A Global Strategy
for the conservation and use of Coconut Genetic Resources
2018-2028

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cirad
LA RECHERCHE AGRONOMIQUE POUR LE DÉVELOPPEMENT

COGENT
Coconut genetic resources for enhanced livelihoods

Bioversity International

generally scattered in many small files not all having the same structure. This put the data at further risk, because over time such bespoke software becomes obsolete, or it becomes difficult to understand the particular structure of the numerous small files used for storing the data.

The Coconut Data Management software (CDM) was created in 1996 by CIRAD for managing palm-by-palm data[32]. This software is presently used in only three COGENT member-countries. Its main advantage is an efficient graphic interface for managing the identity of the palms. The coconut database managed with CDM software in Côte d'Ivoire is the largest and most comprehensive existing database in any COGENT member-country. In October 2013, it contained 8.2 million observations of fruit and bunch harvests conducted on 90,500 palms during 47 years (from 1967 to 2013); and millions of other observations of standard descriptors and fruit component analysis.

2.4.2 Managing international coconut databases

Information on morphology, evaluation, origins and locations of accessions conserved *ex situ* is available in the CGRD[33] which was developed between 1994 and 2013 by CIRAD. Until 2002, the project was funded by the French Government via Bioversity International and implemented in collaboration with COGENT member-countries.

In 1999, the COGENT Steering Committee took the decision to release the CGRD into the public domain, in order to disseminate this useful information and create public awareness about coconut genetic resources[34]. Since 2002 no regular funding has been available to manage this database.

In the CGRD, data on coconut cultivars are divided in two main components: (1) passport data and (2) characterization and evaluation data. It takes into account the standardized descriptors for the coconut palms and the methods detailed in the STANTECH manual. As indicated elsewhere in this Strategy, the CGRD is a crucial strategic tool for three reasons:

- It provides the only means to assess coconut conservation at the global level. Most strategic analyses presented in this Strategy rely on the content of CGRD;
- It provides access to information on conserved germplasm for all users. Curators can be informed of what exists in other genebanks and request germplasm transfers. Breeders can search for and identify the accessions they would like to include in their plans;
- It serves as a data repository, to back up paper documents containing historical data of accessions in the event of loss.

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[32] Version 3 of CDM delivered in March 2000 is able to manage the palm identification traits along with data on observations during the vegetative phase, leaf morphology, stem measurements and state of the palms. It is possible to execute powerful queries on the database, to export data into external file, and to make statistical analysis of widely used experimental designs. The software was introduced in a COGENT training course held in Montpellier in 2002.

[33] Available from URL: http://www.cogentnetwork.org/cgrd-version-6-0-test-version

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

The CGRD software is too technical to be used by farmers and some other stakeholders from the coconut value chain. In order to make germplasm information available in the most user-friendly way, two initiatives were developed:

- A catalogue of conserved germplasm compiled and made available online. Coconut varieties and populations conserved *ex situ* are each described by a page of text and a page of standardized pictures[35];
- To aim at an online publication of the coconut data available in CGRD accessible in a wider database system to be developed by Bioversity International for three commodities - *Musa*, cocoa and coconut. This germplasm Information System, called COCOGIS[36] for coconut, could provide user-friendly access to coconut germplasm data, with the possibility of visualizing germplasm information (passport and characterization standard descriptors) on geo-referenced maps and satellite images. However, development has been suspended due to lack of resources.

The TropGENE database, created and hosted by CIRAD, manages genomic and phenotypic information about many tropical crops[37]. TropGENE contains coconut molecular markers and quality trait loci (QTL) data as well as genotyping studies. It is not envisioned to include other types of information (such as phenotypic data) because these are already available within CGRD. The data for genotyping studies included in TropGENE have been generated by CIRAD and by institutions from COGENT country-members, using 1,293 palms from 160 accessions collected in 34 countries.

Genesys is a global multicrop portal supported by the Secretariat of the Treaty. The Genesys portal aims to provide users with improved access to the millions of accessions held in genebanks worldwide. The only coconut accessions referenced in Genesys are 18 from the USA and 147 from Côte d'Ivoire. It is expected that COGENT data will be included at some point, but this operation requires the signature of bilateral data sharing agreements between each COGENT country member and the repository of the data in order to establish the intellectual property rights of each party.

Obtaining data from curators can be challenging. More than 80% of the data presently available on the CGRD database was obtained when COGENT experts went to the countries and worked directly with curators and their teams. Thanks to CIRAD (Chantal Hamelin, UMR AGAP) and to the three-month Bioversity/COGENT project "Upgrading international coconut genebanks and evaluating accessions" funded by the Trust, CGRD software has recently been updated and improved. Two upgraded versions were released in 2012 and 2013 respectively. More recently, in May 2016,

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[35] See URL: http://www.cogentnetwork.org/conserved-germplasm-catalogue

[36] See URL: http://www.cogentnetwork.org/cocogis-version-1-0-test-version

[37] See URL: http://tropgenedb.cirad.fr/tropgene/JSP/interface.jsp?module=COCONUT

Version 6.1.2 was released on the COGENT website[38] along with an updated user manual in a downloadable pdf format.

At present, none of the COGENT databases available online includes the scientific literature relevant to coconut genetic resources. Such a database is maintained on a voluntary basis by Dr Hugh Harries as the Coconut Time line[39].

2.4.3 Geographic Information Systems.

A Geographic Information System (GIS) may be defined as "a database management system which can simultaneously handle spatial data in graphic form, i.e. maps, or the 'where', and related, logically-attached, non-spatial, attribute data, i.e. the labels and descriptions of the different areas within a map, or the 'what'."(Guarino et al. 2002). GIS technology has been increasingly used in genetic resources studies and conservation. For example, mapping collecting sites has allowed visualizing and extrapolating the distribution of targeted species, as well as locating areas of higher genetic diversity, and areas that are under-represented in conservation or threatened with genetic erosion or global change. Thus, in Vietnam, GIS technology has been used to manage a database of coconut palms selected in farmers' fields, for producing planting material, and to evaluate the effects of climate change in the Mekong Basin through the National Coconut Project led by the Institute for Oils and Oil Plants.

Between 1995 and 2012, coconut researchers from 13 COGENT countries were trained for inputting data into the CGRD, subsequently allowing geo-referencing 60% of the CGRD accessions. In 2013, CIRAD collaborated with COGENT and the CRP-FTA to assess this and other information, and to map global coconut distribution. The localization of all collection sites was systematically checked, significantly improving the quality of COGENT data. Coconut global distribution has been studied using Ecoclimatic Niche Modelling. The resulting maps provide a clearer picture of potential coconut cultivation areas (Figure 2.5), contribute to our understanding of coconut dispersal, and allow a better identification of collecting gaps (under-represented in international collections, see Figure 2.6). This new tool will also be useful for anticipating the effects of climate and sea-level changes. From this perspective, an effort has been recently undertaken to map regions of particular genetic diversity.

Figure 2.5 presents climate suitability for coconut. Dark green indicates marginal areas, while light green and warmer colours are used for increasingly favourable areas. Highly favourable climates are best represented in the Pacific and Indian oceanic regions (Southern Asia to Australia, Eastern Africa and Madagascar, and myriad small tropical islands), corresponding to the natural distribution of the species (Batugal et al. 2005b). Favourable climates are also found in the Gulf of Guinea, the coasts of eastern Brazil and the Guyanas, in all the Caribbean, (where the coconut was introduced in historic times), and in the Pacific coasts of Colombia and Panamá (where the coconut was introduced in Pre-Columbian times).

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[38] See URL: http://www.cogentnetwork.org/cgrd-version-6-0-test-version

[39] See URL : http://cocos.arecaceae.com/