2024

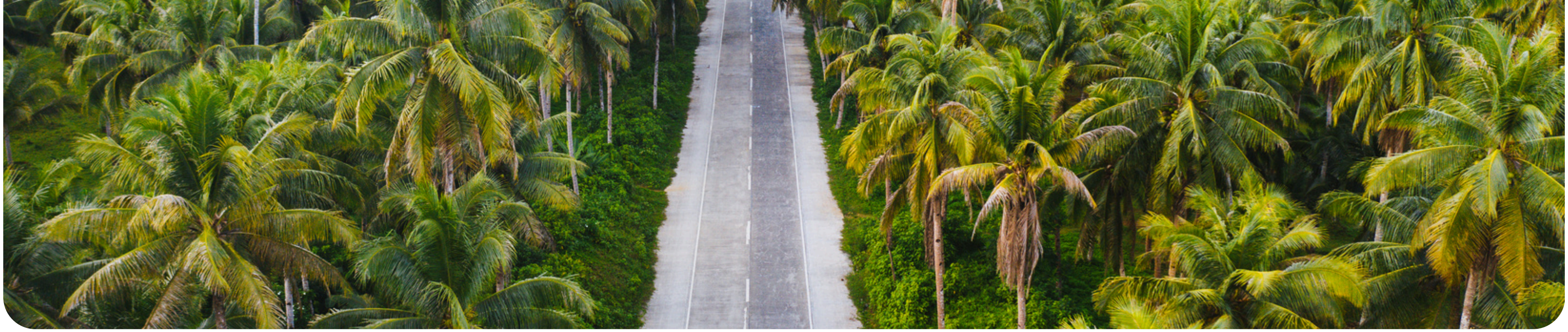
ICC-COGENT NEWSLETTER

INSIDE THIS ISSUE

Lead Author:
Ms. Erlene Manohar
(COGENT Coordinator)

Editor:
Ramon Taniola

Lay-out Artist:
Ma. Jocel Chico



THEME

Conservation Cum Innovation: Crucial to COGENT'S Transformation

Carefully Crafted Constructs

COCOTECH's recent Conference centered on carefully constructed themes—the Advancement of Global Coconut Germplasm, Conservation and Utilization, Productivity Enhancement, Nurturing and Nourishing Sustainable Ecosystems. It focused on fostering cutting-edge innovations as powerful platforms to drive the future. It highlighted a healthy balance between preservation and optimization. Its recurring refrain on value-addition reiterated the development of desired varieties. It called for the creation of a network of support systems at a global scale to better meet the evolving industry and community needs.

Agenda and Advocacy for Action

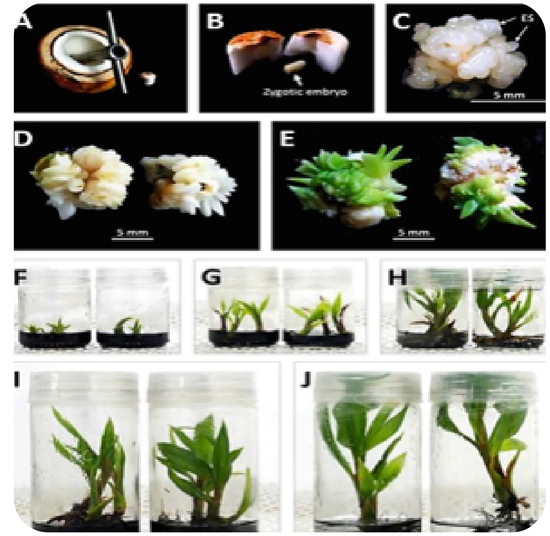
More importantly, the deliberate and diligent choice to connect the conservation of nature to the conservation of life painted a more pressing agenda and advocacy for action. Nature gifted man with such a vast variety and deep diversity of coconuts. Cocotech's 2024 targeted thrusts refreshed and reenkindled a recommitment to reciprocate—beyond an appreciative acknowledgment of a singular source for economic progress to committing all to conserve, preserve and protect the tree of life' rich genetic resources for the use of the upcoming generation.

Selection of Gerplasm with Quality Traits

Australian Government
Department of Foreign Affairs and Trade

Access to Available Ready Resources

FAO-ITPGRFA and Crop Trust together endlessly explore the coconut genebanks' (ICGs/NCGs) rich repertoire of thinking and technology in the field. The proliferation of plans, research, and approaches allows ample access to available and ready resources. This enables employing innovative initiatives to address the constantly changing complex challenges of the industry. The foundation of any agricultural development depends on production. Innovations from the pool of genetic gold mine offer an ore of rewarding opportunities.



Enabling Ecosystem

Industry progress and prosperity involve encouraging an ecosystem enabling thinking and technology. Advancements in coconut breeding, molecular characterization to support diversity conservation, coconut tissue culture for safe germplasm exchange, and allied genebank programs are the catalyzing drivers of industry development.

COGENT INITIATIVES REKINDLED WITH A CAUSE

ERLENE C. MANOHAR COGENT
COORDINATOR

Pivotal in Protecting and Preserving

The International Coconut Genetic Network (COGENT) plays a pivotal role in protecting and preserving vast genetic resources. The changes and challenges of the coconut landscape demand that it recenters and recalibrates. The ever-evolving industry requires revolutionary radical rethinking. The significant shift focuses on formulating longer-term conservation strategies, better genebank management, safer germplasm movement, and the more effective exchange and economic use of genetic resources.

Breaking Barriers

With a scaled-up scope and next-generation goals, COGENT gears up to break barriers towards more sustainable solutions to climate change and perplexing productivity challenges. Under the auspice of the ICC, it bridges better the gaping gaps to gain accelerated access to growing golden opportunities. Exploring and exploiting the value of coconut genetic resources is crucial and critical to more effectively respond to the challenges of the industry. The relentless passionate pursuit of the ICC mandates inevitably ensures enhanced productivity, strong supply stability, and income-augmenting livelihood initiatives for the farmers, their families, and their communities. The crafted ICC-COGENT road map transitions from conservation to optimization breaking off from the binds of traditional socioeconomical context to the longer term more sustainable and comprehensive eco-environmental context as envisioned and enshrined in the 2018 COGENT's Global Strategy Plan.

Performing an Irreplaceable Part

COGENT performs an irreplaceable part as a coconut conservation network. Its crusade for the coconut, centers on protecting nature's generous gift diversity and harnessing the economic value of genetic resources. It fully functions though only if on a longer leash working mode as an independent tech-expert. ICC fills in an assist mode to bolster and boost in the former's continuing quest to protect and preserve germplasm. ICC rises up to a reinforcement role for COGENT for it to shoe into its coordinating task in harmonizing research advances in coconut breeding for varietal improvement. Resulting research findings propel productivity using hybrids and selected genotypes with special traits. These pole-vaulting program milestones make the biggest difference. They demonstrate readiness and responsiveness to industry needs. They reflect resiliency to more effective impact mitigation of climate change.

COGENT INITIATIVES REKINDLED WITH A CAUSE

ERLENE C. MANOHAR COGENT
COORDINATOR

Reaping the Rewards

Ultimately, planet and people reap the rewards as these innovative initiatives translate in time to bigger broader better socio-economic benefits for the coconut farming communities. The preservation of the coconut diversity through ex situ and in-situ conservation, technological innovations and ecological protection serve as a strategic building blocks to maximizing the greatest generated good from genetic resources. A deep dive to unearth and unravel the coconut's immense genetic diversity proves to be a powerful key factor in intensifying productivity and improving breeding efforts. The resulting researches pave the way for more effective pest control and disease resistance and tolerance. These advancements aimed at addressing the adverse effects of environmental climate changes represent the very essence of the COGENT-ITAGs last three years' landmark legacy.

Synergistic Sharing

The synergistic sharing among contributing collaborators – COGENT, the International Coconut Genebanks (ICGs) and National Genebanks (NCGs) benefit member countries through easy and open access to the conserved genetic resources crucial to a nation's economic development. The rich repertoire of resources those three interacting organizations facilitate the mainstream participation of the farmers in partnership with the government and the industry sector in the conservation and exchange of germplasm The selection of varieties and technologies appropriate in increasing the yield and identification of varietal traits for marketable products perhaps pose their most significant contributions to industry progress.

Sowing the Seeds of Sustainability

The inclusive initiatives of COGENT and the member countries do foster mutually beneficial coopetition and the united and unified search for relevance, resiliency and sustainability. Currently, the advent of the green energy sourcing and the increasing market demand for coconut-based foods and its health uses, underscores the need to address stagnating supply and deteriorating productivity. Cutting edge innovations for a sustainable future sees the bigger application context even beyond the socio-economic to include the eco-environmental context. This involves nurturing germplasm conservation and developing a resilient coconut ecosystems. Sowing the seeds of sustainability ultimately thought starts at the source—planting the future is right where it all begins—the farmer, the farm, their families and their communities.

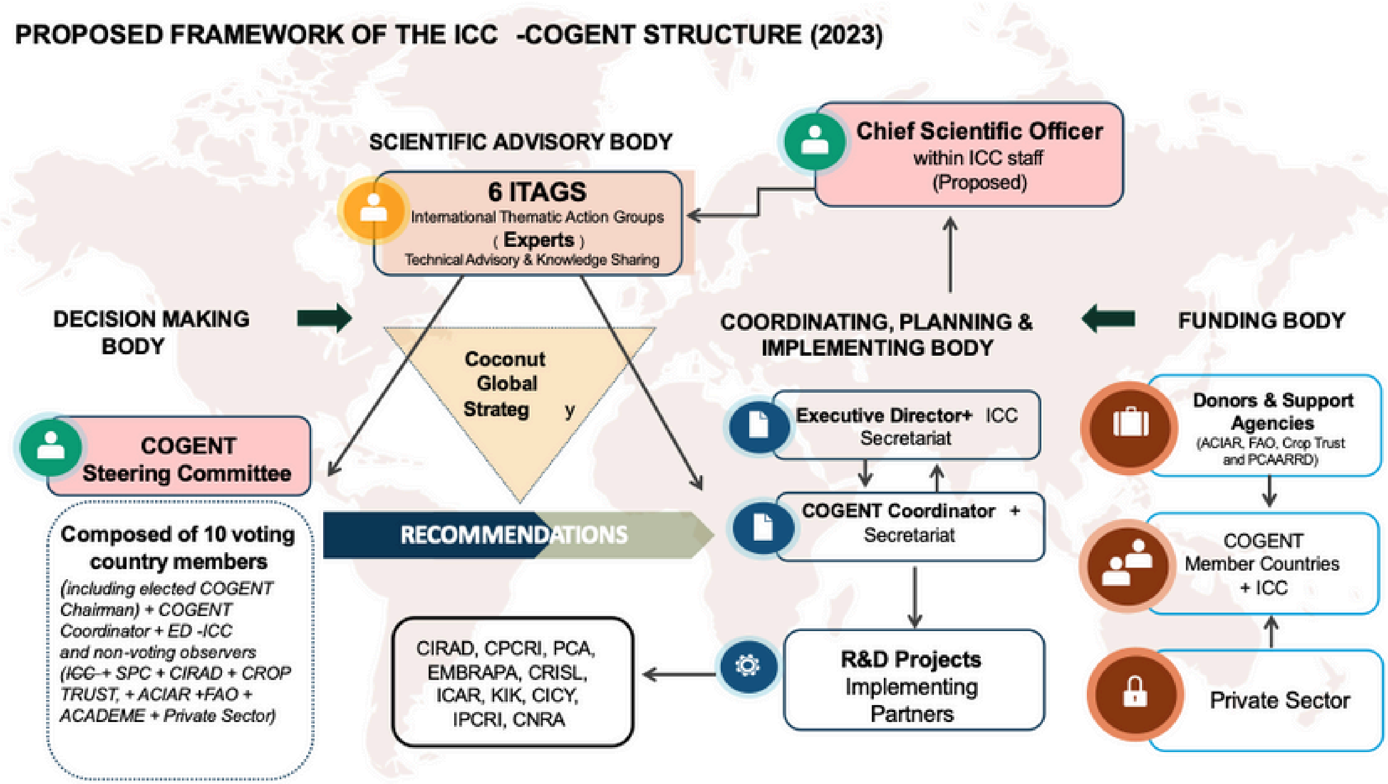
A RENEWED ICC-COGENT STEERING COMMITTEE IN SUSTAINING THE ITAGS' INITIATIVES

JELFINA ALOUW AND ERLENE C. MANOHAR
ICC, EXECUTIVE DIRECTOR AND COGENT COORDINATOR

The COCOTECH big international event on July 26, 2024, at the Westin Hotel, Surabaya, Indonesia stood out as a singular strong testimony to the power of partnership. ICC and COGENT closely collaborated to prepare and plan the annual conference. A Steering Committee diligently detailed the meeting's main program menu using a combination of communication media and modes. The long-distance divide did not deter the team from interacting and engaging in Technology-assisted exchanges 3 invaluable inputs and insights facilitated the blueprinting of best practices for the purpose. The crafted caption concisely captured the targeted theme: Unlocking the Transformation Pathways of COGENT under ICC, for Better Germplasm Conservation and Management. The summit centered on fast-tracking the formulation and formation of intervention initiatives to cope with the quickly evolving coconut crop improvements and increasingly complex industry competition

COGENT is no exception to organizational pitfalls and pushbacks. Despite the odds, it has successfully sustained continuing conservation efforts to protect the vast coconut germplasm collections. It has even in the face of falling resources stopped the deteriorating effects of diversity erosion. The dedication and determination of the ITAG Team and their hard work in the challenging task of germplasm conservation, exchange, use, and sharing of resources have made a big difference. Undoubtedly undaunted, they have defied difficulties. They have survived their struggling steps even during pandemic times. Their collegial commitment to a common cause has made them all the more courageous, and stronger together.

The currently designated COGENT focal persons of the 21 ICC member countries have banded together with their former COGENT members and ITAGs research team in passionate pursuit of a powerful purpose. The bonds of that belief tie them together to rally behind an action agenda. With the guidance of the SC members and in coordination with the ICC Secretariat they have signified their strong intent to implement the proposed plans. The 20th SC meeting jointly organized by ICC and COGENT provides the strongest of salvos to expand, enhance and empower COGENT. The ICC through the Steering Committee has advanced structural and recommendatory re-organizational reforms to beachhead the blueprint for better efficiency and greater effectiveness. The below visually illustrates the initiative:



COCONUT DEVELOPMENT UPDATES FROM THE PACIFIC COMMUNITY

CARMEL E. PILOTTI (PHD)
ASSOCIATE SCIENTIST COCONUT GENETIC RESOURCES-SOUTH PACIFIC

1. Pasifika NiuNet

The inaugural meeting to establish the structure of a regional Coconut Governance Board (CGB) for the Pacific was held in February 2024 in Suva, Fiji. In addition to formalizing the structure, the meeting successfully drafted the terms of reference for the CGB and agreed to call the group Pasifika NiuNet.

A follow-up virtual meeting took place in , 2024 and the next one will be held in September, to confirm the Technical Working Group (TWG) nominations from member countries.
Pasifika NiuNet will coordinate the developments in research and production of coconut in the Pacific region and will collaborate with Pacific Island Countries and Territories and International agencies to improve the livelihoods of farming communities dependent or partially dependent on coconuts.

2. Pacific Coconut Pest Conference

Pacific Coconut Pest Conference website
A conference was convened in the Solomon Islands from 2-5 July 2024 to address the threats from coconut pests to the coconut industry in the Pacific. Prior to this, a series of three virtual webinars was held in collaboration with the ASEAN Fall Armyworm Action Group. The recordings of the three webinars (Palm Crop Pests, Palm Crop Diseases, Activities, and Future Strategies Forum) leading up to the Pacific Coconut Pest Conference can be found here.

List of plenary speakers and include the topic and a photograph of the ICC ED Dr Jelfina Alouw – (I hope you have one). One of the keynote addresses was delivered by ICC Executive Director Dr. Jelfina Alouw who presented[CP1] a review of the global occurrence and distribution of coconut pests and the lessons learned from the Pacific experience, highlighting the crucial need for understanding the interaction between host plant and the pests and boosting plant tolerant system.
Key outcomes and recommendations from the conference are being compiled into an Action Plan that will be conveyed to the CGB for further resourcing and action through the TWG.

3. Coconut resources at the Land Resources Division (LRD)

The LRD) at the Pacific Community (SPC) encompasses several research projects and integrated programs for coconuts. All of them, along with other relevant materials related to coconut research and development in the Pacific can be found on one dedicated website hosted by SPC: the Coconut Tree of Life Knowledge Bank. The platform is still under construction, however as a dynamic website it is constantly updated and any resources from partners or donors are welcome, to increase its outreach to Pacific member countries. 'Coconut Tree of Life", the Pacific knowledge bank for coconut research and development

[CP1]Erelene, please ask Claudio for a photo of Dr Alouw speaking.

THE CURRENT STATUS OF COCONUT GENETIC RESOURCES CONSERVATION

WILMS HANNES, ADKINS W STEVE, PANIS BART

The conservation of coconut genetic resources is essential for the industry to thrive, as breeding programmes rely on the diversity present within a species. However, in the case of the coconut palm, this diversity is under threat and needs to be conserved. The first method to conserve genetic resources is to protect the diversity at its source via in situ approaches. As a domesticated species, the wild coconut palm is quite rare, however, some relicts of wild coconut palm have been found on the Keeling Island of Australia and in the Philippines. However, the only dedicated in situ conservation effort for wild coconut palm is happening on Keeling Island, meaning wild coconuts in other areas are less protected. Whilst the wild coconuts are rare, there exist many landraces over the tropics with unique characteristics, which have been conserved by farmers and are still evolving and adapting to changing conditions. However, these too are in danger as these could be lost when replaced for more profitable varieties or removed with land use changes. Therefore, the indexing and conservation of these unique varieties represent important work that needs to be undertaken which ex-situ conservation can play an important role.

In the case of coconut, genebanks currently hold all of their genetic diversity in field banks. This ex-situ conservation method makes the material more accessible to other farmers and breeders as compared to in situ conservation. The access to the widest possible genetic diversity makes the coconut farming industry more resilient to changing circumstances. But these collections face challenges, as diseases have destroyed material, and land disputes have put a limit on how much diversity a genebank can store. Therefore complimentary in vitro alternatives are currently being developed that mitigate some of the risks associated with field genebanks and can act as a backup or store material which is in low demand. These in vitro conservation methods are, however, still not optimized and are still being improved. For long-term conservation, cryopreservation, which is the storage of biological materials at -196ºC which is the temperature of liquid nitrogen, is considered as a welcome approach for those plants that produce non-storable seeds. As there was, until recently, a lack of micropropagation approaches, most cryopreservation protocols have been developed for embryos and plumules excised from the coconut. While multiple articles have reported rooted plants after cryopreservation, these methods can still not be considered as being standard practices.

Recently there have also been advances in the micropropagation of coconut palms, via somatic embryogenesis and shoot meristem culture. Being able to micropropagate materials on a large scale allows for an easier and cheaper way of dissemination of material as rare varieties could be multiplied and made readily available while in the past this material was quite scarce. Also, for conservation, these novel in vitro multiplication methods allow for new opportunities for germplasm storage as it could make slow growth a viable medium-term conservation method. Additionally, in vitro plants also provide the ideal source material for long-term conservation through cryopreservation, as being applied to other crops such as bananas, potatoes, and garlic. As these developments have been quite recent, the protocols need further optimization and routine use still has to be implemented.

Whilst there is the danger of losing coconut palm genetic diversity, recent coconut research shows that solutions are now developed to mitigate this problem. However, the implementation of research into practice remains an important hurdle. For a more in-depth reading please see the chapter referred to below. it tackles all coconut conservation methods and gives an overview of the benefits, drawbacks, and complementary approaches.

Contributors: Wilms, Hannes, Bazrafshan, Amirhossein, Panis, Bart and Adkins, Steve W., 9781789249736.0009, Botany, Production and Uses, doi:10.1079/9781789249736.0009, (126–142), CABI, Coconut Conservation and Propagation, (2024)

ADVANCES AND PROSPECTS OF COCONUT GENOMICS AND MOLECULAR BREEDING

DR.SIWARET ARIKIT
ASSOCIATE PROFESSOR, SIWARET ARIKIT,
DEPARTMENT OF AGRONOMY,
KASETSART UNIVERSITY, BANGKOK,
THAILAND

Coconut genebanks are at a crucial stage in their development, mainly due to the significant advances in genomic characterization and conservation strategies. The release of the coconut genome was a crucial milestone, providing researchers with a comprehensive map to identify genetic diversity within the species. This genetic data is invaluable for characterizing the germplasm and facilitating the identification of unique traits such as drought tolerance and disease resistance, which are crucial for coconut breeding (Lantican et al. 2019). Despite this progress, many genebanks face challenges integrating genomic data into their conservation efforts, hindering the full utilization of this information. Without adequate bioinformatics resources and standard protocols, genebanks struggle to effectively manage their coconut germplasm collections. Furthermore, the limited sharing of genomic data between institutions exacerbates these challenges and creates a bottleneck in the potential application of genomic tools in breeding programs.

The advent of next-generation sequencing (NGS) technologies and other advanced genomic tools has opened new avenues for coconut breeding and conservation. NGS enables high-resolution genome sequencing, which is critical for the identification and conservation of rare alleles that confer beneficial traits such as biotic and abiotic stresses (Fan et al. 2013). By using these tools, coconut genebanks can more effectively manage the genetic diversity in their collections and help identify underutilized genetic resources. However, many of these technologies are still underutilized due to the lack of standardized protocols and the high cost of bioinformatic analyses. In addition, few genebanks have the technical expertise required to use advanced genomics tools effectively. As a result, the potential of NGS and other genomic technologies is not yet fully exploited in coconut conservation efforts. Establishing protocols for data collection and analysis and providing training in bioinformatics are crucial steps to fully exploit the potential of genomics in this field. Future efforts should focus on improving access to these technologies, especially in developing countries where coconut plays a critical role in food security and livelihoods.

Although significant progress has been made in sequencing the coconut genome, a more diverse and comprehensive reference genome is still needed to capture the full extent of genetic variation within the species. Currently, available reference genomes are based on a limited number of accessions (Yang et al., 2021; Xiao et al. 2017; Wang et al. 2021; Lantican et al. 2019), which may not adequately represent the global diversity of coconuts. Expanding the reference genome to include more diverse accessions from different regions would significantly enhance our understanding of the species' genetic complexity. This expansion is vital for developing robust molecular markers linked to key traits such as disease resistance and environmental stress tolerance. Climate change poses additional challenges to coconut production, and breeding programs need to focus on developing varieties that can withstand extreme weather conditions, pests, and diseases. By leveraging genomic information, breeding programs can more effectively address these challenges and ensure that coconut remains a viable crop for global food security and economic sustainability. By integrating omics approaches—such as genomics, transcriptomics, and proteomics—researchers can gain deeper insights into the molecular mechanisms underlying these traits. Additionally, combining genomic data with phenotypic information could accelerate the identification of genes responsible for desirable traits, thereby increasing the efficiency of breeding programs. To achieve these goals, international collaboration and data-sharing agreements are essential, ensuring researchers have access to a broader range of coconut genomic resources for sustainable breeding initiatives.

ADVANCES AND PROSPECTS OF COCONUT GENOMICS AND MOLECULAR BREEDING

DR.SIWARET ARIKIT
ASSOCIATE PROFESSOR, SIWARET ARIKIT,
DEPARTMENT OF AGRONOMY,
KASETSART UNIVERSITY, BANGKOK,
THAILAND

Building upon this need for a more comprehensive genomic framework, the development of molecular markers has already significantly advanced our understanding of genetic diversity, population structure, and breeding strategies in coconut. DNA markers like simple sequence repeats (SSRs) and single nucleotide polymorphisms (SNPs) have become integral to coconut genetic analysis. For instance, GBS-derived SSR markers successfully classified Thai coconut germplasms into three distinct genetic groups, demonstrating their potential for future breeding efforts (Riangwong et al., 2020). Moreover, the advent of next-generation sequencing (NGS) technologies has accelerated the discovery and application of these markers, enabling high-throughput genotyping and more detailed genetic mapping. NGS has further facilitated the identification of novel alleles and rare variants, which are essential for marker-assisted selection (MAS) in improving traits like quality, agronomic performance, and yield. However, despite these advancements, trait-linked marker development remains limited, with few markers successfully integrated into breeding programs, such as DNA markers for the trait "aroma" in young coconuts (Saensuk et al., 2016; Dumhai et al., 2019). Addressing challenges such as high genotyping costs and limited access to advanced sequencing platforms, especially in resource-limited regions, will require greater investment in infrastructure, capacity building, and enhanced global collaboration among research institutions and genebanks to fully leverage NGS for coconut breeding.

To close the gaps in coconut breeding and genomic integration, international collaboration between genebanks, research institutions, and breeding programs is critical. Such partnerships can lead to the standardization of genomic tools and protocols and enable more effective sharing of resources and expertise. Collaborative projects such as the International Coconut Genetic Resources Network (COGENT) have already demonstrated the benefits of pooling resources for the conservation and utilization of coconut germplasm. These partnerships are critical to building research capacity, especially in regions where coconut is an important agricultural commodity, but the research infrastructure may not be in place. Continued investment in capacity building, particularly in bioinformatics and molecular breeding techniques, will be key to realizing the full potential of genomics in coconut breeding.

STRENGTHENING THE INTERNATIONAL COCONUT GENEBANK FOR LATIN AMERICA AND THE CARIBBEAN (ICG-LAC)

EMILIANO FERNANDES NASSAU COSTA
EMBRAPA, BRAZIL

The International Coconut Genebank for Latin America and the Caribbean (ICG-LAC), hosted by EMBRAPA in Brazil, plays a vital role in conserving coconut genetic resources in the region. The genebank is currently home to a significant collection of accessions (27), including both dwarf and tall coconut varieties from local and international sources. However, the management of these collections varies between the two primary sites, Itaporanga and Betume. While Itaporanga is relatively well-maintained, benefiting from micro-drip irrigation systems and a higher water table, Betume faces challenges due to its remote location, lack of irrigation, and pest infestations, particularly from termites and the black palm weevil.

One major gap in the ICG-LAC is the limited representation of regional coconut diversity, primarily due to concerns about Lethal Yellowing Disease (LYD), which is prevalent in many Central American and Caribbean countries. This limits the inclusion of genetic diversity from those regions. Additionally, financial and staffing challenges, such as a shortage of trained personnel and delays in funding for essential activities like germplasm regeneration, have hampered the genebank's operations. Despite these challenges, the ICG-LAC has significant opportunities to expand its role in global coconut conservation. These opportunities include diversifying its accessions by introducing LYD-tolerant materials from disease-free regions, improving agronomic practices, and strengthening collaboration with other international gene banks. Brazil's status as a country free from LYD further enhances its position as a secure location for coconut germplasm conservation. This unique advantage facilitates greater international cooperation and germplasm exchange, positioning Brazil and the ICG-LAC as key leaders in safeguarding coconut biodiversity. Their efforts will support global breeding programs focused on improving productivity, enhancing disease resistance, and ensuring the long-term sustainability of coconut resources.

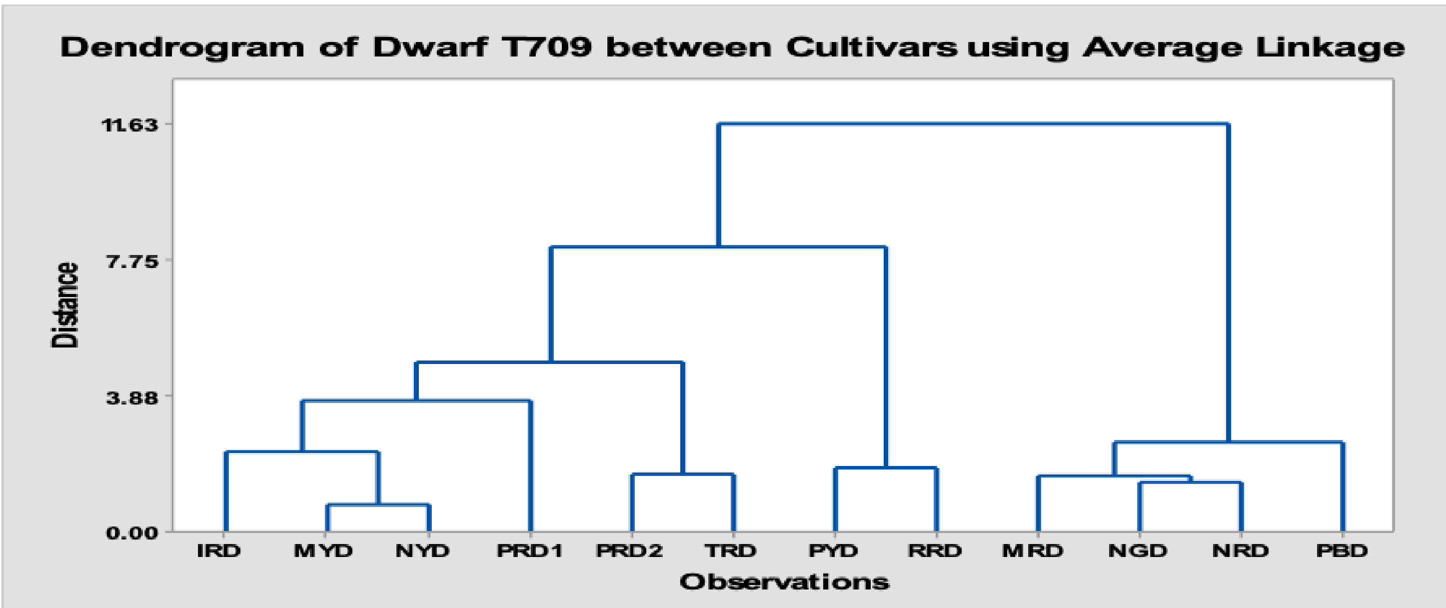
Enhanced research initiatives, such as tissue culture for mass propagation, cryopreservation for long-term conservation, and hybridization programs aimed at developing new coconut varieties, offer additional avenues to strengthen the genebank's contributions to the coconut industry. Moreover, securing funding for these activities will be essential to ensuring the sustainability and success of the ICG-LAC.

THE SOUTH PACIFIC INTERNATIONAL GENEBANK IN PAPUA NEW GUINEA: RESILIENCY AND OPPORTUNITIES

EREMAS TADE AND ALAN AKOU
ICG-SP CURATOR AND DIRECTOR OF KOKONAS INDASTRI KOPORESEN

The International Coconut Gene Bank for the South Pacific region is located at the Stewart Research Station (SRS) of Kokonas Indastri Koporesen, Madang Province, Papua New Guinea. The aim of the ICG-SP as with other genebanks is to conserve in the field genebank a maximum of 200 accessions which will be contributed by member countries in the South Pacific region. Coconut embryo culture technology is the internationally accepted method to be used in the collection and importation of accessions which will be grown in vitro in the laboratory, transferred into pots in the greenhouse and eventually transplanted in the field. Currently, the ICG-SP holds a total of 49 coconut accessions in the field genebank which include 39 tall and 12 dwarf accessions, most of which are national collections offered for the regional centre, as originally contained in the MOA.

The results of the dendrograms of Tall Accessions and Dwarf Acessions showing the linkage between cultivars and the Mahalanobis genetic distance by R-statistics analysis 2018-2021 have shown that there is not much diversity from the Local Tall Accessions at the current germplasm collections. Therefore, there is a need for more collections and germplasm exchange as the majority of the tall accessions are very closely related. Furthermore, the Dwarf Accessions below showed that there is a need for further collections and exchanges through the importation of exotic varieties to increase the genetic pool of diversity in Papua New Guinea.



Genetic Diversity amongst the Dwarf Accessions (The value of Wilks statistics is p=0.009. p<0.05).

Photos of the different coconut accessions at the ICG-SP, Stewart Research Station, Madang, PNG

Based on the report, challenges encountered in the incidence of BCS and CRB of which tolerance screening trial was undertaken. In the case of utilization of conserved germplasm as parent materials for breeding 24 tall parents as male and 3 dwarfs for crossing with 72 progenies were selected for the purpose. The superior varieties for industry use were made available by supplying seed nuts from the ICG-SP to coconut farmers for replanting and hybrids were produced plus the improved genetic Materials. It was also emphasized that the germplasm exchange with South Pacific countries and Territories, and other COGENT member countries was made possible. For income generation, intercropping with food crops and other cash crops for revenue generation to sustain the genebank operational activities was undertaken.

For future plans, expanding the prospection and collection of local coconut accessions for the genebank has to be pursued. Efforts in the development of plant tissue culture protocol through embryogenesis technology are underway and promotion of the genetic resources especially the available superior varieties for industry use and supply of seed nuts from the ICG-SP to coconut farmers for replanting are the major priorities of KIK.

SCIENTIFIC INSIGHT ON COCONUT TO DEVICE CLIMATE CHANGE MITIGATION STRATEGY

K.B. HEBBAR, RAMESH S.V., AND NIRAL V.
ICAR-CENTRAL PLANTATION CROPS RESEARCH INSTITUTE, KASARAGOD 671 124, KERALA, INDIA

Global climate change models predict daily mean temperature to increase by about 1.0 to 3.7°C by the end of the 21st century with an increase in the variability in rainfall and increased frequency of extreme weather events like heat waves, cold waves, drought, and floods (IPCC, 2013). Climate has always been in a state of flux, but the current rate of change is much faster, and the range of weather variables is much broader than ever seen before in modern agriculture. Climate change has far-reaching implications for coconut production and quality, and approaches are required for adapting to new climates. Action must be taken now to adapt in a timely manner and prevent unpredictable and undesirable outcomes. New crop varieties, cropping systems, and agricultural management strategies are needed to provide options to farmers to counterweight these changes.

Coconut (Cocos nucifera L.) is one of the important tropical crops cultivated extensively in 12.08 million ha in 92 countries with an annual production of 69 billion nuts. Coconut provides food security and livelihood opportunities to 20 million people globally through cultivation, processing, marketing, and trade-related activities. Thus, the coconut value chain has a profound influence on rural economies around the world. Coconut can be successfully grown in areas where the annual rainfall is 1300 mm or above, under the prevalence of high humidity, at an optimum temperature between 27 °C and 30 °C, and on moderate to well-aerated soils. Under the changing climate, coconut is exposed to drought, high temperatures, flooding, seawater inundation, cyclones, etc..

Climate variables such as temperature, precipitation, and humidity have an enormous impact on the growth and development of coconuts as in other species, and these factors could also influence their geographical distribution. Increasing temperatures, decreasing humidity, and high radiation worldwide are resulting in an exponential climb in vapor pressure deficit (VPD, which is an increasingly important driver of plant functioning in terrestrial biomes associated with climate change. Under high VPD stomatal conductance decreases and transpiration increases in most species including coconut up until a given VPD threshold, leading to a cascade of subsequent impacts including reduced photosynthesis and growth, and higher risks of carbon starvation and hydraulic failure. Amongst the coconut genotypes, the cells showed high WUE during summer due to better regulation of stomata and biomass gain, despite exhibiting high water use and biomass on account of large leaf area. In dwarfs on the other hand due to insensitive stomata, they continue to lose water without biomass gain as a result they have poor WUE and hence they had poor adaptability under adverse climate conditions.

SCIENTIFIC INSIGHT ON COCONUT TO DEVICE CLIMATE CHANGE MITIGATION STRATEGY

K.B. HEBBAR, RAMESH S.V., AND NIRAL V.
ICAR-CENTRAL PLANTATION CROPS RESEARCH INSTITUTE, KASARAGOD 671 124, KERALA, INDIA

High temperature: Temperature is a major determinant of nut yield in coconut. In young seedlings, it scorches the leaves and reduces photosynthesis while in adult palms it affects fertilization resulting in the shedding of young buttons and hence poor nut set. High-temperature days (Tmax ≥ 33 °C during the daytime) during the first three months of inflorescence opening severely reduce the nut set of an inflorescence. In Sri Lanka, inflorescences opened during the months of January, February, and March, and in India during the months of April and May had very poor nut set because it coincides with a greater number of days with high temperatures (>33 °C). Coconut inflorescence or 'spadix' is monoecious, bearing both male and female flowers, but it is protandrous. The male flowers open, liberate pollen, and fall off for a period of 19–25 days, and 2–4 days after cessation of the male phase, the pistillate (female) flowers become receptive. In the majority of the cultivated varieties of coconut, the asynchrony between the male and female phase warrants the movement of pollen from one flower of either the same plant or a different plant to effect pollination thus making the process of fertilization more vulnerable to high temperature. Thus, high temperature outside the range of its tolerance reduces both pollination and fertilization in coconut, but the botanical and physiological basis of this phenomenon is not apparent.

In coconut, among the different stages of progamic phase, pollen germination with high-temperature stress was well studied under in vitro. The mean cardinal temperatures for pollen germination of coconut genotypes ranged from 23.5 °C to 29.5 °C, 9.7 °C to 16.5 °C and 40.1 °C to 43.9 °C for Topt (Optimum temperature, temperature at which maximum pollen germination is observed), Tmin (Minimum temperature, temperature below which pollen does not germinate) and Tmax (Ceiling temperature, temperature above which pollen does not germinate) respectively, while Tmax values for pollen germination of the most tolerant and less tolerant hybrids were 41.9 °C and 39.5 °C, respectively.

High-temperature stress significantly influences the progamic phase (receptivity of stigma, pollen germination, and pollen tube growth through pistil) of the coconut and could be a cause for poor fertilization of coconut flowers.

High temperatures above 33.7 °C advance nectar secretion and stigma receptivity, coupled with the dull and dry stigmatic surface during receptivity, making it not only unattractive for pollinators but also causing shifts in the flowering phenology (early receptivity) that could severely disrupt plant-pollinator interactions in a cross-pollinated crop coconut. This improved understanding of physiological knowledge

GENETIC RESOURCES CONSERVATION AND BIODIVERSITY PROTECTION, THE FUTURE THINKING FOR COCONUT PROGRAMS SUSTAINABILITY IN THE PHILIPPINES.

CONSORCIA REANO PHD.
PLANT BREEDER OF THE INSTITUTE OF CROP SCIENCE
UNIVERSITY OF THE PHILIPPINES

Coconut continues to be the Philippines' agricultural export champion accounting for 43% of the country's total agricultural exports in 2022 valued at USD 3.2 billion. Traditional commodities such as coconut oil, oleochemicals and copra meal comprised the major products. However, economic and market forces affecting trade as well as biotic and abiotic factors brought an overall decline in production. The resurgence of pests diseases and natural disasters have posed real threats not only in commercial plantations but also in protected stands such as genebanks, ex-situ, and in situ. Although studies on the use of cryopreservation for coconut germplasm are being conducted, the field genebanks remain the only viable option for coconut at this time. However, it is highly vulnerable to biotic and abiotic stresses brought about by climate change. To mitigate the effects of diseases and natural disasters, the establishment of duplicates or triplicates is imperative at the soonest possible time. Genetic erosion or loss of valuable genetic material must be minimized. Complementation of new approaches like cryopreservation and embryo culture with field genebanks holds a viable option.

Although field genebanks are time-consuming, labor intensive, and require a vast area of land, they can serve as a source of new genes for coconut improvement, they can also serve as seed gardens as ready sources of materials for dissemination. While typhoons and diseases have taken their toll on the industry, the productivity of our coconut stands remains low as a result of poor production practices, aging palms, and genetically inferior stands. The PCA-ZRC genebank holds a vast amount of genetic diversity that needs to be explored and utilized, either as genetic sources of desirable alleles for producing genetically superior plants or as sources of planting materials for direct utilization. It holds potential for more diversified uses other than the traditional dollar earners. The establishment of duplicates requires careful consideration of regeneration protocols. Duplicate collections or genebanks should remain as genetically similar to the original materials as possible. Unintentional introduction or introgression of foreign genes, including transgenes, must be prevented in germplasm collections. Genebank processes such as regeneration must be designed to avoid inadvertent introduction of genes through geneflow, avoid selection, and retain genes in low frequencies within the population to ensure that maximum diversity is retained for future use. Best practices in genebanks should be able to achieve a high degree of probability that an accession maintains its original genetic identity over generations of regeneration and storage.

It is necessary that the materials will be produced through a method that simulates the natural reproductive behavior of the accessions. There are four flowering patterns in coconut and these are Type I or strict allogamy, This reproductive behavior needs to be simulated when producing duplicate materials as they dictate the genetic structure of the population or the alleles and genotypes, the ultimate goal of germplasm collection. Information on the flowering behavior will be considered in designing the controlled pollination technique with which the duplicates will be generated for the accession. For the cross-pollinating types, random mating will be simulated by pollinating the females with pollen having identical gametic arrays. Theoretically, a population of male gametes with identical gametic arrays will be produced by collecting pollen from each palm, bulking them, and using them to pollinate the same set of palms. The resulting population of nuts should have the desired genotypic array. Prioritizing the protection of biodiversity is an essential part of mitigating and adapting to the effects of climate change and global warming, a huge task that will demand collaboration and complementation of efforts from all institutions concerned.