Upgrading international coconut genebanks and evaluating accessions

Terminal Report

(01/11/2011 – 30/05/2012)

Photo by R. Bourdeix at the International Coconut Genebank for Africa and Indian Ocean, Marc Delorme Research Station, Côte d'Ivoire

Submitted to the Global Crop Diversity Trust

by

Bioversity International

Authors:
R. Bourdeix, M. Ruas, C. Hamelin, V. Johnson, D. Martinez and R. Sepulveda

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Contents

Final Technical and Financial Report

1. Technical Report

A. Project Details

Project title: Upgrading international coconut genebanks and evaluating accessions	
Trust grant no: GS12006	**Project reference no:** GSP11GAT1_3.2_01
Project starting date: 01 October 2011	**Project end date:** 31 March 2012
Report due date and type: 31 March 2012 – Final Technical and Financial Report	
Period covered by this report: 01/10/11 – 30/04/12	
Implementing Institution:	Bioversity International
Principal investigator:	Roland Bourdeix
Position:	Coordinator, International Coconut Genetic Resources Network (COGENT) CIRAD-BIOS UMR CEFE Bioversity HRF
Address:	Bioversity International Via dei Tre Denari, 472a 00057 Maccarese (Rome) ITALY
Telephone:	(39) 066118.1
Fax:	(39) 0661979661
Email:	r.bourdeix@cgiar.org

B. Executive summary

The project “Upgrading international coconut genebanks and evaluating accessions”, was funded by the global Crop Diversity Trust and implemented by Bioversity International. *Ex situ* coconut conservation is facing an emergency 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. It becomes increasingly dangerous and costly to make the controlled pollinations requested for their regeneration. 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. There is a huge need of capacity building. A large project should be launched to safeguard this germplasm. As written guidelines for controlled pollination proved to be insufficient, video guidelines are more likely to provide effective guidance. The process for updating the global conservation strategy was initiated. One of the main concerns is the selecting best combination of conservation approaches. Databases, comprehensive lists of germplasm, and guidelines regarding coconut nomenclature where made available on line on the COGENT website.

c. *Key collaborating Institutions*

1. Collaborating Institution:	Central Plantation Crops Research Institute
Principal investigator:	V. Niral
Title:	Dr
Address:	Kasaragod, 671124, Kerala India
Telephone:	914994-221199
Fax:	
Email:	niralv@yahoo.com
2. Collaborating Institution:	Zamboanga Research Centre (ZRC) of the Philippine Coconut Authority (PCA)
Principal investigator:	Ramon Rivera
Title:	Dr
Address:	San Ramon, 700 Zamboanga City PHILIPPINES
Telephone:	
Fax:	
Email:	rlrivera_pca@yahoo.com.ph
3. Collaborating Institution:	Coconut Research Institute (CRI)
Principal investigator:	Lalith Perera
Title:	Dr
Address:	Bandirippuwa Estate, Lunuwila 61150 SRI LANKA
Telephone:	94 (31) 2255300 / 2255890
Fax:	94-31-2257391
Email:	director@cri.lk kanthaperera@yahoo.com
4. Collaborating Institution:	Coconut Research Programme Station Cocotier Marc Delorme of the Centre National De Recherche Agronomique (CNRA)
Principal investigator:	Jean Louis Konan
Title:	Dr
Address:	07 BP 13 Abidjan 07 COTE D'IVOIRE
Telephone:	225 05 174183 / 225 21 248872
Fax:	225 23 472411
Email:	jeanlouiskonan@yahoo.fr Konankonanjeanlouis@yahoo.fr
5. Collaborating Institution:	Malaysian Agricultural Research and Development Institute (MARDI)
Principal investigator:	Sariam Othman
Title:	Dr
Address:	P O Box 12301, General Post Office Kuala Lumpur 50774 Malaysia
Telephone:	+605 6489242
Fax:	
Email:	sariam@mardi.gov.my
6. Collaborating Institution:	Embrapa Tabuleiros Costeiros

Principal investigator:	Semíramis Rabelo Ramalho Ramos
Title:	Dr
Address:	Av. Beira Mar, 3250. Bairro Jardins. Aracaju - SE – Brazil
Telephone:	55 XX -79-4009-1332
Fax:	
Email:	semiramis@cpatc.embrapa.br
7. Collaborating Institution:	CIRAD
Principal investigator:	Chantal Hamelin
Title:	Dr
Address:	UMR AGAP Avenue Agropolis - TA A-108 / 03 (Bât. 3, Bur. 106) - 34398 Montpellier Cedex 5 France
Telephone:	+33 4 67 61 59 75
Fax:	+33 4 67 61 71 83
Email:	Chantal.hamelin@cirad.fr
Total budget requested from Trust:	US$ 35,000
Duration of the project:	01 October 2011 – 31 March 2012

D. *Project performance*

1. Brief narrative summary of achievements

The International Coconut Genetic Resources Network (COGENT) includes 39 country members. 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. The achievements of this project are:

1) To update and analyse the germplasm data from six major coconut genebanks, namely Brazil, Côte d'Ivoire, Indonesia, India, Malaysia and Sri Lanka and revitalize the network in order to obtain data from other country members. Databases, comprehensive lists of germplasm, and guidelines regarding coconut nomenclature where made available on line on the COGENT website.

2) To Improve the software "Coconut Genetic Resources Database" which is now presently downloadable from the COGENT Website;

3) To Make the germplasm data available online on the COGENT website and through the GENESYS portal (in process, will be achieved before the end of June 2012);

4) To design a standard procedure for assessing the quality and viability of accessions conserved in coconut genebanks;

5) To launch the process for updating the global coconut conservation strategy. The analysis shows that *Ex situ* coconut conservation is facing an emergency 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. It becomes increasingly dangerous and costly to make the controlled pollinations requested for their regeneration. 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. As written guidelines for controlled pollination proved to be insufficient, video guidelines are more likely to provide effective guidance. There is a huge need of capacity building. A large project should be launched to safeguard this germplasm. One of the main concerns is the selecting best combination of conservation approaches.

2. Main achievements of the project.

This project has significantly contributed to reviving COGENT. The first task was to contact the 39 COGENT country members and ask them to confirm or designate their official COGENT representative. We introduced a new organisational tool, and ask also the country members to designate an alternative COGENT representative in charge of technical tasks. The fact of getting two people involved in COGENT for each member-country is a 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.

The CGRD (coconut genetic resources) database was made available online on the COGENT website. Member-countries were asked to visit the COGENT website, to download the software update their data. ; Skype accounts were created to facilitate the communication between the COGENT secretariat and country representatives and 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.

The CGRD software is presently updated to fit with international standards, and especially the nomenclature aspects which were 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 to produce easily a list of coconut cultivars and not only lists of accessions and populations. We added two FAQ (frequently asked questions) to the COGENT website, one about the nomenclature and the other providing comprehensive lists of coconut accessions and cultivars.

The format for the Geo-referenced information was also made more precise. Dr Chantal Hamelin from CIRAD has released a new CGRD version. The software will be tested during 2 weeks. Then it will be made available on line with updated data before 15th June 2012.

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.

There are still some legal questions to solve regarding data sharing. 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 (source: minutes of the 8th COGENT Steering Committee held in Ho Chi Minh City, Vietnam 20-22 September 1999). **In any event there is no specific agreement for the data to be used and published in other databases than CGRD.** We developed a FAQ about this topic on the COGENT website, together with a draft proposal for Data Sharing Agreement and a CGRD Portal Terms and Conditions of Use:

- What is a Data-Sharing Agreement?

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.

3. Actual deliverables of the project

I. Coconut Genetic Resources Database is updated for six collections and data are available through GENESYS and online in a user-friendly, comprehensive format, including interactive mapping of germplasm by origin and site of conservation.

The data in the CGRD database was updated for the following 6 countries: Brazil, Côte d'Ivoire, India, Indonesia, Sri Lanka and Malaysia. We also received the data from Ghana, Nigeria, Vanuatu and Papua New Guinea but the data was not sufficiently standardized to be incorporated directly in the database. So we wrote again to these countries to get more information before integrating their data. We also worked on the global file and we corrected or added many missing data. From January to May 2012, as shown in tables in the technical attachments of this report:

- The total number of recorded accessions was increased by 19% (from 1416 to 1680)
- The total number of passport data was increased by 36% (from 36534 to 49551)
- The total number of Characterization data was increased by 95% (from 34599 to 67476)

The process for making the data available on GENESYS is launched; Max Ruas from Bioversity is presently working on data transfer. We contacted Dr Elisabeth Arnaud and Dr Dario Valori, IT manager in Bioversity in charge of Genesys database management, for the template for importing data. Max Ruas is using MCPD (Multi Crop Passport Descriptors) standards to transfer the data from CGRD to Genesys. Before the 15th of June 2012, the data will be online at this internet address: http://www.genesys-pgr.org/

We also started to develop a new interface that will be named COCOGIS (Coconut Germplasm Information System. In the future this new interface will replace CGRD and provide a more user-friendly interface. This new interface is not finished but can be accessed at this internet address: www.crop-diversity.org/coconut

II. Guidelines for assessing the quality and value of accessions conserved in coconut genebanks produced/published.

Six comprehensive lists of conserved coconut germplasm were released on the COGENT website in the 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)

We also developed two important guidelines in the FAQ section:

- How an international name is given to a new coconut variety?
- Variety, Cultivar, Population and Accession?

We started to develop decision-making tools for the comparative evaluation of COGENT Genebanks and the upgrading of the strategy. The process is made of two kinds of elements:

- Procedures under the Foxpro Software based on the contents of the CGRD database to evaluate the quality of the data.
- A set of evaluation criteria which describes and evaluates the quality and accuracy of the technical tasks conducted by the genebanks

The comparative evaluation of genebanks is based on the following:

- Passport data: number of total and actives accessions, dates of last inventory/counting
- Characterization data: field observations made in the genebanks and recorded in the database.
- Reproduction technique: utilization and reliability of the controlled pollination technique
- Data management of the genebank: numbering of palms, comprehensive storage and duplication of the data, losses of data.
- “Value” of accessions in term of rarity and genetic representativeness.

III. The process for updating the global coconut conservation strategy launched.

The need to update the current Global Coconut Genetic Resources 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.

The ex situ Coconut conservation is facing an emergency situation. Presently 24 genebanks are conserving 725 unique populations with 1374 accessions representing 725 unique populations. **447 accessions, collected during the 1980s, are becoming very tall**

without being rejuvenated; it becomes increasingly dangerous and costly to make the controlled pollinations requested for their regeneration. 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.. There is a huge need of capacity building. A large project should be launched to safeguard this germplasm. As written guidelines for controlled pollination proved to be insufficient, video guidelines are more likely to provide effective guidance..

The question of the method for climbing the palms must be addressed. In other genebanks, the reliability of the controlled pollination technique is highly questionable and must be addressed by further DNA analyses. The experience we had in Brazil shows that detailed written guidelines are not sufficient to start controlled pollinations in a genebank where this activity is a new one. We think it is necessary to **develop video guidelines** that will strongly help researchers and technical staff to master the processes.

New concepts were recently developed, such as virtual/networked collections and 'Polymotu' (geographic isolation). One of the main concerns is selecting the best combination of conservation approaches. It is needed to study how far the Polymotu concept could and should be integrated in the strategy. Polymotu allows keeping accessions up to 100 years instead of 30 years in genebanks, and producing certified seednuts without using costly controlled pollination; it also shifts conservation and seednut production from governmental services to farmers.

In the framework of the virtual collection, a possible organization is to share the possible financial resources based on evaluating the value and quality of accessions conserved in each genebank. We must study how and to what extent these concepts will be endorsed by COGENT; how and to what extent these concepts could be included in the Global coconut conservation strategy, and how these concepts could help to generate and efficiently deploy long-term funding.

The evaluation clearly shows that the international banks are presently not any better performers than some of the national genebanks. Discussions were conducted with COGENT representatives in Brazil, Côte d'Ivoire, India, Indonesia, and Sri Lanka. Basically Brazil, India, Indonesia want to favour the international genebanks, whereas other countries (Côte d'Ivoire, Sri Lanka and Philippines) want to favour countries having the best managed genebanks. This needs to be discussed during the next COGENT Steering Committee meeting.

We started to develop proposals for upgrading COGENT's organization in order to improve efficiency. These proposals will be discussed during the 16th COGENT Steering Committee Meeting that will be held 8–10 July 2012, at Kochi, Kerala, India.

E. Supporting information/data and access to databases.

Two students in communication[1] and the COGENT coordinator were involved in this process which required extensive communications by email, 'phone and Skype. Table 1 gives a summary of the communication process.

Table 1. Balance of communications with COGENT country members to upgrade the CGRD database

	COGENT countries (39)	Africa and the Indian Ocean	South Asia	Southeast and East Asia	South Pacific	Latin America and 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 which appointed 2 COGENT Representatives	74,35%	77,7%	100%	87,5%	87,5%	40%
% countries which appointed almost 1 COGENT Representative	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 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%

The CGRD database was made available on-line on the COGENT website (http://www.cogentnetwork.org/index.php/genetic-resources-database-cgrd). A new version will be available at the end of June 2012.

[1] Dorine Martinez and Ramon Sepulveda, based in Bioversity Montpellier. Dorine Martinez also went to Sri Lanka to train local researchers.

F. Outputs and Impacts

The time for implementing this project was very short: 5 monthes only for a project involving visits and technical work in 6 countries and to communicate with 39 countries in order to made them install the software and send data ; many activities are now launched and they will be pursued in the coming months.

The following indented outputs was fully achieved: Update and analyse the germplasm data from six major coconut genebanks, namely Brazil, Côte d'Ivoire, Indonesia, India, Malaysia and Sri Lanka and revitalize the network in order to obtain data from other country members. We designed a standard procedure for assessing the quality and viability of accessions conserved in coconut genebanks; and we launched the process for updating the global coconut conservation strategy.

Table 2: analysis of completion rate of passport data and field characterisation data in the CGRD database as of April, 2012

	Completion rate	# accessions	% accessions	Average completion rate
Passport	<40%	424	25	27
	40%< >74%	818	49	59
	>74	438	26	84
	Total	1680	100	57
Field Characterization	=<10%	687	41	6
	10%< >50%	466	28	25
	>50	527	31	74
	Total	1645	100	32

The software "Coconut Genetic Resources Database" has been improved but it has to be tested during two weeks and then we will make the improved version downloadable from the COGENT website. The germplasm data is available online on the COGENT website, but updated data will be released with the new version of the Software.

The process to make it available through the GENESYS portal is launched; the data will be available on-line in June 2012

G. *Deviations from the project work plan*

We shifted part of the budget (3000 USD) from Malaysia to Sri Lanka because Malaysia took a very long time to reply. In any event, we had a one-day meeting with Malaysian researchers in Serdang, and Malaysia sent updated data.

It was initially planned to devote 3000 USD for equipment and manpower in the International Coconut Genebank (ICG) for South East Asia. Finally Dr Thomas, head of CPCRI, told us that the new regulations forbade his institute to accept grants of less than 10000 USD. So we used the money for Dr Thomas to make a scientific visit at the ICG for Africa and Indian Ocean in Côte d'Ivoire, Africa.

H. *Lessons arising from the project activities.*

The COGENT coordinator is a CIRAD researcher who is presently working for 20% of his time only for Bioversity. COGENT coordination is a heavy task; there is no research assistant to help and the only manpower available are students working for short time periods. Although more than 80% of my time was really devoted to COGENT coordination activities, this is not sufficient in regards to the huge task to achieve. The COGENT coordinator remains too much involved in technical and scientific tasks; the consequences are that no sufficient working time is devoted to submitting new research projects and working on upgrading the coconut strategy. In the future, the management of the Coconut Genetic Resources Database should be done by one of the COGENT country members, in the framework of a small but long project under the supervision of Bioversity (budget of 3000 USD per year during 5 years will be sufficient)

A data-sharing agreement is needed between Bioversity and the institutions of the genebanks providing data.

The process for updating the global coconut conservation strategy is launched, but finalizing the strategy is a complex task. The COGENT coordinator is not sure that the Strategy will be fully available in 2012. We are facing emergency situations and the range of possible strategic options must be discussed with the Steering Committee of the COGENT network.

I. *Case studies, innovation or success stories*

Gender analysis approach: the management of genebanks is evolving from man to woman : 3 of the 5 international coconut genebanks are now led by women researchers (namely Brazil, Indonesia, and India), whereas 10 years ago was all were managed by men.

Updating of the CGRD database revealed that Indonesian researchers discovered very rare and precious Makapuno/Kopyor Dwarf varieties in Central Java. These varieties will be used in the framework of a Polymotu project in a small archipelago near Jakarta. For more information, please contact Ismail Maskromo (is_maskromo@yahoo.com) researcher from the Indonesian Palm Research Institute. Videos are available.

J. *Detailed progress against milestones and indicators*

Table 3. Project Outputs and Outcomes, Indicators and Milestones

Reporting Period: 01/10/11 – 31/05/12

A	B	C	D	E	F	G
Activity	**Milestone / Indicator (DO NOT MODIFY)**	**Original Due Date (DO NOT MODIFY)**	**Revised Due Date (DO NOT MODIFY)**	**Completion Date**	**Commentary on Progress and Achievement**	**Not completed (Please provide reasons for non completion and any proposals/plans to address this)**
Brazil – Visit of Dr R. Bourdeix	1) Training 2) Data from genebank updated and transmitted to CGRD webmaster.	20/10/11 to 07/11/11		20/10/11 to 07/11/11	Training done (Semíramis Rabelo Ramalho Ramos, genebank curator and a PHD Student) Multiple contact by Email and Phone in February/March 2012 by Dorine Martinez	
Côte d'Ivoire – Visit of Dr R. Bourdeix	1) Training 2) Data from genebank updated and transmitted to CGRD webmaster.	18/11/11 to 18/12/11		18/11/11 to 18/12/11	Training done. Issali Emmanuel (Breeder) and Koffi Youboué (PHD Student) – Data transmitted to the CGRD	
India – Visit of Dr R. Bourdeix	1) Training 2) Data from genebank updated and transmitted to CGRD webmaster.	08/01/12 to 30/01/12		10/01 to 25/01	Training done (V. Niral, genebank curator and technical assistant) – Data transmitted to the CGRD	
Sri Lanka, Dr Lalith Pereira, COGENT Representative, to join the visit in India	1) Training 2) Data from genebank updated and transmitted to CGRD webmaster.	09/01/12 to 14/01/12		13/02 to 22/02	Training done in Sri Lanka (L. Perera, genebank Curator, 3 more researchers from Sri Lanka; and R. Rivera, genebank Curator of the Philippines). Data transmitted for both Sri Lanka and the Philippines.	
Malaysia – Visit of Dr R. Bourdeix	1) Training 2) Data from genebank updated and transmitted to CGRD webmaster.	01/02/12 to 11/02/12		23 /02 to 25/02	Short training done in Bioversity Kuala Lumpur office, new set of data received from Malaysia Mardi	*The project was shifted from Malaysia to Sri Lanka, but we had a one day meeting with Malaysian researchers, and they sent the data.*
Indonesia– Visit of Dr R. Bourdeix	1) Training 2) Data from genebank updated and transmitted to CGRD webmaster.	12/02/12 to 23/02/12		26/01 to 09/02	Training done – Data transmitted to CGRD	
All countries	1) Development of the tool for evaluation of quality and value			15/01 to 31/03 and	Development of the tool for evaluation done, but further refining needed.	*Need to develop an auto-evaluation tool for other genebanks*

A	B	C	D	E	F	G
Activity	**Milestone / Indicator** **(DO NOT MODIFY)**	**Original Due Date** **(DO NOT MODIFY)**	**Revised Due Date** **(DO NOT MODIFY)**	**Completion Date**	**Commentary on Progress and Achievement**	**Not completed** **(Please provide reasons for non completion and any proposals/plans to address this)**
	of each accession, and applying the tool to the genebank accessions. 2) Concept of networked/virtual collection discussed with genebank curator.			later	Concept of networked/virtual collection discussed with genebank curator in India, Indonesia, Sri Lanka, Côte d'Ivoire and Brazil	
France - Student "Upgrading the CGRD Software" at Bioversity Montpellier with M. Ruas and C. Hamelin	1) Distance training for the installation of the CGRD database and data keyboarding. 2) Improve the software "Coconut genetic Resources Database" 3) Make the germplasm data available online on COGENT website and through the GENESYS portal.	13/02/12 to 05/05/12			Distance training conducted by Student Dorine Martinez CGRD database on line Data available online on COGENT website. Done but will be improved again in June. Through the GENESYS portal not yet, will be done in May-June.	*Max Ruas succeed to have a student not before 7th march 2012. So the job will be done in April and may 2012.*

2. Financial Report

Trust budget (US$)

	Total Budget	Actual Expenditures 31/10/11 – 30/04/12
1. Personnel	7,757	5,508
2. Sub-grants to institutes	9,000	6,000
3. Travel	10,823	15,979
4. Supplies	0	0
5. Equipment	1,832	1,925
6. Coordination and support costs	5,588	5,588
TOTAL	**35,000**	**35,000**

A remaining budget of 1645 USD has been committed to fund the trip of Dr Roland Bourdeix to the 16th Steering Committee (SC) meeting to be held in Kochi, India, from 8th to 10th July 2012. Dr Bourdeix will report the results of this project to the SC. The SC meeting is partially funded by another project from the Global Crop Diversity Trust.

Notes to the Financial Report

1. Detail personnel expenditure incurred indicating whether the staff member is internationally or locally recruited and the amount of time spent on the project.

   Roland Bourdeix indemnities and stipend: US$ 5,808
   Time spent: 35 days.

2. Provide details, cost and purpose, of each trip taken.

   George Thomas to Abidjan: US$ 2,051
   Lalith Pereira to India: US$10,918
   Roland Bourdeix to India/ Malaysia/Indonesia/Sri Lanka: US$ 1,365
   Roland Bourdeix to Kochi, India: US$ 1,645

3. Provide a detailed breakdown of expenditure incurred on training.

4. Provide details of services received, consultancy rate and length of time spent by each consultant.

5. Provide a list of supplies purchased, items may be grouped where appropriate.
   DHL and TNT costs: US$ 147
   Computer equipments: US$419
   Pollination bags: US$ 240

6. List all agreements entered into with other entities providing details of the amount paid and results achieved.
   Letters of Agreement with IPRI (LOA12IN05): US$ 3,000 and CRI (LOA12IN04): US$ 3,000

7. Provide a list of all equipment purchased.
   Dell laptop: US$ 1,119

Prepared by:	**Certified by:**
_____	_____
Name	Name
Position	*Position*

3. Technical attachments

A. Number of accessions and passport data

The analysis was conducted under the software Foxpro on the file access.dbf of the CGRD Database. This file contains 202 fields gathering all passport and characterization data. We first evaluated the number of records per site of conservation, using the following categories:

- The total number of accessions recorded in the CGRD database. Some of these accessions are old and have already been cut down; for some accessions the number of living palms was never recorded in the database.
- The number of active accessions: An accession is considered as active only if there is at least one living palm. Maybe some of the removed accessions are also active, but the curators of genebank will have to provide the basic information about the number of living palms for the accessions to be taken in account.
- The number of active accessions having a date of last inventory/counting: An accession may be represented by at least one living palm, but no date of last inventory/counting; these were removed.
- The number of unique populations and cultivars: for instance in India 3 accessions of “Andaman Giant Tall”, counted as 1; in Côte d’Ivoire, 2 accessions of “West African Tall Mensah” and 3 accessions of “West African Tall Akabo”, and counted in total as 2.

Table 4. Comparative evaluation of the number of accessions recorded in the Coconut Genetic Resources Database for all genebanks as of 22th may 2012.

Countries and Genebanks	Number of registered accessions	Number of active accessions	Active accessions with date of inventory	Average date of last inventory for active accession	Number of unique active populations and cultivars	Number of relevant Passport Data
Benin CRC Sémé Podji	4	0	0	0	0	116
Mexico CICY Yucatan	20	0	0	0	0	568
Pakistan	32	0	0	0	0	192
Papua New Guinea CCRI	0	0	0	0	0	0
Tonga Ministry of Agriculture	7	0	0	0	0	45
China Wenchang Coconut Research Inst.	17	17	4	1999	3	366
Western Samoa	9	6	6	2001	6	84
Fiji Taveuni Coconut Centrei	11	10	9	1988	10	413
Ghana OPRI	16	15	15	1999	13	206
Bangladesh Bari	40	16	13	2000	16	699
Malaysia Depart. of Agric. Sabah	45	37	34	1998	19	968
Solomon Islands Yandina Res. Centre	21	20	16	1974	20	398
Brazil EMBRAPA	29	23	23	2011	23	1286
Jamaica Coconut Industry Board	60	47	0	0	28	923
Vietnam Dong Go Experimental Centre	31	31	31	1995	31	1221
Malaysia MARDI Hilir Perak	44	44	42	1995	44	1213
Vanuatu Saraoutou Research Centre	79	57	50	2000	44	2494
Papua New Guinea Stewart Res. Centre	57	50	0	0	49	937
Thailand Chumphon Hort. Research Centre	52	51	51	1995	49	1480
Tanzania Nat. Coconut Dev. Programme	72	65	0	0	57	2420
Cote d'Ivoire CNRA Marc Delorme R. S.	149	124	124	2011	61	5782
Indonesian Palm Research Institute	203	84	84	2011	62	5747
Sri Lanka Coconut Research Institute	157	154	154	2005	127	6322
Philippines Coconut Authority	224	224	224	2004	130	6444
India CPCRI	301	299	88	2006	170	9227
Total 22th May 2012	**1680**	**1374**	**968**		**962**	**49551**
Total 31th December 2011	1416	1193	772		860	36534

B. Data management in the genebanks

In a perennial plant such as the coconut palm, the constraints connected with its biology increase the cost of the scientific progress and aggravate the consequences of possible errors. In fact, a genetic experiment frequently covers an area of eight hectares for a minimum period of twelve years. Consequently, coconut research not only needs high investments but also a great functional stability. On the human level, coconut genetic research requires resolute patience and a certain stoicism: mostly, a researcher analyses the trials planted by his/her predecessor, and establishes experiments that will be analyzed by his/her successors.

In various countries, numerous research years have been lost as a result of different types of accidents, such as fires, floods, revolutions, turnover of personnel or simply the lack of funds leading to a complete program stop. Therefore, it is of principal importance to make sure that the collected data at the research stations will be available and safely kept for many years. These data should be duplicated systematically in two geographically different places. These may be two different national institutes, or an national institution cooperating with a specialised international research institute.

Sri Lanka and Côte d'Ivoire have recently lost data due to computer failures. In our opinion, for each coconut tree in a research station, a unitary identification key should exist. This key generally is composed in the following way:

- a code of the experimental station
- a code number of the planting plot in the station (often three figures)
- a code number of the planting line within the plot (generally two figures)
- a code number of the tree within the line (two figures)
- a code corresponding with the year of planting.

In this way, even if a plantation has been cut down and replanted again, the unitary identification will avoid any confusion.

Table 5.
Comparative evaluation of the management of the data in 9 genebanks

	Evaluation criteria		Brazil	Côte d'Ivoire	India	Indonesia	Malaysia*	Papua N.G. *	Philippines	Samoa	Sri Lanka
1	Does the number of living palms was counted during the last 3 years and this information transmitted to the database or available in a report in the public domain?	10	0	10	10	10	0	**n.a.**	0	0	10
2	Was a comprehensive list of coconut germplasm transmitted to the CGRD database, and does this list fit with international standards related to international names and abbreviation of coconut cultivars??	10	10	10	10	10	0		0	0	10
3	Is a map of the conservation fields available, and does it indicate the identity of the germplasm?	10	10	10	0	10	10		10	10	10
4	Is a detailed satellite image of the genebank available?	5	5	5	0	5	0		5	5	0
5	Are the palms individually numbered?	10	10	10	10	10	10		10	10	10
6	Are the identities of the palms recording a unique identification key, including year of planting?	5	0	5	0	0	0		0	0	0
7	Are the identities of the palms safely kept using comprehensive files easily available and safely duplicated, with dedicated software?	10	0	10	0	0	0		10	0	10
8	Is a yearly planning of field observations available?	5	0	0	0	0	0		0	0	0
9	Is the percentage of palms for which at least one parent palm is known (generally mother palm)>50?	5	0	0	0	0	0		5	0	0
10	Is the percentage of palms for which 2 parents palms are known (Controlled pollination)>25?	10	0	10	0	0	0		0	0	0
11	Is somebody in charge of management and comprehensive conservation of the whole data produced by the research station?	10	0	10	0	0	0		0	0	10
12	No massive loss of data during the 5 last years	10	0	0	10	10	10		10	0	0
	Global evaluation	**100**	**35**	**80**	**40**	**55**	**30**		**45**	**25**	**60**

c. Controlled Pollination and regeneration methods

The main urgency concerns the way genebanks are reproducing and regenerating accessions. At least 13 genebanks, three of which are international, have ageing accessions and do not use controlled pollination to reproduce them.

Within the international genebanks:

- Indonesia is presently regenerating all its accessions using open pollinated seednuts, and in our opinion these accessions are mixing.
- Papua New Guinea, as far as we know, never had the laboratory and the equipment for making controlled pollinations.
- The Brazil genebank is presently trying to develop a controlled pollination lab, but is facing both lack of funds and lack of manpower. The few technical staff are older and cannot easily climb many trees.
- India is using pollination bags that are too thin bags and are permeable to pollen, and the bags used do not have plastic windows to facilate seeing pollination activities.
- Côte d'Ivoire seems to have good controlled pollination methods, but the recent DNA analysis may indicate that it may have a quite high rate of illegitimate seednuts.

Within the other genebanks:

- The Philippines is using a good controlled pollination technique, but suffers from a lack of technical staff; among the 224 accessions and 130 populations recorded, at least 40 are aged 25 years-old or more and have not yet been regenerated.
- Vanuatu is using a good pollination technique.
- Sri Lanka is using a quite good pollination technique but, in our opinion the bag tissue is too thin. Some genetic trials using molecular markers could help to estimate the illegitimacy rate of the present process, but we still waiting an estimation from Sri Lanka.
- As far as we know, all the other national genebanks are not using controlled pollination to reproduce their accessions.

Table 6: Criteria for evaluating the controlled pollination process for the regeneration of accessions

	Evaluation criteria		Brazil	Côte d'Ivoire	India	Indonesia	Malaysia	Papua NG	Philippines	Samoa	Sri Lanka
1	Does the genebank have a laboratory devoted to controlled pollination?	10	0	10	10	10	10	0	10	0	10
2	Is this lab active? (at least 200 controlled pollinations (CP) during the last 2 years)	10	0	10	10	na	0	0	10	0	10
3	Does the pollination bags allows true to type reproduction of the germplasm? Is the tissue impermeable to pollen and the timing of bagging appropriate?	20	0	20	0	na	0	0	20	0	10
4	When harvesting for pollen, is the pollen processed in isolation (in bags without direct contact with ambiant air) in order to avoid contamination with unwanted pollen?	5	0	10	0	na	0	0	10	0	0
5	Are blank pollinations regularly conducted in order to check the process (pollination with talc powder only without telling to the technical staff)	10	0	10	0	na	0	0	10	0	0
6	Is the catalogue of controlled pollination computerized?	5	0	3	0	na	0	0	5	0	0
7	Is each seednut from CP tagged with a CP number in the nursery? Are these CP numbers remaining attached to the seedlings until the field planting? Are these CP numbers recorded in a field map in order to check the experimental design after the planting?	10	0	5	0	na	0	0	5	0	0
8	Does the whole process allow to cross-check the results of controlled pollination using DNA markers? (by checking that the progenies are really from the planned female and male parents).	10	0	10	0	na	0	0	10	0	0
9	Were molecular markers used to check the controlled Pollination Process	10	0	10	0	na	0	0	0	0	10
10	Does DNA markers indicate that the whole process have a low rate of mistake?	10	0	0	0	na	0	0	0	0	0
	Global evaluation	**100**	**0**	**88**	**20**	**10**	**10**	**0**	**80**	**0**	**40**

D. Germplasm movements from and to the genebank

The following table clearly demonstrates that, with the exception of Côte d'Ivoire, the international genebanks are not the most active genebanks in terms of releasing germplasm:

- Côte d'Ivoire is very active in releasing germplasm to other countries, but the germplasm released is quite limited in terms of number of cultivars (48 only). The genebank did not introduce successfully new cultivars for more than 15 years, and no germplasm survey was organized by the genebanks since 1957.
- India is very active in collecting germplasm in other countries, but releases only a very few germplasm to other COGENT member-countries.
- As far as we know, Brazil never released a variety to another genebank.
- The activity of International Genebanks of Indonesia and Papua New Guinea is scant in term of both importing germplasm from abroad and exporting germplasm to other COGENT countries.
- The Philippines and Sri Lanka are the most active national genebanks for germplasm exchanges.

Table 7. Criteria for evaluating the germplasm movements

(needs further update of the CGRD database**)**

	Evaluation criteria		Brazil	Côte d'Ivoire	India	Indonesia	Malaysia	Papua NG	Philippines	Samoa	Sri Lanka
1	Does the genebank accept bilateral international germplasm exchanges?	10	0	10	10	10	10	n.a.	10	10	10
2	Does the genebank accept unilateral germplasm transfers? (germplasm sent to a COGENT country member without receiving germplasm)	20	0	20	0	0	0		20	20	20
3	More than 10 accessions sent abroad during the last 5 years	10	0	10	0	0	0		10	0	10
4	More than 20 accessions sent abroad during the last 10 years	10	0	10	0	0	0		0	0	0
5	More than 5 accessions collected from farmers fields in the country during the last 5 years	5	5	0	10	10	10		10	0	10
6	More than 20 accessions collected from farmers fields in the country during the last 10 years	10	0	0	10	10	0		0	0	10
7	More than 5 accessions collected abroad from farmers fields during the last 5 years	5	0	0	5	0	0		0	0	0
8	More than 20 accessions collected abroad from farmers fields during the last 10 years	10	0	0	10	0	0		0	0	0
9	More than 5 accessions introduced from other COGENT genebanks during the last 5 years	5	5	5	5	0	0		5	0	5
10	More than 10 accessions introduced from other COGENT genebanks during the last 10 years	5	5	5	5	0	0		5	0	5
11	More than 50% of accessions introduced from other COGENT genebanks during the last 5 years are successful (more than 50 palms surviving)	10	0	0	0	0	0		0	0	0
	Global evaluation	100	15	60	55	30	20		60	30	70

E. Characterization data of the accessions

In order to evaluate the content of the database, the 202 fields of the database were classified[2] in 10 categories relevant for genebank evaluation, as shown on table 8.

Table 8: classification of the fields in the CGRD database for genebanks evaluation

Classification of the fields in CGRD	Number of Fields	Codes
Passport data relevant for genebank evaluation	28	P1
Characterization data: description of the site where the accession is planted	10	C1
Characterization data: Germination	9	CG
Characterization data: inflorescence and floral biology	32	CI
Characterization data: leaf	18	CL
Characterization data: stem	13	CS
Characterization data: fruit and oil analysis	19	CF
Characterization data: yields of bunches, fruits and copra	16	CY
Passport data not relevant for genebank evaluation, such as “site” and “accession number” (mandatory) or “other number 1” or “Synonim 2”	51	P0
Characterization data: information not relevant for genebank evaluation (such as “site number” or old unused fields for fruit analysis)	6	C0
Total	202	

[2] we worked on the file “ACCESS.DBF”. Foxpro Instruction : SELECT distinct classif,COUNT(*) GROUP BY classif FROM eval2012 INTO TABLE temp.dbf

Table 9: characterization data recorded in the Coconut Genetic resources database according to sites of conservation as of 7th February 2012

CGRD6	# registered accessions	# active acces-sions	Site	Germi-nation	Floral biology	Leaf	Stem	Fruit and oil	Yields of bunches fruits and copra	Total	%
Benin CRC Sémé Podji	4	0	20	0	0	0	0	0	0	20	**2**
Brazil EMBRAPA	29	23	242	91	416	239	143	320	214	1665	32
China Wenchang CRI.	17	17	86	68	0	0	0	158	0	312	**10**
Cote d'Ivoire CNRA.	149	124	1370	774	1988	1402	1050	1808	1771	10163	38
Fiji Taveuni Coconut Centrei	11	10	92	35	108	100	72	92	37	536	27
Ghana OPRI	16	15	48	0	7	7	9	0	0	71	**2**
India CPCRI	301	299	2418	880	4214	2699	1505	2556	1850	16122	30
Indonesian Palm Research Institute	203	84	1497	274	1377	905	578	1272	728	6631	18
Jamaica Coc. Industry Board	60	47	302	26	53	52	53	28	8	522	**4**
Malaysia Depart. of Agric. Sabah	45	37	207	29	413	105	59	72	39	924	**11**
Malaysia MARDI Hilir Perak	44	44	375	0	572	586	410	507	171	2621	33
Mexico CICY Yucatan	20	0	197	155	0	266	182	0	0	800	22
Pakistan	32	0	64	0	444	448	192	0	0	1148	20
Papua New Guiinea SRC	57	50	315	0	0	370	74	0	0	759	**7**
Philippines Coconut Authority	224	224	1840	183	1251	1400	1044	1538	1003	8259	20
Solomon Islands Yandina	21	20	147	0	0	0	0	0	0	147	**3**
Sri Lanka Coconut Res. Inst.	157	154	1452	634	2948	1895	1079	1784	1158	10950	39
Tanzania National CDP	72	65	628	0	18	222	29	60	6	963	**7**
Thailand Chumphon	52	51	264	0	120	96	37	243	0	760	**8**
Tonga Ministry of Agriculture	7	0	33	0	72	88	61	20	0	274	22
Vanuatu Saraoutou Res. Cent	79	57	651	155	260	306	219	171	6	1768	**12**
Vietnam Dong Go Exp. Centre	31	31	222	93	198	140	126	252	62	1093	20
Western Samoa	9	6	36	0	0	0	0	0	0	36	**2**
Bangladesh Bari	40	16	182	0	216	188	75	193	78	932	**13**
Total 22th May 2012	1680	1374	12688	3397	14675	11514	6997	11074	7131	67476	17
Total 31th December 2011	1416	1193	8914	1229	5872	6460	3930	5118	3076	34599	**11**

F. “Values” of accessions in terms of rarity and genetic representativeness

The fact that a population or a cultivar is conserved only one genebank does not mean that this accession is really rare or endangered.

Many populations and cultivars were collected in farmers fields and new cultivar names were often given, but there is no evidence that these accessions are really different from the other accessions collected previously. When looking at the data, there is sometimes no available information about the peculiarity of these accessions and no characterization data available from both parent palms and the accession conserved in the genebank.

So it is necessary not only to calculate the number of unique accessions per genebank, but also to check the peculiarity of these accessions.

Table 10. General overview of the duplications of accessions at world level (all genebanks)

Country and Genebank	# registered accessions	# active accessions	# active distinct populations	Unique Population	Duplicated only	≤3 accessions per population	4 - 10 accessions per pop.	>10 accessions per pop.
Bangladesh Bari	40	16	16	13 (81%)	2 (13%)	0 (0%)	0 (0%)	1 (6%)
Benin CRC Sémé Podji	4	0	0	0	0	0	0	0
Brazil EMBRAPA	29	23	23	13 (57%)	0 (0%)	0 (0%)	3 (13%)	7 (30%)
China Wenchang Coconut Research Inst.	17	17	17	1 (6%)	2 (12%)	0 (0%)	0 (0%)	14 (82%)
Cote d'Ivoire CNRA Marc Delorme R. S.	149	124	108	2 (2%)	22 (20%)	15 (14%)	35 (32%)	34 (31%)
Fiji Taveuni Coconut Centrei	11	10	10	4 (40%)	1 (10%)	0 (0%)	1 (10%)	4 (40%)
Ghana OPRI	16	15	13	1 (8%)	0 (0%)	0 (0%)	5 (38%)	7 (54%)
India CPCRI	301	299	293	66 (23%)	97 (33%)	65 (22%)	39 (13%)	26 (9%)
Indonesian Palm Research Institute	203	84	77	47 (61%)	6 (8%)	7 (9%)	14 (18%)	3 (4%)
Jamaica Coconut Industry Board	60	47	47	2 (4%)	12 (26%)	2 (4%)	12 (26%)	19 (40%)
Malaysia Depart. of Agric. Sabah	45	37	37	0 (0%)	4 (11%)	0 (0%)	4 (11%)	29 (78%)
Malaysia MARDI Hilir Perak	44	44	44	35 (80%)	0 (0%)	1 (2%)	2 (5%)	6 (14%)
Mexico CICY Yucatan	20	0	0	0	0	0	0	0
Pakistan	32	0	0	0	0	0	0	0
Papua New Guiinea Stewart Res. Centre	57	50	49	42 (86%)	2 (4%)	1 (2%)	1 (2%)	3 (6%)
Philippines Coconut Authority	224	224	224	61 (27%)	84 (38%)	17 (8%)	32 (14%)	30 (13%)
Solomon Islands Yandina Res. Centre	21	20	19	8 (42%)	1 (5%)	0 (0%)	4 (21%)	6 (32%)
Sri Lanka Coconut Research Institute	157	154	153	88 (58%)	24 (16%)	6 (4%)	23 (15%)	12 (8%)
Tanzania National Coconut Dev. Prog.	72	65	63	32 (51%)	2 (3%)	1 (2%)	8 (13%)	20 (32%)
Thailand Chumphon Hort. Res. Centre	52	51	50	39 (78%)	0 (0%)	1 (2%)	3 (6%)	7 (14%)
Tonga Ministry of Agriculture	7	0	0	0	0	0	0	0
Vanuatu Saraoutou Research Centre	79	57	55	19 (35%)	7 (13%)	1 (2%)	12 (22%)	16 (29%)
Vietnam Dong Go Experimental Center	31	31	30	20 (67%)	0 (0%)	0 (0%)	5 (17%)	5 (17%)
Western Samoa	9	6	6	3 (50%)	2 (33%)	0 (0%)	0 (0%)	1 (17%)
Total	**1680**	**1374**	**1334**	**496**	**268**	**117**	**203**	**250**

G. *Structure of the database*

Table 11. List of fields in the CGRD database and their classification for evaluation of the genebanks

	Descriptor name	Field name	classi-fication	Field type
1	SITE OF CONSERVATION	SITE	P0	C
2	ACCESSION NUMBER	ACCESS_NB	P0	C
3	DONOR NAME	DONOR_NAME	P1	C
4	DONOR NUMBER	DONOR_NB	P0	C
5	FEMALE PARENT ACCESSION NUMBER	FEM_ACC_NB	P1	C
6	MALE PARENT ACCESSION NUMBER	MAL_ACC_NB	P1	C
7	Other number 1	OTHER_NB1	P0	C
8	Other number 2	OTHER_NB2	P0	C
9	Other number 3	OTHER_NB3	P0	C
10	Category (= 'Type')	CATEGORY	P1	N
11	Colour 1	COLOUR1	P1	N
12	Colour 2	COLOUR2	P0	N
13	Colour 3	COLOUR3	P0	N
14	Translation/transliteration	CULT_NAME	P1	C
15	Synonym1	SYNONYM1	P1	C
16	Synonym2	SYNONYM2	P0	C
17	Synonym3	SYNONYM3	P0	C
18	Accepted abbreviation	ABBREV	P1	C
19	NUMBER OF PALMS IN THE FEMALE PARENT POPULATION	NB_FEM_POP	P1	N
20	Exact or estimated for descriptor 1.9	EX_FEM_POP	P0	N
21	NUMBER OF PALMS FROM THE FEMALE PARENT POPULATION REPRESENTED BY THE SAMPLE	NB_FEM_SAM	P1	N
22	NUMBER OF PALMS IN THE MALE PARENT POPULATION	NB_MAL_POP	P1	N
23	Exact or estimated for descriptor 1.11	EX_MAL_POP	P0	N
24	NUMBER OF PALMS FROM THE MALE PARENT POPULATION REPRESENTED BY THE SAMPLE	NB_MAL_SAM	P1	N
25	ACQUISITION DATE	ACQ_DATE	P1	C
26	POLLINATION GROUP	POLL_GROUP	P1	N
27	TYPE OF MATERIAL RECEIVED	TYPE_MAT	P1	N
28	ACCESSION SIZE	ACC_SIZE	P1	N
29	DATE OF LAST INVENTORY	AC_SIZE_DT	P1	C
30	TYPE OF MAINTENANCE	TYPE_MAIN	P1	N
31	NOTES	ACC_NOTES	P1	M
32	COLLECTING INSTITUTE(S)	COLL_INST	P1	C
33	SITE NUMBER	SITE_NB	P0	C
34	COLLECTOR'S NUMBER	COLL_NB	P0	C
35	COLLECTION DATE OF ORIGINAL SAMPLE	COLL_DATE	P1	C
36	COUNTRY OF COLLECTION	COUNTRY	P1	C
37	PROVINCE/STATE	PROVINCE	P1	C
38	DEPARTMENT/COUNTY	DEPT	P1	C
39	COLLECTION SITE	COLL_SITE	P1	M
40	LATITUDE OF COLLECTION SITE	COLL_LAT	P1	C
41	LONGITUDE OF COLLECTION SITE	COLL_LONG	P1	C
42	Origin of population to be sampled	ORIGINE	P1	N
43	Generation structure	GENERATION	P1	N
44	Age estimate of parent material	AGE	P1	N
45	Collection source	COLL_SRCE	P1	N

	Descriptor name	Field name	classi-fication	Field type
46	ADJACENT PALM STATUS (Isolation)	ADJ_ISOL	P1	N
47	ADJACENT PALM STATUS (Type (Same/Different) if not isolated)	ADJ_TYPE	P1	N
48	COLLECTION PROCEDURE	COLL_PRO	P1	N
49	SAMPLING PROCEDURE	SAMP_PRO	P1	N
50	STATUS OF SAMPLE	STAT_SAMP	P1	N
51	GENERAL APPEARANCE OF POPULATION	APPEARANCE	P1	N
52	POLLEN SOURCE	POLLEN_SRC	P1	N
53	EMBRYO CULTURE STATUS	EMBR_CULT	P0	N
54	TISSUE CULTURE STATUS	TISS_CULT	P0	N
55	SIZE OF THE POPULATION	SIZE_POP	P1	N
56	Exact or estimated size of the population	EX_SIZ_POP	P1	N
57	Unit of descriptor size of the population	UN_SIZ_POP	P1	N
58	PLANT POPULATION DENSITY	DENSITY	P1	N
59	Exact or estimated number of number of palms sampled	EX_SAMPLE	P0	N
60	NUMBER OF PALMS SAMPLED IN THE POPULATION	NB_SAMPLE	P1	N
61	Method used for estimation of descriptor 2.22	ME_SAMPLE	P0	N
62	TOTAL NUMBER OF SEEDNUTS, PLANTLETS OR EMBRYOS COLLECTED	NB_SEEDNUT	P1	N
63	TOTAL WEIGHT OF POLLEN COLLECTED [g]	POLLEN_WEI	P0	N
64	CROPPING SYSTEM AND ASSOCIATED FLORA	CROP_SYST	P1	N
65	CULTIVATION STATUS	CULT_STAT	P1	N
66	LOCAL/VERNACULAR NAME	LOC_NAME	P1	C
67	Language or ethnic group	LANGUAGE	P1	C
68	USES OF THE SOURCE POPULATION (1)	USE1	P1	N
69	USES OF THE SOURCE POPULATION (2)	USE2	P0	N
70	USES OF THE SOURCE POPULATION (3)	USE3	P0	N
71	Other use of the source population	OTHER_USE	P0	C
72	Frequency of spicata type	SPICATA	P0	N
73	Frequency of plicata type	PLICATA	P0	N
74	Frequency of androgena type	ANDROGENA	P0	N
75	Frequency of makapuno type	MAKAPUNO	P0	N
76	Other special character	OTHER_CAR	P0	C
77	Frequency of other special character	OTHER_FREQ	P0	N
78	OVERALL APPEARANCE/SHAPE OF CROWN OF PARENT TREE	CROWN	P1	N
79	COLLECTOR'S NOTES	COLL_NOTES	P1	M
80	COUNTRY	RI_COUNTRY	C1	C
81	Site number	RI_NB	C0	C
82	Latitude	RI_LAT	C1	C
83	Longitude	RI_LONG	C1	C
84	Elevation [m]	RI_ELEVAT	C1	N
85	Name of farm or institute	RI_FARM	C1	C
86	EVALUATOR'S NAME AND ADDRESSE	EVALUATOR	C1	M
87	Evaluator's notes	EVAL_NOTES	C0	M
88	Date of harvest	HARVEST_DT	CG	C
89	Date of sowing	SOWING_DT	CG	C
90	Number of nuts set to germinate	GER_SET_NB	CG	N
91	Number of germinated nuts	GER_NUT_NB	CG	N
92	Number of days to 25% germination	GERM_25	CG	N
93	Number of days to 50% germination	GERM_50	CG	N
94	Number of days to 75% germination	GERM_75	CG	N
95	Number of days to maximum germination	GERM_MAX	CG	N
96	Maximum germination rate	MAX_PERC	CG	N
97	Date of field establishment	FIE_EST_DT	C1	C
98	Planting density	PL_DENSITY	C1	N

	Descriptor name	Field name	classi-fication	Field type
99	Age at the time of measurement [years]	TIM_MEA_AG	C1	N
100	Girth at 20cm above soil level [cm]	GIR_20	CS	N
101	Standard deviation for girth at 20 cm above soil level [cm]	SD38	CS	N
102	Girth at 1.5m height [cm]	GIR_150	CS	N
103	Standard deviation of girth at 1.5 m height [cm]	SD39	CS	N
104	Date 1	DATE1	CS	C
105	Height 1 [cm]	HEIGHT1	CS	N
106	Standard deviation of height 1 [cm)	SD40	CS	N
107	Date 2	DATE2	CS	C
108	Height 2 [cm]	HEIGHT2	CS	N
109	Standard deviation of height 2 [cm)	SD41	CS	N
110	Bole category	BOLE_CAT	CS	C
111	Height of 10 internodes	LEA_SC_HEI	CS	N
112	Standard deviation of height of 10 internodes	SD43	CS	N
113	Petiole length [cm]	PETIO_LEN	CL	N
114	Standard deviation of petiole length [cm]	SD2	CL	N
115	Petiole width [cm]	PETIO_WID	CL	N
116	Standard deviation of petiole width [cm]	SD3	CL	N
117	Petiole thickness [cm]	PETIO_THIC	CL	N
118	Standard deviation of petiole thickness [cm]	SD4	CL	N
119	Rachis length [cm]	RACHIS_LEN	CL	N
120	Standard deviation of rachis length [cm)	SD5	CL	N
121	Number of leaflets	LEALT_NB	CL	N
122	Standard deviation of leaflets number	SD6	CL	N
123	Leaflet length [cm]	LEALT_LEN	CL	N
124	Standard deviation of leaflet length [cm]	SD7	CL	N
125	Leaflet width [cm]	LEALT_WID	CL	N
126	Standard deviation of leaflet width [cm]	SD8	CL	N
127	Rate of leaf production	Y_LEA_NB	CL	N
128	Standard deviation of rate of leaf production	SD9	CL	N
129	Sample size	SAMPL_SIZE	C1	N
130	Length of central axis [cm]	CEN_AX_LEN	CI	N
131	Standard deviation of length of central axis [cm]	SD10	CI	N
132	Length of stalk [cm]	STALK_LEN	CI	N
133	Standard deviation of stalk length [cm]	SD11	CI	N
134	Stalk girth [cm]	STALK_GIR	CI	N
135	Standard deviation of stalk girth [cm)	SD12	CI	N
136	Stalk width [cm]	STALK_WIDT	CI	N
137	Standard deviation of stalk width [cm]	SD44	CI	N
138	Stalk thickness [cm]	Stalk_thic	CI	N
139	Standard deviation of stalk thickness [cm]	SD45	CI	N
140	Number of spikelets with female flowers	F_FL_SP_NB	CI	N
141	Standard deviation of number of spikelets with female flowers	SD13	CI	N
142	Number of spikelets without female flowers	N_FL_SP_NB	CI	N
143	Standard deviation of number of spikelets without female flowers	SD14	CI	N
144	Length of spikelet [cm]	SPIKLT_LEN	CI	N
145	Standard deviation of spikelet length [cm]	SD15	CI	N
146	Number of female flowers	FEM_FL_NB	CI	N
147	Standard deviation of number of female flowers	SD16	CI	N
148	Number of inflorescences/year	Y_INF_NB	CI	N
149	Standard deviation of number of inflorescences/year	SD17	CI	N
150	Concordance of phases	PHASE_CONC	CI	N
151	Standard deviation of concordance of phase	SD18	CI	N
152	Length of male phase [days]	MAL_PH_LEN	CI	N

	Descriptor name	Field name	classi-fication	Field type
153	Standard deviation of length of male phase [days]	SD19	CI	N
154	Length of female phase [days]	FEM_PH_LEN	CI	N
155	Standard deviation of length of female phase [days]	SD20	CI	N
156	Period between phases [+ days]	INT_PH_PER	CI	N
157	Standard deviation of period between phases [days]	SD21	CI	N
158	Period between successive inflorescences [+ days]	SU_INF_PER	CI	N
159	Standard deviation of period between successive inflorescences [days]	SD22	CI	N
160	Age when 50% palms bear their first (unopened) spathe [months]	NOP_INF_AG	CI	N
161	Age when 50% palms with open inflorescences [months]	OP_INF_AG	CI	N
162	Number of leaves emitted until the leaf bearing the first inflorescences	B_IN_LE_NB	CL	N
163	Standard deviation of # leaves until the leaf bearing the first infl.	SD25	CL	N
164	Fruit polar section	FR_POL_SEC	CF	N
165	Fruit equatorial section	FR_EQU_SEC	CF	N
166	Number of trees analysed	NB_TREES	CF	N
167	Fruit weight [g]	FR_WEI	CF	N
168	Standard deviation of fruit weight [g]	SD26	CF	N
169	Nut weight [g]	NUT_WEI	CF	N
170	Standard deviation of nut weight [g]	SD27	CF	N
171	Shell and meat weight [g]	S_AN_M_WEI	C0	N
172	Standard deviation of shell and meat weight [g]	SD28	C0	N
173	Shell weight [g]	SHELL_WEI	CF	N
174	Standard deviation of shell weight [g]	SD29	CF	N
175	Meat weight [g]	MEAT_WEI	C0	N
176	Standard deviation of meat weight [g]	SD42	C0	N
177	Endosperm thickness [mm]	ENDO_THIC	CF	N
178	Standard deviation of endosperm thickness [mm]	SD30	CF	N
179	Solid endosperm dry matter content	S_E_DR_MAT	CF	N
180	Standard deviation of solid endosperm dry matter content	SD31	CF	N
181	Date observations began	OBS_BEG_DT	CY	C
182	Date observations ended	OBS_END_DT	CY	C
183	Percentage of mortality	MORTALITY	CY	N
184	Number of palms observed	OBS_P_NB	CY	N
185	Number of bunches/palm/year	BUN_P_Y_NB	CY	N
186	Standard deviation of number of bunches/palm/year	SD32	CY	N
187	Number of ripe nuts/palm/year	RN_P_Y_NB	CY	N
188	Standard deviation of ripe nuts/palm/year	SD33	CY	N
189	Copra weight per nut [kg]	CO_NUT_WEI	CY	N
190	Standard deviation of copra weight per nut [kg]	SD34	CY	N
191	Copra yield/palm/year	CO_P_Y_YIE	CY	N
192	Standard deviation of copra yield/palm/year	SD35	CY	N
193	Dry matter content oil [%]	DR_ME_OIL	CY	N
194	Standard deviation of dry matter content oil [%]	SD36	CY	N
195	Fresh meat oil content [%]	FR_ME_OIL	CY	N
196	Standard deviation of fresh meat oil content [%]	SD37	CY	N
197	HUSK WEIGHT	HUSK_WEI	CF	N
198	STANDARD DEVIATION FOR HUSK WEIGHT	SD46	CF	N
199	WATER WEIGHT	WATER_WEI	CF	N
200	STANDARD DEVIATION FOR WATER WEIGHT	SD47	CF	N
201	ENDOSPERM KERNEL WEIGHT	ENDO_WEI	CF	N
202	STANDARD DEVIATION FOR ENDOSPERM KERNEL WEIGHT	SD48	CF	N

Table 12. List of Foxpro procedures developed to analyse the content of the CGRD Database

Name	files needed	Action	results and remarks
eclate.prg	ACCESS.DBF	Separate the cultivar name from population name for most of tall and dwarf varieties	Be care of the King coconut varieties, it needs manual care
List_acc.prg	ACCESS.DBF	Provide a comprehensive list of accession s with decision making tool	needs to be completed with characterization evaluation an d molecular evaluation
2012eva1.prg	SITE.DBF 2012EVAL.DBF ACCESS.DBF	Calculation of the numbers of accessions and the numbers of passport data in the CGRD database	Data sent to a world file TEMP.DOC - Use the world option: convert text into table with $ separations
2012eva2.prg	SITE.DBF 2012EVAL.DBF ACCESS.DBF	Calculation of the numbers of characterization passport data in the CGRD database	Data sent to a world file TEMP.DOC - Use the world option: convert text into table with $ separations
2012eva3.prg	SITE.DBF ACCESS.DBF	Calculation of the numbers of unique accessions in the CGRD database	