Mozambique	Haiti
7.	Vietnam		Vanuatu	Nigeria	Honduras
8.			Samoa	Seychelles	Jamaica
9.				Tanzania	Mexico
10.					Trinidad-Tobago

The establishment of COGENT paved the way for the global and regional coordination of coconut conservation efforts. With the increasing threat of genetic erosion and widespread poverty in coconut growing communities, there is a need to further support the conservation initiatives of coconut growing countries to upgrade the collections and to enhance and accelerate the documentation, evaluation, conservation and use of coconut genetic resources.

1.1 Process of developing a Global Coconut Conservation Strategy

Over the past 5 years, COGENT had conducted several consultations on the conservation and use of coconut diversity to assist coconut growing countries to develop a progressive conservation strategy (Annex 1). Such a strategy aims to optimize the conservation of as much representative diversity as possible in the most cost-effective manner for the short, medium and long term. In November 2004, the Global Crop Diversity Trust (Trust) supported a meeting of the major coconut producing countries to review and update the strategy and identify priority conservation activities. The updated strategy was referred to the COGENT Steering Committee (SC), to representatives of coconut growing countries and COGENT partner research organizations, and, based on their feedback, a revised draft was produced. The COGENT-SC approved the revised Strategy during its meeting in India in November 2005. In December 2007, participants in the ICG and National Genebank Curators Workshop/COGENT SC Meeting reviewed the Strategy to further rationalize the collections. This updated Global Coconut Conservation Strategy defines the framework for promoting the effective conservation and use of coconut genetic resources over the next 10 years to guide coconut producing countries in developing their own conservation strategies. This strategy and the identified priority activities for the next 10 years are described below.

1.2 Integrated approach to coconut conservation

The coconut conservation strategy is anchored on promoting the sustainable protection of diversity and maximizing its use. In developing the conservation strategy, coconut growing countries recognized that no one method of conservation can meet all conservation needs and that there is a need to employ a combination of methods to ensure the sustainable conservation of as much diversity as possible. The Strategy encourages the participation of governments, partner organizations in both developing and developed countries, NGOs and coconut farmers themselves.

The components of the Conservation Strategy are:

1) conservation in national field collections;
2) conservation in the multi-site International Coconut Genebank (ICG);
3) *in vitro* embryo culture, somatic embryogenesis and cryopreservation;
4) *in situ* and on-farm conservation; and
5) Promoting conservation through use by:
    a) developing and implementing a globally coordinated coconut breeding programme,
    b) establishing farmer community-managed coconut seedling nurseries,
    c) 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;
    d) developing and disseminating catalogues of conserved germplasm and farmers' varieties, and
    e) upgrading and supporting the wide use of the International Coconut Genetic Resources Database (CGRD).

2. Scope and status of coconut conservation

2.1 Conservation in national field collections

National governments, through their coconut research institutes or their equivalents, hold important coconut germplasm collections in their research stations. To date, 28 institutes in 23 countries have conserved, characterized and registered accession data in COGENT's CGRD. A total of 1,416 accessions were characterized, in varying levels of completeness, in the database (Table 2).

Table 2. Documented data (as of 2003) on national collections in the CGRD with percentage of passport descriptors (P) and evaluation descriptors (E) and the number with photographs and molecular data

	Country	Site	No. of access.	25-75% passport (P) data[1]	25-75% Eva/char. (E) Data[2]	With pictures	With molecular data
1.	**Benin**	CRC, Sémé Podji	4	4	4	4	3
2.	**Côte d'Ivoire**	CNRA Marc Delorme Research Station, Port-Bouët	99	92	71	73	67
3.	**Ghana**	Coconut Programme, OPRI, Sekondi	16		4	15	14
4.	**Tanzania**	National Coconut Development Programme, Dar Es Salaam	72	71	69	35	33
		AFRICAN REGION	**191**	**167**	**148**	**127**	**117**
5.	**Brazil**	EMBRAPA, Aracaju-SE	16	16	16	10	10

	Country	Site	No. of access.	25-75% passport (P) data[1]	25-75% Eva/char. (E) Data[2]	With pictures	With molecular data
6.	**Jamaica**	Coconut Industry Board, Kingston[3]	60	16	58	32	36
7.	**Mexico**	Centro de Investigacion Cientifica de Yucatan, Merida	20	20	1	1	2
		LATIN AMERICA-CARIBBEAN REGION	**96**	**52**	**75**	**43**	**48**
8.	**Bangladesh**	BARI, Gazipur	40	18	37		
9.	**India**	CPCRI, Kasaragod	212	141	211	76	52
10.	**Pakistan**	Research Station, Islamabad	32				
11.	**Sri Lanka**	Coconut Research Institute, Lunuwilla	78	78	64	5	10
		SOUTH ASIAN REGION	**362**	**237**	**312**	**81**	**62**
12.	**Fiji**	Taveuni Coconut Centre, Taveuni	11	8	7	5	5
13.	**Papua New Guinea**	Cocoa and Coconut Research Institute, Rabaul	3		3	5	30
14.	**Papua New Guinea**	Stewart Research Station Madang	54	31	54	3	2
15.	**Samoa**	RS, Apia, Olomanu Coconut Seed Garden	9		9	4	3
16.	**Solomon Islands**	RS, Yandina	21	4	21	10	11
17.	**Tonga**	Ministry of Agriculture, Nuku'alofa	7		1	2	2
18.	**Vanuatu**	Saraoutou Research Station, Santo, VARTC	79	71	11	48	53
		SOUTH PACIFIC REGION	**184**	**114**	**106**	**77**	**106**
19.	**China**	Coconut Research Institute, Wenchang	17	15	17		14
20.	**Indonesia**	Bone Bone Experimental Garden, Manado, S. Sulawesi[4]	41	35	41		
21.	**Indonesia**	Mapanget Experimental Garden, Manado, N. Sulawesi	74	74	45	14	17
22.	**Indonesia**	Pakuwon Experimental Garden, Manado, W. Java[5]	25	22	25	8	10
23.	**Indonesia**	Sikijang Experimental Garden, Manado[4]	30	30	30	3	5
24.	**Malaysia**	Department of Agriculture, Sabah	45	23	30	23	19
25.	**Malaysia**	MARDI, Hilir, Perak, Terengganu	44	34	39	40	38
26.	**Philippines**	Philippine Coconut Authority, Zamboanga	224	221	219	194	51
27.	**Thailand**	Chumphon Horticultural Research Centre, Chumphon	52	42	52	9	8
28.	**Vietnam**	Dong Go Experimental Center, Ho Chi Min City	31	30	16	9	8
		SOUTHEAST ASIAN REGION	**583**	**526**	**514**	**300**	**170**
		TOTAL FOR ALL REGIONS	**1416**	**1096**	**1155**	**628**	**503**

[1]25-75 % Passport data registered in the CGRD
[2]25-75% of Evaluation/characterization data registered in the CGRD
[3]Some of the accessions are possibly dead due to lethal yellowing
[4]Status of germplasm is not clear as the Experimental Gardens are no longer under the Indonesian Coconut and Palmae Research Institute
[5]Accessions now <25 due to clearing of the land

Access and Benefit Sharing

Being an Annex 1 crop of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), coconut germplasm can be accessed by countries which have ratified the International Treaty and which have declared these collections in the public domain. For those which have not ratified the Treaty, access can be made through bilateral arrangements.

Gaps in national field collections

Gaps in the collections in the South Pacific Island countries, especially in the atolls, have been identified in a survey done by CIRAD, and in the Indian Ocean countries in a survey done by the Central Plantation Crops Research Institute (CPCRI), India. There is a need to enhance the collections from these climate change-vulnerable island countries which may face the permanent loss of their coconut diversity when sea levels rise due to global warming. There is also a need to identify, collect and conserve germplasm with resistance/tolerance to diseases, including lethal yellowing in Africa and in the Latin America and the Caribbean region; foliar decay in Vanuatu; cadang-cadang in the Philippines, the Kalimantan wilt in Indonesia, and Kerala wilt in India. There is a need to identify, collect and conserve drought-tolerant germplasm, noting that almost all coconuts are grown in rainfed conditions. Finally, there is a need to collect and conserve materials with specific desirable characteristics that have potential for producing high-value products through value addition by coconut farmers.

2.2 Conservation in the multi-site International Coconut Genebank

While national field genebanks are important sources of germplasm for the development of improved varieties, germplasm exchange among countries has been limited due to technical, policy and political constraints. Several countries do not have the capacity to propagate, prepare and ship disease-free materials, lack the policy cover for exchange, and could not deal with countries with different political systems. To address these constraints and to foster an efficient and effective system of germplasm conservation, evaluation and safe movement, the COGENT Steering Committee decided in 1995 to establish a multi-site International Coconut Genebank (ICG). The ICG today comprises five regional genebanks hosted by Indonesia for Southeast and East Asia (SEA), Papua New Guinea for the South Pacific (SP), India for South Asia (SA), Côte d'Ivoire for Africa and the Indian Ocean (AIO) and in 2006 the ICG for Latin America and the Caribbean (LAC) was formally initiated in Brazil.

The mandates of the ICG are to:

1) conserve nationally and regionally identified priority diversity;
2) conserve internationally identified priority diversity;
3) further assess the diversity, evaluate the performance of the conserved germplasm and disseminate related information;
4) make germplasm available in accordance with agreed protocols; and
5) conduct research and training.

The ICG field genebank collections are held in-trust under the auspices of FAO. Successor agreements under the aegis of the FAO Commission on Plant Genetic Resources for Food and Agriculture are in the process of being signed by the ICG host countries to bring the collections under the International Treaty. The Governments of Cote d'Ivore and Papua New Guinea have signed for the collections in the ICG-AIO and the ICG-SP, respectively, while the Agreements for the ICG-SA, ICG-SEA and ICG-LAC are currently being reviewed by the Governments of India, Indonesia, and Brazil, respectively. The designated germplasm is shared under the terms of the standard material transfer agreement (SMTA) as part of the multilateral system of access and benefit sharing created by the Treaty or of the MTA specified in the Memorandum of Agreement (MOA) establishing the ICG in the case of India, Indonesia and Brazil which have yet to sign the successor Agreements under the Treaty. Table 3 shows the date of signing of the hosting MOA and the ITPGRFA successor Agreements, and the status of conserved germplasm in each of the host countries.

Table 3. Germplasm conserved in the International Coconut Genebank

Name of Genebank	Date of signing of the hosting MOA	Date of signing of the ITPGRFA successor Agreement	Number of cultivars initially designated in the MOA	Number of cultivars currently conserved in the ICG[1]
India International Coconut Genebank for South Asia	30 October 1998	Under review	49	99
Papua New Guinea International Coconut Genebank for the South Pacific	10 November 1998	9 May 2007	55	59
Indonesia International Coconut Genebank for Southeast and East Asia	26 May 1999	Under review	52	42
Côte d'Ivoire International Coconut Genebank for Africa and the Indian Ocean	14 September 1999	5 February 2007	49	99
Brazil International Coconut Genebank for Latin America and the Caribbean	8 June 2006	Under review	22	24
Total			**259**	**323**

[1]Some of the cultivars are duplicates but may differ in origin, number of palms, or year of planting. Refer to Annex 2 for details.

The sites for the ICG were chosen based on surveys conducted by coconut experts, who considered and evaluated several important criteria. Thus, the basic needs of field genebanks such as safety and security, accessibility, environment etc. have been considered. In considering these criteria, two principles were highlighted. First, the importance of having a balance between elite lines and accessions that represent a broad range of genetic diversity from the region as a whole was recognized from the beginning. Second, it was agreed that the nationally important accessions that cannot be accommodated in the regional genebanks, i.e. those which are only important to one or a few countries, would be maintained in the national collections under the responsibility of the national programmes. Thus, from the beginning it was apparent that national collections and the ICG would complement each other to accommodate as much coconut genetic diversity as possible.

Thus, 85-90% of each of the regional fieldbank collections will consist of the following varieties from the region:

1) major varieties (parents of existing hybrids and advanced generations of selected cultivars);
2) varieties/cultivars threatened with genetic erosion or loss;
3) varieties/cultivars with special traits/genetic markers; and
4) genotypes used in diversity studies using molecular markers.

The remaining 10-15% of the collection will consist of a set of frequently requested cultivars, comprising a "working collection" which will be maintained in all the genebanks to enable their facilitated distribution and use in breeding programs

The ICG field genebanks are established, maintained and managed by national programmes with guidance from COGENT and Bioversity. In the Agreements, host countries agreed to commit resources for the establishment, maintenance, germplasm evaluation and the data gathering required for the effective management of the genebank. Additional operational support, including funds for the importation and growing of embryos *in vitro* and in the nursery comes from national and international donors and income generating activities such as the production and marketing of high-value products from all parts of the coconut; intercropping and livestock raising as appropriate. Currently, the ICG-AIO receives support from the Trust for regeneration of old palms and the ICG-LAC from the Government of Brazil for the establishment of the field genebank.

Accessions are imported in the form of excised embryos, grown *in vitro* in the laboratory, transplanted into the greenhouse and eventually into the field. These accessions, which are planted in the field genebanks of about 200 hectares, are characterized and evaluated using morphometric and molecular marker protocols to determine their diversity, performance, and potential for coconut improvement work.

The conservation strategy envisions that the ICG laboratories and facilities will be further developed and upgraded to enable them to locate more representative diversity, identify and eliminate duplicates, conduct disease indexing, process pollen and embryos for export, conduct cryopreservation and train coconut researchers in evaluating, conserving and using coconut germplasm.

It is envisioned that each of the five regional field genebanks will conserve up to a maximum of 200 accessions[1]. To ensure that the gene pool of each of the conserved varieties is sufficiently captured, each accession must have 45 palms (15 x 3 blocks) for dwarf and 90 palms (45 x 3) for tall varieties. Germplasm that represent regional diversity will be contributed by the coconut-producing countries in each region, while germplasm that are important for coconut improvement may be obtained from the ICG or national collections in other regions. Care must be taken to ensure that each accession that represents the diversity in the region is unique and is not duplicated in the same collection. This will be further validated using molecular marker studies.

When resources permit, geographical gap-filling collections will be undertaken to conserve coconut diversity from areas that are under-represented in national and international genebanks. Priority would be those areas which have been previously

[1] The minimum number of palms per accession is determined by the number needed to represent the genetic diversity of the population while the resources available determine the maximum. Assuming that the material will be conserved for the next 200 years (frequency of replanting in a field genebank is 30 years for Dwarfs; 40 years for Talls, giving 4 - 6 generations). If the decision is to have a 90% probability of maintaining the alleles with a frequency of >5%, a population of about 40-60 will be needed per accession. To characterize the accession accurately, the optimum number of palms per accession = 90 palms (Rao, 2005)

identified[2]. In some of these locations, the cultivated area and economic value of coconut may be small, but diversity is endangered precisely due to its comparative low economic importance. Coconut diversity may also be endangered due to the possible effects of global warming.

Access and availability

Based on the MOA signed by each host country, the germplasm in the ICG is available to all coconut producing countries. In the successor ICG Agreements, this access is extended to all parties of the International Treaty. While each of the ICG field banks is primarily meant to serve specific regional needs, there is no restriction for any country to access germplasm from any of the regional genebanks. The requested accessions will be sent in the form of embryos or pollen after disease indexing to ensure safe movement. To make the ICG hosting sustainable, requesting countries will be charged the cost of producing the seednuts and for preparing the embryos, disease indexing and shipping and a pro-rata cost of maintenance. These germplasm transfers are covered by the SMTA which is a provision in all ICG hosting agreements.

The ICG includes the collection of the host country as well as duplicates of nationally conserved germplasm. The actual status of conservation of the germplasm in the five regional genebanks, updated through a survey conducted from May to August 2007, is summarized in Annex 2.

As many countries cannot afford to adequately maintain their collections and many of these collections and those in farmers' fields are threatened by natural and man-made calamities, there is a need to accelerate the full establishment and upgrading of the regional gene banks to protect germplasm from genetic erosion and to promote wider use of coconut diversity. This will require increasing the number of conserved material up to a maximum of 200 accessions in each ICG host country, upgrading and expansion of current embryo culture laboratories, germplasm importation, growing embryos *in vitro,* transplanting resulting seedlings and maintenance in the field gene banks

There is also a need to support the full establishment of the recently initiated ICG in Brazil for the LAC region, and to protect the LAC germplasm from the lethal yellowing disease, which is the most dreaded disease affecting the LAC and African countries. Likewise, due to squatting problems in the initial site of the ICG-SEA in Sikijang, Sumatra, Indonesia, there is now a need to establish an expansion area elsewhere. A 150-hectare site has been identified for this expansion in Manado, North Sulawesi which is near the laboratory facilities of the Indonesian Coconut and Palmae Research Institute, the implementing agency for the ICG. Priority will be placed in developing projects that involve the important role of the genebanks in supporting the germplasm needs of the regions, and that include the necessary budgetary support to the genebanks to enable them to address these needs.

[2] Including the west coast of South and Central America; Micronesia and the eastern part of Polynesia; Irian Jaya and the Moluccas archipelago; the tropical coasts of Australia; Madagascar; and localized areas in Somalia, Myanmar, Laos and Sarawak in Malaysia (Bourdeix et al. 2005a; Bourdeix et al. 2005b).

Full establishment of the ICG hosted by Brazil and upgrading of the ICGs hosted by India, Indonesia and Papua New Guinea and Côte d Ivoire.

COGENT's multi-site International Coconut Genebank provides an effective mechanism for access to conserved germplasm, field performance evaluation, safe movement and use. To effectively support the use of conserved coconut germplasm to benefit people, there is a need to facilitate access to germplasm by coconut breeding programmes. For this purpose, there is a need to upgrade the five ICGs through importation of germplasm from member countries to complete the 200 accessions to be conserved in each site so that these can be subsequently characterized, evaluated and shared. These will include the importation and conservation of the resistant/tolerant varieties for the dreaded lethal yellowing disease affecting Africa and the LAC regions, i.e. Malayan Yellow Dwarf, Malayan Red Dwarf, Chowgat Orange Dwarf, Sri Lanka Green Dwarf, Vanuatu Tall, Panama Tall, and additional accessions to be identified though molecular marker studies; and germplasm that are resistant/tolerant to root wilt disease of India, the Kalimantan disease of Indonesia, the cadang-cadang disease of the Philippines and foliar decay disease of Vanuatu. The Trust is currently funding the regeneration of 50 accessions in Côte d'Ivoire which are now very old (Annex 2).

A more efficient system that integrates the regional and national genebank collections will be considered to safely conserve coconut genetic resources for the long term and to make them available as public goods. This will be done through a global "Virtual Collection" consisting of the most appropriate accessions from the regional and national genebanks (those that are genetically unique and important regardless of where they are located). A well coordinated andintegrated ICG system will enable conservation under common quality standards for acquisition, safety duplication, regeneration, characterization and evaluation, documentation and distribution.

2.3 **In vitro** ***embryo culture, somatic embryogenesis and cryopreservation***

Although conservation in field genebanks is the most popular and practical method of coconut conservation, the field genebank has several disadvantages:

1) It occupies a large land area;
2) It is labour- and time-intensive to maintain;
3) Extreme care in labelling and managing fields is necessary;
4) Controlled pollinations for producing true-to-type seedlings of allogamous accessions are costly;
5) Many biotic and abiotic factors impact on the safe conservation of the germplasm;
6) It is inconvenient to transport as the volume of the planting material is quite large (as either seednuts or seedlings in polybags); and
7) International germplasm exchange is restricted by quarantine requirements and the availability of reliable embryo/tissue culture techniques which are required for the safe movement of germplasm.

In vitro culture techniques

Thus, it is necessary to complement field genebanks with other conservation methods. The use of *in vitro* culture techniques, including slow growth and cryopreservation, represents an important additional option for the medium and long-term conservation of coconut.

Coconut is a species with large seeds with no dormancy and germination of mature seed (fruit) starts within 2-3 weeks after harvest or after it drops to the ground. These two characteristics drastically limit the amount of material that can be gathered during collecting missions. A simple and efficient *in vitro* field collecting technique has been developed which involves extracting the embryos from the nuts and inoculating them directly onto culture medium. Embryos can be kept for two months before transfer to culture in a controlled laboratory environment.

Conventional slow growth protocols are not currently available for coconut due to the difficulties encountered in the propagation techniques for this crop. However, short-term conservation of zygotic embryos has been achieved by using culture conditions which delay germination for twelve months. Additional experiments are needed to assess the applicability of this technique to a wide range of varieties. Currently, the *in vitro* embryo culture process itself, i.e. from the inoculation of embryos *in vitro* to the production of whole plants ready for transfer *in vivo*, has been refined through a collaborative effort involving 12 partner countries (Annex 3). This has significantly improved the *in vitro* culture step of the whole process, especially recovery rates. However, there is need for further refinement of the techniques, as well as hands-on training and laboratory upgrading to enable the optimal application of the techniques during field collection and transfer to the lab, and in acclimatization of the resulting plants both *in vitro* and *in vivo*. Finally, additional refinement is needed to improve the development and growth in the field of plants coming from *in vitro* culture. The present recovery rate is currently low, averaging less than 30% recovery from collected embryo to transplantable seedlings.

Embryo culture technology for collecting and safe movement of germplasm

In vitro techniques have been used extensively for exchanging coconut germplasm in the form of excised embryos inoculated *in vitro*. The FAO/IBPGR Technical Guidelines for the Safe Movement of Coconut Germplasm recommend that coconut germplasm be distributed in this form to reduce chances of introducing diseased material into disease-free areas and COGENT has been following these guidelines. IPGRI/COGENT has published a Manual on Germplasm Health Management for the International Coconut Genebank which serves as a guide for ICG and national genebank managers and the quarantine service.

To further collect important germplasm especially in isolated locations to address the threats to genetic erosion, there is a need to upgrade the efficiency of the embryo culture technology to enable the collection and safe movement of germplasm. This effort is limited by the current low seedling recovery from embryo *in vitro* culture, the FAO-IPGRI recommended method for safe germplasm movement, which at present averages about 30% of embryos collected from the field. As the number of palms and fruits of specific germplasm selected for conservation during collecting expeditions is often low for some identified germplasm materials, this problem has resulted in inadequate number of plants in the genebanks which does not allow for the statistical evaluation of their field performance as prescribed in the COGENT STANTECH Manual. It is therefore proposed that the embryo *in vitro* culture technique, which was developed through a previous DFID- and ADB-funded project of COGENT, be refined through collaborative research among selected advanced laboratories. This would make collecting of important germplasm with limited number of palms and fruits more effective and evaluation of conserved germplasm statistically sound. As the same technology is also used to propagate the highly-priced but non-germinating soft-endosperm coconut varieties through embryo rescue, improvement of the technology will also benefit poor farmers who could derive 3-5 times more income from soft-endosperm coconut varieties, i.e. Makapuno in the Philippines, Kopyor in Indonesia and Dikiri Pol in Sri Lanka.

Pollen conservation

Pollen conservation is another option for coconut germplasm conservation. Pollen can be easily collected and cryopreserved in large quantities, occupying very little space. In addition, exchange of germplasm through pollen poses fewer problems of quarantine than is the case for seed or other propagules. Additional research is needed to further develop and refine an appropriate technique. Once this technique is refined, it can be used as an adjunct to *in vitro* conservation so that the pollen of *in vitro* conserved material could be used for coconut improvement purposes, instead of waiting for the regenerants to grow and flower.

Somatic embryogenesis

The potential of somatic embryogenesis as a tool for coconut germplasm conservation and accelerated use has been explored. If successful, it could be used to rapidly multiply parent materials to provide adequate numbers of plants for breeding or replanting. During the COGENT Steering Committee meeting in 2005, it was strongly recommended that more focused research on establishing appropriate protocols for somatic embryogenesis be pursued. Such a technique can aid greatly in coconut germplasm management as well as in rapid multiplication and mass propagation for both breeding and replanting programmes.

Somatic embryogenesis technology

One of the problems in the use of conserved germplasm to develop improved varieties is often the lack of adequate number of palms of selected germplasm. Only about 12-24 plants can be efficiently produced using controlled pollination from each coconut palm per year. Likewise, once a variety has been developed, tested and selected after an average of 15 years, it takes a long time to propagate them for commercial planting in bigger scale. A previous EU-funded project on rapid vegetative coconut propagation using somatic embryogenesis, involving five advanced laboratories, resulted in a recovery of only two percent (2% embryos per plumule). Recently, the innovative coconut research of the Centro Investigacion Cientifico de Yucatan in Merida, Mexico on the same subject has generated a breakthrough for improving the technology. From a single coconut plumule (young leaf), CICY projects that it could now generate 200,000 embryos which can eventually result in at least 10,000 coconut seedlings. CICY has offered to IPGRI/COGENT to refine and downstream the technology through collaborative research and training with COGENT to adjust the technology to the germplasm and laboratory conditions of member countries. This technology, if upgraded, can be used to produce adequate number of planting materials for conservation in field genebanks and for breeding. It could also be used to propagate desirable varieties for commercial planting.

Cryopreservation
For long-term conservation, preliminary experiments have led to the development of a cryopreservation protocol, which has been successfully applied to zygotic embryos of four different genotypes. Additional work is required to refine the cryopreservation technique and to carry out experiments with additional genotypes. It is envisioned that the ICGs will serve as the repository of cryopreserved germplasm when these are fully capable. However, repository arrangements with capable partner institutions such as the Secretariat of the Pacific Communities (SPC) may also be explored.

To ensure efficient and safe movement of germplasm, there is a need to improve the coconut embryo culture protocols, in order to increase the recovery of embryo-cultured plants, particularly in the stages of plant acclimatization *in vitro* and *in vivo*. There is also a need to undertake additional research on cryopreservation using different representative varieties to identify suitable plant tissues to be conserved across different accessions.

Two major constraints related to cryopreservation as a long term strategy for coconut conservation are the lack of an efficient regeneration protocol for coconut and the unverified fidelity of genetic materials regenerated from cryopreserved tissues. The future of long term conservation of coconut through cryopreservation would depend on the results these studies. Therefore, there is a need to develop an efficient regeneration protocol using somatic embryogenesis. To further test the efficiency of cryopreservation, there is a need to conduct molecular marker-based analysis of regenerated materials to test their genetic fidelity.

Cryopreservation technology
For long-term conservation, CIRAD had developed in the 1980s, in collaboration with Côte d'Ivoire, the initial cryopreservation technology for coconut which demonstrated that coconut embryos can be conserved at low temperature and successfully generated after one year. In 2000-2001, IPGRI/COGENT and CIRAD collaborated to refine the technology and to train coconut researchers from five coconut producing countries on the use of the upgraded technology. There is now a need to support research that would test the use of this technology across a range of genetic diversity and over a longer period of time to determine its feasibility in developing country laboratories. Cryopreservation has the potential to conserve germplasm for 50 years in other crops and, if fully developed for coconut, would be a cost-effective method to use for long-term conservation to complement *ex situ* conservation in field genebanks.

2.4 **In situ** ***and on-farm conservation***

About 85% of coconuts are grown in South and Southeast Asia and the effects of farmers' practices in this region on the extent and distribution of genetic diversity are of great importance. It is thus likely that the major part of coconut diversity will remain *in situ*, in the yards or gardens of small farmers, undisturbed tropical sea coasts and uninhabited islands.

Today, many farmers' varieties are in danger of being lost, resulting in genetic erosion of some of the most adapted and needed germplasm for sustainable coconut production. Initial results indicate that the threats to genetic erosion caused by urbanization, shifts to other more profitable crops, calamities such as drought, typhoons, pests and diseases are real and need to be addressed. The lethal yellowing disease, for example, has been the greatest disincentive to coconut production in Africa and the LAC region. The disease spread is so rapid that it is moving at the rate of 50 km per year in the Yucatan peninsula. More recently, rising sea levels due to climate change threaten the permanent loss of coconut diversity in atolls and island countries where coconut is considered one of the most, if not the most important, crop for food and for sustaining the fragile farming systems.

Sustainable *in situ* conservation will require community participation, control of land rights in local communities, systematic documentation of farmers' knowledge of coconut diversity, education, extension and development of environmental awareness. Of equal importance is the principle that any *in situ* conservation programme must also benefit local communities. Management by local communities can often develop effective links to national efforts on documentation, conservation and use. This can attract commercial and private agencies to be partners in on-farm conservation efforts and can lead to much wanted linkages between public, community and private sectors in plant genetic resources conservation.

In almost all coconut growing communities, there is presently little information available on the status of the genetic diversity maintained by coconut growing communities. In the past, the measurement of genetic diversity in coconut depended largely on morphometric traits. The use of morphometric, farmers' knowledge and molecular markers to characterize farmers' varieties, which has been initiated by COGENT, will assist in better understanding of the structure of genetic diversity both at a specific site and across regions.

In situ conservation has the distinct advantage of conserving already adapted germplasm that has naturally evolved in particular environments. However, there is no sustainable mechanism to effectively monitor and document the effect of *in situ* conservation without a specific conservation project and allocated budget in national programmes. Through the support of DFID, ADB and IFAD, a COGENT project is testing the viability of strategies in 35 communities in 15 coconut producing countries (Bangladesh, India, Sri Lanka, China, Indonesia, Malaysia, the Philippines, Thailand, Vietnam, Fiji and Papua New Guinea, Ghana, Tanzania, Mexico and Jamaica) of four coconut-based income generating activities, including:

1) production and marketing of high-value products from all parts of the coconut-the kernel, husk, shell, water, wood, leaves and roots;
2) intercropping cash and food security crops,
3) livestock/fodder production; and
4) production and planting of high-quality coconut seedlings which are raised in community-managed nurseries.

The community-managed nurseries propagate seed nuts for on-farm conservation from identified local varieties, which are selected by farmers and a coconut breeder in a participatory rapid appraisal of community genetic resources and in coconut diversity fairs; and from introduced high-value varieties from other locations. Selected local varieties are paint-marked to identify suitable varieties both for *in situ* conservation and for propagation. The community-managed nurseries are informal seed systems not dependent on government resources, and because of this, they are envisioned to be a sustainable tool for promoting *in situ* and on-farm conservation. The project has identified and characterized 89 important farmers' varieties and a total of over 62,000 seedlings from these farmers' varieties were conserved *in situ* and on-farm. Proposals are being prepared to seek support for testing these coconut-based sustainable livelihood models in Africa and LAC, and for coconut *in situ* conservation.

On-farm conservation will not only conserve the original materials that have been sampled for *ex situ* conservation (through the field gene banks, pollen or *in vitro* methods) but also those that have not been collected so far. Together with *ex situ*, on-farm conservation helps to conserve and use a much larger genetic diversity of coconut. The strategic aim of this component of the strategy is to learn more in order to strike an appropriate balance between *in situ*/on farm and *ex situ* conservation.

A new conservation strategy, which involves planting of single coconut varieties on small islands, serves both conservation and breeding purposes. The geographical remoteness of the islets will ensure isolated reproductive systems that are needed for true-to-type breeding, avoiding the use of the costly technique of controlled pollination. This strategy includes both in situ and ex situ conservation – an Indonesian Islet, for instance, could be planted either with a local variety or a Polynesian variety.

3. Promoting conservation through use

The value of conserved germplasm is not maximized until it is used to benefit humankind, especially the poor. Accordingly, the coconut conservation strategy seeks to promote conservation though use. Mechanisms include the following initiatives:

1) developing a globally-coordinated coconut breeding programme;
2) community-managed coconut seedling nurseries;
3) linking conservation with the broader areas of research and development;
4) development and dissemination of catalogues of conserved germplasm and farmers' varieties and other public awareness materials on coconut high-value products and uses for food, nutrition and health; and
5) upgrading of the CGRD

3.1 Globally coordinated coconut breeding programme

A globally coordinated breeding programme would facilitate the use of available germplasm worldwide and expedite work on developing improved varieties.

Specifically, the programme's aims are:

- further characterize conserved germplasm and farmers' varieties using morphometric and molecular marker techniques;
- screen and identify ecotypes tolerant or resistant to lethal yellowing disease and drought;
- improve yields for specific uses and adaptation;
- develop varieties which are suitable for the production of high-value products from husk, fibre, shell, meat, water, wood and leaves;

- develop technical support systems for national breeding programmes (i.e. information, pollen and embryo provision, etc.); and
- provide a platform to promote the dissemination and use of the results of the coconut breeding projects to achieve socioeconomic and environmental impact.

Ultimately, the programme should be able to significantly increase the choice of varieties and hybrid cultivars among coconut growing countries, by maximizing the use of available genetic resources and information about them for breeding purposes, and improve the quality of the planting materials for distribution to users or farmers.

3.2 Community-managed coconut seedling nurseries

In the past, many coconut farmers relied on planting materials produced by government agencies, which were generally inadequate, expensive and could not serve large numbers of farmers. Because farmers earned marginal incomes from coconut, there was no strong or conscious effort to select planting materials from their best varieties and palms. Consequently, the planting of important local and introduced varieties was limited and the full potential of this diversity was not maximized. Through its "Poverty reduction in coconut growing communities" project (described in the section on *in situ* and on farm conservation), COGENT has developed a mechanism to address this constraint through the establishment of community-managed coconut seedling nurseries that are not dependent on the government. This project which was initially implemented in eight Asia Pacific countries has convinced Indonesia, the Philippines and Vietnam to expand the number of communities using their national budgets. In addition to the IFAD-funded follow up project involving 15 countries, proposals are being prepared to test this approach in 25 countries worldwide.

Under the project, farmers' preferred varieties will be conserved *in situ* and on-farm and, based on morphometric and molecular marker characterization, some will be selected for *ex situ* conservation either in national genebanks or in the ICG. This will enhance the value of these *ex situ* collections as they will address framers' varietal preferences. Conversely, some high-value varieties already conserved in the national genebanks and ICGs which will be identified for introducing in the participating poverty reduction project communities would provide further links between *in situ* and *ex situ* conservation and use.

3.3 Molecular marker technology for locating and characterizing conserved germplasm and farmers' varieties

Many coconut germplasm materials look different but may be genetically similar. Conversely, they may look similar but are actually genetically different. To avoid the problem of conserving more than what is necessary and maintaining duplicate genetic diversity, molecular marker-based techniques to complement morphometric methods of characterization need to be supported. This technique based on molecular markers, is also important in efficiently locating important genetic diversity in farmers' fields that could be conserved *ex situ*. In 2000, CFC funded a collaboration between Bioversity and CIRAD to develop a microsatellite kit and its associated software for characterizing coconut germplasm. The initial technology has been tested in seven countries (India, Indonesia, the Philippines, Sri Lanka, Côte d'Ivoire, Brazil and Jamaica). The technology has met some initial success, and now, there is a need to further refine its application in developing country laboratories and specific coconut types, and apply the refined technology to characterize a wider range of conserved germplasm and farmers' varieties.

3.4 Linking conservation with broader areas of research and development

In 2002, the coconut community launched a Global Coconut Research for Development Programme which provides a platform for coordination and collaboration - on genetic resources improvement and socioeconomics and policy support by COGENT; on agronomy and farming systems and crop protection by CIRAD; and on processing and marketing by APCC. Cooperation among these partners is at their initial stages but could provide strategic advantages in linking conservation of diversity and use.

3.5 Catalogues and other public awareness materials on coconut varieties, coconut high-value products and uses for food, nutrition and health

To fully appreciate the value of both *ex situ* and *in situ* conserved germplasm, there is a need to document their origin, vegetative, fruit and nutrition characters and their adaptation to biotic and abiotic stresses. As many researchers, students and farmers do not have the opportunity to travel and see these varieties in the countries where they are located, the publication and dissemination of catalogues containing such information will popularize these genetic resources and promote their further study and possible use.

3.6 The International Coconut Genetic Resources Database (CGRD)

The CGRD is used by coconut breeders worldwide to identify accessions they would like to use in their breeding. The CGRD is also distributed to major libraries in coconut growing countries. Together with the catalogues of conserved germplasm and farmers' varieties, which will also be distributed similarly, researchers, teachers and students could use them to further study and understand the nature and value of coconut genetic resources. These initiatives, no doubt, will promote greater use and consequent conservation of these genetic resources.

The usefulness of the database depends to a large extent on the quantity and quality of information it contains and its dissemination to coconut breeders worldwide. At present, it contains passport and characterization data for 1,416 accessions in 28 conservation sites in 23 countries (Table 2). However, out of the 1,416 accessions, only 1,155 have 25-75% of the needed characterization and evaluation data; only 503 have molecular data (using microsatellite kits) and only 628 have pictures. Furthermore, since the last update of the database in 2003, some of the accessions have been lost due to disease, cutting down of the palms, and other reasons.

To enable coconut breeders to select desired parents and fully use the conserved germplasm for breeding, there is a need, not only to update the CGRD, but to upgrade it as well. A survey of coconut workers done by COGENT in 2006 identified several necessary enhancements, including new functionalities such as interoperability with other databases and the possibility of inputting data directly through the Internet. The update will integrate the newly developed Minimum Descriptor List for morphometric characterization of conserved coconut germplasm, which was recently developed through a wide consultation with coconut workers. It is necessary to generate not only morphometric data, but also molecular marker data and photographs for the initial 23 countries and similar data from additional coconut growing countries in the near future. The photographic documentation of about 50% of these collections has been initially conducted through the support of IFAD and CIRAD, and this will be published in a "Catalogue of Conserved Germplasm". Enhancement of the database will take into consideration added value through collaboration between CIRAD and the Bioversity Commodities for Livelihoods Program which developed and maintains the MGIS (*Musa* Germplasm Information System) to ensure that database improvement, administration, and user support are sustained over the long term.

4. Priority conservation strategies of COGENT

The coconut growing community advocates a progressive conservation and use strategy with the ultimate goal of providing sustainable benefits to poverty-mired coconut farmers and coconut growing countries worldwide in the short, medium and long term. The previous sections of this strategy paper summarized the scope and status of coconut conservation to date and the gaps that need to be addressed. This section recommends priority activities that need to be implemented in the next 10 years, for which resources will be sought.

The role of COGENT in developing and implementing the strategy is important for two major reasons:

1) the network is owned and managed by 38 coconut producing countries – national genebanks are owned by national programmes; the international genebanks are hosted and maintained by strong national programmes; and
2) the COGENT Steering Committee, which represents major coconut producing countries of each region, decides on research priorities and provides oversight to the implementation of agreed programmes

Based on the above analysis of the scope and status of coconut conservation, the following priority activities for the global coconut conservation strategy were identified. This strategy is based on the threats and opportunities that affect the sustainability of the coconut industry and the resource-poor coconut farmers which constitute 96% of coconut producers.

1. Refinement and dissemination of improved embryo culture, somatic embryogenesis and cryopreservation technologies;
2. Refinement and wider application of the molecular marker technology (microsatellite kits) for locating and characterizing diversity, and for more efficient management of genebanks;
3. Upgrading COGENT's Coconut Genetic Resources Database through the development of new and improved functionalities, the generation and registration of more morphometric and molecular marker data, and better dissemination of information in the public domain;
4. Additional collecting and conservation of germplasm in national genebanks to address the gaps identified in surveys by CIRAD and CPCRI and conserve farmers' varieties with desirable traits for coconut product value addition;

5. Rationalization of genebank collections, including establishment of the recently initiated International Coconut Genebank for Latin America and the Caribbean (ICG-LAC), upgrading of the ICGs hosted by India, Indonesia, Papua New Guinea and Côte d'Ivoire, and development of a global virtual genebank system of unique and important but widely dispersed accessions;
6. In situ and on-farm conservation of important farmers' varieties in at least 25 countries worldwide through Bioversity/COGENT's "Poverty reduction in coconut growing communities' project. A related need is the study of coconut seedlings networks to better understand, from the anthropological and ethnological aspects, how farmers select, manage and conserve their coconut palms, how these practices are evolving with cultural changes, and their consequences on the genetic structure of coconut populations;
7. Promoting conservation through use by supporting national coconut breeding efforts in a globally coordinated breeding programme; testing new approaches to conservation such as the use of islets for *in situ* conservation as well as for breeding and seed nut production; linking with research activities to serve as platform for the utilization of conserved diversity; and developing catalogues of conserved germplasm and farmers' varieties, high-value products and coconut food recipes, and other public awareness materials to increase coconut consumption.

Development of national and regional coconut conservation strategies

With the development and approval of the global coconut conservation strategy which will serve as the overall coconut conservation framework, it is imperative that each coconut producing region of the world develop their regional conservation strategies. These strategies will flesh out the plan of action for conservation of coconut, based on the analysis of common problems and opportunities for each region and the resources needed to support them. Subsequently, the national coconut conservation strategies should be fleshed out based on available national resources and plant genetic resources policies of each coconut producing country. This will enable countries to conserve their precious coconut diversity and establish the needed mechanisms to use and share these with other countries.

6. Conclusion

Coconut is an important crop of developing countries as it provides food, drink, nutrition, shelter and employment to poor people and foreign exchange earnings to many countries. However, the industry is suffering from low productivity and unstable markets for the traditional low priced coconut product – the copra (dried kernel). These problems are compounded by the rapid genetic erosion which threatens the sustainability of the coconut industry. Coconut farmers, of which 96% are smallholders, are marginalized and most live below the poverty line. This conservation strategy was formulated to address these situations in coconut producing countries**.**

The above-described global coconut conservation strategy provides the overall global framework for the conservation of coconut diversity from which specific regional and national strategies can be developed to suit the needs and available resources of each region and of each coconut producing country.

The strategy reviews the status of coconut conservation and use, the gaps in research and lists the COGENT priority conservation and related activities for the next 10 years. It also describes and justifies the strategic priorities and activities which are relevant to Global Crop Diversity Trust and for which support is requested.

It is hoped that the strategy will be supported by all coconut producing country governments and relevant research and development institutions so that the concerns of the beleaguered coconut industry and resource-poor coconut farmers can be effectively addressed.

7. Acronyms

ADB	Asian Development Bank
AIO	Africa and the Indian Ocean
APCC	Asian and Pacific Coconut Community
Bioversity	Bioversity International – previously the International Plant Genetic Resources Institute
CFC	Common Fund for Commodities
CGIAR	Consultative Group on International Agricultural Research
CGRD	International Coconut Genetic Resources Database
CICY	Centro Investigacion Cientifico de Yucatan
CIRAD	Centre de cooperation internationale en recherche agronomique pour le développement
COGENT	International Coconut Genetic Resources Network
CPCRI	Central Plantation Crops Research Institute
DFID	Department for International Development
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
IBPGR	International Board for Plant Genetic Resources, previously IPGRI and now Bioversity
ICG	International Coconut Genebank
IFAD	International Fund for Agricultural Research
IPGRI	International Plant Genetic Resources Institute, now Bioversity
ITPGRFA	International Treaty for Plant Genetic Resources for Food and Agriculture
LAC	Latin America and the Caribbean
MOA	Memorandum of Understanding
SA	South Asia
SC	Steering Committee
SEA	Southeast and East Asia
SMTA	Standard Material Transfer Agreement
SP	South Pacific
STANTECH	Standard Techniques
TRUST	Global Crop Diversity Trust

8. References

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Bourdeix R, Guarino L, Rao V R and L Baudouin. 2005b. Status, gaps and strategy in coconut germplasm collecting *In* Coconut Genetic Resources eds P Batugal, V Ramanatha Rao and J Oliver (eds) International Plant Genetic Resources – Regional Office for Asia, the Pacific and Oceania (IPGRI-APO), Serdang, Selangor DE, Malaysia

Rao VR. 2005. Coconut Field Genebank *In* Coconut Genetic Resources eds P Batugal, V Ramanatha Rao and J Oliver (eds) International Plant Genetic Resources – Regional Office for Asia, the Pacific and Oceania (IPGRI-APO), Serdang, Selangor DE, Malaysia

Annex 1. List of consultative groups and participants

Events	Participants
2nd International Coconut Genebank Meeting and Consultation on Proposed Globally Coordinated Coconut Breeding 30 Oct -1 Nov 2002 Kasaragod, India (Supported by funds from DFID)	• Dr. V Rajagopal,(India, ICG-SA Leader) • Dr. H Novarianto (Indonesia, ICG-SEA Leader) • Mr. M Faure (Papua New Guinea, ICG-SP Leader) • Dr. J Louis Konan (Cote d'Ivoire, ICG-AIO Leader) • Mr. G Santos (Philippines, Breeder) • Mr. J M D T Everard (Sri Lanka, Breeder) • Mr. F Rognon (France, BUROTROP Director) • Dr. P Rethinam (Indonesia, APCC Executive Director) • Dr. P Batugal (Malaysia, Bioversity COGENT Coordinator) • Dr. V Ramanatha Rao (Malaysia, Bioversity Scientist) • Dr. P Mathur (India, Bioversity Scientist)
12th COGENT Steering Committee Meeting 9 - 12 November 2003 Merida, Mexico (Supported by funds from Bioversity and CFC)	**SC Members:** • Dr. G Kalloo (India, ICG-SA Representative) • Mr. T Sitapai (Papua New Guinea, ICG-SP Representative) • Dr. M Ballo Koffi (Cote d' Ivoire, ICG-AIO Representative) • Dr. E Tupinamba (Brazil, ICG-LAC Representative) • Dr. C Jayasekara (Sri Lanka, SA Regional Representative) • Mr. C Carpio (Philippines, SEA Regional Representative) • Dr. L Guarino (Fiji, SP Regional Representative) • Dr. A Kullaya (Tanzania, AIO Regional Representative) • Dr. C Oropeza (Mexico, LAC Regional Representative) • Dr. P Rethinam (Indonesia, APCC Executive Director) • Dr. P Batugal (Malaysia, Bioversity COGENT Coordinator) **Other attendees :** • Dr. J Louis Konan (Cote d'Ivoire, ICG-AIO/CFC Project Leader) • Mr. K Mkumbo (Tanzania, CFC Project Leader) • Mr. A Sanoussi (Benin, CFC Project Leader) • Mr. B Been (Jamaica, CFC Project Leader) • Mr. R Castillo (Mexico, CFC Project Leader) • Dr. L Baudouin (France, CIRAD Geneticist) • Dr. S Barbosa (Brazil, EMBRAPA Intl Cooperation Coordinator) • Mr. J Piña (Mexico, INIFAP Director) • Dr. M Anishetty (Italy, FAO Senior Officer) • Dr. C Hoogendoorn (Italy, Bioversity Deputy Director General) • Dr. P Batugal (Malaysia, Bioversity COGENT Coordinator)
13th COGENT Steering Committee Meeting 22 - 24 November 2004 Kuala Lumpur, Malaysia (Supported by funds from Bioversity, The Trust and CFC)	**SC Members:** • Dr. S Arulraj (India, ICG-SA Representative) • Dr. D Allorerung (Indonesia, ICG-SEA Representative) • Mr. T Sitapai (Papua New Guinea, ICG-SP Representative) • Dr. M Ballo Koffi (Cote d' Ivoire, ICG-AIO Representative) • Dr. E Tupinamba (Brazil, ICG-LAC Representative) • Mr. C Carpio (Philippines, SEA Regional Representative) • Dr. C Oropeza (Mexico, LAC Regional Representative) • Dr. C Jayasekara (Sri Lanka, SA Regional Representative) • Dr. L Guarino (Fiji, SP Regional Representative) • Dr. A Kullaya (Tanzania, AIO Regional Representative) • Dr. P Rethinam (APCC, Executive Director) • Dr. P Batugal (Bioversity/COGENT, Coordinator)

Events	Participants
	Other attendees : • Dr. H Novarianto (Indonesia, ICG-SEA Leader) • Dr. M Faure (Papua New Guinea, ICG-SP Leader) • Dr. J Louis Konan (Cote d'Ivoire, ICG-AIO Leader) • Mr. A Sanoussi (Benin, CFC project leader) • Mr. B Been (Jamaica, CFC Project Leader) • Mr. R Castillo (Mexico, CFC Project Leader) • Dr. R Bourdeix (France, CIRAD Geneticist) • Dr. H Omont (France, CIRAD representative) • Mr. J Piña (Mexico, INIFAP Director) • Mr. A Peters (Samoa, Asst CEO Crop Division, Min Agric) • Ms. E Manohar (Philippines, Entomologist) • Dr. M Anishetty (India, FAO Retired Senior Officer) • Dr. P Sajise (Malaysia, Bioversity APO Regional Director) • Dr. R Rao (Malaysia, Bioversity Scientist)
14th COGENT Steering Committee Meeting 28 Nov – 1 Dec 2005 Kasaragod, Kerala, India (Supported by funds from Bioversity)	**SC Members:** • Dr. V Rajagopal (India, ICG-SA Representative) • Dr. D Alleurung (Indonesia, ICG-SEA Representative) • Mr. T Ovasuru (PNG, ICG-SP Representative) • Dr. J Louis Konan (Cote d'Ivoire, ICG-AIO Representative) • Dr. A Cardoso (Brazil, ICG-LAC Representative) • Dr. C Jayasekara (Sri Lanka, SA Regional Representative) • Mr. C Carpio (Philippines, SEA Regional Representative) • Dr. L Guarino (Fiji, SP Regional Representative) • Dr. A Kullaya (Tanzania, AIO Regional Representative) • Dr. C Oropeza (Mexico, LAC Regional Representative) • Dr. P Rethinam (Malaysia, APCC Executive Director) • Dr. P Batugal (Malaysia, Bioversity COGENT Coordinator) **Other attendees :** • Dr. R Bourdeix (France, CIRAD Geneticist) • Dr. M Dollet (France, CIRAD Scientist) • Dr. R Markham (France, Director. Bioversity Commodities for Livelihoods Programme)
ICG Curators and SC Meeting 10 – 13 Dec 2007 Los Baños, Laguna, Philippines (Supported by funds from Bioversity)	**SC Members:** • Dr. C Jayasekara (Sri Lanka, ICG-SA Representative and Vice Chairman, SC) • Dr. C Carpio (Philippines, ICG-SEA Representative) • Dr. G Thomas (India, ICG-SA Representative) **Genebank Curators:** • Mr. M Faure (Papua New Guinea, ICG-SP Curator) • Dr. J L Konan (Cote d'Ivoire, ICG-AIO Curator) • Dr. E Tupinamba (Brazil, ICG-LAC Curator) • Dr. H Novarianto (Indonesia, ICG-SEA Curator) • Mr. R Rivera (Philippines) **Other attendees :** • Dr. R Bourdeix (France, CIRAD Geneticist) • Dr. E Rillo (Philippines, Tissue Culture Expert) • Dr. L Guarino (GCDT Representative) • Mr. R Arancon (APCC Executive Director) • Dr. P Batugal (Philippines, ex-COGENT Coordinator) • Dr. R Markham (France, Director, Bioversity Commodities for Livelihoods Program) • Dr. M L George (Malaysia, COGENT Coordinator)

Annex 2. Status of germplasm conservation in the International Coconut Genebank

ICG-South Asia

Updated, December 2007 by Dr. Niral

No	Cultivar name	Code	Source	No of palms	Year planted
1	Agailjhara Tall	AGIT	Bangladesh	9	2004
2	Andaman Giant Tall	AGT	India	78	2001
3	Andaman Ordinary Tall	ADOT	India	73	1998
4	Andaman Ranguchan Tall	ART	India	68	2001
5	Ayiramkachi Tall	AYRT	India	72	2001
6	Bagharpara Tall		Bangladesh	13	2004
7	BARI Narikel-I		Bangladesh	22	2004
8	BARI Narikel-II		Bangladesh	35	2004
9	Benaulim Tall	BENT	India	82	1998
10	Blanchisseuse Tall	BLIT	India	79	2001
11	Borneo Tall	BONT	India	81	1999
12	British Solomon Islands Tall	BSIT	India	43	2001
13	Calangute Tall	CALT	India	58	2001
14	Cameroon Red Dwarf	CRD	India	82	2001
15	Chinashukania Red Dwarf	CHRD	Bangladesh	1	2004
16	Chinashukania Tall	CHNT	Bangladesh	17	2004
17	Chowghat Green Dwarf	CGD	India	68	2001
18	Cochin China Tall	CCNT	India	67	2001
19	Coco Bleu Tall	CBLT	Seychelles	13	1999
20	Coco Fesse Tall		Reunion	2	1999
21	Coco LeHaut Tall	CLHT	Seychelles	1	1999
22	Coco LeRein Tall	CLRT	Seychelles	1	1999
23	Coco Raisin Tall	CAST	Seychelles	2	1999
24	Comoros Tall	CHT	Comoros	2	2004
25	Comoros Tall Brown	CHT	Comoros	5	2004
26	Comoros Tall Green	CHT	Comoros	6	2004
27	Comoros Tall Madagascar	CHT	Madagascar	8	2004
28	Comoros Tall Red	CHT	Comoros	7	2004
29	Comoros Yellow Dwarf		Comoros	9	2004
30	De La Reunion Tall		Reunion	5	1999
31	East African Tall Kenya	EAT32	India	65	2001
32	East African Tall Zanzibar	EAT33	India	82	1998
33	Gonthembili Tall	GTBT	Sri Lanka	10	2004
34	Guelle Rose Tall	GRT	Mauritius	9	1999
35	Hanimaadhoo Tall Green		Maldives	5	2004
36	Hanimaadhoo Tall Medium Round		Maldives	3	2004
37	Hanimaadhoo Tall Oblong Semi		Maldives	8	2004
38	Hanimaadhoo Tall Yellow		Maldives	2	2004

ICG-South Asia

Updated, December 2007 by Dr. Niral

No	Cultivar name	Code	Source	No of palms	Year planted
39	Indian East Coast Tall	ECT	India	85	2001
40	Indian West Coast Tall Spicata	WCT01	India	54	2001
41	Java Tall	JVT	India	78	2001
42	Kaadedhdhoo Tall Oblong		Maldives	5	2004
43	Kaadedhdhoo Tall Yellowish Green		Maldives	4	2004
44	Kappadam Tall	KPDT	India	86	2001
45	Kayemkola Tall	KAKT	Bangladesh	19	2004
46	Khairtala Tall	KHT	Bangladesh	12	2004
47	King Coconut	RTB	India	82	2001
48	King Kumbra Tall		Maldives	7	2004
49	Laccadive Micro Tall	LMT	India	83	1998
50	Lifou Tall	LFT	India	60	2001
51	Macapuno Tall Coco Gra	MCT03	Seychelles	1	1999
52	Malayan Green Dwarf	MGD	India	50	2001
53	Malayan Red Dwarf	MRD	India	30	2001
54	Malayan Red Dwarf Kulasekharam	MRD01	India	34	2001
55	Malayan SS Apricot Tall	SSAT	India	82	2001
56	Malayan SS Green Tall	SSGT	India	69	2001
57	Malayan Tall FMS	MLT01	India	85	1998
58	Malayan Yellow Dwarf	MYD	India	76	1998
59	Malayan Yellow Dwarf Kulasekharam	MYD01	India	34	1999
60	Malayan Green Dwarf Kulasekharam	MGD02	India	37	2001
61	Nadora Tall		India	55	2001
62	Nicobar Tall Auck Chung	NICT06	India	40	2002
63	Nicobar Tall Campbell Bay	NICT01	India	11	2004
64	Nicobar Tall Car	CART	India	59	2001
65	Nicobar Tall Katchal	NICT02	India	75	2004
66	Nicobar Tall Kimios	NICTO4	India	42	2004
67	Nicobar Tall Kimmai	NICT03	India	32	2002
68	Nicobar Tall Tamaloo	NICT05	India	39	2002
69	Panama Tall Jamaica	PNT03	India	90	1999
70	Pemba Green Dwarf	PEGD	Mauritius	2	1999
71	Pemba Red Dwarf Mauritius	PRD03	Mauritius	2	1999
72	Pemba Red Tall	PERT	Mauritius	2	1999
73	Philippines Lono Tall	NDRT	India	66	2001
74	Philippines Ordinary Tall	PLNT	India	88	1998
75	Pubail Tall		Bangladesh	6	2004

ICG-South Asia

Updated, December 2007 by Dr. Niral

No	Cultivar name	Code	Source	No of palms	Year planted
76	Rupdia Tall		Bangladesh	30	2004
77	Sambava Tall	SHBT	Madagascar	4	2004
78	Sambava Tall Green	SHBT01	Madagascar	7	2004
79	San Ramon Tall	SNRT	India	86	2001
80	Sri Lanka Green Dwarf	PGD	Sri Lanka	12	2004
81	Sri Lanka Red Dwarf	SLRD	Sri Lanka	26	2004
82	Sri Lanka Tall	SLT	India	45	2001
83	Sri Lanka Yellow Dwarf	CYD	Sri Lanka	18	2004
84	St. Vincent Tall	STVT	India	79	2001
85	Standard Kudat Tall	STKT	India	38	2001
86	Tiptur Tall	TPT	India	67	1998
87	Uzirpur Tall		Bangladesh	11	2004
88	West African Tall	WAT	India	56	1999
89	West African Tall Madagascar	WAT08	Madagascar	3	2004
90	West Coast Tall	WCT	India	90	1998

ICG-Southeast/East Asia

Updated, November 2007 by Dr. Hengky Novarianto

No	Cultivar name	Code	Source	No of palms	Year planted
1	Bali Tall**	BAT	Mapanget, Indonesia	90	2006
2	Bali Yellow Dwarf*	BAYD	Mapanget, Indonesia	9	2000
3	Bali Yellow Dwarf**	BAYD	Mapanget, Indonesia	90	2006
4	Banyuwangi Tall*		East Java, Indonesia	55	2004
5	Bitunuris Tall*		North Sulawesi, Indonesia	10	2001
6	Bloro Tall*		East Nusa Tenggara, Indonesia	10	2004
7	Boeara Tall*		Southeast Sulawesi, Indonesia	76	2004
8	Dobo Tall*		Southeast Maluku, Indonesia	95	2006
9	Kapal Dwarf*		North Sulawesi, Indonesia	1	2001
10	Kolono Tall*		Southeast Sulawesi, Indonesia	5	2004
11	Koting B Tall*		East Nusa Tenggara, Indonesia	10	2004
12	Kramat Red Tall*		North Sulawesi, Indonesia	52	2007
13	Kramat Tall*		North Sulawesi, Indonesia	100	2007
14	Malayan Green Dwarf*	MGD	Malaysia	6	2007
15	Malayan Tall*	MLT	Malaysia	2	2007
16	Mapanget Tall**	MPT	Mapanget, Indonesia	90	2006
17	Matanggonawe Tall*		Southeast Sulawesi, Indonesia	52	2004
18	Melongoane Tall*		North Sulawesi, Indonesia	35	2000
19	Molumbulahe Tall*		North Sulawesi, Indonesia	80	2007
20	Nias Yellow Dwarf*	NYD	Mapanget, Indonesia	60	2000
21	Nias Yellow Dwarf**	NYD	Mapanget, Indonesia	90	2006
22	Palapi Tall*		North Sulawesi, Indonesia	1	2001
23	Palu Tall**	PUT	Mapanget, Indonesia	90	2006
24	Papua Tall Biak**	PPT03	Papua, Indonesia	90	2007
25	Papua Tall Merauke**	PPT01	Papua, Indonesia	90	2007
26	Papua Tall Sarmi**	PPT02	Papua, Indonesia	90	2007
27	Raja Brown Dwarf*	RBD	Mapanget, Indonesia	53	2000
28	Raja Brown Dwarf**	RBD	Mapanget, Indonesia	90	2006
29	Rarumis Tall*		North Sulawesi, Indonesia	19	2001
30	Salak Green Dwarf*	SKD	Mapanget, Indonesia	43	2001
31	Salak Green Dwarf**	SKD	Kima Atas, Indonesia	90	2006
32	Santombalang Tall*		North Sulawesi, Indonesia	48	2000
33	Sawarna Tall**	SAT	Mapanget, Indonesia	90	2006
34	Solo Tall*		Central Sulawesi, Indonesia	2	2001
35	Sumenep I Tall*		East Java, Indonesia	36	2004

ICG-Southeast/East Asia

Updated, November 2007 by Dr. Hengky Novarianto

No	Cultivar name	Code	Source	No of palms	Year planted
36	Sumenep II Tall*		East Java, Indonesia	40	2004
37	Tebing Tinggi Dwarf**	TTD	Mapanget, Indonesia	90	2006
38	Tehele Tall*		North Sulawesi, Indonesia	85	2007
39	Tenga Tall**	TGT	Mapanget, Indonesia	90	2006
40	Tilang Tall*		East Nusa Tenggara, Indonesia	5	2004
41	West Papua Tall Manokwari**	WPT01	Papua, Indonesia	90	2007
42	West Papua Tall Sorong**	WPT02	Papua, Indonesia	90	2007

* Located in Paniki
** Located in Pandu

ICG-South Pacific

Updated, December 2007 by Dr. Mathias Faure

No	Cultivar name	Code	Source	No of palms	Year planted
1	Ajoa Tall	OLT2	PNG	75	1994
2	Baibara Tall	BBR	PNG	73	1994
3	Baluan Tall	MLT3	PNG	75	1994
4	Bougainville Tall	BLT	PNG	21	2002
5	Boze Tall	KWT2	PNG	79	1994
6	Bubuletta Tall	MBT4	PNG	34	1995
7	Cook Island Tall	COKT	Cook Islands	1	2005
8	East Sepik Tall Vokio	ELT04	PNG	105	1995
9	East Sepik Tall Yangoru	ELT03	PNG	86	1995
10	Etalata Tall	ETT	PNG	77	1995
11	Garuk Tall	GUKT	PNG	38	2004
12	Gaungo Tall	WLT1	PNG	76	1994
13	Guanaga Tall	KKT1	PNG	90	1995
14	Hawain Tall	ELT02	PNG	78	1995
15	Hisihu Tall	HLT	PNG	78	1995
16	Ikoea Red Dwarf	IRD	PNG	36	1995
17	Iokea Tall	VLT3	PNG	76	1994
18	Karkar Tall Ulatava	KKT03	PNG	88	1994
19	Karu Tall	NLT1	PNG	77	1994
20	Keakea Tall	VLT2	PNG	75	1994
21	Kenapit Tall	NLT2	PNG	77	1994
22	Kenim Tall	KKT2	PNG	74	1995
23	Kikibator Tall	OLT3	PNG	74	1994
24	Lako Tall	MLT2	PNG	79	1994
25	Lamur Tall	LMT	PNG	24	2002
26	Lawes Tall	MLT1	PNG	77	1994
27	Liara Tall	MVT2	PNG	80	1995
28	Madang Brown Dwarf	MBD	PNG	83	1994
29	Malayan Red Dwarf	MRD	PNG	81	1994
30	Malayan Yellow Dwarf	MYD	PNG	83	1994
31	Markham Farm Tall	MVT1	PNG	96	1995
32	Marshall Island Tall	MITA	Marshall Islands	2	2005
33	Miha Kavava Tall	VLT1	PNG	75	1994
34	Natava Many Fruited Tall	GMT5	PNG	69	1995
35	Natava Tall	GLT3	PNG	80	1994
36	Naviro Tall	WLT2	PNG	77	1994
37	New Massava Tall	GLT4	PNG	80	1994
38	Nias Green Dwarf	NGD	PNG	65	1995
39	Nias Red Dwarf	NRD	PNG	62	1995

ICG-South Pacific

Updated, December 2007 by Dr. Mathias Faure

No	Cultivar name	Code	Source	No of palms	Year planted
40	Nias Yellow Dwarf	NYD	PNG	66	1994
41	Pellavarua Tall	GLT1	PNG	78	1994
42	PNG Red Dwarf 1	PRD01	PNG	81	1994
43	PNG Red Dwarf 2	PRD02	PNG	85	1994
44	PNG Yellow Dwarf	PYD	PNG	38	1995
45	Poligolo Tall	PLT	PNG	81	1994
46	Rabaul Red Dwarf	RARD	PNG	81	1994
47	Raulawat Tall	GLT2	PNG	79	1994
48	Rennell Island Tall	RIT	PNG	77	1994
49	Saiho Tall	OLT1	PNG	81	1994
50	Severimabu Tall	KWT1	PNG	72	1994
51	Siagara Tall	MBT3	PNG	35	1995
52	Sohu Tall	NLT3	PNG	78	1996
53	Spicata Brown Dwarf	SBD	PNG	20	2004
54	Spicata Red Dwarf	SRD	PNG	21	2004
55	Spicata Yellow Dwarf	SYD	PNG	25	2004
56	Talasia Tall	TRT	PNG	47	1995
57	Tuvalu Island Tall	TUV01	Tuvalu Islands	1	2005
58	Tuvalu Island Tall	TUV06	Tuvalu Islands	1	2005
59	Wutung Tall	SLT2	PNG	74	1995

PNG, Papua New Guinea

ICG-Africa/Indian Ocean

Updated, December 2007 by Dr. Jean Louis Konan

No	Cultivar name	Code	Source	No of palms	Year planted
1	**Andaman Giant Tall**	**AGT**	**India**	**16**	**1968**
2	Andaman Giant Tall	AGT	Cote d'Ivoire	113	1982
3	**Andaman Ordinary Tall**	**ADOT1**	**India**	**20**	**1968**
4	Andaman Ordinary Tall	ADOT2	Cote d'Ivoire	147	1982
5	**Aromatic Green Dwarf**	**AGD7**	**Philippines**	**14**	**1980**
6	Baybay Tall	BAYT	Philippines	97	1982
7	**Brazil Green Dwarf**	**BGD**	**Station Fomento Agricola**	**217**	**1966**
8	Cambodia Tall Koh Rong	KAT10	Cambodia	167	1970
9	Cambodia Tall Koh Rong		Cote d'Ivoire	37	1988
10	Cambodia Tall Battambang	KAT09	Cambodia	173	1970
11	Cambodia Tall Battambang		Cote d'Ivoire	31	1988
12	**Cambodia Tall Kampot**	**KAT03**	**Cambodia**	**13**	**1967**
13	**Cambodia Tall Kompong Trach**	**KAT05**	**Cambodia**	**4**	**1967**
14	Cambodia Tall Kompong Trach		Cote d'Ivoire	20	1995
15	**Cambodia Tall Kopal Tani**	**KAT04**	**Cambodia**	**6**	**1967**
16	Cambodia Tall Kopal Tani		Cote d'Ivoire	8	1995
17	Cambodia Tall Ktis Battambang		Cambodia	19	1971
18	Cambodia Tall Ream	KAT07	Cambodia	196	1970
19	Cambodia Tall Ream		Cote d'Ivoire	39	1988
20	Cambodia Tall Sre Cham	KAT08	Cambodia	123	1970
21	Cambodia Tall Sre Cham		Cote d'Ivoire	35	1988
22	**Cambodia Tall Tuk Sap**	**KAT02**	**Cambodia**	**30**	**1967**
23	**Cambodian Green Dwarf**	**CGD**	**Cambodia**	**131**	**1970**
24	**Cameroon Kribi Tall**	**CKT01**	**Cameroon**	**98**	**1952**
25	Cameroon Kribi Tall	CKT02	Cote d'Ivoire	149	1982
26	**Cameroon Red Dwarf**	**CRD01**	**Cameroon**	**121**	**1956**
27	**Cameroon Red Dwarf**	**CRD02**	**Cote d'Ivoire**	**207**	**1981**
28	Cameroon Red Dwarf	CRD03	Cote d'Ivoire	239	1981
29	**Catigan Green Dwarf**	**CATD**	**Philippines**	**70**	**1981**
30	**Comoro Moheli Tall**	**CMT**	**Moheli Plantation STD**	**359**	**1972**
31	**Brazil Green Dwarf**	**BGD**	**Fraguirre y Compania S.A.**	**26**	**1959**
32	**Brazil Green Dwarf**	**BGD**	**Cote d'Ivoire**	**126**	**1981**
33	Brazil Green Dwarf	BGD	Cote d'Ivoire	138	1981
34	**Gazelle Peninsula Tall**	**GPT**	**Papua New Guinea**	**148**	**1981**
35	**Malayan Yellow Dwarf**	**MYD**	**Ivory Coast**	**98**	**1955**
36	Malayan Yellow Dwarf	MYD	Cote d'Ivoire	63	1981
	Malayan Yellow Dwarf	MYD	Cote d'Ivoire	147	1982
37	Malayan Yellow Dwarf	MYD	Cote d'Ivoire	52	1981
	Malayan Yellow Dwarf	MYD	Cote d'Ivoire	148	1982

ICG-Africa/Indian Ocean

Updated, December 2007 by Dr. Jean Louis Konan

No	Cultivar name	Code	Source	No of palms	Year planted
	Malayan Yellow Dwarf	MYD	Cote d'Ivoire	27	1983
38	**Kappadam Tall**	**KPDT01**	**India**	**8**	**1968**
39	Kappadam Tall	KPDT02	Cote d'Ivoire	96	1982
40	**Karkar Tall**	**KKT01**	**Papua New Guinea**	**59**	**1975**
41	Karkar Tall	KKT02	Papua New Guinea	40	1984
42	Kinabalan Green Dwarf	KIND	Philippines	59	1982
43	**Laccadive Micro Tall**	**LMT**	**India**	**121**	**1979**
44	**Laccadive Ordinary Tall**	**LCT**	**India**	**147**	**1978**
45	**Madang Brown Dwarf**	**MBD**	**Papua New Guinea**	**72**	**1979**
46	**Malayan Green Dwarf**	**MGD01**	**Malaysia**	**28**	**1959**
47	Malayan Green Dwarf	MGD02	Cote d'Ivoire	110	1983
	Malayan Green Dwarf	MGD02	Cote d'Ivoire	78	1983
48	**Malayan Red Dwarf**	**MRD01**	**Malaysia**	**31**	**1959**
49	Malayan Red Dwarf	MRD02	Cote d'Ivoire	40	1981
	Malayan Red Dwarf	MRD02	Cote d'Ivoire	108	1982
	Malayan Red Dwarf	MRD02	Cote d'Ivoire	5	1983
50	**Malayan Red Dwarf**	**MRD03**	**Cote d'Ivoire**	**87**	**1981**
	Malayan Red Dwarf	**MRD03**	**Cote d'Ivoire**	**117**	**1982**
	Malayan Red Dwarf	**MRD03**	**Cote d'Ivoire**	**23**	**1983**
51	**Malayan Tall**	**MLT01**	**Malaysia**	**129**	**1961**
52	Malayan Tall	MLT02	Cote d'Ivoire	138	1982
53	**Malayan Yellow Dwarf**	**MYD01**	**Malaysia**	**52**	**1960**
54	Malayan Yellow Dwarf	MYD02	Cote d'Ivoire	6	1981
	Malayan Yellow Dwarf	MYD02	Cote d'Ivoire	166	1982
55	Malayan Yellow Dwarf	MYD03	Cote d'Ivoire	39	1981
	Malayan Yellow Dwarf	MYD03	Cote d'Ivoire	162	1982
	Malayan Yellow Dwarf	MYD03	Cote d'Ivoire	20	1983
56	**Markham Valley Tall**	**MVT**	**Papua New Guinea**	**85**	**1982**
57	**Mozambique Tall**	**MZT01**	**Mozambique**	**223**	**1970**
58	Mozambique Tall	MZT02	Cote d'Ivoire	149	1981
59	**Niu Leka Dwarf**	**NLAD01**	**Koronivia Research Stat.**	**31**	**1967**
60	**Niu Leka Dwarf**	**NLAD02**	**Cote d'Ivoire**	**222**	**1978**
61	**Palu Tall**	**PUT**	**Multi Agro Corporation**	**149**	**1984**
62	**Panama Tall Aguadulce**	**PNT01**	**Panama**	**147**	**1980**
63	**Panama Tall Monagre**	**PNT02**	**Panama**	**148**	**1980**
64	**Pilipog Green Dwarf**	**PILD**	**Philippines**	**48**	**1982**
65	Rangiroa Tall	RGT01	French Polynesia	31	1962
66	**Rangiroa Tall**	**RGT02**	**French Polynesia**	**122**	**1969**
	Rangiroa Tall	RGT02	French Polynesia	44	1988
67	Rangiroa Tall	RGT03	Cote d'Ivoire	44	1988

ICG-Africa/Indian Ocean

Updated, December 2007 by Dr. Jean Louis Konan

No	Cultivar name	Code	Source	No of palms	Year planted
68	Rennell Island Tall	RIT01	Solomon	443	1968
69	Rennell Island Tall	RIT02	Cote d'Ivoire	142	1988
70	Rotuman Tall	RTMT	Fiji	73	1970
71	Solomon Island Tall	SIT01	Solomon	389	1968
72	**Solomon Island Tall**	**SIT02**	**Cote d'Ivoire**	**138**	**1988**
73	**Sri Lanka Green Dwarf**	**PGD**	**Sri Lanka**	**37**	**1972**
74	Sri Lanka Green Dwarf		Sri Lanka	141	1978
75	Sri Lanka Tall Ambakelle	SLT02	Sri Lanka	266	1972
76	Tacunan Green Dwarf	TACD	Philippines	59	1982
77	Tagnanan Tall	TAGT01	Philippines	336	1974
78	Tagnanan Tall	TAGT02	Philippines	395	1978
79	**Tahitian Red Dwarf**	**TRD**	**French Polynesia**	**79**	**1978**
80	Tahitian Tall	TAT01	French Polynesia	269	1959
81	**Tahitian Tall**	**TAT02**	**French Polynesia**	**123**	**1969**
82	Tahitian Tall	TAT03	Cote d'Ivoire	145	1988
83	**Takome Tall**	**TKT**	**Indonesia**	**48**	**1981**
84	**Tenga Tall**	**TGT**	**Indonesia**	**137**	**1984**
85	**Ternate Brown Dwarf**	**TBD**	**Indonesia**	**84**	**1984**
86	Thailand Green Dwarf	THD	Thailand	143	1978
87	Thailand Tall Ko Samui	THT04	Thailand	113	1968
88	Thailand Tall Ko Samui		Cote d'Ivoire	142	1988
89	Thailand Tall Sawi	THT01	Thailand	388	1967
90	Thailand Tall Sawi		Cote d'Ivoire	143	1988
91	Tonga Tall	TONT	Tonga	98	1970
92	Vanuatu Tall	VTT	Vanuatu	442	1970
93	**West African Tall Akabo**	**WAT03**	**Bénin**	**685**	**1952**
94	West African Tall Akabo		Cote d'Ivoire	149	1982
95	**West African Tall Benin**	**WAT02**	**Bénin**	**195**	**1952**
96	**West African Tall Mensah**	**WAT04**	**Bénin**	**601**	**1954**
97	**West African Tall Mensah**		**Cote d'Ivoire**	**139**	**1982**
98	**West African Tall Ouidah**	**WAT06**	**Bénin**	**67**	**1954**
99	West African Tall Ouidah		Cote d'Ivoire	148	1982

Note: Accessions in bold are being regenerated with funds from the Trust

ICG-Latin America/Caribbean

Updated, November 2007 by Dr. Evandro Almeida Tupinamba

No	Cultivar name	Code	Source	No of palms	Year planted
1	Brazil Green Dwarf Jiqui**	BGD1	Rio Grande do Norte, Brazil	350	1984
	Brazil Green Dwarf Jiqui**	BGD1	Rio Grande do Norte, Brazil	141	2003
2	Brazil Green Dwarf Sousa**	BGD2	Paraiba, Brazil	137	2005
3	Brazil Red Dwarf Gramame**	BRD2	Paraiba, Brazil	150	1984
	Brazil Red Dwarf Gramame**	BRD2	Paraiba, Brazil	98	2003
4	Brazil Yellow Dwarf Gramame**	BYD3	Paraiba, Brazil	150	1984
	Brazil Yellow Dwarf Gramame**	BYD3	Paraiba, Brazil	106	2003
5	Brazilian Tall Baia Formosa	BRT08	Rio Grande do Norte, Brazil	21	2005
6	Brazilian Tall Barreirinhas	BRT04	Maranhao, Brazil	65	2005
7	Brazilian Tall Luis Correia	BRT07	Piaui, Brazil	40	2005
8	Brazilian Tall Merepe	BRT09	Pernambuco, Brazil	120	2002
9	Brazilian Tall Olho de Cravo	BRT02	Sergipe, Brazil	10	2005
10	Brazilian Tall Pacatuba	BRT10	Sergipe, Brazil	110	2002
11	Brazilian Tall Praia do Forte	BRT01	Bahia, Brazil	400	1985
	Brazilian Tall Praia do Forte	BRT01	Bahia, Brazil	158	2000
12	Brazilian Tall Santa Rita	BRT05	Pernambuco, Brazil	60	2005
13	Brazilian Tall São José do Mipubu	BRT06	Rio Grande do Norte, Brazil	43	2005
14	Brazilian Tall Senador Georgino Vaelino	BRT03	Rio Grande do Norte, Brazil	12	2005
15	Cameroon Red Dwarf	CRD	Cameroon	110	1984
	Cameroon Red Dwarf	CRD	Cameroon	115	1983
16	Malayan Red Dwarf	MRD	Malaysia	110	1984
	Malayan Red Dwarf	MRD	Malaysia	61	1983
17	Malayan Tall	MLT	Malaysia	96	1985
18	Malayan Yellow Dwarf	MYD	Malaysia	110	1984
	Malayan Yellow Dwarf	MYD	Malaysia	97	1983
19	Rennell Island Tall	RIT	Rennell	96	1985
20	Rotuman Tall		Rotuman	96	1985
21	Tahitian Tall		Polynesia	96	1985
22	Tonga Tall		Tonga	96	1985
23	Vanuatu Tall	VTT	Vanuatu	96	1985
24	West African Tall		Cote d'Ivoire	140	1985

* To be replanted in Itaporanga
** Replanted in Itaporanga in 2003
*** To be obtained from Cote d'Ivoire

Annex 3. List of countries involved in the collaborative work to refine tissue culture techniques for coconut

PARTNER	TITLE	DURATION
1. BANGLADESH Bangladesh Agricultural Research Institute	• Adoption of COGENT Upgraded Coconut Embryo Culture Protocol in BARI	• Mar 2001 - Oct 2002
2. CUBA Instituto de Investigaciones de Citricos y Otros Frutales	• Increasing the Efficiency of Embryo Culture Technology to Promote Germplasm Collection	• Sep 1998 - Feb 2000
3. INDIA Central Plantation Crops Research Institute	• Increasing the Efficiency of Embryo Culture to Promote Germplasm Collection • Introduction of Coconut Germplasm from COGENT Member Countries into the International Coconut Genebank for South Asia • Introduction of Coconut Germplasm from Cogent Member Countries into the International Coconut Genebank for South Asia	• Jul 1998 - Feb 2000 • Feb 2001 - Oct 2002 • Feb 2001 - Oct 2002
4. INDONESIA Research Institute for Coconut and Palmae	• Coconut Embryo Culture Research to Develop Effective Technology for the Production of Coconut Seedlings from the High-Value Soft-Endosperm Coconut Variety "Kopyor" • Introduction ff Coconut Germplasm from COGENT Member Countries into the International Coconut Genebank for Southeast And East Asia • Increasing the Efficiency of Embryo Culture Technology to Promote Germplasm Collection, Conservation and Exchange	• Feb 2001 - Oct 2002 • Feb 2001 - Oct 2002 • May 1998 - Feb 2000
5. MEXICO Centro de Investigacion Cientifica de Yucatan	• Improvement of Embryo Culture Efficiency for the Safe Movement of Coconut Germplasm • Utilization of Embryo Culture Technology for Germplasm Conservations: Development of Medium Term Conservation for Coconut Zygotic Embryos	• May 1998 - Feb 2000 • May 1998 - Feb 2000
6. MALAYSIA Malaysian Agricultural Research and Development Institute	• To Validate the COGENT Upgraded Coconut Embryo Culture Protocol on 3 Local Malaysian Coconut Varieties	• Apr 2001 - Oct 2002 •
7. PHILIPPINES Philippine Coconut Authority	• Development of an Improved Embyro Culture Protocol for Coconut • Coconut Embryo Culture Research to Develop Effective Technology for the Production of Coconut Seedlings from the High-Value Soft-Endosperm Coconut Variety "Lono" • Mass Production of Dwarf X Makapuno F1 Hybrids and Establishment of Regional Makapuno Seed Farms	• May 1998 - Feb 2000 • Feb 2001 - Oct 2002 • Feb 2001 - Oct 2003

PARTNER	TITLE	DURATION
Visayan State College of Agriculture	• Assessment of *In Vitro* Growth Performance of Embryos of 3 Different Coconut Types using the COGENT Upgraded Coconut Embryo Culture Protocol	• Mar 2001 - Oct 2002
University of the Philippines Institute of Plant Breeding	• Improvement of Coconut Embryo Culture Efficiency for Germplasm Collection And Conservation	• May 1998 - Feb 2000
8. PAPUA NEW GUINEA Cocoa and Coconut Research. Institute	• Increasing the Efficiency of Coconut Embryo Culture Rescue to Facilitate Collecting and the Safe Movement of Germplasm • Introduction of Coconut Germplasm from COGENT Member Countries into the International Coconut Genebank for South Pacific	• Nov 1998 - Feb 2000 • Feb 2001-Oct 2002
9. SRI LANKA Coconut Research Institute	• Increasing the Efficiency of Embryo Culture Technology to Promote Germplasm Collection and Exchange • Coconut Embryo Culture Research to Develop Effective Technology for the Production of Coconut Seedlings from the High-Value Soft-Endosperm Coconut Variety "Dikiri Pol"	• May 1998 - Feb 2000 • Feb 2001 - Oct 2002
10. TANZANIA Mikocheni Agricultural Research Institute	• Increasing the Efficiency of *In Vitro* Culture of Zygotic Coconut Embryos to Promote Germplasm Collection	• Jun 1998 - Feb 2000
11. THAILAND Department of Agriculture	• Application Of COGENT Upgraded Coconut Embryo Culture Protocol using 3 Thai Coconut Varieties	• Mar 2001 – Oct 2002
12. VIETNAM Oil Plant Institute	• Validating the COGENT Upgraded Coconut Embryo Culture Protocol using Vietnam Coconut Varieties	• Mar 2001 - Oct 2002