ICG - SP APPRAISAL

EXECUTIVE SUMMARY

More than 1,000 coconut accessions representing more than 400 cultivars are conserved within five resource-constrained international coconut field genebanks (ICGs) and 19 national coconut genebanks (NCGs) across the world, many of which do not operate according to the minimum required germplasm management standards. COGENT is conducting genebank appraisals to assess key collections': i) hosting agreement status; ii) management effectiveness; iii) roles, services and use, and linkages with users and other stakeholders; iv) performance targets and work plans; and v) collection status within the global context. Based on the findings, the appraisals will recommend appropriate upgrades to technical capacity, information management, infrastructure and accessions, and help develop a sustainability plan.

This first ICG appraisal for the South Pacific (ICG-SP) in Papua New Guinea (PNG), has briefly assessed coconut conservation issues and activities in: breeding; characterization; collecting; conservation; data(base) management; extent of germplasm sharing; genebank design; genebank maintenance; germplasm sharing; ICG establishment cost estimation and funding sources; ICG land ownership arrangements; income generation; and seednut and seedlings production. This report presents 52 prioritized recommendations on what the newly establishing ICG-SP needs to do to ensure it can effectively operate.

As well as gaining a clearer appreciation of the dedication, expertise and many achievements of ICG-SP staff over many years, and a better understanding the complex coconut conservation context, the appraisal has revealed many critical gaps and requirements.

To mitigate the risk of phytoplasma infection causing Bogia Coconut Syndrome (BCS) preparation of a newly situated genebank in Puni Puni is ongoing and the appraisal team expects that the advice given in this report will help in this process. Furnished also with the experience from other genebanks, the community has an opportunity to establish this new genebank on a more sustainable, realistic and manageable footing, that will allow dynamic germplasm exchange within and beyond the multilateral system. From the many recommendations offered in this report (see tables 10 and 11 section 3), the most critical ones include:

1. The varieties presently conserved in Madang should be described in the COGENT catalogue of Conserved germplasm, and the varietal descriptions generated should be used to produce a National catalogue of PNG coconut varieties.
2. The varieties presently conserved in Madang should be appropriately characterized and the data transferred to COGENT and ICC, and/or integrated in the CGRD.
3. The genebank should be conserved to serve as a giant disease resistance test against the Bogia Disease.
4. In situ data during surveys should be safely recorded and shared with ICC/COGENT, which should develop a strategy for international conservation of coconut data.

It will also be crucial that COGENT organizes a way to safeguard and keep of data for all the ICGs. A data sharing agreement should be developed and endorsed and possibly added in the future MOAs regarding ICCs.

BACKGROUND

More than 1,000 coconut accessions[1] representing more than 400 varieties are conserved within five resource-constrained international coconut field genebanks (ICGs) and 19 national coconut genebanks (NCGs) across the world. All five ICGs, and some NCGs reportedly do not operate according to the minimum required germplasm management standards, thus limiting coconut germplasm exchange. the International Coconut Genetic Resources Network (COGENT) is conducting genebank appraisals aim to assess each collection's: i) hosting agreement status; ii) management effectiveness; iii) roles, services and use, and linkages with users and other stakeholders; iv) performance targets and work plans; and v) collection status within the global context. Based on the findings, the appraisals will recommend appropriate upgrades to technical capacity, information management, infrastructure and accessions, and help develop a sustainability plan.

To monitor the activities and performance of the ICGs, COGENT as per recommendation of Steering Committee has to undertake Appraisal to established the current status of ICGs and assess the management of the host countries as stipulated in the MoA in agreement with ITGRFA. The first appraisal was undertaken in Papua New Guinea, the ICG for South Pacific.

Figure 1: Karkar Tall (KKT) (Image: J. Oliver)

Papua New Guinea is a country in Oceania, occupying the eastern half of the island of New Guinea and numerous offshore islands (the western portion of the island is part of Indonesian provinces of Papua and West Papua). It is located in the southwestern Pacific Ocean, in a region defined since the early 19th century as Melanesia. It is one of the most diverse countries on Earth, with over 850 indigenous languages and at least as many traditional societies, out of a population just under 6 millions.

The PNG Cocoa and Coconut Research Institute established in 1986 is the research arm of the cocoa and coconut industries in the country. The Stewart Research Station of CCRI, located at Murunas in Madang Province, conducts breeding and evaluation studies, as well as agronomy and entomology research. CIRAD has played an important role in the establishment of this research centre providing staff, training, technical assistance and funding. In the 1970s, a number of exotic coconut populations were brought into PNG, initially as planting material. Local populations believe that large but fewer nuts involve less labour while still giving similar copra yield to that from palms with smaller but more nuts.

In 1998, the Memorandum of Understanding (MoU) establishing the International Coconut Genebank for the South Pacific (ICG-SP) in Papua New Guinea was signed between PNG and IPGRI/COGENT, with the FAO as trustee. The Stewart Research Station hosts the ICG-SP for the conservation, evaluation and use of important germplasm from the South Pacific region. Substantial progress has been made on the establishment of the ICG including land clearing, renovation of the embryo culture laboratory, training local staff, establishment of local and Dwarf accessions. There were 52 accessions listed: 41 local Tall, six local Dwarfs and five exotic Dwarf populations in the ICG that are being characterized. Since the advent of the phytoplasma Bogia Coconut Syndrome incursion, the genebank is in the process of be relocated , and accessions collected from original sites, and transferred to the quarantine site of Punipuni, until they can safely be transferred to the new genebank site in xxx

Further discussions were held during the 19th Steering Committee (SC) meeting hosted by the Thai government, in Bangkok back-to-back with the 48th Asia Pacific Coconut Community[3] (APCC) COCOTECH meeting. Delegates began elaborating this ToR for the appraisals. Subsequent discussions in Jakarta recommend a three-step process:

Step 1: ICG managers to provide genebank status report according to an agreed and shared format by 31 February 2019

Step 2: Conduct Rapid Appraisals guided by finalised ToR and ICG reports from step 1, by end April /mid-May 2019

Step 3: Detailed ICG assessments completed in June and July 2019

These appraisal dates have been subsequently postponed, to align with when predicted funding becomes available during 2019-2020

Objectives

The specific objectives of the proposed appraisals of ICGs are to:

i. Review the status of hosting agreements to ensure legal and institutional support
ii. Assess the effectiveness and efficiency of the management, operations, facilities, and activities of each of the ICGs.
iii. Assess the roles, services and use of the ICGs, and the linkages with users and other partners.
iv. Review the status of the ICGs with respect to performance targets and the feasibility of proposed work plans to reach targets.
v. Consider the status of individual collections maintained by the ICGs in the context of a global system for long-term conservation and use of the selected coconut accessions in question.
vi. Provide actionable recommendations and pathways for the strengthening of the ICGs' operations within the host Government framework and their linkages to COGENT member countries based on perceived country needs.

The appraisal was facilitated by ICC staff Dr Pons Batugal, assisted by Vincent Johnson, Interim COGENT Coordinator and Dr Ehsan Dulloo, *In-situ* conservation expert and continuity liaison with the Bioversity International- CIAT Alliance, who provided background information, coordinated the development of the agenda, managed any user or partner survey, and coordinated the execution of the review on site. The ICC or Bioversity staff member facilitated all review sessions and assisted in the review, and the completion of the final report.

APPRAISAL PROCESS

This first ICG appraisal was conducted in PNG by using a method of focused group discussion and Participatory Rapid Appraisal (PRA) undertaken in 3 stages as outlined below:

Stage 1: Review of the ICG-SP Documentation and Performance Assessment through Focused Group Discussion (FGD)

The Appraisal Team requested the following documents:

i. Long-term grant agreement(s)

ii. Annual technical reports and workplans
iii. Self-assessment of past and current performance of ICGs
iv. Manuals, website and related materials of ICGs
v. Any relevant strategic planning documents for ICGs
vi. Relevant past reviews of ICGs (e.g. the Cirad mission to ICG-AIO)
vii. The past 5-year budget or expenditures of ICGs
viii. Any other materials needed by the appraisal team as background

Stage 2: Actual Field Visit

Interactions took place in advance of the site visit, between the Appraisal Team member and Bioversity International /ICC staff, by email or conference call.

The team visited the Stewart Research Station (SRS) Madang and met with researchers and officers in charge. The team briefed the SRS staff on the purpose of the ICG-SP assessment. Then the SRS staff briefed the team on the status of the genebank. Then the team conducted a field visit to validate the status of the genebank as reported.

All Appraisal Team member(s) and the ICG Curators were involved in the development of the agenda for the site visit. This is an important process during which specific issues and questions are identified for review and relevant stakeholders and users were consulted.

The Appraisal Team members conducted site visits following the agreed agenda. The site visits involved interactions between the Appraisal Team members and relevant senior officers, researchers, and breeders, as well as the technical field staff following an agreed agenda (see Annex 2). The Appraisal Team member(s) determined the scale of these interactions in the development of the agenda.

Appraisal Team members may wish to reviewed together the findings at the end of each day. They also adjusted the agenda in order to pursue certain issues in greater detail. The draft recommendations were be presented to KIK after the first draft to agree for the final review.

The team leader noted more specific brief methodological details as indicated in the opening paragraph of appropriate sections of the findings.

Stage 3: Completing the Report and Presenting the Recommendations for Action Planning

The team wrote the draft report based on available data submitted by SRS and the field visit findings. The report has been submitted to ICC for initial review to ensure that the recommendations are clear and actionable. ICC and COGENT solicited response from each of the five ICGs and provided its own response to the recommendations. In the event of a lack of endorsement by a particular ICG, the ICC or COGENT to a recommendation, further discussions were undertaken between the ICC, COGENT, Appraisal Team members and the senior officers responsible for the ICGs.

The report will also be made available on the ICC-COGENT website and provided to ACIAR.

The ICC will also review the completed ICG Appraisal Reports and a report was presented in the 56th ICC Session/Ministerial Meeting held in 2021. The Covid-19 pandemic conditions caused the delays of the subsequent appraisals.

FINDINGS AND TECHNICAL OBSERVATIONS

A. Legal Aspects

The MoA with Milne Bay Provincial Government and Maramatama LLG for the use of Stewart Research Station in Madang Province for the ICG-SP has been signed for use over a 99-year period. The collection will soon be re-established in a new site, to avoid Bogia Syndrome phytoplasma infection, and acquisition of 129 hectares is in progress. Once the land is surveyed and portions mapped and registered, title will be transferred to Kokonas Industri Koporesen (KIK).

Regarding the international status of the collection, the host government signed an agreement with FAO, on behalf of the Governing Body of the International Treaty, and Bioversity International, on behalf of COGENT, in accordance with Article 15 of the International Treaty (see annex 5.2). The agreement is in the course of being amended to reflect ICC as the new COGENT host organization.

B. General Genebank Management

- *Conserved germplasm authenticity* In a few genebank plots, some Talls are mixed with Dwarfs in the same planting rows
- *Level of maintenance and wellbeing of accessions*
- *Weeding.*
- *Irrigation and fertilization*: Irrigation is not practised at ICG-SP
- *Intercropping*: SRS is currently piloting the following intercrops: cocoa, pineapple, taro, vanilla.
- *Controlled pollination and other regeneration methods*

There is no controlled pollination laboratory in Stewart Research Station (SRS), so any disseminated varieties were only obtained via open pollination and are thus mixes between neighbouring accessions. Experimental hybrids were produced via assisted pollination in isolated seed gardens, with no inflorescence bagging or emasculations, but pollinating with a mix of talc and pollen from at least 20 different male parents from the same variety, limiting the range of possible combinations.

C. Coconut Germplasm Conserved in PNG

The team: i) asked local staff to supply a list of available germplasm; ii) extracted available data from the coconut genetic resources database (CGRD) and compared the two lists, with special emphasis on International names and abbreviations of cultivars and populations; and iii) asked for any recent or a new inventory/counting of the living palms of accessions of the genebank. (The new inventory can then be done on a genebank map by indicating a “x” at the places were palms are dead. These maps can be scanned and added as annexes to the reports).The genebank field maps for ICG-S, provided by Dr Bourdeix can be found in Annex 5.4.

Most of the ICG-SP germplasm is conserved in Stewart Research Station (SRS) and Rabaul, some in the Manabo seed gardens, and a small amount in other locations, as described in Annex 5.3). Among the 57 accessions registered in the Coconut Genetic Resources Database (CGRD, see annex 5.3 table 12), 54 of them are located in SRS and 3 in Rabaul[4]; 7 accessions (of which the 3 from Rabaul) have a zero value for accession size (although in the list, there is no location listed. The inventory was updated and transmitted by T. Eremas in September 2019, but some data are still missing (7 accessions are remaining with 0 value for accession size, some of them seem to be lost). There are some new accessions available in the genebank, especially Spicata Dwarfs, but they are not yet registered in the CGRD.

Annex 5.3 provides detailed information of ICG-SP accessions data extracted from the CGRD (tables 13-15)), and indications of data status. The germplasm data review highlights concerning gaps and degraded accessions. Many last inventory dates are more than 10 years-old, or missing, and living palm numbers often unrecorded. Many populations are highly endangered, conserved by only one accession and planted more than 24 years ago, or their planting dates are missing. Descriptor completion rates for both passport and characterization data are unacceptably low, and the appraisal could not determine the level of need for merging potentially duplicate populations. Data for accessions planted in Manabo have even more gaps. Some Spicata variants and Garuk types have sometimes been wrongly described as new varieties Other locations are host to poorly documented coconut germplasm including at Gobaragere, Kapogere, and Rigo (planted for experimental and demonstration purposes) and include at least nine foreign Tall-type introductions. (see annex 5.3 for more details).

D. Germplasm Characterization and Evaluation

From the many accession-based observations only a part of the data has been captured on computer, few of these data were analyzed and even less were published in scientific articles or in the CGRD. As is customary accessions' characterization data were collected in farmer's field during collecting missions, but this original data has been lost.As an example of what characterizations may miss, some Dwarf varieties in PNG are highly sensitive to environmental variations, as illustrated in figure 1.

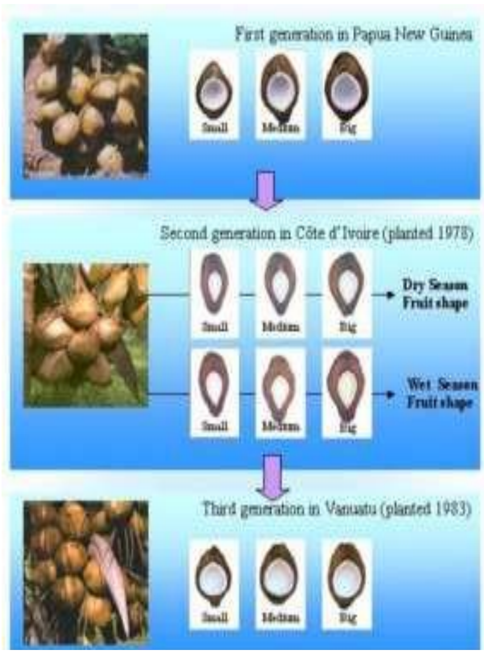

Figure 1. Environmental variation of fruit shape and size in the cultivar Madang Brown Dwarf (MBD)

E. Germplasm Data management

CDM data: Availability of palm-by-palm data was assessed using Coconut Data Management software (CDM) and associated database. Data includes identification of characters, immature vegetative observations, leaf morphology, stem measurements, flowering dates, inflorescence morphology, fruit and bunch return, fruit component analyses, and state of the palms. This provided estimates of data completeness for coconut bunches, fruit and fruit analysis, and other characterization data, as well as numbers trial plot, other codes and trials duration. No hard copy data back-up was available. A backed-up copy of the PNG data was provided to Dr J. Maot, ICG- SP in September 2019. Since 2007 bunch data collection has dwindled from around 40,000 data points (dps) per year to less than 1,000, and 185 dps lacked any year of observation. Observations conducted on > 9,000 palms belonged to only 6 experiments, (5 hybrid tests and 1 genebank). Only the father palm was mentioned for ≥3,400 records. Between 2003 and 2009, 9,204 fruit analyses were conducted across only 4 hybrid experiments. Data errors included where whole fruit weights were lower than the de-husked- or split-fruit weight. Other putative errors were detected in SRS CDM software-linked data. Many data remain on floppy disks, unreadable by the available computer. A critical and large dataset is stored in MS Excel format, that needs to be analysed for filling data and information gaps in the CGRD and the catalogue of conserved germplasm. A hard copy statistical report on SRS germplasm data analyses is available at SRS and will be supplied.

CGRD Data: was extracted, copied an Excel file named SRSCGRD.XLS and sent to SRS researchers. The CGRD contains 202 fields, almost all of them corresponding to international descriptors as listed in the STANTECH Manual. (see annex 5.16 for complete list of all 202 data fields, and table 1 below for list of categories in 10 categories). Field-based characterization data was evaluated with the following findings: i) there are no characterization data for *germination*; ii) *planting density* is not indicated; iii) for *stem characteristics*: only 37 accessions data among 57 accessions record stem girth at 20 cm, and none for stem girth at 150 cm; no leaf-scar counting, and no palm-height measurements; iv).for *leaf characteristics*: there are data on 37 accessions among 57 for some descriptors only: petiole length, width and thickness; rachis length; leaflet number and length. No data provided for the other leaf characteristics; v) No data available for characterization of the inflorescence, fruit component analysis and yields of bunches and fruits.

Table 1: Classification of the Fields in the CGRD Database for Genebanks Evaluation (Yellow Fields= Observations)

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

*COGENT Catalogue Data***:** Data was extracted on countries, varieties and population available in the catalogue, then checked to determine if varietal descriptions come from the country itself or from another country, then seeing what texts and photographs were available but not yet published. Recommendations indicate work needed for completion. Only five varietal descriptions of PNG-hosted germplasm are presently included in the Catalogue. Only 3 varieties are described, with two of them described in distinct two locations (see table 14/15 in Annex 5.5b). Despite the 2003 CIRAD training for the standard coconut varietal descriptions no input has been received. Some of pictures were digitized and are still available, but others were stored as negatives in Bioversity’s

Malaysia office and subsequently lost.

F. Utilization of conserved germplasm in breeding programs and seed production

Table 2 outlines nut, copra and oil yields for promising ICG-SP accessions (15) and hybrids (6). These are ranked according to overall performance, assuming that the VCO yield potential adds significant value compared to other traits, and so its ranking is double weighted. Generally, the Tall-types are outperforming the dwarfs, and the hybrids doing even less well. However, breeders will need to also consider other key added-value traits such as phytoplasma resistance, drought tolerance, and coconut water-, or medium-chain triglycerides content.

Table 2: ICG-SP key accessions performance (nut, copra and oil yields)
Note: Hybrids in red italics

Type	Name	Nuts/palm		Nuts/ha		Copra yield		VCO yield				Weighted score	
		Rank	#	Rank	#	Rank	T/ha	Rank	Nuts/L	Rank	L/ha	Rank	Score
T	Rennel Island Tall (RIT)	3	72	5	10224	2	2.95	3	8	1	1278	1	3.6
T	East Sepik Tall (ELT3)	9	61	10	8662	3	2.47	1	7	2	1237	2	5.6
T	Karkar Tall (KKT1)	5	70	7	9940	7	2.00	4	9	3	1104	3	6.6
T	East Sepik Tall (ELT4)	6	69	8	9798	1	3.14	6	11	6	891	4	7.8
T	Markham Valley Tall (MVT2)	11	58	13	8236	4	2.15	4	9	5	915	5	9.2
T	Markham Tall (MVT1)	12	49	19	6958	6	2.10	1	7	4	994	6	9.4
T	Karkar Tall (KKT2)	7	65	9	9230	9	1.89	6	11	7	839	7	10.2
T	Oro Tall (OLT1)	3	72	5	10224	10	1.87	11	13	8	786	8	11.2
T	Milne Bay Tall (MBT3)	1	76	3	10792	5	2.11	17	16	10	675	9	12.6
T	Vailala Tall (VLT2)	2	75	4	10650	8	1.93	17	16	11	666	10	14.0
D	Malayan Red Dwarf (MRD)	9	61	2	10980	15	1.43	15	15	9	732	11	14.8
H	*MRD x OLT3*	*13*	*48*	*14*	*7680*	*17*	*1.40*	*9*	*12*	*12*	*640*	*12*	*17.2*

H	*PBD x MVT1*	*20*	*40*	*21*	*6400*	*12*	*1.50*	*6*	*11*	*14*	*582*	*13*	*18.6*
D	PNG Brown Dwarf (PBD)	18	46	12	8280	18	1.26	11	13	13	637	14	19.2
H	*PBD x KKT3*	*17*	*47*	*17*	*7520*	*13*	*1.45*	*11*	*13*	*15*	*578*	*15*	*19.8*
D	Malay an Yellow Dwarf (MYD)	8	63	1	1134 0	21	1.02	19	20	17	567	16	20.4
H	*PBD x WLT2*	*19*	*43*	*20*	*6880*	*14*	*1.44*	*9*	*12*	*16*	*573*	*17*	*20.6*
H	*MRD x RIT*	*13*	*48*	*14*	*7680*	*11*	*1.56*	*15*	*15*	*19*	*512*	*18*	*21.2*
H	*MRD x KKT3*	*13*	*48*	*14*	*7680*	*16*	*1.42*	*14*	*14*	*18*	*549*	*19*	*21.4*
D	PNG Red Dwarf 2 (PRD2)	13	48	11	8640	20	1.03	20	26	20	332	20	24.8
D	Rabaul Red Dwa rf (RRD)	20	40	18	7200	19	1.22	21	28	21	257	21	28.2

Annex 5.6 contains a table format (table 19) for recording varieties and hybrids identified with traits of interest for breeding and seed production.

G. Germplasm Sharing - Movements from and to PNG

The CGRD was searched to determine which varieties from PNG are in other COGENT genebanks. Other sources were checked to see if such varieties may have been sent abroad but not registered in the CGRD. Old germplasm movement records were checked for useful information.

Germplasm requested by other countries

There are 41 Tall accessions and 12 Dwarfs conserved in the ICG-SP. No country has officially requested germplasm from the ICG-SP. This is due to lack of: i) effective dissemination of characterization data on conserved germplasm; ii) proactive training on genetic resources and breeding for SP countries; iii) proactive program of breeding and germplasm sharing; iv) facilities for controlled pollination with bagging

Varieties from PNG conserved in other countries

The varieties presented in table 22, Annex 5.8 have been sent from PNG to other COGENT countries. Some of these varieties were first sent to the Marc Delorme Research Centre in Côte d'Ivoire, Africa; then the African genebank shared these with many other countries.

Records of old germplasm movements

Annex 5.8b outlines movements of over 2000 seednuts transferred to Côte d'Ivoire during the 1960s to 1980s, which were important in breeding programs.

H. Financial Aspects in SRS

The method consists of establishing a list of projects and funding dedicated to coconut conservation and breeding in the country. Some relevant information is available on the COGENT website by country. Special attention must be paid to the fruit production of the genebank and breeding programmes, on how this production is presently marketed, and how better income could be generated.

SRS presented 2019 revenues and expenses for both the genebank and the associated commercial plantation. Table 3 shows that genebank copra sales revenues earned slightly more (US$2,330) than the running costs. Assuming costs were spread over the 57 accessions, this is US$224/ accession, with net earnings of US$41/accession. Table 4 shows that the linked SRS plantation copra sales revenues earned US$54,610 and spent US$73,730, a nett cost of $19,120. Taken together, the genebank and plantation show a slight deficit of $16, 780, (Table 5), with the genebank 'subsidising some of the costs of the plantation. With increasing productivity and diversification to include intercrops and developing HVCPs, the genebank plantation could earn significantly more revenues.

Genebank Expenses and Earnings (Not Including Technical Staff Salaries)

Table 3: ICG-SP expenses and earnings 2019

Item	US$
Copra Sales Revenues	15,050
Total Expenses (chemicals, equipment, wages[5], fuel, office)	12,715
Profit	2,335
Average costs per accession (@57 accessions)	223
Earnings /accession	264
Net profit/ accession	41

Plantation: **Profit expenses and income (Sales minus operating costs)**

Table 4. ICG-SP plantation expenses and earnings 2019

	Item	(US$ '000)
Income	Dry coconuts sales	3.94
	Copra sales	38.79
	Cocoa sales	11.69
	Diesel sales	0.15101
	Cash back	0.03496
	Total sales revenues	**54.61**
Expense	Casual wages[6]	60.54
	Other expenses	13.19
	Total Expenses	**73.73**
Nett amount		**(19.12)**

Total Summary for SRS Plantation & SRS Genebank Revenue & Expenses

Table 5: ICG-SP plantation and Genebank expenses and earnings 2019

	Item	(US$ '000)
Inco me	Genebank	15.05
	Plantation	54.61
	Total	69.66
Expe n	Genebank	12.72
	Plantation	73.73
	Total	86.44
	Income minus expenses	(16.78)

Funds provided by PNG government to ICG-SP (Ismail? Pons?)

Table 6: ICG-SP Funding Status

Funding Source	Amount ('000)		Reason
	PGK	US$	
PNG government recurrent budget for genebank allocation	50	14.67	sanitation & upkeep due to BCS.
KIK allocation–in 2019	1,600	470	SRS R&D
National Planning and monitoring	5,500	1,610	for R&D total including the above
Provincial government	0	0	
Total	7,150	2,095	

5 The profit computation does not include total cost of salaries of technical persons managing the genebank.

6 as for footnote above

Funds provided by other donors (Ismail? Pons?)

- Nil

Funds generated by the genebanks

In 2019, 49.2 tons of fresh copra was produced at SRS valued at PNGK 52,819 (US$15,050). It is sold and PNGK 45,000 (US$13,203) is used for field upkeep. Virgin coconut oil is currently being produced and sold with a current production of ___litres/year, valued at XX US. Production and sale of coconut fiber and peat from the husk is being explored. There are recommendations to explore other income streams from high value coconut products (HVCPs) and intercrops via a proposed sustainability plan.

I. Towards a New International Genebank (Puni Puni)

GPS coordinates for the new site have been recorded (see table 21, annex 5.10a) and the report outlines concepts and ideas for a new genebank design, including recommendations on controlled hand pollination; senile, tall palm replacement; germplasm hygiene; land tenure; germplasm data management and new ways of collecting.

The ICG-SP is currently being transferred to a new site. Other ICGs are also facing the need to transfer or to redesign. Although there are currently 57 accessions conserved in the ICG-SP, according to the COGENT Strategy, in establishing a new ICG we would aim to conserve 200 accessions in total, which would require at least 118ha, assuming 50% Dwarf and 50% Tall types and a planting density of 120 palms/ha (table 7)

Table 7[7] Estimating Area Needed for 200 Accessions (50:50 Tall: Dwarf)

Palm typ	Accession size	Planting density	Area/ accession	# accessions	Total area
	# palms	# palms/ha	ha	#	ha
Dwarf	45	120	0.375	100	37.5
Tall	96	120	0.8	100	80
TOTALS				**200**	**117.5**

Cost estimates for establishing a world class ICG

ICC and COGENT consulted coconut genebank managers from the ICG for Africa and the Indian Ocean (ICG-AIO) in Côte d'Ivoire, the Philippines (PCA), and ICG-SP, PNG to estimate costs for establishing a new 200 accession, 120ha world-class ICG. Costs for restoring and transferring 200 accessions were extrapolated from detailed estimates recently calculated for transferring 60 accessions in ICG-AIO Côte d'Ivoire, with information from a recent Cirad feasibility study (see Annex 15.11b for summary report). The likely establishment cost will be more than US$ 14.14 million[8] (see table 8 for summary and annex 5.11a for detailed breakdown), with annual maintenance costs of up to US$0.56 million (see table 6). The budget allocation for transfer is PNGK 915,000 (US$268,550)

7 source COGENT Strategy

8 Assumptions: i) consumer price rate of 150% for PNG compared with Côte d'Ivoire; ii) there is no difference between collecting or receiving new accessions and restoring / transferring existing accessions; iii) a 10% contingency fund (ICG-AIO assumed 30%)

Table 8: Estimated Costs for Establishing a 200-Accession, 120Ha ICG

ITEM	US$ million
Land Development (120 ha)	1.55
Facilities	
Site construction	0.13
Buildings (labs, greenhouses, workshops)	0.38
Equipment (generator/electricity; farm machinery; IT/office equipment; tools; cameras; water management; vehicles)	0.62
Seednut Production (nursery, nut processing, storage)	0.09
Germplasm Restoration & Transfer (200 accessions)[9]	10.08
Sub total	12.85
Contingency (10%)	1.29
GRAND TOTAL	**14.14**

Table 9: Estimated Range of Annual Running Costs (from COGENT Strategy)

US$/accession		US$ total (for 200 accessions)	
low	high	low	high
762	2,787	152,400	557,400

Possible funding sources (Ismail?)

9 extrapolated from Cirad feasibility study

RECOMMENDATIONS

1. Priority Recommendations

Table 10: Top Priority Recommendations for ICG-SP

Area		Recommendation
1.1 Legal aspects		1. Ensure the new land title is transferred to Kokonas Industri Koporesen (KIK) and land tenure secured as a public utility
		2. Ensure the new, updated tripartite Article 15 agreement between ITPGRFA, the PNG Government and ICC is signed up upon receipt.
1.2 General genebank management	Germplasm authenticity	3. Ensure tall/dwarf mixtures are avoided in order to reduce confusion of technical staff and labor force in the data gathering. Each planting row should be preferably planted with a single accession.
	Accession maintenance	4. Use of cocoa as intercrop should be re-evaluated as it poses a risk to *Phytophthora* infection for the coconut palms with same species of causal pathogen.
		5. Conduct a cost-benefit analysis for feasible and high-value intercrops
1.3 Controlled pollination & other regeneration methods		6. The use of controlled pollination is recommended, not least for efficient coconut breeding.
1.6 Germplasm data management		7. The accessions inventory in the genebank should be mapped (see annex 5.4) including the locations and indicating the dead palms as these allow inspectors to see the dynamics of dying palms.
		8. Germplasm data gaps need to be filled as follows: inventories must be updated, living palm numbers validated, accessions upgraded, rationalised and/or duplicated where needed; & descriptor completion rates for both passport & characterisation data increased to acceptable levels.
		9. Data gap-filling up is especially needed for accessions planted in Manabo, and for material at Gobaragere, Kapogere, and Rigo
		10. Following any introduction of several populations of the same cultivar, molecular and characterization data should be comprehensively analysed to decide if all the collected populations should be kept separately, or some merged, or renamed as new cultivars accordingly (see: http://www.cogentnetwork.org/faq/140-naming)
		11. Errors in CDM data need to be corrected, gaps filled, and collection frequency restored to pre- 2007 levels
		12. Hard-copy statistical report on SRS germplasm data analyses to be supplied to COGENT.

Area	Recommendation
	13. Routine statistical analyses should be conducted.
	14. These is a need to set up an annual reporting format and procedure articulating the observations conducted during the year. For each variety or hybrid tested, this report must indicate the number of palms observed for fruit and bunch return, the number of palms observed for fruit analysis and vegetative measurements, and the average and standard deviation of the measurements done.
	15. COGENT should organize a way to safeguard data for all the ICGs.
	16. A data sharing agreement should be developed and endorsed and possibly added in the future MOAs regarding ICCs.
1.8 Additional prospecting and collecting expeditions	17. The ICG-SP Priority Accessions Collection Schedule (see table 17) needs updating.
1.9 Germplasm sharing	18. Effective dissemination of characterization data on conserved germplasm;
	19. The ICG-SP to develop facilities for controlled pollination with bagging
1.10 Financial aspects in SRS	20. Maximize host government funding support, as well as the support provided by other donors
	21. In collaboration with ICC-COGENT consider in addition to copra and germplasm and planting material supply, how high value coconut products (HVCPs) such as VCO and coconut sugar, and intercrop production can generate extra ICG-SP revenues, and boost nut productivity to support the ICG-SP. Dedicated genebank focal person who should develop project proposals including those listed in annex 5.9:
	22. Use all the 1.10 information to help ICG-SP co-develop the proposed COGENT ICG-SP business sustainability plan
1.11 Towards a new ICG-SP (Puni Puni)	23. Review its budget for establishing the new genebank using information provided in this report, which combines estimates from genebank managers, the consultations within the COGENT strategy, the ICG-AIO transfer feasibility study and ICG-SP's experienced staff
	24. Reconsider potential plans regarding establishing a first-class that may not fully address field constraints. This will include considering the two ICG-SP establishment options outlined in this report: either set up i) a *classical genebank*, with all the needed infrastructure, resources, equipment and a regular team of 4 to 8 people devoted to controlled pollination for breeding and genebank management, or ii) a *genebank with special designs* trying to integrate tree buffers and large plots that will allow use with open pollination only. Please note that controlled pollination can also be used in such designs.

2. Specific Recommendations

Table 11: 2nd Priority Recommendations for ICG-SP

Area	Recommendation
1.2 General genebank management	1. Consider mulching with cacao leaves in controlling weeds of already established coconut germplasm with cocoa intercrops. Cacao leaves also boost potassium levels
	2. Consider cover-cropping for weeds control. *Mucuna bractaeta* is preferred as cover crop as it is very efficient in killing/blanketing all weeds. It is affordable as you need only once to plant only 4 seeds (costing US$0.10) around each coconut palm. It also fixes up to 250 kg N/ha/year
	3. Consider irrigation or fertigation. The cost of fertigation has been reduced ten-fold from US$10,000/ha to US$1,000/ha, with lifespan of 8-10 years @ US$100/ha/year. Supplies water during dry months and spreads fertilizer application every month for effective continuous nutrition support to coconut palms
	4. Apply MYKOVAM, a concoction of 12 races of Mycorrhiza fungi. It Increases soil Cation Exchange Capacity (CEC) and improves palms' nutrient absorption capacity. It is affordable: A single application is required of 2 tablespoons/palm costing only US$ 1/palm. The fungus will then multiply by itself.
	5. Apply Bioyodal soil ameliorant. It contains 14 macro- and micronutrients. It is affordable: Apply 0.5 kg/palm every 3 years (costing $US 0.17)
	6. Apply coconut coir dust at the base of each palm. It contains up to 8% K. It absorbs 8 times its volume of water and increases the water absorptive capacity of the soil. It is affordable: Coir dust from coconut husk is a farm by-product.
1.6 Germplasm characterization, evaluation and data management	7. All Spicata variants and Garuk types should be re-described as variants and not described as new varieties. Rabaul has at least four kinds of Spicata Dwarfs' populations needing to be registered and conserved. Some DNA analysis may be required to identify the varieties to which they are related.
	8. During any new collecting missions, care must be taken to keep and secure the new data collected from farmers' fields.
	9. Dwarf varietal sensitivity to environmental variations must also be evaluated.
	10. The CDM data stored only on floppy disks needs to be transferred and integrated into the ICG-SP germplasm data system
	11. Data held exclusively in MS Excel format needs to be analysed for filling data and information gaps in the CGRD and the catalogue of conserved germplasm.
	12. Within the CGRD data gaps in field-based characterisation data should be filled for stem and leaf characteristics (incomplete); and for germination; planting density; inflorescence; fruit component analysis and yields of bunches and fruits (none).

Area	Recommendation
	13. Consider updating data in the COGENT Catalogue (only 5 ICG-SP varietal descriptions included)
	14. Errors in fruit.dbf data need to be corrected, and gaps filled.
	15. Even where data is computerized, the original paper datasheet should be kept on file
	16. If a publication giving the results of breeding experiments is not found, there is a need to conduct a balance of breeding experiments, to re-check the data, then re-do a complete set of statistical analyses on these data, and to publish a scientific paper on this topic
	17. ICG-SP staff should access the downloadable Coconut Data Management software here[10]:; & the Coconut Data Management manual here[11]:
1.7 Utilization of conserved germplasm in breeding programmes & seed production	18. All ICGs, (incl. ICG-SP) should document high-performing hybrids & varieties globally and information shared with member countries, in format given in table 10, annex 5.6 to include for each variety: Name; Av. # nuts per palm; # nuts/ha; copra /VCO yield, & % medium chain fatty acids (MCFA)
	19. ICGs should identify & conserve parents with promising traits and share these with member countries.
	20. COGENT should train member countries on genetic resources conservation and breeding.
	21. COGENT through ICGs should help capable member countries establish a proactive breeding program and a system of distributing breeding materials.
1.9 Germplasm sharing	No country has officially requested germplasm from the ICG-SP. To enable this, the appraisal recommends:
	22. distinguish germplasm movements conducted before or after the genebank acquired international status
	23. Provide proactive training on genetic resources and breeding for SP countries;
	24. Develop proactive program of breeding and germplasm sharing
1.10 Financial aspects	25. Review list of projects and funding dedicated to coconut conservation and breeding, with special attention paid to fruit production of the genebank and breeding programmes, on how this production is presently marketed, and how better income could be generated.
1.11 Towards a new ICG-SP (Puni Puni)	26. Review the detailed new genebank design advice provided in this report on geo-localisation; controlled hand pollination; senile/ overly tall palm replacement; germplasm hygiene; land tenure; germplasm data management and new ways of collecting.
	27. Consider adopting adapted (Indian) palm-climbing techniques to reduce climbing frequency for CHP
	28. Bearing in mind that collecting and breeding require a great deal of resources, especially time, consider a new way of collecting germplasm (as opposed to that outlined in the Stantech Manual), where selecting palms with interesting traits and their breeding could start in farmers' fields.

10 https://drive.google.com/open?id=0B1x7R7bGIHorM2ZfVFI3aEk1Ync

11 https://drive.google.com/open?id=0B1x7R7bGIHorS1R3X29mZlRwR28

CONCLUSION

Despite the highly appreciated dedication, expertise and many achievements of ICG-SP staff over many years even with the complexity of coconut conservation, the appraisal has disclosed many critical gaps and requirements. These were discussed in details in this report and addressed in the prioritized 52 recommendations as listed in above tables 10 and 11.

The examples of the three previous coconut genebanks in PNG (before Stewart Research Station) at present situations where *all the data and all the conserved varieties were lost, this* should be avoided. Something should remain both for PNG stakeholders and the ICC/COGENT community. So, the appraisal team strongly recommends:

1. The varieties presently conserved in Madang should be described in the COGENT catalogue of conserved germplasm, and the varietal descriptions generated should be used to produce a National Catalogue of PNG coconut varieties.
2. The varieties presently conserved in Madang should be appropriately characterized and the data transferred to COGENT and ICC, and/or integrated in the CGRD.
3. The genebank should be conserved to serve as disease resistance test against the Bogia Disease.
4. *In situ* data during surveys should be safely recorded and shared with ICC/COGENT, which should develop a strategy for international conservation of coconut data.

The preparation of the new genebank in Punipuni is on-going and the appraisal team expect that the advice given in this report will help in this plan. Armed with the experience from other genebanks, the community has an opportunity to establish this new genebank on a more sustainable, practical and manageable that will allow dynamic germplasm exchange within and beyond the multilateral system.

The time allocated to technical assessments of data during this appraisal was too short. There is a need to work with researchers on computers during 4 to 5 days, and to be able to discuss technical options, in order to try to assess precisely the data, and possibly help them to better organize it. This crucial technical appraisal should preferably be conducted before the rest of the official visit, as in this way appraisers will have a complete view of the status of the data before starting.

The fact that vast amounts of data lost in PNG was given back by Dr Roland Bourdeix from his own private computer suggest that it will be crucial that COGENT organizes a way to safeguard and keep of data for all the ICGs. A data sharing agreement should be developed and endorsed and possibly added in the future MOAs regarding ICCs.

ACKNOWLEDGEMENT

The International Coconut Community (ICC) and the appraisal team would like to thank the Australian Centre for International Agricultural Research's (ACIAR's) Horticulture Program, and the Australian Department for Foreign Affairs and Trade (DFAT) for supporting the genebank appraisals under its grant for revitalizing COGENT. The team would also like to thank the Kokonas Indastri Koporesen of PNG for supporting the mission and all the PNG research team at Stewart Research Station and Puni Puni for their warm welcome and availability during this visit. A special thanks too to Dr Uron Salum latterly from ICC and to the Land Resources Division of SPC who contributed to the organization and funding of this appraisal. A special note for Dr Roland Bourdeix' s dedicated contributions to the appraisal and compiling this report, and thanks also to Vincent Johnson for his editorial support.

ANNEXES

Assessment Team and Assigned Appraisal Topics

Dr. Roland Bourdeix (Team Leader)

1. Collecting
2. Conservation
3. Characterization
4. Database management
5. Some suggestions for Genebank design
6. Germplasm sent to other countries

Dr. Ismael Maskromo

1. Cost estimate for establishing a world-class ICG
2. Possible fund sources

Dr. Pons Batugal

1. Genebank Maintenance
2. Germplasm sharing
3. Breeding
4. Seednuts and seedlings produced at SRS
5. Income generation
6. ICG land ownership arrangements

ICG-SP SIGNED ARTICLE 15 AGREEMENT

AGREEMENT
between
THE GOVERNMENT OF PAPUA NEW GUINEA
as host of The International Coconut Genebank for the South Pacific
and
THE INTERNATIONAL PLANT GENETIC RESOURCES INSTITUTE
acting on behalf of the International Coconut Genetic Resources Network
and
THE FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
acting on behalf of the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture

PREAMBLE

The Government of Papua New Guinea as host of the International Coconut Genebank for the South Pacific (hereinafter referred to as the "Host Government"); the International Plant Genetic Resources Institute, (hereinafter referred to as "IPGRI"), one of the Centres of the Consultative Group on International Agricultural Research (hereinafter referred to as "CGIAR"), acting on behalf of the International Coconut Genetic Resources Network (hereinafter referred to as "COGENT"), and the Food and Agriculture Organization of the United Nations (hereinafter referred to as "FAO"), acting on behalf of the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture (hereinafter referred to as the "Governing Body");

Considering the importance to humanity of protecting and conserving plant genetic resources for food and agriculture for future generations;

Recalling the Agreement between the Government of Papua New Guinea, IPGRI and FAO placing coconut germplasm collections under the auspices of the FAO signed on 10 and 30 November 1998;

Considering the International Treaty on Plant Genetic Resources for Food and Agriculture adopted by the FAO Conference at its Thirty-first Session in 2001, which entered into force on 29 June 2004 (hereinafter referred to as the "Treaty");

Noting that in Article 15 of the Treaty, the Contracting Parties to the Treaty recognize the importance to the Treaty of *ex situ* collections of plant genetic resources for food and agriculture, held in trust by the International Agricultural Research Centres of the CGIAR, and call upon the Centres to sign agreements with the Governing Body with regard to such *ex situ* collections, and that Article 15 provides that the Governing Body will also seek to establish agreements for the purposes stated in this Article with other relevant international institutions;

Reaffirming the commitment of the Parties to this Agreement to the conservation, sustainable use and equitable sharing of benefits arising from the utilization of plant genetic resources for food and agriculture;

Noting that the Governing Body, on 16 June 2006, has approved the terms of the present Agreement;

Have agreed as follows:

Article 1
Application and interpretation of this Agreement

1. This Agreement shall be construed and applied in a manner consistent with the provisions of the Treaty.

2. The terms used in this Agreement that are also used in the Treaty shall have the same meanings assigned to them as in the Treaty.

3. Any reference in this Agreement to IPGRI, or the International Coconut Genebank for the South Pacific, shall include their successors in title.

Article 2
Rights and obligations of the Parties to this Agreement

The Host Government hereby agrees to place the *ex situ* collection held by it in trust under the agreement with IPGRI and FAO referred to in the Preamble, and known as the International Coconut Genebank for the South Pacific, within the purview of the Treaty in accordance with the following terms and conditions:

(a) Plant genetic resources for food and agriculture listed in *Annex I* of the Treaty and held by the Host Government in the International Coconut Genebank for the South Pacific shall be made available in accordance with the provisions set out in Part IV of the Treaty.

(b) Plant genetic resources for food and agriculture other than those listed in *Annex I* of the Treaty and collected before its entry into force that are held by the Host Government in the International Coconut Genebank for the South Pacific shall be made available in accordance with the provisions of the Material Transfer Agreement (hereinafter referred to as the MTA) currently in use pursuant to agreements between the International Agricultural Research Centres of the CGIAR and the FAO. This MTA shall be amended by the Governing Body no later than its second regular session, in consultation with the Centres, in accordance with the relevant provisions of the Treaty, especially Articles 12 and 13, and under the following conditions:

  (i) The Host Government shall periodically inform the Governing Body about the MTAs entered into by the International Coconut Genebank for the South Pacific, according to a schedule to be established by the Governing Body;

  (ii) The Contracting Parties in whose territory the plant genetic resources for food and agriculture were collected from in situ conditions shall be provided with samples of such plant genetic resources for food and agriculture on demand, without any MTA;

(iii) Benefits arising under the above MTA that accrue to the mechanism mentioned in Article 19.3f of the Treaty shall be applied, in particular, to the conservation and sustainable use of the plant genetic resources for food and agriculture in question, particularly in national and regional programmes in developing countries and countries with economies in transition, especially in centres of diversity and the least developed countries; and

(iv) The Host Government shall take, or ensure that the International Coconut Genebank for the South Pacific takes, appropriate measures, in accordance with its capacity, to maintain effective compliance with the conditions of the MTAs, and shall promptly inform the Governing Body of cases of non-compliance.

The Host Government and IPGRI recognize the authority of the Governing Body to provide policy guidance relating to the International Coconut Genebank for the South Pacific.

The scientific and technical facilities in which the International Coconut Genebank for the South Pacific is conserved shall remain under the authority of the Host Government, which undertakes to manage and administer it in accordance with internationally accepted standards, in particular the Genebank Standards as endorsed by the FAO Commission on Genetic Resources for Food and Agriculture.

Upon request by the Host Government, the Secretary of the Governing Body of the Treaty (hereinafter referred to as the "Secretary") and IPGRI shall endeavour to provide appropriate technical support.

The Secretary shall have, at any time, right of access to the facilities, as well as right to inspect all activities performed therein directly related to the conservation and exchange of the material covered by this Article.

If the orderly maintenance of the International Coconut Genebank for the South Pacific is impeded or threatened by whatever event, including *force majeure*, the Secretary and IPGRI, with the approval of the Host Government, shall assist in its evacuation or transfer, to the extent possible.

The International Coconut Genebank for the South Pacific shall be included in the list of International Agricultural Research Centres of the CGIAR and other relevant international institutions to be held by the Secretary, and will have facilitated access to plant genetic resources for food and agriculture listed in *Annex I* under the Multilateral System, in accordance with Article 15.2 of the Treaty.

The Governing Body will encourage Contracting Parties to provide the International Coconut Genebank for the South Pacific with access, on mutually agreed terms, to plant genetic resources for food and agriculture not listed in *Annex I* that are important to the programmes and activities of the International Coconut Genebank for the South Pacific.

The International Coconut Genebank for the South Pacific shall be invited to attend sessions of the Governing Body as an observer.

Article 4
Consultations regarding implementation

The Host Government and IPGRI shall consult periodically with the Secretary or such other person or entity as the Governing Body may designate regarding the effective implementation of this Agreement. The results of such consultations shall be reported to the Governing Body.

Article 5
Amendment

1. The Governing Body, the Host Government, or IPGRI may propose that this Agreement be amended by giving notice thereof.

2. Should the Treaty be amended in such a way as to significantly change the rights or obligations of the Parties to this Agreement, the Parties to this Agreement hereto shall consult regarding any amendments to the provisions of this Agreement that may be required or such other measures as may be required.

3. If there is a mutual agreement in respect of the amendment, the amendment shall enter into force on whatever date is set.

Article 6
Duration of the Agreement

1. It is the intention of the Parties that this Agreement should remain in force in perpetuity. However, should circumstances beyond its control make it impossible for any Party to fulfil its obligations under this Agreement or fulfil them in a manner compatible with its mandate, any Party may, after a period of two years from the entry into force of this Agreement, give notice to the other Parties of its withdrawal from this Agreement. Such withdrawal shall take effect one year from the date of receipt of such notice. In the event of such a withdrawal, the Parties to this Agreement hereto shall consult with a view to ensuring that the in-trust collections are maintained consistently with the Treaty through other arrangements.

2. This Agreement may be terminated by mutual agreement between the Parties to this Agreement.

Article 7
Settlement of disputes

Any dispute concerning the implementation of this Agreement, which cannot be settled by negotiations between the Parties to this Agreement, shall be settled by arbitration in accordance with the procedures set out in Part I of *Annex II* to the Treaty, except that the references to the Director-General of FAO shall be replaced by references to the Secretary-General of the Permanent Court of Arbitration.

Article 8
Depositary

The Director-General of the FAO shall be the Depositary of this Agreement. The Depositary shall:

(a) send certified copies of this Agreement to the Contracting Parties to the Treaty, to all the Members of the FAO and to any other Government which so requests;

(b) arrange for the registration of this Agreement, upon its entry into force, with the Secretariat of the United Nations in accordance with Article 102 of the Charter of the United Nations;

(c) inform the Contracting Parties to the Treaty, and FAO Members of

  (i) the signature of this Agreement in accordance with Article 9; and

  (ii) the adoption of amendments to this Agreement in accordance with Article 5.

Article 9
Coming into Force

This Agreement shall come into force on the ninetieth day after its signature by the authorized representative of the FAO acting on behalf of the Governing Body and by the authorized representatives of the Host Government and of IPGRI.

Food and Agriculture Organization of the United Nations, acting on behalf of the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture

by: Jacques Diouf
Director-General
(signature)

Date: - 9 MAY 2007

The Government of Papua New Guinea, as host of the International Coconut Genebank for the South Pacific

by:
(signature)

Date: 6/03/07

The International Plant Genetic Resources Institute, acting on behalf of the International Coconut Genetic Resources Network (COGENT)

by: Emile A.G. Frison
Director General
(signature)

Date: 05 MAR. 2007

Accessions Conserved in ICG-SP

a) STEWART RESEARCH STATION AND RABAUL

Each accession is recorded in the CGRD with the following information (see tables 12 and 13): accession number; international name; population origin; international abbreviation; date of first planting (DP); uniqueness (U) – that is the number of accessions that are conserving a specific population of coconut palms (cultivar + population)); Date of last counting/inventory (Dlc); Number of living palms; Population where the date of last inventory is missing or more than 10 years-old, or the number of living palms is unknown: the number of palms remaining alive in the field is uncertain and must be updated; Population highly endangered, conserved by only one accession and planted more than 24 years ago or for which the planting date is missing. Data must be updated, and decision must be taken rapidly to regenerate it or to loss it.; Population highly endangered, conserved by only one accession and that should be regenerated in the 5 coming years; Population with a number of living palms far below the standard (< 40 living palms); Completion rate (%) of the descriptors of the passport section (highlighted in orange when the completion rate < 40%); Completion rate (%) of the descriptors for the field characterization (highlighted in light orange when the completion rate <10%)

The list of accessions was made more comprehensive by adding some criteria and analysis of the rarity of the germplasm and the quality of the data provided. This will help both users, to better understand germplasm conservation, and genebanks for improving the data available in the Coconut Genetic Resources Database.

Inventory updated in September 2019 for Madang only (SRS)

Accessions numbers starting with Coconut and Cocoa Research Institute are in Rabaul

Table 12: List of the 57 coconut accessions conserved in PNG and listed in the CGRD database

	Accession Number	International name	Population	Interna-tional abbre -viation	DP	NBA	Dlc	U	PAS	CHAR
1	SRS BBR	Baibara Tall		BBR	1994	**81**	2019	1	31	12
2	SRS ELT05	East Sepik Tall	Marineberg	ELT05	1995	**??**		1	31	12
3	SRS ELT02	East Sepik Tall	Hawain	ELT02	1995	**78**	2019	1	33	12
4	SRS ELT03	East Sepik Tall	Yangoru	ELT03	1995	**78**	2019	1	33	12
5	SRS ELT04	East Sepik Tall	Vokio	ELT04	1995	**107**	2019	1	33	12
6	SRS GRT03	Gazelle Peninsula Tall	03 R	GPT03		**19**	2019	1	31	1
7	SRS GYT02	Gazelle Peninsula Tall	02 Y	GPT02		**18**	2019	1	33	1
8	SRS GYT03	Gazelle Peninsula Tall	03 Y	GPT03		**10**	2019	1	33	1
9	SRS GLT01	Gazelle Peninsula Tall	01	GPT01	1994	**81**	201	1	24	12

							9			
10	SRS GLT03	Gazelle Peninsula Tall	03	GPT03	1994	81	2019	1	33	12
11	SRS GLT04	Gazelle Peninsula Tall	04	GPT04	1994	80	2019	1	33	12
12	SRS GMT05	Gazelle Peninsula Tall	05	GPT05	1994	81	2019	1	33	12
13	SRS GRT02	Gazelle Peninsula Tall	02 R	GPT02	1996	9	2019	1	33	12
14	SRS GLT02	Gazelle Peninsula Tall	02	GPT02	1994	81	2019	1	35	12
15	SRS HLT	Hihisu Tall		HLT	1994	81	2019	1	31	12
16	SRS IRD	Iokea Red Dwarf		IRD	1995	14	2019	1	31	2
17	SRS ILT	Iokea Tall		ILT	1994	14	2019	1	29	2
18	CCRI KKT	Karkar Tall		KKT		??		14	18	1
19	SRS KKT01	Karkar Tall	Guanaga	KKT01	1995	85	2019	1	33	12
20	SRS KKT02	Karkar Tall	Kinim	KKT02	1996	88	2019	1	33	12
21	SRS KKT03	Karkar Tall	Ulatava	KKT03	1994	85	2019	1	35	12
22	SRS KWT01	Kiwai Tall	Severimabau	KWT01	1994	81	2019	1	33	12
23	SRS KWT02	Kiwai Tall	Boze	KWT02	1994	81	2019	1	33	12
24	CCRI PBD	Madang Brown Dwarf		MBD		??		10	25	1
25	SRS PBD	Madang Brown Dwarf		MBD	1994	99	2019	10	31	2
26	SRS MRD	Malayan Red Dwarf		MRD	1995	99	2019	30	25	2
27	SRS MYD	Malayan Yellow Dwarf		MYD	1995	99	2019	34	27	2
28	SRS MAT01	Manus Tall	Lawes	MAT01	1994	81	2019	1	33	12
29	SRS MAT02	Manus Tall	Lako	MAT02	1994	81	2019	1	33	12
30	SRS MAT03	Manus Tall	Baluan	MAT03	1994	81	2019	1	33	12
31	CCRI MVT	Markham Valley Tall		MVT		??		12	22	1
32	SRS MVT01	Markham Valley Tall	Markham Fa	MVT	1997	??		1	25	12
33	SRS MVT02	Markham Valley Tall	lLara Vill	MVT	1995	??		1	33	12
34	SRS MBT03	Milne Bay Tall	Siagara	MBT03	1996	42	2019	1	33	12
35	SRS MBT04	Milne Bay Tall	Bubuleta	MBT04	1996	42	2019	1	33	12
36	SRS NLT04	Namatanai Tall	Etalat	NLT04	1994	83	2019	1	33	2

37	SRS NLT01	Namatanai Tall	Karu Village	NLT01	1994	**81**	2019	1	33	12
38	SRS NLT02	Namatanai Tall	Kenapit	NLT02	1994	**81**	2019	1	33	12
39	SRS NLT03	Namatanai Tall	Sohu	NLT03	1994	**74**	2019	1	33	12
40	SRS NGD	Nias Green Dwarf		NGD	1996	**99**	2019	5	24	2
41	SRS NRD	Nias Red Dwarf		NRD	1996	**66**	2019	1	24	2
42	SRS NYD	Nias Yellow Dwarf		NYD	1996	**66**	2019	8	24	2
43	SRS OLT01	Oro Tall	Saiho	OLT01	1994	**81**	2019	1	33	12
44	SRS OLT02	Oro Tall	Ajoa	OLT02	1994	**81**	2019	1	33	12
45	SRS OLT03	Oro Tall	Kikibator	OLT03	1994	**81**	2019	1	33	12
46	SRS PARD01	Papua New Guinea Red Dwarf		PARD01	1995	**99**	2019	2	25	2
47	SRS PARD02	Papua New Guinea Red Dwarf		PARD02	1994		20	2	25	2
48	SRS PYD	Papua New Guinea Yellow Dwarf		PYD	1995	**51**	2019	1	25	2
49	SRS PLT	Poligolo Tall		PLT	1994	**81**	2019	1	27	12
50	SRS RARD	Rabaul Red Dwarf		RARD	1995	**99**	2019	1	27	2
51	SRS RLT	Rennell Island Tall		RIT	1994	**81**	2019	23	29	12
52	SRS TRT	Talasea Red Tall		TRT	1995	**155**	2019	1	29	12
53	SRS VLT01	Vailala Tall	Miha Kavava	VLT01	1994	**81**	2019	1	31	12
54	SRS VLT02	Vailala Tall	Keakea	VLT02	1994	**81**	2019	1	31	12
55	SRS WLT01	West New Britain Tall	Gaungo	WLT01	1994	**78**	2019	1	31	12
56	SRS WLT02	West New Britain Tall	Naviro	WLT02	1994	**81**	2019	1	31	12
57	SRS WUNT	Wutung Tall		WUNT		**??**	2019	1	18	1

Table 13: caption acronyms for Table 9

DP	Date (year) of planting	Notes
U	Uniqueness Number of accessions that, in the CGRD database, are conserving a specific population of coconut palms (cultivar + population).	For instance, the ***Malayan Yellow Dwarf*** is conserved as 34 accessions scattered in many genebanks; the ***Thailand Brown Dwarf*** is conserved by only one accession in Thailand.
DLC	Date of last counting/inventory	
NBA	Number of living palms.	there is no date of inventory, or if this inventory was conducted several years ago, we do not know if these palms are still alive.
	Population where the date of last inventory is missing or more than 10 years-old, or the number of living palms is unknown: the number of palms remaining alive in the field is uncertain and must be updated	543 accessions do not have a date of the last inventory; for 440, the inventory dates back more than 10 years old. For 153 accessions, the number of living palms is missing.
	Population highly endangered, conserved by only one accession and planted more than 24 years ago or for which the planting date is missing. Data must be updated, and decision must be taken rapidly to regenerate it or to loss it.	607 populations are conserved in one genebank only, of which at least 255 were planted 25 years ago or later, and of which 39 have no recorded date of planting.
	Population highly endangered, conserved by only one accession and that should be regenerated in the 5 coming years	607 populations are conserved in one genebank only, of which 75 are aged from 20 to 25 years.
	Population with a number of living palms far below the standard (< 40 living palms)	536 accessions have only between 1 and 39 living palms according to the last inventory.cc
PAS	Completion rate (%) of the descriptors of the passport section (highlighted in orange when the completion rate < 40%)	Average completion rate is 57%. 424 accessions among 1680 have a completion rate of less than 40%.
CHAR	Completion rate (%) of the descriptors for the field characterization (highlighted in light orange when the completion rate <10%)	Average completion rate is 32%. 687 accessions among 1680 have a completion rate of less than 10%.

Spicata variants

Population and variant are terms that have a special meaning for the actual coconut nomenclature. Population and variant refer to a group of individuals obtained from a cultivar. Population can be designated to any subgroup located in a restricted location. Variant could be a preferable term for special morphological types which may be found in different cultivars; for example, a special inflorescence shape exists called Spicata, where the number of spikelets and male flowers are greatly reduced. This variant can be encountered in many cultivars originating from countries as distant as India, Papua New Guinea, the Philippines, and Samoa.

So when Spicata variant are discovered somewhere, they should not be described as new varieties, but as a variant of already the existing cultivar and population from which they are derived. For instance, if a Spicata Tall Type palm is discovered in KarKar Island, it should not be named as a new cultivar, but as a population/variant of the cultivar KarKar Tall: *KarKar Tall Spicata*

In the Case of Papua New Guinea, in Rabaul we have seen at least four kinds of Spicata Dwarfs with fruits coloured Yellow, Red (called Red but often apricot color), Green and Brown. So all these populations need to be registered and conserved. *Some DNA analysis may be required* to identify the varieties which whom they are related.

So the names of the "Spicata" presently conserved or described in PNG should be modified, as they are presently as shown in table 14.

Table 14: Names of Spicata varieties in PNG.

Type	Present Accession Name (Cultivars)	# palms	Suggested name
Tall	Spicata Brown Tall	22	Depends on the cultivar of origin (for instance! Kar Kar Tall Spicata)
	Spicata Green Tall	8	idem
	Spicata Red Tall	3	Idem
Dwarf	Spicata Brown Dwarf	7	Madang brown Dwarf Spicata
	Spicata Red Dwarf	16	Papua Red Dwarf Spicata
	Spicata Yellow Dwarf	12	Papua Yellow Dwarf Spicata

Garuk types

This is a special type with soft and crispy endosperm, very distinct from Makapuno types and able to germinate. As this is not a variety but a few palms found among a variety, the question of naming this population should be further studied.

b) MANABO SEED GARDEN

The following inventory was transmitted by Julius Maot in October 2019.

Table 15: Inventory of the Manabo Seed garden

No.	Accession Number/Block Number	International Name	Interna-tional Abbr.	DP	NBA
1	Block 16 (Rit Solomon)	Rennel Island Tall	RIT	1987	180
2	Block 15 (Hausik)	Rennel Island Tall	RIT	2000	152
3	Block 9	Malayan Red Dwarf	MRD	1987	333
4	Block 6	Rennel Island Tall	RIT	2000	414
5	Block 5 (Open Pollination)	Rennel Island Tall X	RIT &	2000	145
6		Malayan Red Dwarf	MRD	2000	286
7	Block 4	Malayan Red Dwarf	MRD	1987	399
8	Block 3	Malayan Red Dwarf	MRD	1987	113
9	Block 2 (Open Pollination)	Rennel Island Tall X	RIT &	2000	157
10		Malayan Red Dwarf	MRD	2000	240
11	Block 1	Rennel Island Tall	RIT	2000	450
12	Block 10 (Open Pollination)	Markham Valley Tall	MVT1 &	2000	52
13		Malayan Red Dwarf	MRD	2000	106
14	Block 11 (Open Pollination)	Markham Valley Tall	MVT1 &	2001	89
15		Malayan Yellow Dwarf	MYD	2001	152
16	Block 12 (Open Pollination)	Markham Valley Tall	MVT1 &	2001	102
17		Malayan Yellow Dwarf	MYD	2001	188
18	Block 13 (Open Pollination)	Markham Valley Tall	MVT1 &	2001	108
19		Png Brown Dwarf	PBD	2001	198
20	Block 14	Markham Valley Tall	MVT1	2000	80
21	Block 16 B (Senile Blocks)	West African Tall	WAT	1983	5
22		Markham Valley Tall	MVT1	1983	17
23		Rennel Island Tall	RIT	1983	30

c) GERMPLASM LOCATED IN OTHER LOCATIONS

Julius Maot visited to Kapogere in 2010. Only about 50 senile coconut palms remained, and the experimental map of the research station had been lost. So it was not possible to recover any of the coconut varieties previously planted at Kapogere. So the accessions cited in this section can be considered as lost.

1900-10, the government established agricultural centres at Rigo, Kapogere and Gobaragere to supply material for planting such crops as rubber, coconuts, cocoa and sisal, to test a wide range of other crops and shade trees. Roads and bridges were gradually constructed in the Rigo area and nearer Port Moresby to serve the developing copper mines. Demonstration plots of various cultivars were planted during the early 1930s at the Bubia Lowland Agricultural Experimental Station. In 1964, a new trial was planted at Kapogere Agricultural Station in the Central District, Papua. The scope of the trial was broadened to include ≥ 9 foreign introductions: New Hebrides, Solomon Islands, Malaysia, Rennell

Island, Singapore, Ceylon-Random, Ceylon-Selected, Maldives and Fiji Talls.

3.2 ICG-SP Data Management

a) Palm by palm data

Here the methodology here consists of estimating the available palm x palm data, which was and is presently recorded. For instance, if the Coconut Data Management software (CDM) is used, the available files must be analysed (using the software CDM or the FoxPRO software) in order to get an estimation of the number of "Bunches and Fruit" data, and the number of "fruit analysis data", and the number of other characterization data. The experiments (plot numbers, other codes) and the period during which these observations have been conducted should also be given. Then a rapid appraisal technique should be used to estimate the quality of data by searching for incompatibilities - such as fruit production without bunch production, or weight of husked nut over the weight of whole nut. If data are kept under MS Excel or any other software, a similar approach should be considered.

CDM (Coconut Data Management) is a software package intended to manage experimental data observed on collections or experimental fields of coconut over a long period following a regular schedule. It is based on the STANTECH manual which describes the organization of field planting, data gathering, and data analysis, along with the characters to be observed. Data management is made for every planted palm. Version 3 is able to manage the database containing these palms with their identification characters, along with data concerning immature vegetative observations, leaf morphology, stem measurements, flowering dates, inflorescence morphology, fruit and bunch return, fruit component analyses, and state of the palms. As the location of every palm in the field is recorded in the database, it is possible to draw maps of the fields with geographical representation of characters. Observations are dated with year and month and it is possible to record one value per character and per month. It is possible to execute powerful queries on the database, to export data into external files, and to make statistical analysis of widely used designs. The manual can be downloaded at this URL:.

https://drive.google.com/file/d/0B1x7R7bGIHorS1R3X29mZlRwR28/view?usp=sharing

From 2012, Dr R. Bourdeix has conserved a set of the PNG data that were the data that has been entered into the software CDM, Coconut Data Management. This set remains available on demand. The best (cleaned) files were also copied on a computer at SRS in the directory d;\backup Files\CDMV3\SRS . **A copy was released in September 2019 to Dr J. Maot.**

To extract any data from CDM to MS Excel, click on the dbf file name (for instance Fruit.dbf), it will open the Foxpro software; then open the command window (fenetre then commande) and write: "copy to temp.xls type xl5"; "copy(blank)to(blank)temp.xls(blank)type xl5"; it will generate an excel file named temp.xls with all the data.

In 2012, the CDM software had been used over 9 years (2003), Dr Faure used it first, then Wendy used it from 2004 without training, she used the CDM manual. Before that the data were entered into MS Excel files (we asked for an example of excel file but did not receive it). We analysed the PNG data in CDM the 21/11/2012 using the Foxpro Software, which was used for writing both CDM and CGRD software.

Analysis of the file Bunch.dbf

In the file Bunch.dbf, 201853 records. Data starts in 2003 up to 2011. 35,000 to 45,000 data points per year were recorded from 2003 to 2006, reducing to about 15,000 data points per year in 2007 and 2008, then reducing again to less than 1,000 per year. There are about 185 data points without any year of observation, and this is abnormal. It was empty data and we deleted them.

We found about 122 data items with more than 50 fruits harvested at the same time that need to be verified. The instructions “set filter to nb_bunch=0 and nb_fr<>0” on the Bunch.DBF give 5 records that needed to be corrected, so we replaced the number of bunches by 1.

Analysis of the file trees.dbf

The analysis of the file trees.dbf shows that observations were conducted on 9,230 palms belonging to only 6 experiments, 702, 703, 704, 05, 706 (hybrid tests) and 709 (genebank). For 3,412 records, the father palm was mentioned but not the mother palm, and we completed information regarding the mother palm.

Analysis of the file Fruit.dbf

The analysis of the file Fruit.dbf shows that 9,204 fruit analyses were conducted. However, the fruit analysis was conducted only in 4 fields, 061, 064, 071, 092 which are hybrid experiments. Fruit analysis was conducted only from 2003 to 2009, with low number in 2007. We searched all the data where the weight of the whole fruit with husk was lower than the weight of the de-husked fruit (coconut) and we found 297 (set filter to fr_totw<nut_totw). We searched all the data where the weight of the coconuts was lower than the weight of split coconut and we found 320 (set filter to nut_totw<spnut_totw). These errors discovered in 2012 were indicated as needing to be corrected.

Normally, even if the data is computerized, the original paper datasheet where the data was registered is preciously conserved. We did not obtain information regarding this aspect from SRS researchers.

Putative Errors detected in the data of CDM Software at SRS research Station

In 2012, Dr Roland Bourdeix conducted an analysis of the data available in CDM format, and he found some apparent errors to be corrected. Details are given in annex 3 of this document. Taking into account these mistakes, if they were not corrected, there is a need to re-do some statistical analysis after cleaning the data.

Data remaining on floppy disks

The local research team indicated that many data may remain on floppy disks that are no longer readable by the available computer. The expert indicated that there are services for that for instance in Australia, please visit:

https://www.doctordisk.com.au/services/data-conversion-services/index.html

Data stored on Excel files

M. Julius Maot sent to us a critical and large dataset in entered in Excel files and not in the CDM software. These data need to be analysed and the results used to complete the CGRD and the catalogue of conserved germplasm.

b) Data in CGRD

Here the methodology here consists of:

1) extracting the data on accessions available in the CGRD database

2) checking if all accessions available in the genebank are properly recorded in the CGRD database

3) evaluating the degree of completion of characterization data (germination, stem, leaf, inflorescence, fruit and yield).

We extracted all existing data in the Coconut Genetic Resources Database for Stewart Research Station in an Excel file named SRSCGRD.XLS, which was sent to SRS researchers.

The CGRD contains 202 fields, almost all of them corresponding to international descriptors as listed in the STANTECH Manual. List of all the fields existing in the CGRD database is given in annex 4 of this report.

In order to evaluate the content of the database, the 202 fields of the database can be divided in 10 categories relevant for genebank evaluation, as shown on table 14

Table 17: Classification of the fields in the CGRD database for genebanks evaluation (a repeat from table 1 in report)

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

Our evaluation focuses on the lines coloured in yellow, because only they contain field observations. Here is the balance of existing data;

- There are no characterization data for germination
- The planting density is not indicated,
- For stem characteristics, there is only 37 data among 57 accessions for girth of the stem at 20 cm, nothing for girth of the stem at 150 cm, no leaf scar counting and no measurement of the height of the palm.
- For leaf characteristics, there are data on 37 accessions among 57 for some descriptors only:

petiole length, width and thickness; rachis length; leaflet number and length. No data is provided for the other leaf characteristics.

- No data is available for characterisation of the inflorescence, for fruit component analysis and yields of bunches and fruits.

The data in CGRD should be completed to keep this crucial information for the future. It is an important part of what will remain from the SRS international coconut genebank from the scientific point of view. The data must also be used to make the decisions about the future of the various populations collected for the same cultivars.

d) Data in the COGENT catalogue of conserved germplasm

Here the assessment methodology here consists of:

1) extracting the data on countries varieties and population available in the COGENT catalogue of conserved germplasm

2) checking if these varietal descriptions come from the country itself or from another country
3) making a balance of the texts and photographs available but not yet published

4) indicate the work to be achieved to reach a satisfactory level of completion

Only five varietal descriptions of PNG-hosted germplasm are presently included in the COGENT Catalogue of Coconut conserved Germplasm. They are: KarKar Tall, described from India genebank; Madang Brow Dwarf, described from Côte d'Ivoire and Vanuatu, with one picture from PNG; Markham Valley Tall, described from Côte d'Ivoire and India. Only 3 varieties are described, with two of them described in distinct two locations (see table 15).

In February 2003, under a COGENT contract, Jean Pierre Labouisse from CIRAD conducted a scientific visit to train local researchers (Mathias Faure was the most concerned) for making standardized descriptions of coconut varieties using COGENT guidelines. After that PNG researchers were supposed to finish the work, consisting on remaining pictures and descriptive texts, but COGENT never received this input.

Some of the pictures were digitalized and are still available. Some other pictures were left as negative films conserved in Bioversity's office in Malaysia when Dr Pons Batugal left COGENT coordination. All these negative films from more than 12 countries, have unfortunately been lost.

Table 18: list of varieties from PNG that are described in the COGENT catalogue of conserved germplasm.

Name and abbreviation	Page	Authors	Origin of pictures & description
Karkar Tall (KKT)	184-185	Ratnambal MJ, Niral V, Krishnan M	India
Madang Brown Dwarf (MBD) in Côte d'Ivoire	186-187	Bourdeix R, Ovasuru T, Konan JL	Côte d'Ivoire
Madang Brown Dwarf (MBD) in Papua New Guinea and Vanuatu	188-189	Ovasuru T, Faure M, Bourdeix R, Labouisse JP	PNG, Vanuatu
Markham Valley Tall (MVT) in Côte d'Ivoire	190-191	Bourdeix R, Ovasuru T, Labouisse JP, Konan J.L.	Côte d'Ivoire
Markham Valley Tall (MVT) in India	192-193	Ratnambal MJ, Niral V, Krishnan M	India

All the varieties presently conserved in Stewart Research Station should be described in the catalogue of conserved germplasm; they will serve also as National catalogue of coconut varieties for Papua New Guinea.

3.3 Germplasm sharing - movements from and to PNG

a) ICG-SP varieties conserved in other genebanks

N: number of alive palms; DLC: date of last counting; U; PAS; CHAR, for other fields please see the caption already provided for table 9.

Table 21: Varieties from PNG conserved in other COGENT genebanks as of CGRD, 2019

Gene[12] bank Code	Accession Number	International name	Interna-tional abbre-viation	Date of planting	N	DLC	U	PAS	CHAR
CIB	CIB KKT R1	Karkar Tall	KKT		41		14	59	22
CIB	CIB MVT R1	Markham Valley Tall	MVT		10		12	20	1
IND	IND011	New Guinea Tall	NGAT	1940	41		1	27	57
YSI	YSI MVT	Markham Valley Tall	MVT	1960	32	1974	12	35	6
CIB	CIB KKT	Karkar Tall	KKT	1964	13		14	45	2
CIB	CIB MVT	Markham Valley Tall	MVT	1964	6		12	22	2
IND	IND084	Karkar Tall	KKT	1972	14		14	31	50
IND	IND085	Markham Valley Tall	MVT	1972	12		12	33	52
SMD	SMD GNG1	Karkar Tall	KKT	1975	59	2007	14	53	56
PHL	ZRC FT3	Karkar Tall	KKT	1977	123	2012	14	57	63
IPRI	IPR-PKT013	Karkar Tall	KKT	1978	0	2012	14	39	6
IPRI	IPR-PKT014	Markham Valley Tall	MVT	1978	0	2012	12	39	6
PHL	ZRC FT2	Gazelle Peninsula Tall	GPT	1979	134	2012	8	57	65
PHL	ZRC FT4	Markham Valley Tall	MVT	1979	124	2012	12	57	65
SMD	SMD NBN	Madang Brown Dwarf	MBD	1979	71	2007	10	59	59
DOAS	UDARS 15	Karkar Tall	KKT	1983	19	1999	14	25	24
DOAS	UDARS 16	Markham Valley Tall	MVT	1983	14	1999	12	27	24
IND	IND118	Gazelle Peninsula Tall	GPT	1983	53		8	61	12
IND	IND117	New Guinea Kavieng Tall	KVT	1983	27		1	63	12
IND	IND114	New Guinea Kiriwana Tall	KRT	1983	37		1	59	12
IND	IND116	New Guinea Orange Dwarf	NGOD	1983	31		1	63	12
VT	VT NBN	Madang Brown Dwarf	MBD	1983		2000	10	59	46

12 see table 19 below for origin genebank codes explanation

Gene[12] bank Code	Accession Number	International name	Interna-tional abbre -viation	Date of planting	N	DLC	U	PAS	CHAR
SMD	SMD GNG4	Gazelle Peninsula Tall	GPT	1984	148	2007	8	51	41
SMD	SMD GNG1 B	Karkar Tall	KKT	1984	40	2007	14	55	32
SMD	SMD GNG3	Markham Valley Tall	MVT	1984	85	2007	12	51	40
VT	VT GGZ	Gazelle Peninsula Tall	GPT	1985		2000	8	67	28
VT	VT GKK	Karkar Tall	KKT	1985		2000	14	63	19
IND	IND085 R1	Markham Valley Tall	MVT	1989	12		12	76	7
NCDP	NCDP-T16	Karkar Tall	KKT	1989	180		14	65	7
NCDP	NCDP-D11	Madang Brown Dwarf	MBD	1990	150		10	71	8
CHRC	CHRC026	Madang Brown Dwarf	MBD	1991	11	1999	10	84	3
PHL	PPC GPT A07	Gazelle Peninsula Tall	GPT	1993	46	1998	8	47	7
PHL	PPC KKT A02	Karkar Tall	KKT	1993	44	1998	14	45	7
PHL	PPC MVT A06	Markham Valley Tall	MVT	1993	43	1998	12	47	7
VT	VT NBN R1	Madang Brown Dwarf	MBD	1994	87	2000	10	69	12
CHRC	CHRC026 R1	Madang Brown Dwarf	MBD	1995	21	1999	10	88	3
VT	VT GKK R1	Karkar Tall	KKT	1999	105	2000	14	92	14
VT	VT GGZ R1	Gazelle Peninsula Tall	GPT	2000	96		8	33	6
CRI	CRI GPT	Gazelle Peninsula Tall	GPT	2006	8	2007	8	84	90
CRI	CRI MBD	Madang Brown Dwarf	MBD	2006	2	2007	10	90	90
CRI	CRI MVT	Markham Valley Tall	MVT	2006	16	2007	12	88	90
SMD	SMD GNG4 R1	Gazelle Peninsula Tall	GPT	2008	157	2012	8	94	91
SMD	SMD GNG1 R1	Karkar Tall	KKT	2008	145	2012	14	98	92
SMD	SMD NBN R1	Madang Brown Dwarf	MBD	2008	133	2012	10	92	92

Table 22: List of site names extracted from CGRD (by R. Bourdeix in October 2020)

Site name	Collecting institute as indicated in CGRD	Country abbreviation	Country
BARI	BARI	BGD	Bangladesh
BRA	EMBRAPA/CPATC	BRA	Brazil
CHIN	CRI-CATAS	CHN	China
CHRC	Chumphon Hort. Res. Cent.	THA	Thailand
CIB		JAM	Jamaica
CICY	CICY	MEX	Mexico
CRI	CRI Sri Lanka	LKA	Sri Lanka
DGEC		VNM	Vietnam
DOAS	DOA Sabah	MYS	Malaysia
IND	CPCRI	IND	India
IPRI	RICP Manado Indonesia	IDN	Indonesia
MHP		MYS	Malaysia
NCDP	NCDP	TZA	Tanzania
OPRI		GHA	Ghana
PAKI		PAK	Pakistan
PHL	PCA-ZRC	PHL	Philippines
SMD	IRHO	CIV	Côte d'Ivoire
SP	SRC-Sèmè Podji	BEN	Benin
SRS		PNG	Papua New Guinea
TCC		FJI	Fiji
TON		TON	Tonga
VT	VARTC, Saraouto u, Vanuatu	VUT	Vanuatu
WS		WSM	Samoa
YSI	JCRS-Levers	SLB	Solomon Island

b) Records of old germplasm movements

The variety Markham Valley Tall was introduced in Africa from Lae. First missed introduction: 500 Seednuts of MVT left Lae (Papua New Guinea) the 27 October 1972, but arrived in Ivory Coast only 23 March 1973; few germinations. Second introduction: 313 seednuts received 17 October 1983 (PB/SEL n°146 - DC n° 605). About 15% already germinated when arriving. Prepared by M. MACARA. Only 85 palms initially planted on plot 142. R. Bourdeix, 1999.

The variety KarKar Tall was introduced in Africa from Port Moresby. First introduction: 11 May 1971, 1000 KarKar seednuts where shipped from Port Moresby but where destroyed in Singapore before arriving in Ivory Coast. Second introduction: September 1974, 120 Kar Kar seednuts where shipped from LAE by airplane but arrived in Ivory Coast only the 30 January 1975. No germination. Third introduction: February 1975, 120 Kar Kar seednuts where shipped from LAE by airplane and arrived in Ivory Coast the first April 1975. Good germination. It was sent from Department of Agriculture, Stock and Fisheries, KONEDOBU. Prepared by A.E. CHARLES, Agriculture Experiment Centre, BUBIA: "Open pollination seednuts not from the source but for from palms of this source growing in a variety trial at Kapogere in Papua ... 15 other varieties in this trial". Another previous introduction of Karkar pollen was made in 1969 from Solomon Islands. This introduction has been used for the pollinations of genetic trials n° 7 and 9 in Marc Delorme Research Centre. Also 100 seednuts received 17 October 1983 (PB/SEL n° 146- DC n° 605). Prepared by M. MAKARA (see SMD GNG1 B). R. Bourdeix, 1999. 75 palms initially planted in 1975 on the plot 102 are now considered as original introduction. In July 1995, 20 % of death, 7 % of abnormal or illegitimate trees.

c) New way of collecting

The method given by the Stantech Manual is as follows: "**Collecting of nuts for ex situ conservation**. Choose 100 normal palms at random towards the middle of the population and take a sample of two nuts per palm to generate a total of 200 nuts. If the number of palms in the population is too small, the number of sample nuts per palm can be increased. Between 80 and 100 plants should be planted in the genebank. Sample nuts from heaps should only be used when there is no alternative."

PNG researchers are free to use this recommended method but in the opinion of Dr Roland Bourdeix, this method is obsolete. Collecting and breeding take too much time. Selection of best palms and breeding should start in farmers' fields. In the Pacific region, coconut populations are often mixed for historic reasons linked to the copra boom. So select palms having common interesting traits, select preferably green palms when available, select nuts with a pink color inside the husk when available. An important point is to take care not to select hybrids mistaken for good Tall-type palms.

Each coconut palm (and even other tree crops) planted in a coconut genebank should be identified by a mother palm number (often given in farmer's fields). This mother palm number should be recorded in a field map. It should be also recorded in a separate file indicating its geographical localization (latitude and longitude). Thus, if necessary, it will be possible to return to the mother palm and, if this mother palm still alive, to collect more seednuts. For the technical application of this golden rule, please see under.

To know more, see:

Two "golden rules" for coconut collection and breeding programmes

Ideas for replanting the Olomanu Seed garden

5.14 References

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5.15 Characterization/evaluation data from SRS secured in the CGRD

Data from Papua New Guinea available in CGRD: stem girth at 20 cm and its standard deviation

Caption

Nb	Field name	Explanation
2	Access_nb	Accession number
15	Cult_name	Name of the cultivar
16	Population	Population Name
105	Fie_est_dt	Date of field establishment
107	Tim_mea_ag	Age at the time of measurement [years[14]]
108	Gir_20	Girth at 20cm above soil level [cm]
109	Sd38	Standard deviation for girth at 20 cm above soil level [cm]

Data

Access_nb	Cult_name	Population	Fie_est_dt	Tim_mea_ag	Gir_20	Sd38
CCRI KKT	Karkar Tall		111994			
CCRI MVT	Markham Valley Tall		111994			
CCRI PBD	Madang Brown Dwarf		111994			
SRS BBR	Baibara Tall		111994	46	172,8	23,8
SRS ELT02	East Sepik Tall	Hawain	021995	43	169,7	20,7
SRS ELT03	East Sepik Tall	Yangoru	031995	42	165,5	22,7
SRS ELT04	East Sepik Tall	Vokio	021995	43	179,7	23,8
SRS ELT05	East Sepik Tall	Marineberg	041995	41	158,5	19,7
SRS GLT01	Gazelle Peninsula Tall	01	051994	52	152,1	30,5
SRS GLT02	Gazelle Peninsula Tall	02	061994	52	161,6	20,7
SRS GLT03	Gazelle Peninsula Tall	03	051994	52	152,9	23,7
SRS GLT04	Gazelle Peninsula Tall	04	061994	51	138,4	14,5
SRS GMT05	Gazelle Peninsula Tall	05	061994	51	162,9	23,5
SRS GRT02	Gazelle Peninsula Tall	02 R	031996	30	138,1	18,5
SRS GRT03	Gazelle Peninsula Tall	03 R	031996			

[14] *Note from RB: for this field the data in the table and CGRD need to be corrected, it is in month instead of year*

Access_nb	Cult_name	Population	Fie_est_dt	Tim_mea_ag	Gir_20	Sd38
SRS GYT02	Gazelle Peninsula Tall	02 Y	031996			
SRS GYT03	Gazelle Peninsula Tall	03 Y	031996			
SRS HLT	Hihisu Tall		121994	45	165,1	17,1
SRS ILT	Iokea Tall		091994			
SRS IRD	Iokea Red Dwarf		021995			
SRS KKT01	Karkar Tall	Guanaga	021995	43	152,9	29,4
SRS KKT02	Karkar Tall	Kinim	1996	33	139,6	28
SRS KKT03	Karkar Tall	Ulatava	051994	52	155,9	20,9
SRS KWT01	Kiwai Tall	Severimabau	111994	46	177,5	28,4
SRS KWT02	Kiwai Tall	Boze	091994	48	156,8	21,4
SRS MAT01	Manus Tall	Lawes	051994	52	151,5	19,8
SRS MAT02	Manus Tall	Lako	051994	52	144,8	17,6
SRS MAT03	Manus Tall	Baluan	051994	52	157,4	24,7
SRS MBT03	Milne Bay Tall	Siagara	021996	31	138	15,4
SRS MBT04	Milne Bay Tall	Bubuleta	021996	31	139,6	11,3
SRS MRD	Malayan Red Dwarf		021995			
SRS MVT01	Markham Valley Tall	Markham Fa	1997	21	137,3	32,2
SRS MVT02	Markham Valley Tall	lLara Vill	121995	33	169,7	45,3
SRS MYD	Malayan Yellow Dwarf		021995			
SRS NGD	Nias Green Dwarf		1996			
SRS NLT01	Namatanai Tall	Karu Village	051994	52	161,3	18,5
SRS NLT02	Namatanai Tall	Kenapit	061994	51	157,9	18,4
SRS NLT03	Namatanai Tall	Sohu	061994	51	166,3	17,9
SRS NLT04	Namatanai Tall	Etalat	051994			
SRS NRD	Nias Red Dwarf		1996			
SRS NYD	Nias Yellow Dwarf		1996			
SRS OLT01	Oro Tall	Saiho	061994	51	157,3	19,7
SRS OLT02	Oro Tall	Ajoa	061994	51	172,5	19,5
SRS OLT03	Oro Tall	Kikibator	061994	51	168,7	24,8
SRS PARD01	Papua New Guinea Red Dwarf		021995			
SRS PARD02	Papua New Guinea Red Dwarf		121994			
SRS PBD	Madang Brown Dwarf		121994			

Access_nb	Cult_name	Population	Fie_est_dt	Tim_mea_ag	Gir_20	Sd38
SRS PLT	Poligolo Tall		061994	51	180,8	21,1
SRS PYD	Papua New Guinea Yellow Dwarf		021995			
SRS RARD	Rabaul Red Dwarf		011995			
SRS RLT	Rennell Island Tall		051994	52	133,7	27,7
SRS TRT	Talasea Red Tall		041995	42	116,8	16,8
SRS VLT01	Vailala Tall	Miha Kavava	091994	48	154,2	22,9
SRS VLT02	Vailala Tall	Keakea	051994	52	176,3	22,2
SRS WLT01	West New Britain Tall	Gaungo	061994	51	152,5	19,7
SRS WLT02	West New Britain Tall	Naviro	061994	52	152	25,5
SRS WUNT	Wutung Tall		061994			

Data from PNG available in CGRD: leaf petiole length, width, thickness, leaf rachis length, Leaflet number & their standard deviations: Caption explanation

Nb	Field name	Explanation
2	Access_nb	Accession number
15	Cult_name	Name of the cultivar
16	Population	Population Name
105	Fie_est_dt	Date of field establishment
107	Tim_mea_ag	Age at the time of measurement [years[15]]
121	Petio_len	Petiole length [cm]
122	Sd2	Standard deviation of petiole length [cm]
123	Petio_wid	Petiole width [cm]
124	Sd3	Standard deviation of petiole width [cm]
125	Petio_thic	Petiole thickness [cm]
126	Sd4	Standard deviation of petiole thickness [cm]
127	Rachis_len	Rachis length [cm]
128	Sd5	Standard deviation of rachis length (cm)
129	Lealt_nb	Number of leaflets
130	SD6	Standard deviation of leaflets number

[15] *Note from RB: for this field the data in the table and CGRD needs to be corrected, it is in months instead of year*

Data

Access_nb	Cult_name	Population	Fie_est_dt	Tim_mea_ag	Petio_len	Sd 2	Petio_wid	Sd 3	Petio_thic	Sd 4	Rachis_len	Sd 5	Lealt_nb	Sd 6
CCRI KKT	Karkar Tall		111994											
CCRI MVT	Markham Valley Tall		111994											
CCRI PBD	Madang Brown Dwarf		111994											
SRS BBR	Baibara Tall		111994	46	181,6	13,8	6,53	0,88	2,99	0,55	443,7	30,3	110,2	6,2
SRS ELT02	East Sepik Tall	Hawain	021995	43	176,1	18,7	6,89	0,88	3,12	0,28	459,4	31,7	108,2	5,7
SRS ELT03	East Sepik Tall	Yangoru	031995	42	173,9	10,1	7,19	0,74	3,44	0,71	468	25,5	113,4	5,5
SRS ELT04	East Sepik Tall	Vokio	021995	43	179,9	13,4	6,53	0,55	3,05	0,33	426,7	49,5	107,7	5,1
SRS ELT05	East Sepik Tall	Marineberg	041995	41	179,4	14,2	6,76	0,68	3,54	0,71	426,2	48,3	157,2	52,6
SRS GLT01	Gazelle Peninsula Tall	01	051994	52	180,1	12,3	7,15	0,56	3,13	0,32	451,4	24,9	104,9	6,1
SRS GLT02	Gazelle Peninsula Tall	02	061994	52	185,3	33,6	7,26	0,67	3,14	0,28	450,7	31,8	103,7	6,6
SRS GLT03	Gazelle Peninsula Tall	03	051994	52	187,8	21	8,12	8,67	3,21	0,63	445,1	44,3	104,5	8,4
SRS GLT04	Gazelle Peninsula Tall	04	061994	51	196,4	27,6	7,34	0,46	3,15	0,61	459,3	36,2	106,9	5,1

SRS GMT05	Gazelle Peninsula Tall	05	061994	51	178,4	17,4	6,81	0,63	3	0,43	439,4	52,1	106,3	4,6
SRS GRT02	Gazelle Peninsula Tall	02 R	031996	30	150	20,9	4,97	0,81	2,78	0,43	248,1	42	144,6	23,5

Access_nb	Cult_name	Population	Fie_est_dt	Tim_mea_ag	Petio_len	Sd 2	Petio_wid	Sd 3	Petio_thic	Sd 4	Rachis_len	Sd 5	Lealt_nb	Sd 6
SRS GRT03	Gazelle Peninsula Tall	03 R	031996											
SRS GYT02	Gazelle Peninsula Tall	02 Y	031996											
SRS GYT03	Gazelle Peninsula Tall	03 Y	031996											
SRS HLT	Hihisu Tall		121994	45	181,4	28,6	6,66	0,73	3,01	0,35	463	32,2	108,6	5,5
SRS ILT	Iokea Tall		091994											
SRS IRD	Iokea Red Dwarf		021995											
SRS KKT01	Karkar Tall	Guanaga	021995	43	173,5	28	5,61	1,09	3	0,49	331,7	62,6	140,1	46,1
SRS KKT02	Karkar Tall	Kinim	1996	33	175,2	23,2	6,04	1,3	3,09	0,66	346,3	73,3	154,4	47,3
SRS KKT03	Karkar Tall	Ulatava	051994	52	200,4	39,1	7,51	0,69	3,46	0,48	456,3	29,9	107,2	5,7
SRS KWT01	Kiwai Tall	Severimabau	111994	46	177,7	12,7	6,94	0,53	3,27	0,41	433,2	49,4	107,7	6,6
SRS KWT02	Kiwai Tall	Boze	091994	48	176,7	15,7	7,01	0,77	3,21	0,43	441,4	35,7	107,7	6,7
SRS MAT01	Manus Tall	Lawes	051994	52	176	13,7	7,21	0,5	3,17	0,33	462,1	31,7	107	5,1
SRS MAT02	Manus Tall	Lako	051994	52	178,6	13,7	7,14	0,5	3,17	0,33	468,4	28,3	107,8	5,1
SRS MAT03	Manus Tall	Baluan	051994	52	179,5	29,4	6,74	0,78	3,01	0,55	460,9	34,7	104,8	5,2
SRS MBT03	Milne Bay Tall	Siagara	021996	31	179	38,3	5,54	0,67	2,91	0,55	339	52,3	179,5	21,6
SRS MBT04	Milne Bay	Bubuleta	021996	31	171,9	30	5,38	0,54	3,1	0,44	318,6	42,7	179,1	17,7

	Tall													

Access_nb	Cult_name	Population	Fie_est_dt	Tim_mea_ag	Petio_len	Sd 2	Petio_wid	Sd 3	Petio_thic	Sd 4	Rachis_len	Sd 5	Lealt_nb	Sd 6
SRS MRD	Malayan Red Dwarf		021995											
SRS MVT01	Markham Valley Tall	Markham Fa	1997	21	168,6	33,7	5,9	1,69	3,11	0,85	334,5	91,2	137,5	45,1
SRS MVT02	Markham Valley Tall	ÏLara Vill	121995	33	186	29,5	6,43	0,6	3,09	0,38	393,9	42,2	148,6	50,8
SRS MYD	Malayan Yellow Dwarf		021995											
SRS NGD	Nias Green Dwarf		1996											
SRS NLT01	Namatanai Tall	Karu Village	051994	52	167	13,4	7,13	0,49	2,98	0,53	431,4	44,2	105,7	5,7
SRS NLT02	Namatanai Tall	Kenapit	061994	51	180,4	10	7,36	0,81	3,18	0,35	452	28,8	107,6	5,5
SRS NLT03	Namatanai Tall	Sohu	061994	51	172	14,4	7,02	0,64	3,11	0,25	441,5	31,5	107,3	6,2
SRS NLT04	Namatanai Tall	Etalat	051994											
SRS NRD	Nias Red Dwarf		1996											
SRS NYD	Nias Yellow Dwarf		1996											
SRS OLT01	Oro Tall	Saiho	061994	51	175,3	17,2	7,48	0,49	3,13	0,55	468,1	29,9	105,6	5,3
SRS OLT02	Oro Tall	Ajoa	061994	51	195,4	15,9	6,83	0,73	3,33	0,57	465,7	87	110,6	14

SRS OLT03	Oro Tall	Kikibator	061994	51	181	15,8	7,42	0,6	3,2	0,37	472,3	30,9	107,6	5,7
SRS PARD01	Papua New Guinea Red Dwarf		021995											

Access_nb	Cult_name	Population	Fie_est_dt	Tim_mea_ag	Petio_len	Sd 2	Petio_wid	Sd 3	Petio_thic	Sd 4	Rachis_len	Sd 5	Lealt_nb	Sd 6
SRS PARD02	Papua New Guinea Red Dwarf		121994											
SRS PBD	Madang Brown Dwarf		121994											
SRS PLT	Poligolo Tall		061994	51	184	14,3	7,26	9,34	3,39	0,4	444,2	36,7	107,8	5,4
SRS PYD	Papua New Guinea Yellow Dwarf		021995											
SRS RARD	Rabaul Red Dwarf		011995											
SRS RLT	Rennell Island Tall		051994	52	183,9	21,5	8,39	0,91	3,25	0,58	451,2	49,9	108,9	46,1
SRS TRT	Talasea Red Tall		041995	42	153,3	23,8	4,8	0,67	2,59	0,5	259,5	30,3	170,3	5,1
SRS VLT01	Vailala Tall	Miha Kavava	091994	48	191,5	11,6	7,11	0,42	3,46	0,37	460,3	33,5	108,1	5,3
SRS VLT02	Vailala Tall	Keakea	051994	52	183,7	23,4	6,92	0,88	3,23	0,4	471,7	75	110	7,2
SRS WLT01	West New Britain Tall	Gaungo	061994	51	177,2	15,5	6,76	0,72	3,2	0,53	450,5	34,9	107,6	4,9

SRS WLT02	West New Britain Tall	Naviro	061994	52	183,6	17,4	7,1	0,42	3,29	0,46	454,3	59,6	107,5	6,6
SRS WUNT	Wutung Tall		061994											