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project

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Acronyms

ACIAR	Australian Centre for International Agricultural Research
APCC	Asian and Pacific Coconut Community
BCS	Bogia coconut syndrome
CATAS	Chinese Academy of Tropical Agricultural Sciences, Hainan
CBD	Convention on Biological Diversity
CePaCT	Centre for Pacific Crops and Trees
CGIAR	Consultative Group on International Agricultural Research
CGRD	Coconut Genetic Resources Database
CIRAD	Centre de coopération Internationale en Recherche Agronomique pour le Développement
CNRA	Centre National de Recherche Agronomique de Côte d'Ivoire
COGENT	International Coconut Genetic Resources Network
CRB-G	Coconut Rhino Beetle-Guam Strain
CRI	Coconut Research Institute, Sri Lanka
CRP	CGIAR research programme
DFAT	Department of Foreign Affairs and Trade (Australia)
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária
FAO	Food and Agriculture Organization of the United Nations
FTA	Forests, Trees and Agroforestry (CRP)
GCDT	Global Crop Diversity Trust
ICAR-CPCRI	Indian Council of Agricultural Research- The Central Plantation Crops Research Institute
ICG (-AIO / -SP)	COGENT International Coconut Genebank (of the African & Indian Ocean (Côte d'Ivoire) and South Pacific (PNG), respectively)
IDOs	Intermediate Development Outcomes
IPGRI	International Plant Genetic Resources Institute
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
ITAG	COGENT International Thematic Action Groups (7 created in 2012)
LAMP	Loop-mediated isothermal AMPLification primer
MLS	Multilateral system
MoA	Memorandum of Agreement
PNG	Papua New Guinea
SPC	Secretariat of the Pacific Community (now the Pacific Community)
SRA	Small Research Activity

1 Executive summary

Grown in over 90 tropical countries, on more than 12-million ha and by countless homesteads, coconut is important to millions of smallholder households. The future of coconut production and livelihoods critically depends on its broad genetic diversity, much of which is threatened by key pests and diseases, and the effects of climate change (including increasingly severe cyclones and drought). Further investment is needed to build coconut stakeholders' capacity and resilience across the value-chain, particularly for genetic resources conservation.

In the wake of recent CGIAR and Bioversity strategic realignments, after almost three decades, Bioversity no longer has sufficient resources to continue hosting the International Coconut Genetic Resources Network (COGENT) Secretariat, nor does it possess the required core scientific competences in coconut research. Therefore a new Secretariat hosting arrangement is being established for COGENT, within the Asia Pacific Coconut Community (APCC-new global name forthcoming).

The specific objectives of this SRA have been to: 1) finalise and launch COGENT's new revised Global Strategy, 2) assure the technical and organizational underpinning for conservation and use of coconut genetic diversity in the Pacific and globally, and 3) To elucidate international efforts to address key biotic threats to coconut diversity in the Pacific.

Several elements are being drawn together, including exploring how to secure the safety and effectiveness of the 5 international collections (ICGs), so they can fully participate in the MLS. The ICGs and other collections need protecting from the critical threats of key pests and diseases, climate change, urbanization, industrialization, changes in land-use, land-grabbing, and need protecting. The linked International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) obligations need respecting, germplasm data needs safeguarding and updating within the Coconut Genetic Resources Database (CGRD), and most importantly *the Global Strategy for the conservation and use of coconut genetic resources*, needs launching and then implementing via COGENT's International Thematic Action Groups (ITAGs). Against the backdrop of increasing demand for coconut, plantings worldwide are senile and facing declining productivity.

Research teams from member-countries have shown interest in coconut genomics, ranging from coconut genome *de novo* sequencing and marker-assisted selection through to transcriptomics. The progress in conventional breeding is hindered by the relatively low nut production and the long generation time in coconut. Genomics studies will help to more effectively address crucial aspects of coconut breeding, such as disease resistance, genetic inheritance of the two kinds of dwarfism existing within the species, and the genetic components for higher yields and quality. COGENT's genomics ITAG is well placed to help link different teams involved with this important work.

Effective germplasm exchange is one of the priorities of ICGs and is critical for research, increasing diversity and genetic improvement in the receiving countries. However, exchanging germplasm as zygotic embryos has met with limited success, and newer ways of *in vitro* exchange are showing more promise and need further investigation. There are increasing phytosanitary restrictions that impede exchange, due to the pests and diseases that affect different countries in the world including where the ICGs are located. So more research is needed on effective management and control of biotic threats.

Part of this SRA grant-work has supported finalising the revised Strategy. An effective and sustainable mechanism for implementing the Strategy over the coming decade was considered during the workshop, and has now been proposed to be developed via COGENT's re-forming International Thematic Action Groups (ITAGS). Part of the workshop considered reshaping the ITAGs.

Another part of the SRA workshop has considered how COGENT might best be sustained in the years to come, and presented different scenarios for hosting the COGENT Secretariat. The SC meeting developed and ratified ten recommendations linked to COGENT coordination and hosting and various aspects of Strategy implementation (see Annex 10.1.1).

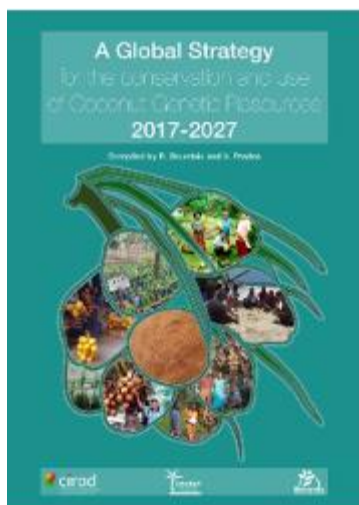
Finally the workshop also provided an opportunity for delegates to consider current knowledge and discuss 16 different options for combatting the two most serious biotic threats prevalent in the pacific region, Bogia Coconut Syndrome (BCS) and Coconut Rhinoceros Beetle (CRB). These included: : i) surveillance/ scouting/ early warning/ regional alerts, knowledge management; ii) quarantine; iii) diagnostics; iv) trapping; v) epidemiological studies / awareness raising of life cycles; vi) planting material management; vii) sanitation; viii) resistance/tolerance trials; ix) laboratory trials; x) mixed cultivar cropping to increase genetic diversity; xi) cover intercropping ; xii) studies for resistance gene markers; xiii) coconut genomics; xiv) biological control ; xv) threshold management; and xvi) disease management resources audit.

For successful germplasm conservation and exchange, COGENT needs to be sustained, and this SRA has helped to articulate the way forwards through finalising the Strategy, developing a sustaining mechanism and considering how key biotic threats to coconut productivity in the pacific and beyond can best be addressed.

2 Background

Grown in over 90 tropical countries, on more than 12-million ha and by countless homesteads, coconut is important to millions of smallholder households. The future of coconut production and livelihoods critically depends on its broad genetic diversity, much of which is threatened by key pests and diseases, and the effects of climate change (including increasingly severe cyclones and drought). Further investment is needed to build coconut stakeholders' capacity and resilience across the value-chain, particularly for genetic resources conservation.

2.1 COGENT's new *Global Strategy for Conservation and Use of Coconut Genetic Resources* and its implementation



Beginning in 2012 and via scores of worldwide consultations, the International Coconut Genetic Resources Network ([COGENT](#)) has developed its new 2017-2023 [Global Strategy for Conservation and Use of Coconut Genetic Resources](#) (the Strategy), which has been finalised during this grant reporting period 2017, partly with this support from DFAT/ACIAR, when final review feedback was integrated.

Chapter 1 introduces the background context and rationale for this new *Global Strategy*. Chapter 2 provides a global analysis of the present status of coconut genetic resources conservation and use. Chapter 3 focuses on prioritizing the actions and research needed to effectively secure coconut diversity and enhance its use, and proposes plans to develop concrete mechanisms, skills and research that will permit the

global coconut community to achieve the Strategy's objectives.

In 2016, the world produced around 60 million tonnes of coconuts, mainly for domestic consumption, but also for copra, oil, fibre, timber, milk and 'water'. Over millennia, hundreds of diverse coconut varieties have been developed, some being selected and improved for specific uses.

The status of the five International Coconut Genebanks (ICGs) is of particular concern, as fully functioning genebanks are required to underpin the necessary conservation, sharing and use of coconut germplasm, that are critical for implementing the Strategy. The collection in the South Pacific ICG of Papua New Guinea (PNG) is threatened by a lethal phytoplasma, Bogia Coconut Syndrome (BCS), and in response the PNG government is re-establishing a new collection in a safe site, by transferring the originally collected accessions from their origins. This collection should ultimately be augmented by new diversity within Fiji, PNG and Samoa, identified by an ongoing project funded by the UK government [Darwin Initiative](#). The collection in the ICG for Africa and the Indian Ocean (ICG-AIO) in Côte d' Ivoire is threatened by urbanisation and lethal yellowing disease. Both ICGs are subject to article 15 of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), whereby the signatories: ICG host governments, FAO and Bioversity International are obliged to take measures to protect the collection against such threats.

Part of the grant-work supported finalising the revised Strategy. An effective and sustainable mechanism for implementing the Strategy over the coming decade was considered during the workshop, and has now been proposed to be developed via COGENT's re-forming International Thematic Action Groups (ITAGS). Part of the workshop considered reshaping the ITAGS.

2.2 Sustaining the Coconut Genetic Resources Network (COGENT)



Created in 1992 under a CGIAR mandate, and hosted by Bioversity International, COGENT endeavours to strengthen international collaboration in coconut genetic resources conservation and use to promote improving coconut production on a sustainable basis, and to help boost livelihoods and incomes of coconut stakeholders in developing countries, who are mostly poor smallholders. COGENT comprises 39 country-members (representing ~98% global production, 80% of which is produced in the Asia-Pacific). It has a steering committee (SC) of representatives from COGENT's five regions¹, as well as the COGENT chair, vice-chair and coordinator, and observers from Bioversity International, the Asia-Pacific Coconut Community (APCC), the Pacific Community (SPC), the Global Crop Diversity Trust (GCDT) and the *Centre de coopération Internationale en Recherche Agronomique pour le Développement* (CIRAD).

COGENT's SC aims to hold biennial meetings to plan and coordinate global efforts to sustain effective conservation and use of coconut genetic resources across the Asia-Pacific and worldwide². However, since recent CGIAR reforms, COGENT's existence has become seriously jeopardised by lack of funding and other resources. Because of this COGENT was unable to hold its 2016 SC meeting, and has scant resources to continue supporting the Secretariat, that has been hosted by Bioversity until now.

Part of the workshop considered how COGENT might best be sustained in the years to come, and presented different scenarios for hosting the COGENT Secretariat. The SC meeting developed and ratified ten recommendations linked to COGENT coordination and hosting and various aspects of Strategy implementation (see Annex 10.1.1). The first 3 recommendations specifically focus on the future hosting arrangement for COGENT's Secretariat. If COGENT is to be successful there needs to be greater links and collaboration between stakeholders working in the field of conserving and using coconut genetic resources.

2.3 Key Biotic Challenges for Asia-Pacific Coconuts

In 2016, the Asia-Pacific region produced an estimated 51.5 million tonnes of coconuts, representing around 86% global production³. Aside from the ravages of cyclones and other extreme weather events, this production is being increasingly jeopardised by two key biotic threats:



Figure 1: CRB Damage (source : <http://www.spc.int/blog/a-new-biotype-of-coconut-rhinoceros-beetle-discovered-in-the-pacific/>)

i) the coconut rhinoceros beetle (CRB-*Oryctes rhinoceros* L.), spreading across Asia, from India to Indonesia, whose sap-feeding adult causes debilitating damage.

¹ Southeast Asia; South Asia and the Middle East; South Pacific; Latin America and the Caribbean; Africa and the Indian Ocean

² <http://www.cogentnetwork.org/meetings/steering-committee-meetings/17th-cogent-steering-committee-meeting>

³ FAOSTAT -March 2018

A recently-evolved biotype from Guam (CRP-G)⁴ is resistant to commonly used entomopathogenic biocontrol, unlike the susceptible Pacific biotype (CRP-P), and now poses a serious threat to regional coconut and other palm production.

ii) Bogia Coconut Syndrome (BCS)- a relatively recently identified lethal-yellowing disease, caused by a vector-borne phytoplasma, that causes premature fruit drop and rapid death. BCS also affects other species including areca palms (*Dyopsis lutescens*) and banana⁵ (*Musa spp.*) There are no curative actions for LYD. Today, only strict preventive actions (quarantine areas, and cut and burn) are able to contain the disease.

The workshop provided an opportunity for delegates to consider current knowledge and discuss what steps may be taken in combatting these serious threats moving forwards (see notes in Annex 10.4) .

⁴ <http://www.spc.int/blog/a-new-biotype-of-coconut-rhinoceros-beetle-discovered-in-the-pacific/>
<http://www.pacificislandtimes.com/single-post/2018/02/25/Special-Report-Invasive-species-are-a-crisis-for-Guam-and-the-Pacific-right-now>

⁵ in which it is known as Banana Wilt-Associated Phytoplasma- BWAP

3 Objectives

The overall objective of this small research and development activity (SRA) was to **determine how best to sustain the conservation and use of coconut genetic diversity for the Asia-Pacific Region and globally.**

Efforts to conserve and exchange coconut genetic resources, in support of better livelihoods for millions of women and men in coconut-growing communities in Asia-Pacific and worldwide, have been supported over the last 25 years by a network of national and regional coconut genebanks coordinated under the auspices of COGENT. As mentioned in section 2.1, COGENT has recently finalised its revised *Global Strategy for Conservation and Use of Coconut Genetic Resources*. However, the genetic resources themselves (especially in the South Pacific region) are at great risk from two emerging biotic threats (Bogia coconut syndrome (BCS) and the Coconut Rhino Beetle-Guam Strain (CRB-G)) and the coordinating mechanism that underpins this international effort (i.e. COGENT) is under threat from recent changes in the funding model for the international agricultural research centres.

This SRA seeks to address to inter-linked research questions:

1. How can efforts to promote the conservation and use of coconut genetic resources for improved livelihoods in the Pacific be effectively coordinated, within the region and globally?
2. How can the international response to urgent biotic threats to coconut diversity in the Pacific best be coordinated?

The specific objectives are to:

1. finalise and launch the *Global Strategy for Conservation and Use of Coconut Genetic Resources*, particularly how this relates to the Pacific region
2. assure the technical and organizational underpinning for conservation and use of coconut genetic diversity in the Pacific and globally
3. elucidate international efforts to address key biotic (pests) threats to coconut diversity in the Pacific

The overall deliverables are:

1. A finalised version of *the Strategy*, particularly how this relates to the Pacific region
2. A proposed mechanism to sustain COGENT (or its functions to support the 'Global Strategy') for the future, in the Pacific and at the global level. The COGENT SC and the workshop delegates framed the proposals in terms of a new set of recommendations from the COGENT steering committee
3. An outline Action Plan for addressing biotic threats to coconut diversity (and concomitantly coconut cultivation) in the Pacific region, which also link to the workshop SC recommendations

4 Operations

Methodology and Activities

As stated above, the specific objectives of this SRA are to: 1) **finalise and launch COGENT's Global Strategy**, 2) **assure the technical and organizational underpinning for conservation and use of coconut genetic diversity in the Pacific and globally**, and 3) **To elucidate international efforts to address key biotic and abiotic threats to coconut diversity in the Pacific**;

The draft workshop structure and agenda had already been articulated during the SRA proposal development. Following endorsement, activities as described below were implemented during the reporting period.

Prior to the November 2017 workshop, in order to finalise and launch the *Global Strategy* (**Objective 1**), the ex-officio COGENT coordinator solicited final feedback on narrative content from the ICG curators, COGENT members and the GCDT. Feedback was integrated into the existing almost complete narrative, and after final reviews by the compiling editors⁶, the Strategy was laid out in time for the COGENT SC meeting in the first week of November 2017. During the workshop, the Strategy was discussed, and the brochure outline of the full strategy was ratified and launched. Strategy implementation was also discussed as part of objective 2.

In working towards developing/strengthening a mechanism for supporting conservation and use of coconut genetic diversity (**Objective 2**), activities to organise and hold the 2017 COGENT workshop and SC planning in Fiji were conducted by Bioversity staff and CIRAD (Alexia Prades) working with SPC staff, Fijian colleagues and the SC Chairman and vice-chairman.

The meeting venue and agenda (see annex 10.12) were finalised and agreed with the COGENT SC. Delegates lists were compiled (see Annex 10.13), and invitations (see annex 10.14) dispatched. Invited delegates included: the ex-officio COGENT coordinator; 12 SC members from 12 countries including COGENT's current chair and vice-chair; 7 international observers (ACIAR, Australia; Bioversity International, Italy; CIRAD, France; SPC, Fiji; APCC, Indonesia; and GCDT, Bonn); and a representative of the International Treaty (ITPGRFA). Key coconut scientists, and representatives from Government, private sector and coconut-grower organisations were also invited. The occasion provided an opportunity to strengthen partner relations, including via the opening formalities delivered by key stakeholders from ACIAR, APCC, Bioversity, CIRAD and the Fijian government

The workshop included a combination of internal and open sessions featuring a range of presentations according to the agenda, and included breakout group work for brainstorming and reflection.

A pre-workshop study compared how Bioversity has dedicated resources to coordinate or host a number of genetic resources and other networks. These included: [CacaoNet](#), [MusaNet](#), the European Forest Genetic Resources Network ([EUFORGEN](#)-hosted) and the European Cooperative Programme for Plant Genetic Resources ([ECPGR](#)-hosted); as well as the global banana-researcher network [ProMusa](#), and Bioversity's 4 regional banana networks: [Innovate Plantain](#) (West and Central Africa); the Banana Asia-Pacific Network ([BAPNET](#)); the Banana Research and Development Network for Latin America and the Caribbean ([MUSALAC](#)); and the Banana Research Network for Eastern and Southern Africa ([BARNESA](#)). (see Study terms of reference- annex 10.21) The

⁶ Dr Roland Bourdeix (COGENT coordinator 2011-2014), Dr Alexia Prades (COGENT coordinator 2015-2017 and Vincent Johnson (current ad-interim coordinator)

investigation involved COGENT's SC and members, as well as other key stakeholders (see study timeline in annex 10.22). Some groundwork was already laid, and the COGENT Chair and Vice Chair already informed during recent SC side-meetings and formal communication from Bioversity and CIRAD DGs (see annex 10.23).

The study also formulated network Secretariat hosting criteria. Candidate hosting organisations were then reviewed according to the established/ agreed criteria. The study also developed alternative hosting terms reference (see Annex 10.21) in time for SC discussion (a 1-2 page outline of each option (see consolidated versions annex 10.24), how well the criteria are met including budgetary criteria). After the options were presented, the SC members voted on their preferred option. It was hoped that a firm timeline for transition of the COGENT Secretariat to the new host could have been articulated during the workshop, but more time is needed. The authors propose a deadline of 22 August 2018, when the new arrangement can be presented at the 48th APCC COCOTECH meeting.

On the last day a field visit was arranged to the Pacific Green furniture factory near Nadi

To achieve **objective 3**, during the workshop, delegates broke into two groups to discuss current status of regional biotic threats to coconut diversity, and what measures are currently being deployed to mitigate these threats, as well as identifying any research gaps, and how such gaps might be filled . It was hoped that participants would explore how to adopt a more concerted approach where appropriate, or where more individual approaches may be needed in certain scenarios. SPC presented a summary of the recently concluded Pacific workshop on CRB, and Richard Markham of ACIAR outlined the need for an action plan for the Pacific area, focusing on CRB and Bogia Coconut syndrome, as well as alluding to the planned climate threat mapping work within the Darwin-funded regional project.

On the penultimate day, the workshop developed ten COGENT recommendations arising from all sessions of the workshop. These were then ratified on the last day, and sanctioned by the outgoing COGENT chair and ad-interim COGENT coordinator

5 Achievements against activities and outputs/milestones

Objective 1: To finalise and launch the Global Strategy for Conservation and Use of Coconut Genetic Resources

no.	activity	outputs/ milestones ⁷	completion date	comments
1.1	finalise narrative	strategy brochure finalised	24/10/2017	Electronic version ready 5-days before workshop. Hard copies printed in time for sharing and reference at workshop
1.2	finalise layout		24/10/2017	
1.3	publish	strategy brochure electronically published	25/10/2017	
1.4	print	Hard copy brochure printed	26/10/2017	
1.5	launch	strategy brochure launched	02/11/2017	
1.1	finalise narrative	Full strategy chapters 0,1,2 and annexes finalised	25/10/2017	updating was needed, now complete, except <i>invited preface</i> (perhaps from Gabrielle Persley – Richard Markham’s suggestion)
1.2	finalise layout		24/10/2017	Existing layout needed moderate adjustment
1.1	finalise narrative	Full strategy chapter 3 finalised	28/10/2017 then Est. 13/04/2018	After workshop ‘finalised’ narrative contained some contended areas further review requested by chapter author, final editing still to be completed
1.2	finalise layout		28/10/2017	Layout complete
1.3	publish	full strategy document electronically published	Estimate 04/05/2018	Could be sooner (if no final distractions)
1.4	print	full strategy document printed	By 31/05/2018	
1.5	launch	full strategy document launched	22/08/2018	Suggested date to synchronise with 48 th APCC COCOTECH meeting in Bangkok, and possibly to coincide with formal transfer of COGENT Secretariat

⁷ Traffic light colors indicate extent of achievement

Objective 2: To assure the technical and organizational underpinning for conservation and use of coconut genetic diversity in the Pacific and globally

no.	activity	outputs/milestones	completion date	comments
2.1	Pre-workshop activities Workshop organisation	workshop announced	18/09/17	Standard workshop logistics rolled out, back-to-back with Darwin coconut project in Samoa, but uncomfortably tight turnaround
		Invitations extended with draft agenda	02/10/2017	
		Venue finalised	02/10/2017	
		Agenda finalised	26/10/2017	
		Travel itineraries/ bookings completed	26/10/2017	
		Press release disseminated	26/10/2017	
		Delegates welcome pack information compiled	26/10/2017	
2.2	Review of COGENT Secretariat hosting resources and criteria	criteria, options and resources for Secretariat hosting compiled	27/10/2017	OK, but caution needed in estimated true costs of hosting Secretariat.
2.3	discussion and voting	Long-term viable COGENT hosting arrangements presented and best option agreed	02/11/2017	OK, APCC was voted as the nominated host
2.4	presentation and discussion	Coconut GR Strategy presented & launched	02/11/2017- full launch at COCOTECH 22/08/18	Brochure delivered and launched. Delay in launch of full Strategy caused by contention over narrative in Chapter 3 (see objective 1)
2.5	Breakout groups	Coconut GR Strategy implementation workplan/ roadmap developed	02/11/2017	Ideas discussed/outline produced, but delegates agreed implementation plan needs to be fleshed out after Strategy and ITAGs finalised. ITAGs will oversee implementation, ITAGs to be re-formed/ confirmed/ created via COGENT nomination process in 2018
2.6	presentations	COGENT activities and needs for each of the five regions presented.	02/11/2017	Brazil and Côte d'Ivoire reps had travel / authorisation complications and presentations delivered by attending colleagues. Content variable

no.	activity	outputs/milestones	completion date	comments	
2.7	discussions	COGENT galvanised, with members' commitment secured to implement the Strategy and COGENT's research agenda.	02/11/2017	includes a) reinforcing COGENT 's commitment to supporting mitigating regional and global threats to coconut diversity and production, b) developing better understanding of COGENT's role in engaging with key stakeholders, c) COGENT International Thematic Action Groups (ITAGs) and, d) establishing a fund-raising taskforce see also post-workshop	
2.8	training on MLS, germplasm management, threat mitigation and monitoring	ICG curators' capacity for germplasm management within the MLS built	02/11/2017	Useful input from TRUST presentations and ITPGRFA remote presentation (representatives unable to interact as parallel 7 th governing body meeting in Rwanda same week	
2.9	round-table brainstorming sessions	Identifying opportunities for public-private partnerships, & ways to upgrade current conservation and use practices, including how COGENT will assist in climate-change preparedness.	03/11/2017	Insufficient time was available to include this agenda item, only two private sector delegates attended ⁸ ,	
2.10	Drafting and ratifying 10 recommendations	10 recommendations for COGENT future actions	03/11/2017	OK	
2.11	SC meeting nominations & voting	New COGENT Chair and Vice-Chair elected	03/11/2017	OK	
2.12	Post-workshop activities/ follow up	ITAG re-structuring nominations	New ITAGs, with new themes represented, and new members and leaders nominated/ established as appropriate.	22/08/2017	In time for COCOTECH- . ITAG leaders have to be elected and they have to build their team.
2.13		Workshop report drafting	Draft SRA technical report produced	31/03/2018	OK
2.14		Interactions between COGENT SC and APCC , and others	COGENT Secretariat/ Bioversity Article 15 obligations transferred	22/08/2017	In time for COCOTECH
2.15		Interactions between COGENT SC and APCC , and others	COGENT sustained, viable and functional to support ongoing coconut GR conservation and MLS worldwide	22/08/2017	In time for COCOTECH

⁸ *Umapathyfarms.com* gave an interesting presentation on barcoding in hybrid nut production

no.	activity	outputs/milestones	completion date	comments
2.16	Drafting Strategy implementation roadmap	Strategy implementation roadmap	Estimate by 22/08/18	Use original chapter 4 of Strategy as starting point. This activity will be performed by the ITAGs' leaders. Hence, it will be completed after the ITAG leaders' election and ITAG composition are validated by the SC (remote voting process).
2.17	Implementation of Strategy	Strategy implemented	Ongoing by end2027	Ongoing- funding, capacity and other resources need further mobilizing

Objective 3: To elucidate international efforts to address key biotic and abiotic threats to coconut diversity in the Pacific

no.	activity	outputs/ milestones	completion date	comments
3.1	articulating current status of measures addressing key BIOTIC threats, and then identifying any research gaps, and how such gaps might be filled.	An Action Plan for comprehensively addressing these selected threats to coconut diversity in the Pacific region, linked to an outline action plan for addressing key global threats	02/11/2017	Only partially completed, this is an enormous undertaking, and the workshop only skimmed the surface, but gained insights into threats in different COGENT member countries.

6 Key results and discussion

6.1 Objective 1 – To finalise and launch the Global Strategy

The new *Global Strategy for the Conservation and Use of Coconut Genetic Resources* is the culmination of scores of worldwide expert consultations over more than 6 years⁹. Chapter 1 introduces the background context and rationale of the Strategy. Chapter 2 provides a global analysis of the present status of coconut genetic resources conservation and use. Chapter 3 focuses on prioritizing the actions and research needed to effectively secure coconut diversity and enhance its use, and proposes plans to develop concrete mechanisms, skills and research that will permit the global coconut community to achieve the Strategy's objectives. Against the backdrop of a rapidly changing 'coconut conservation landscape', its production has been prone to debate and contention. Dwindling support for coconut research has also hampered the final delivery of this document, but now thanks to the support of ACIAR and DFAT, the authors, compilers and editors are happily anticipating its final publication in the coming weeks.

The electronic and hard-copy versions of the brochure were published in time for the Workshop. Ideally, delegates could have benefited from a longer pre-workshop period to review the contents for more meaningful discussions, although perhaps the time for further meaningful discussions is past (in the light of such already extensive consultation). However, although the bulk of the full strategy narrative has been finalised and laid out, chapter 3 (*Where do we go from here*) required and has just received a further post-workshop review, to ensure that meaningful narrative is not excluded in the assiduous editing. Accordingly we can only publish and print the full Strategy when this reviewed chapter has been copy-edited and proof-read. In the meantime Annex 10.4 contains the hyperlinks to the current versions of each section. Restricted numbers of hard copies of the brochure are available and some hard copies of full strategy document should be available soon on request, as appropriate and according to budget restrictions. It is proposed that the Strategy be formally launched at the upcoming 48th APCC COCOTECH meeting in Bangkok in August 2018.

All of that said, such a Strategy is of little value unless it is implemented for coconut genetic resources to be more effectively conserved and used. The SRA work specifically addresses this need in aiming to achieve its second objective.

6.2 Objective 2- To assure the technical and organizational underpinning for conservation and use of coconut genetic diversity in the Pacific and globally

COGENT's essential *raison-d'être* is to assure the technical and organizational underpinning for conservation and use of coconut genetic diversity (including that of the Pacific). Although coconut plays a key role in the lives of hundreds of millions, years of neglect threatens to extinguish some of its unique diversity, and to seriously constrain linked livelihoods, as well as jeopardizing the future viability of COGENT. Bioversity International has hosted the COGENT Secretariat since its birth, but no longer has the resources to provide such support.

⁹ This was implemented as a part-time (10% full time) and sometimes discontinuous task during this period, in numerous steps and by different persons.

To help achieve this second objective, the SRA has supported a study to consider criteria, explore options and assess the required resources for hosting the COGENT Secretariat in the years to come. It has also supported running the workshop in Fiji to provide a forum for: i) COGENT's SC agreeing on the best alternative hosting arrangement moving forwards; ii) Presenting and launching the Strategy, and developing an implementation workplan; iii) Sharing updates on COGENT activities and needs for each of its five regions; iv) Galvanising COGENT members' commitment to implement the Strategy and COGENT's research agenda; v) Building ICG curators' germplasm management capacity within the MLS; vi) Developing priority recommendations for COGENT's future actions and vii) Electing a new COGENT Chair and Vice-Chair

6.2.1 Alternative hosting arrangements for the COGENT Secretariat

The need to identify a new Secretariat hosting arrangement to keep COGENT effective and ensure completion and implementation of Global Coconut GR Strategy arose from recent CGIAR systemic changes that have reduced Bioversity's available resources to support the COGENT Secretariat. The study and SC discussions highlighted resource requirements for IT support, finance, administration, HR, communications, and fundraising support etc. Although Bioversity has no core coconut research expertise, it was noted that it has farming-systems expertise linked to other palm species and GR management experience. CIRAD has supported COGENT via technical expertise and coordination for the Secretariat. Two researchers were successively seconded 2011 to 2017

To explore alternative hosting arrangements, Bioversity International i) appointed 'COGENT Hosting Arrangement Officer'; ii) drafted the hosting study TOR, iii) provided a Joint Communication from CIRAD/Bioversity DGs to COGENT's Chair/ Vice Chair; and iv) developed a COGENT hosting plan to recommend a set of scenarios for presentation to COGENT's SC for sustainable hosting of the network. Final decisions for any new arrangement for Secretariat hosting were taken by SC (not Bioversity).

The study reviewed i) what resources Bioversity needed in order to continue supporting the COGENT Secretariat, and ii) Bioversity's existing mandate/ obligations towards hosting COGENT Secretariat/ TREATY. The study identified four essential hosting criteria that would be required by any potential host institution: i) global reach; ii) located in 'coconut region', iii) relevant coconut links; and iv) possessing the necessary capacities (support services; networking, fundraising- including Windows 1-3, Bilateral and possibly subscription income). The study consulted other relevant stakeholders to develop alternative hosting arrangements, and held initial bilateral interactions, then planned for multilateral interactions which were not executed due to time-zone logistical constraints.

During the SC workshop alternative hosting arrangements were presented, with main options: APCC, and SPC (or combined), and others including continuing with Bioversity International, or considering CPCRI, India; or CATAS, China. Each option was presented in the light of its pros and cons, or comparative advantages. (see annex 10.25)

The SC /members decided on their preferred option as APCC, provided the organisation achieved its planned UN status. A formal timeline for transition to a new sustainable long-term hosting arrangement has yet to be developed , although it is proposed that this be done as soon as possible, according to time and other resource availability, but before the APCC 48th COCOTECH meeting.

SC members had also been willing to consider an interim hosting arrangement along with longer-term arrangement. APCC and SPC are arguably equally strong contenders, although the SC selected APCC as the new host organisation. It has strong links with Asia Pacific Coconut Community, including SPC/PCA; strong liaison with high-level government, international and private sector bodies; effective linkages between GR , production and postharvest; is located in primary production zone; could assume existing

obligations, and lobby for TREATY Article 15 cover for other ICGs; global reach forthcoming; capacities for effective support services; networking, fundraising; is gearing up for genebank audits, planning to encourage genebank strategy development, can hold Back-to-back meetings with Cocotech meetings (economies of scale, and is keen to adopt multilateral hosting arrangement if feasible. Much of these strengths are shared by SPC, which has superior technical capacity, although neither is yet truly/ fully global in scale. There is a possibility both APCC and SPC could be ultimately involved in hosting COGENT. It was also noted that the hosting governance mechanism needs to be independent of the host and fully transparent.

From consulting with other network administrators (especially MusaNet), and comparing with COGENT's requirements to date, the study also identified annual resource requirements for hosting the Secretariat and coordinating a network, as outlined in Table 1.

Table 1: Resources needed to support a network secretariat

ITEM		SUB-CATEGORY
Staff	Coordinator	<i>Technical writing</i>
		<i>Fundraising</i>
		<i>Genebanks (esp ICGs) liaison and monitoring</i>
		<i>Partner/ member liaison</i>
		<i>Accession Data management/ harmonisation (CGRD)</i>
	Admin Assistant	Standard admin support
Meetings		biennial SC meeting (1.5 pa)
		monthly virtual meetings
		training/ capacity building meetings
Communications		Website maintenance
		multi-media- videos, flyers, leaflets
		Publications (including layout)
Admin.		Running costs/ rental office space/website
		Materials (stationary/ miscellaneous)
Travel		
overheads		
contingency (5%)		

Whilst the costs associated with hosting's annual resource requirements will vary according to region and context Bioversity provided a fully costed estimate that compared hosting located in Europe with that in India, and also using local and international staff costs. The range of annual costs ran from US\$90,000 to US\$250,000. The APCC will be reviewing its lower cost estimates in the light of this exercise.

6.2.2 Developing a Strategy implementation workplan

Presenting and launching the Strategy has already been discussed above in section 6.1. On day two in the afternoon, despite the contentions over chapter 3 narrative, the Strategy was officially launched. Dr Perera, the outgoing chair, re-launched the International Thematic Action Groups (ITAGS), reminding delegates of how they had been previously formed. The ITAG leader designated by consensus or voting. The ITAG leader then designates 4 researchers all belonging to institutions and countries from the COGENT network. Then the team of 5 researchers designates new ITAG members by consensus or voting. The maximum size of the ITAGs will be 20 researchers, as acting members, and 10 junior non-voting members (students). As soon a researcher is involved as acting member, (s)he can participate in selecting the next ITAG members. Researchers from

non-member countries are welcome in ITAGs, so long as they don't outnumber researchers from COGENT member-countries.

Delegates broke into two groups to brainstorm how a Strategy implementation plan may best be developed to effectively guide implementation, and then each group reported in report in plenary.

Delegates were unanimous in agreeing that the International Thematic Action Group (ITAG) leaders should take responsibility for overseeing the implementation of those parts of the Strategy that link to their theme. However, for this to happen COGENT first needs to coordinate the proposed nominations from all country members and the SC for i) any changes to the number and list of current seven thematic groups (see <http://www.cogentnetwork.org/action-groups>) and also Annex 10.26; ii) any change or creation of ITAG leaders, and iii) any changes to the composition of the ITAG team. SC 2017 recommendation 4 in Annex 10.11 refers to this and also includes the original implementation plan that was drafted by Roland Bourdeix, as a very advanced starting point. Discussions outlined the slight revision to the above-mentioned draft process for ITAG (re)formation and nominations, that was agreed by the SC as follows:

1. Country members to solicit nominations for ITAG leaders not necessarily just within COGENT membership
2. COGENT secretariat will review scientific profile of nominees, (criteria to include thematically linked experience in research field, publications, track record of research projects, links with research and policy community,)
3. Remote vote of ITAG leaders by SC
4. ITAG leader to select ITAG members (5-20) including gender balance where possible, and senior / junior), balance of geographical regions; (for senior choices-thematically linked experience in research field, publications, track record of research projects, links with research and policy community- junior same but lighter)
5. See TOR for ITAG leaders to be posted on website (2014 SC meeting) and attached to soliciting message

It is proposed that the new ITAGs will be finalised before the APCC 2018 COCOTECH meeting, and a draft workplan articulated as time allows.

For this brainstorming exercise, both groups worked with table of contents of the Strategy, and the Brochure. Group one was insistent that a Gantt chart and timeline should be developed, whereby implementation would managed as a large long-term (10-year) programme (see annex 10.27 for format developed in the Workshop, and based on the Strategy table of contents/ sections). This could also be informed by the above-mentioned time-line produced by Dr Bourdeix. Group 2 worked with the same documents. Discussions began by a phase on comments on the Strategy and then tried to see which sub-regional network might lead certain part of the Strategy, along with the relevant ITAGs. Group 2 agreed on having:

- Africa and Indian Ocean leading the work on 3.2 and 3.3 (global concept of coconut collection + ex situ conservation) with relevant ITAGS
- South Pacific on 3.4. (in situ conservation) with relevant ITAGS
- Latin America and the Caribbean on 3.6. (safe movement) with relevant ITAGS
- Biodiversity/India on 3.8 (database management) with relevant ITAGS
- South East Asia on 3.7. (promoting uses) with relevant ITAGS

6.2.3 Sharing updates on COGENT activities and needs

Presentations provided regional updates from Brazil and Côte d'Ivoire (*in absentia*), India, Indonesia and PNG, as well as updates from regionally active stakeholders including

ACIAR, APCC, SPC, and CIRAD, including the outgoing coordinator's report on activities since the last SC meeting, which included a reminder of COGENT's mandate, and the ongoing work in characterisation and managing LYD.

Brazil provided some new and interesting data on phytoplasma vector studies, as well as the genebank statistics. **Côte d'Ivoire** reminded delegates also of the ICG-AIO statistics, and their on-going characterisation work, work on LYD and the worsening threat from urbanisation and development (now critical¹⁰). **India** reported on some seed-garden work, Indian coconut value chains, an exemplary germplasm exchange record - new accessions (23) and sharing 30 accessions, progress in breeding programmes, genetic improvements and capacity building programmes, and also in cryopreservation and genomics work. **Indonesia** highlighted its vast 3.5 million Ha coconuts, and outlined its breeding programmes and private sector collaboration. Finally PNG reported on the importance of coconuts to 35% population and progress on BCS containment.

ACIAR highlighted the importance of regional biotic threats such as BCS and CRB covered in 6.3 below. APCC reported on the recent Ministerial meeting in Kiribati, the current market trends, and the level of interest from potential new member-countries beyond the region in Africa and Latin America. APCC also re-affirmed its willingness to collaborate in not only activating but sustaining the operations of COGENT in the long term-basis. SPC highlighted its new 4-pillar regional strategy, and outlined some recent successes with CePaCT and especially in Taro production, at the same time re-affirming willingness to support COGENT. CIRAD congratulated COGENT members for maintaining activities under the extremely difficult financial circumstances and proposed its technical assistance through participation of its researchers to the ITAGs' activities and future project's designed to implement the Strategy

6.2.4 Building ICG curators' germplasm management capacity within the MLS

Half of day 2 provided COGENT delegates with some knowledge and capacity building for more effective germplasm and genebank management. A private sector Indian coconut producer, Umapathy Farms, presented some cutting-edge work on advanced coconut seedlings systems (production and nurseries management and sophisticated nutrient and water management) and quality certification using barcoding for traceability. Other technical presentations updated delegates on transferring tissue culture technology (micropropagation, somatic embryogenesis and *in vitro* protocols); the latest successes from Leuven in coconut cryopreservation (Korean case-study); recent coconut genomic developments, an overview of international databases for managing data on conserved germplasm, and issues on exchanging germplasm, with a focus on safety problems of Pacific Region)

Representatives from the Global Crop Diversity Trust and ITPGRFA¹¹ provided two informative presentations on the Multilateral System promoted by the Treaty (Art 15) and Practical Aspects using Standard Transfer Material Agreements (SMTAs), which allowed delegates to appreciate the relative simplicity of using this tool, and how the MLS on benefit sharing works in practice.

6.2.5 Obligations under International Agreements

As mentioned above, another important consideration that was discussed in a couple of different sessions is the network Host's obligations to jointly ensure the integrity of the international collections/ICGs in the event of threats, along with the host government and FAO. In February and May 2007 Bioversity international (ex-IPGRI) signed MoAs with the

¹⁰ <http://www.africanewsquick.net/archives/17918>

¹¹ A video presentation sent remotely from the ITPGRFA 7th Governing Body meeting in Rwanda

ITPGRFA and RCI and PNG governments concerning respectively ICG-AIO and ICG-SP This falls under clause 2g Article 15 of the Treaty:

If orderly maintenance of the ICG is impeded or threatened by whatever event including force majeure the Secretary and IPGRI (Bioversity), with the approval of the host government shall assist in its evacuation or transfer to the extent possible.

New agreements will need drafting transferring obligations to new body. According to article 6 of agreements, Bioversity International needs to give one year's notice to withdraw from agreements.

The remaining three ICGs (Brazil, India, Indonesia) fall under agreements governed by the Convention for Biological Diversity (CBD), which carry similar obligations (designated accessions only)- article 5c if ICG threatened, and notice to quit is also required- 2 years before end of a 4-year period (starting May 2006), so Bioversity will need to provide notice in May 2018.

6.2.6 Electing a new COGENT Chair and Vice-Chair

As is customary in SC meetings, a new Chair and Vice Chair were elected. SC members outlined the following three scenarios:

Table 2: 2017 COGENT SC Chair and Vice-Chair voting scenarios

#	Chair	Vice chair
1	Brazil	PNG
2	PNG	Brazil (remain)
3	PNG	Cote d'Ivoire/ Tanzania

Normally the Vice Chair becomes the Chair, but the Brazilian Vice Chair was unable to attend the 2017 SC meeting. Also, the Vice Chair normally hosts the next SC meeting (it had been planned for Brazil this time for various logistical and financial reasons this was not possible). Because there has not been an SC meeting in PNG, and it's possible the next SC meeting may coincide with the final Darwin project meeting in PNG, the SC wanted to involve PNG in these scenarios. **In the end the SC voted for JAMES KAIULO of KIK, PNG to become Chair and ANDREW JACOB NGEREZA, of Tanzania to become the Vice Chair, so as include the African continent.**

6.2.7 COGENT meeting 2019

The SC identified four countries willing to host the next SC meeting : China, Mexico, PNG and Tanzania, and by majority vote PNG was selected, partly as this coincides with the expected next Darwin Initiative meeting planned for PNG.

There is still a possibility that other COGENT member-countries may also be willing to host the meeting. However COGENT will need to assess the funding and other resource requirements well in advance.

6.3 Objective 3 – To elucidate international efforts to address key biotic threats to coconut diversity in the Pacific

As cited in the introduction, aside from the ravages of cyclones and other extreme weather events, Asia-Pacific coconut production is being increasingly jeopardised by two key biotic threats:



→ 3 genes : - 4 groups : Caribbean, Ghana-Mozambique, Tanzanie, PNG
 - Subgroups : Dom Rep. # Mexico and Cuba
 Mozambique # Ghana



i) the coconut rhinoceros beetle (CRB- *Oryctes rhinoceros* L.), spreading across Asia, from India to Indonesia, whose sap-feeding adult causes debilitating damage. A recently-evolved biotype from Guam (CRP-G)¹² is resistant to a commonly occurring entomopathogenic virus, unlike the susceptible Pacific biotype (CRP-P), and now poses a serious threat to regional coconut and other palm production.

ii) Bogia Coconut Syndrome (BCS)- a relatively recently identified lethal-yellowing disease, caused by a vector-borne phytoplasma, that causes premature fruit drop and rapid death. BCS also affects other species including areca palms (*Dyopsis lutescens*) and banana¹³ (*Musa spp.*). A recent molecular study has confirmed this phytoplasma belongs to a new group (Dollet et al 2017)

¹² <http://www.spc.int/blog/a-new-biotype-of-coconut-rhinoceros-beetle-discovered-in-the-pacific/>

<http://www.pacificislandtimes.com/single-post/2018/02/25/Special-Report-Invasive-species-are-a-crisis-for-Guam-and-the-Pacific-right-now>

¹³ in which it is known as Banana Wilt-Associated Phytoplasma- BWAP

Dr Richard Markham of ACIAR introduced the session, articulating the need to develop/update regional action plans to combat these two serious biotic threats. Dr Jan Helsen, the Director of the Land Resources Division of the Pacific Community (SPC) then summarised the October 2018 Coconut Rhino Beetle Pacific Area Coordination Workshop. Separate regional initiatives for containing BCS are ongoing.

6.3.1 October Pacific Week CRB workshop

In already considering a regional action plan for CRB control, the October Pacific Week workshop outlined the need to i) identify key actors; ii) identify and implement (or continue implementing) an effective suite of measures to prevent, contain, suppress and/or eradicate CRB as appropriate, iii) initiate an increased and more coordinated regional program to address short-, medium- and long-term goals in the protection of the palm industries in the Pacific, and iv) participate in a follow-up workshop scheduled in March by USDA in Guam.

The CRB workshop covered the four main areas of : Policy and Strategy; Biosecurity and Quarantine; Research and Development, and Extension/ Collaboration / Communications (text below cited from Jan Helsen's minutes see annex10.4).

Policy & Strategy

- 1. Increase cooperation and coordination of research, biosecurity and communications.*
- 2. A Pacific CRB Coordinating Committee (CC) be established under the auspices of the Regional Technical Meeting on Plant Protection, and that this CC coordinates national efforts, seeks the support of funding agencies and coordinates relevant research, biosecurity and communication initiatives.*
- 3. SPC offered to host interim CRB Secretariat within Land Resources Division. The secretariat may form a working group to assist in the planning of CRB-G activities, and that such a group would have key members of national control efforts, private industry and researchers.*

Biosecurity & Quarantine

- 1. Review and reinforcement of biosecurity procedures at pre-border, border and post-border (internally, between islands or districts).*
- 2. Need to improve regional communication and coordination of national policy through International Plant Protection Convention (IPPC) and Pacific Plant Protection Organisation (PPPO) and/ or the Regional Technical Meeting on Plant Protection (RTMPP)*
- 3. Sharing of awareness and communications around pathways and early warning systems such as pest alerts.*
- 4. Efforts to improve border facilities to enable proper handling and inspections of materials*
- 5. PICTs should develop their own National CRB-G Emergency Response Plan (ERP) and train staff.*
- 6. The workshop recommended review of legislation and regulation on movement between islands*

Research & Development

- 1. Need for research within an Integrated Pest Management framework.*
- 2. Major socio-economic issues that will require additional expertise obtained through a centre of excellence and extensive advocacy;*
- 3. Need for a comprehensive research on biological control agents including bio-discovery and testing of new agents.*
- 4. More research on attractants and lures and trap designs. Further research also on beetle biotype variations and exploration of irradiation/sterilization techniques.*

5. *Need to standardize damage assessment and bioassays and in improving regional laboratory facilities.*
6. *Further scoping and research on pesticide options, and application methods – for example, stem injection approaches to protect palm trees from beetle damage.*
7. *Phyto-sanitation and management of organic waste was a vital CRB management practice and that further research into disposal techniques and economics are needed.*

Extension/ Collaboration / Communications

1. *Urgent need for a range of awareness and knowledge management tools to enable different audiences to understand the problem and contribute to actions to reduce the spread of CRB*
2. *Improvement of partnerships and coordination at all levels, particularly with key players from the private sector, rural advisory services and research institutes.*
3. *Continued strengthening of awareness and knowledge of CRB amongst stakeholders in the coconut industry and the general public.*
4. *Further baseline data collection and systematic monitoring and evaluation of the impact of CRB-G.*
5. *The workshop recommended mobilising the general public, communities and individuals to implement effective waste management and sanitations at both non-infested (pre-emptive measure) and infested areas to destroy breeding habitat for CRB*

6.3.2 Workshop recommendations for CRB and BCS control in the region

Following this introduction delegates broke into two groups (one for each key threat) to share current knowledge and discuss what steps may be taken to combat these serious threats.

Table 3 below summarises the discussions and main points raised by both groups. Sixteen different areas of pest management were discussed which, given more thought could be categorised into the sub-headings of policy & strategy; biosecurity & quarantine; research & development, and extension/ collaboration / communications. Each group had loosely categorised their listed management options into 'prevention' or 'containment', although many measures fall into both categories. The areas discussed have been ordered in a logical sequence as follows: i) surveillance/ scouting/ early warning/ regional alerts, knowledge management; ii) quarantine; iii) diagnostics; iv) trapping; v) epidemiological studies / awareness raising of life cycles; vi) planting material management; vii) sanitation; viii) resistance/tolerance trials; ix) laboratory trials; x) mixed cultivar cropping to increase genetic diversity; xi) cover intercropping ; xii) studies for resistance gene markers; xiii) coconut genomics; xiv) biological control ; xv) threshold management; and xvi) disease management resources audit.

Evidently each option needs more detailed discussion, and perhaps when implementing the recommendation of 'forming a Pacific CRB (and BCS?) Coordinating Committee (CC), with a Secretariat hosted by the Land Resources Division of SPC, 'the CC could assimilate these points and others raised by other groups. In any and all events a regional initiative should gather momentum to address these two biotic challenges that threaten not just coconut but other key regional crops, with perhaps a more concerted approach.

Table 3: Outline basis for Pacific regional action planning to manage CRB and BCS

Option	Biotic Threat	
	BCS (+ other phytoplasmas/viroids?) (Group 1)	CRB (Group 2)
Surveillance/ scouting/ early warning/ regional alerts, knowledge management	Early warning infolink (farmers) (from Group 2)	Early warning infolink (farmers),
	Plant health clinics/ doctor (from Group 2)	Plant health clinics
	Info pest net (from Group 2)	Info pest net/ database updating
	Data scouting (from Group 2)	Data scouting (senescence)
Quarantine	use of disease-free areas/ control vectors, control planting material movement	Biosecurity – checks, surveillance, intelligence, direct inspection, pheromone trapping in risk areas (can attract invasion!)
Diagnostics	physical symptoms diagnosis, supported by new molecular tools	diagnosing physical symptoms, and recognising pest life-cycle stages, plant health clinics
Trapping	vector cages/ leaf hopper control	Pheromone traps with NPV RISK RELATES TO HIGH %SENILE PALMS
		Nano pheromone traps (info exchange) http://cnas-re.uog.edu/wp-content/uploads/2015/09/CRB-Trapping.pdf to understand life cycle and control points
Epidemiological studies / awareness raising of life cycles	Special vector studies	Tracking – mark and recapture, and to locate breeding spots
	modelling	modelling
	factors affecting range and spread	factors affecting range and spread, including flight distance (2 scenarios-normal and cyclone)
Planting material collection and management strategy	Ensure effective / safe, clean movement (research issues)	
	Embryos/ planting material from disease-free areas	
	Characterising infectible units	
	list and adopt comprehensive precautionary principles, noting LYD can be transmitted by coconut embryo	
Sanitation	Cryo- rescue , refer to the “Black’s method” ¹⁴	Incentivise clearing sanitation/felling
	farmers sometimes not able / willing to do this efficiently so sometimes mobile teams need to be deployed to assist	include post cyclone relief
Resistance/Tolerance	to be established using susceptible varieties and indicator palms and	Screening coconut for resistance to CRB by feeding trials/ feeding preference

¹⁴ Gurr GM, Johnson AC, Ash GJ, et al. Coconut Lethal Yellowing Diseases: A Phytoplasma Threat to Palms of Global Economic and Social Significance. *Frontiers in Plant Science*. 2016;7:1521. doi:10.3389/fpls.2016.01521.

Option	Biotic Threat	
	BCS (+ other phytoplasmas/viroids?) (Group 1)	CRB (Group 2)
Trials	source of sustained inoculum.	trials
	Each country should identify their most and least susceptible varieties. [germplasm for these trials could also be shared using TC multiplication]-related strains of the phytoplasma should be identified	
	Screening vs BCS- plant out genotypes in BCS hotspots	
Laboratory trials...	an alternative to resistance trials in field. Samples (seedlings) of varieties may be screened in a 'Magenta Box' (experiment described by Dr Oropesa to examine respective rates of infection by different vector species	
Mixed cultivar cropping to increase genetic diversity	a. Supply open-pollinated nuts from genebank to farmers. These could be georeferenced for follow-up assessment	
	b. TC clones could be distributed for this purpose as well - care should be taken that these be developed from inflorescence ex-plants rather than from plumula ex-plants- to eliminate heterozygosity	
	c. Study the mechanism of resistance in Vanuatu Tall	
Cover intercropping		to reduce breeding sites
Studies for resistance gene markers	researchers from outside of COGENT may need to be called upon to carry out this work.... The ITAGs could be instrumental.	
Coconut genomics	Coconut genomes to be examined for evidence of integration of phytoplasma. This could be done by identification of signature sequences derived from the . In the case of vectors (etc) someone simultaneous trapping could be carried out in affected areas by phytoplasma.	
Biological control		(e.g. scolius) combinations of fungal viral, nematode agents : http://guaminsects.net/anr/sites/default/files/CRB2014-05-04_0.pdf
		biologically enhance wood breakdown
		research on bio control agents (Nudivirus)
		Mange to acceptable level/ threshold
Threshold management		understanding if minimum levels of infestation acceptable
Disease management resources audit	manpower resources – 3 of coconut researchers in each country should be assessed with view to recommending an increase also young researchers should be recruited in the interests of continuity.	
	ensure regionwide collaboration	

In any pest control action plan pest diagnosis plays a key role. With regard to phytoplasmas, and in this case BCS, there have been recent advances in developing practical field diagnostic kits. New technology has been developed that can purify DNA ready for amplification in 30 seconds without any need for pipetting. (Zou et al., 2017) It has now been adapted it for extracting DNA from coconut palm shavings samples, even in the middle of coconut plantations¹⁵, new LAMP primers have been developed along with a method to lyophilize individual LAMP reactions (Jimmy Botella- unpublished pers communication).

The groups also highlighted other problematic biotic threats in their specific situations as listed in table 4. The coconut hispine beetle (*Brontispa longissima*) was listed as the next most important threat, and several comments were made by the group regarding its control: Lack of surveys- need for broader surveillance; update P&D databases (SPC/CABI/FAO) needed; further research on biocontrol killing at adult palm stage- fungi/ earwigs; general awareness of symptoms/ epidemiology needs raising; ACIAR Biocontrol of invasive pests projects; building islands capacities'needed; research reasons for success/ failure.

The other listed threats (see table 4) included: *Botrydiplodia theobromae* (associated with nut-fall); coconut crabs (*Birgus latr*); coconut flat moth (*Agonoxena argaula*); coconut foliar decay virus (CFDV); Phytophthora spp. (associated with bud rot and premature nut-fall); and coconut stick insect (*Graeffea crouanii*).

Table 4: other pests of some regional/ country importance

Pest	Country					comments
	Fiji	Hawaii	Samoa	Tonga	Vanuatu	
Botrydiplodia						
Brontispa						
Coconut Crabs						
Coconut flat moth <i>Agonoxena argaula</i>						
CRB						field sanitation, virus pheromone traps
foliar decay virus						
Phytophthora						
stick insects						EGC parasitoids

¹⁵ <http://journals.plos.org/plosbiology/article?id=10.1371%2Fjournal.pbio.2003916#abstract0>

7 Impacts

7.1 Scientific impacts – now and in 5 years

Coconut genetic resources conservation and use will be sustained for the long-term. This will include COGENT's scientific support to coconut research through its International Thematic Action Groups (ITAGs): 1 *Ex-Situ* Coconut Conservation and Related Methodologies; 2. Coconut Genomics; 3. Coconut Breeding; 4 Phytopathology, Entomology and Coconut Germplasm Movements; 6. Ethnobiology & Socioeconomics; 7. Coconut *in-vitro* Culture Techniques. Particularly relevant to the objectives of this SRA, the Phytopathology ITAG should work with the SPC's (proposed) CRB and BCS platform to deal with these key regional biotic threats, to protect coconut and other palm production within and beyond the region. All six of these areas are of vital importance in supporting scientific advances in the coming years

These impacts will only begin to be realised if the national- and more particularly the 5 international genebanks can build their capacity and resources and begin to function according to their required roles in effectively conserving and exchanging coconut germplasm within the MLS. For all of this to happen the COGENT Secretariat must first be successfully transferred to APCC, and a new network coordinator be recruited to oversee the implementation of the new Global Strategy.

When all of this is in place COGENT can apply itself to successfully coordinating the conservation and use of coconut diversity in the Asia-Pacific region and globally, for the eventual benefit of those millions of households that depend on coconut for their livelihoods.

7.2 Capacity impacts – now and in 5 years

COGENT should play a key role in continuing to build the capacities of the genebanks and their staff, especially for the ICGs. This SRA has helped lay some groundwork for more extensive capacity building, although follow up will be needed for both the capacity to conserve important diversity, and the capacity to address the challenges posed by BCS, CRB and other biota within and beyond the region. Workshop delegates were provided insights into how the MLS should work, and given this awareness, it is more likely that the genebanks can effectively conserve and share their accessions. If COGENT flourishes, it will be in a stronger position to help continue building the genebanks' capacity to conserve and share/use the material in their collections.

7.3 Community impacts – now and in 5 years

Coconut is important to millions of smallholder households. The future of coconut production and livelihoods critically depends on its broad genetic diversity, much of which is threatened by key pests and diseases, and the effects of climate change (including increasingly severe cyclones and drought). This SRA is unlikely to have much direct impact on coconut smallholders and their communities within the next 5 years. Further investment is needed to build coconut stakeholders' capacity and resilience across the value-chain, particularly for genetic resources conservation. However, the SRA has contributed to capacity building, awareness raising, and helping to develop a mechanism whereby COGENT might flourish in a new hosting arrangement. All of this could contribute ultimately to improved livelihoods.

7.3.1 Economic impacts

Any involvement in implementing measures that successfully reduce the adverse effects of BCS and CRB and increase the diversity of the exploited coconut varieties in the region will create economic benefits for Pacific smallholders, and the coconut industry as a whole. This should include higher income from improved productivity. COGENT's activities can also help make improved or more resilient and diverse germplasm more accessible to more producers, which will also help growers to be sustain their or improve productivity over the longer term, and in the face of anticipated climate change.

7.3.2 Social impacts

Coconut has always been important in Pacific society, culturally and economically. SRA outcomes may include enabling Pacific communities to continue their fundamental relationship with this 'tree of life', and perhaps even pursue new avenues of working with palms.

7.3.3 Environmental impacts

Coconuts are associated with resilience, and the key environmental impact arising from this SRA will be improved resilience to climate change, in the event of COGENT being able to coordinate the responses needed to prepare for the adverse effects of anticipated (and unanticipated) climate change/ extremes

7.4 Communication and dissemination activities

A COGENT Communications ITAG was launched at the 2014 SC meeting, but due to dwindling resources it has never been activated. Under the new hosting arrangement, APCC will ensure communications and dissemination will be integrated into the existing portfolio of communications activities implemented by the new COGENT host APCC (and probably with links to the SPC), and informing the new website. Tools like posters/flyers etc. will be given to the official COGENT country-member representatives for dissemination in their country and region.

8 Conclusions and recommendations

8.1 Conclusions

In the wake of recent CGIAR and Bioversity strategic realignments, after almost three decades, Bioversity no longer has sufficient resources to continue hosting the International Coconut Genetic Resources Network (COGENT) Secretariat, nor does it possess the required core scientific competences in coconut research. Therefore a new Secretariat hosting arrangement is being established for COGENT, within the Asia Pacific Coconut Community (APCC-new global name forthcoming).

The specific objectives of this SRA have been to: 1) finalise and launch COGENT's new revised Global Strategy, 2) assure the technical and organizational underpinning for conservation and use of coconut genetic diversity in the Pacific and globally, and 3) To elucidate international efforts to address key biotic and abiotic threats to coconut diversity in the Pacific.

Several elements are being drawn together, including how to secure the safety and effectiveness of the 5 international collections (ICGs), so they can fully participate in the MLS. The ICGs and other collections need protecting from the critical threats of key pests and diseases, climate change, urbanization, industrialization, changes in land-use, land-grabbing, and need protecting. The linked International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) obligations need respecting, germplasm data needs safeguarding and updating within the coconut genetic resources database (CGRD), and most importantly *the Global Strategy for the conservation and use of coconut genetic resources*, needs launching and then implementing via COGENT's International Thematic Action Groups (ITAGs). Against the backdrop of increasing demand for coconut, plantings worldwide are senile and facing declining productivity.

Many research teams from member-countries have shown interest in coconut genomics, ranging from coconut genome *de novo* sequencing and marker-assisted selection through to transcriptomics. The progress in conventional breeding is hindered by the relatively low nut production and the long generation time in coconut. Genomics studies will help to more effectively address crucial aspects of coconut breeding, such as disease resistance, genetic inheritance of the two kinds of dwarfism existing within the species, and the genetic components for high yielding varieties. COGENT's genomics ITAG is well placed to help link different teams involved with this important work.

Effective germplasm exchange is one of the priorities of ICGs and is critical for research, increasing diversity and genetic improvement in the receiving countries. However, exchanging germplasm as zygotic embryos has met with limited success, and newer ways of *in vitro* exchange are showing more promise and need further investigation. There are increasing phytosanitary restrictions that impede exchange, due to the pests and diseases that affect different countries in the world including where the ICGs are located. So more research is needed on effective management and control of biotic threats.

Part of this SRA grant-work has supported finalising the revised Strategy. An effective and sustainable mechanism for implementing the Strategy over the coming decade was considered during the workshop, and has now been proposed to be developed via COGENT's re-forming International Thematic Action Groups (ITAGs). Part of the workshop considered reshaping the ITAGs.

Another part of the SRA workshop has considered how COGENT might best be sustained in the years to come, and presented different scenarios for hosting the COGENT Secretariat. The SC meeting developed and ratified ten recommendations linked to

COGENT coordination and hosting and various aspects of Strategy implementation (see Annex 10.1.1).

Finally the workshop also provided an opportunity for delegates to consider current knowledge and discuss 16 different options for combatting the two most serious biotic threats prevalent in the pacific region, Bogia Coconut Syndrome (BCS) and Coconut Rhinoceros Beetle (CRB). These included: : i) surveillance/ scouting/ early warning/ regional alerts, knowledge management; ii) quarantine; iii) diagnostics; iv) trapping; v) epidemiological studies / awareness raising of life cycles; vi) planting material management; vii) sanitation; viii) resistance/tolerance trials; ix) laboratory trials; x) mixed cultivar cropping to increase genetic diversity; xi) cover intercropping ; xii) studies for resistance gene markers; xiii) coconut genomics; xiv) biological control ; xv) threshold management; and xvi) disease management resources audit.

For successful germplasm conservation and exchange, COGENT needs to be sustained, and this SRA has helped to articulate the way forwards through finalising the Strategy, developing a sustaining mechanism and considering how key biotic threats to coconut productivity in the pacific and beyond can best be addressed.

8.2 Recommendations

8.2.1 General recommendations arising from stakeholder exchanges

These recommendations are summarised in section 8.1, and articulated in detail in the SC recommendations listed in the next subsection and fully articulated in Annex 10.1

- i) Further investment is needed to build coconut stakeholders' capacity and resilience across the value-chain, particularly for genetic resources conservation.
- ii) In time for launch at the APCC Cocotech meeting in August 2018:
 - a. Finalise and implement COGENT Secretariat transfer to APCC including the associated ITPGRFA Article 15 and CBD obligations
 - b. Finalise the publication of the Global Strategy docs by end May 2018, and prepare for the launch at COCOTECH
 - c. Finalise the nominations and rebuilding of the ITAGs and their leadership
 - d. Prepare a first version the 10-year implementation plan of the Strategy
 - e. Begin the recruitment process for the new COGENT coordinator
- iii) Develop a sustainable funding mechanism (endowment?) for COGENT
- iv) Interact with SPC regarding a regional platform to manage key biotic and abiotic threats in a way that links with the appropriate SC recommendations , Strategy Implementation and ITAGs. The starting point could be with BCS and CRB.

8.2.2 Developing priority recommendations for COGENT's future actions

After reviewing the recommendations arising from the 17th SC meeting (in Sri Lanka, 2014) , and bearing in mind the current state of coconut genetic resources research, the SC and other COGENT members developed a priority list of ten recommendations arising from the discussions during this SRA, which ..

- i) Interim coordination of COGENT
- ii) New Hosting arrangement for COGENT Secretariat
- iii) New COGENT Secretariat and Coordinator recruitment

- iv) Global Coconut GR Conservation and Use Strategy Implementation
- v) Coconut Genebanks Audit
- vi) Securing Coconut Genebanks' land tenure for the long term
- vii) Managing Key Biotic stresses threatening coconut
- viii) Accessing Coconut Genomics Mapping Populations (in Côte d'Ivoire)
- ix) Safe coconut germplasm exchange- via in vitro zygotic embryos
- x) Towards an upgraded Coconut Genetic Resources Database

9 References

9.1 References cited in report

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FAOSTAT - consulted March 28, 2018: <http://www.fao.org/faostat/en/#data/QC>

Gurr GM, Johnson AC, Ash GJ, et al. Coconut Lethal Yellowing Diseases: A Phytoplasma Threat to Palms of Global Economic and Social Significance. *Frontiers in Plant Science*. 2016;7:1521. doi:10.3389/fpls.2016.01521.

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Vaqalo, M., Marshall S. Jackson T., and Moore, A., (2017). A new biotype of Coconut Rhinoceros Beetle discovered in the Pacific, SPC Pest Alert No 52, ISSN 1727-8473. http://www.spc.int/wp-content/uploads/2017/08/Pest-Alert-52-Coconut-Rhino-Beetle_finaledits.pdf

Zou Y, Mason MG, Wang Y, Wee E, Turni C, Blackall PJ, et al. (2017) Nucleic acid purification from plants, animals and microbes in under 30 seconds. *PLoS Biol* 15(11): e2003916. <https://doi.org/10.1371/journal.pbio.2003916>

9.2 List of publications produced by project

Bourdeix R. Johnson V., & Prades, A (2017) :*Brochure* : [Global Strategy for Conservation and Use of Coconut Genetic Resources](#), Bioversity International, Rome, Italy.

10 Appendixes

10.1 COGENT 2018 SC meeting and workshop

10.1.1 Recommendations arising



COGENT
-Recommendation 1

10.1.2 Agenda



Final meeting
agenda SC Meeting

10.1.3 Invited participants



Tentative_Participan
ts-List_03_10_17.xlsx



Participants
List_COGENT SC Me

10.1.4 Invitation



COGENT SC
meeting Member in\

10.1.5 CIRAD participation



CIRAD COGENT
future collaboration

10.2 COGENT Hosting arrangement study

10.2.1 Hosting study ToR



hosting study TOR
summary v2.docx

10.2.2 Hosting Study time line



ganttt Chart hosting
study and other CO

10.2.3 Initial letter to COGENT Chair and Vice chair regarding informing on upcoming hosting study



letter to COGENT
SC-140217.pdf

10.2.4 Presentation of hosting options to SC



COGENT Hosting
options study_VJ.pdf

10.2.5 hosting options' comparative advantages



COGENT hosting
study options comp

10.2.6 Draft list ITAGs and leaders/ draft nomination form



ITAGs and
Leaders.docx

10.2.7 Draft 10-year implementation roadmap



COCOSTRAT ROAD
MAP-V2.xlsx

10.3 Strategy chapter/ document dropbox file links

Brochure:

https://www.dropbox.com/s/gd4cmdns7aukt4a/Brochure_final_LLD_Oct_25_2017_full%20web%20version.pdf?dl=0

CH 0: https://www.dropbox.com/s/xvq735y2g6bxc2f/20171030_Chapter0_final.pdf?dl=0

Ch1/2:

https://www.dropbox.com/sh/tatbut5dd5938b9/AAA8m0GuwZWrWM6dZ_tN7ZuDa?dl=0

PDF version: https://www.dropbox.com/s/tn9ehc6ratkda9o/20171030_Chapter3_final_cp.pdf?dl=0

Word version: https://www.dropbox.com/s/nuey7ohfugasqvb/20171030_Chapter3_final_cp.docx?dl=0

Chapter 3 reviewed Feb-March 2018:

<https://www.dropbox.com/s/is2yuay5nfz6bzi/Chapter%203%20-%20Where%20we%20need%20to%20be%202018-03-15%20LP.doc?dl=0>

final PDF version:

https://www.dropbox.com/s/tn9ehc6ratkda9o/20171030_Chapter3_final_cp.pdf?dl=0

Word version:

https://www.dropbox.com/s/nuey7ohfugasqvb/20171030_Chapter3_final_cp.docx?dl=0

Annexes:

https://www.dropbox.com/s/cs6p3lapz2ep20b/Annexes_cp2.docx-vj_clean.docx?dl=0

10.4 Notes from Biotic threat action planning session



notes for biotic
threat action plan.d