COCOINFO INTERNATIONAL

Volume 28 No. 2, 2021

ISSN 0854-5006

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VOLUME 28 NO. 2, 2021 | ISSN 0854-5006

COCOINFO INTERNATIONAL

Photo by Biko Wesa, 1st Winner of World Coconut Day Competition

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Cocoinfo International is a popular journal on the coconut industry published twice a year by the International Coconut Community (ICC)
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Foreign subscription rates including airmail postage for one year (two issues) is US$ 35.00 (ICC Member) or US$ 40.00 (Non-ICC Member Countries)

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DO WE NEED RAPID CLONAL PROPAGATION FOR COCONUT?

The coconut sector has not fully exploit market opportunities arising from consumer preferences for healthy and environmentally safe products, and rapid global population growth. For more than a decade, the world's total coconut production has been largely unchanged and failed to meet market demand. Senility is the main cause of low production, followed by major pest and disease attacks, lack of desired planting materials, poor agronomic practices, climatic conditions, and natural disasters, and land conversion to other uses. In some countries, senile and unproductive palms have reached more than 50%.

Conventional coconut propagation may take a long time to replant old, unproductive palms. Therefore, it is necessary to innovate a propagation system for high-yielding varieties with high productivity, resistance to pests and diseases, fast fruiting, and better oil quality. Propagation of disease-tolerant planting material is also needed to address the challenges of several major diseases such as Lethal Yellowing Diseases (LYD) and Bogia Coconut Syndrome (BCS) caused by Phytoplasma.

Innovation in propagation techniques through Somatic Embryogenesis (SE) can accelerate the availability of desired varieties and solve the seed transport costs. Innovations to improve and enhance the existing micropropagation techniques to produce affordable seeds at the farmer level should be pursued as it would be a greater support for the industry.

Fortunately some laboratories in several countries have established protocols for the clonal propagation of coconut. We are aware of challenges found in developing effective and efficient clonal propagation technologies. Each laboratory has their own techniques, quality of the technique, facilities, and support system as well as success rates. Certain laboratories claim that their method has some advantages and strengths compared to others in terms of producing identical characteristics due to lower likelihood of somaclonal variation.

The International Coconut Community (ICC) had met virtually and visited some laboratories and discussed challenges and opportunities of developing micropropagation technique of coconut palms to produce plantlets efficiently with an affordable prices. Collaborative research efforts through the International Thematic Action Group four (ITAG4) of the Coconut Genetic Resources Networks (COGENT) and ICC-COGENT member countries are encouraged to improve the technology, validate it in coconut producing countries, and accelerate the technology transfer through a mutualistic collaboration. I'd like to take this opportunity to let the readers know that next year ICC-COGENT will hold Tissue Culture Symposium and Workshop in collaboration with national and international research institutes and organizations. The symposium and the workshop will be held in hybrid mode. We will ask our partners to contribute and share the latest progress on Tissue Culture, challenges and opportunities to increase coconut production to meet the growing market demand.

DR. JELFINA C. ALOUW
Executive Director
Editor-in-Chief

DOES COCONUT OIL HAVE A ROLE AGAINST COVID-19?

Fabian M. Dayrit[1]

The World Health Organization (WHO) declared COVID-19 a global pandemic on March 11, 2020, eighteen months ago. Shown in Figure 1 are the trends in confirmed cases of COVID-19 in selected member countries of the ICC covering the period from March 2020 to August 2021 (Figure 1).

Following are some general trends and observations:

- COVID-19 cases come in spikes.
- The trend patterns vary significantly among ICC countries.
- The overall global trend is an increase.

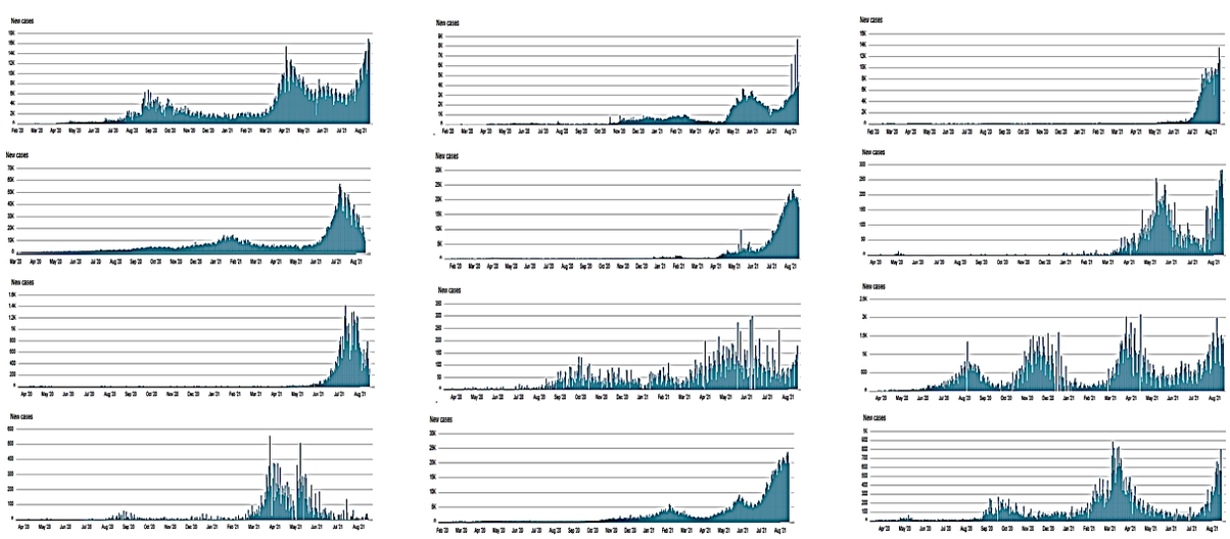

Figure 1. Trends in new COVID-19 Confirmed Cases Among Selected ICC Member Countries from March 2020 to August 2021. (Source: WHO, visited on: Aug. 24, 2021. https://www.who.int/countries/#V)

It has been said that this global pandemic will not end unless it is ended in all countries. Although no one can predict what will happen to this pandemic, what is known is that the SARS-CoV-2 virus mutates and it will continue to mutate and spread rapidly unless it is controlled. Today, it is the Delta variant that is circulating in most countries. The behavior of the Delta variant has been described as being so radically differently from the original Wuhan virus that many countries have been forced to change their pandemic planning. It is not known how this virus might evolve in the future (Kupferschmidt, 2021).

THE PHARMA STRATEGY

The dominant strategy being used to address the COVID-19 pandemic is the pharmaceutical strategy. This can be described as three-fold:

- To develop antiviral drugs
- To prime the immune system with vaccines
- To provide anti-inflammatory drugs

How successful has this Pharma strategy been?

Antiviral drugs. Up to this time, there are no new anti-SARS-CoV-2 drugs that have been developed. What we have are repurposed drugs, such as remdesivir. But this is very expensive. There is a continuing effort to screen existing drugs to repurpose them for COVID-19.

Immune system. Vaccines are agents that are meant to prime the immune system to prepare it to recognize and react to the virus more rapidly if it infects the individual. Today, there are a number of vaccines available which are based on different technologies.

By their nature, viruses mutate. The vaccines that we have today were developed more than a year ago, against the original Wuhan virus. So, their efficacy against the various variants that arise needs to be determined.

A vaccine roll-out, even under the best conditions, takes a long time. The current vaccines are projected to take until 2023 to reach the whole world. So it may take around 2 years for a vaccine to be made available globally. And by that time, we do not know what variant will have developed.

Although vaccines are our best weapon against COVID-19, WHO director-general Tedros Ghebreyesus already warned in February 2021 that: "A vaccine on its own will not end the pandemic!" We need more than vaccines!

Anti-inflammatory drugs. Much of the major damage caused by SARS-CoV-2 is an extreme immune reaction of the body, which causes severe inflammation, called the cytokine storm. It is the cytokine storm which causes serious organ damage and death. Thus, anti-inflammatory drugs are an important part of COVID-19 treatment.

However, for many COVID-19 survivors, post-COVID effects may linger. The so-called "long COVID" is characterized by a wide range of symptoms, such as: difficulty breathing or shortness of breath, constant tiredness or fatigue, difficulty thinking or concentrating (sometimes referred to as "brain fog"), mood changes, constant cough, chest or stomach pain, or headache, and others. Long-COVID may be a chronic disease.

Clearly, a purely pharmaceutical strategy is essential but is inadequate to address the COVID-19 pandemic, especially for developing countries.

DOES COCONUT OIL HAVE A ROLE AGAINST COVID-19?

Lauric acid and monolaurin have been shown previously through in vitro studies to be active against a number of viruses. A preliminary assay against the SARS-CoV-2 virus itself showed efficacy at low viral load. Coconut oil has been shown to have anti-inflammatory and immunomodulatory properties in animal studies. Coconut oil has also been shown to be effective in small clinical trials to treat HIV-AIDS. Because VCO is anti-inflammatory, VCO is proposed to modulate immune responses by upregulating neuroprotective factors and by suppressing inflammatory mediators and oxidative stress through intracellular signaling pathways.

Clinical Study: Virgin Coconut Oil is Effective in Lowering C-Reactive Protein Levels among Suspect and Probable Cases of COVID-19 (Agdeppa, 2021)

In May 2020, a clinical trial was launched to determine the efficacy of VCO against COVID-19. This first clinical trial was a randomized double-blind placebo-controlled clinical study to determine whether VCO can be used as an adjunct prophylaxis to prevent the progression of symptoms among

mild cases of COVID-19. This was a 28-day feeding study.

There were two main indicators used: recovery from COVID-19 symptoms and level of C-reactive protein (CRP) in the blood. CRP is a protein that is analyzed in the blood. CRP is a quantitative measure of inflammation or infection. CRP level less than 5 mg/L indicates recovery from inflammation or infection.

The results showed that recovery from COVID-19 symptoms was more rapid in the VCO group compared with the Control group. At day 2, 17% in the VCO group showed improvement compared to only 4% in the Control group. Full relief from COVID-19 was attained by day 18 in the VCO group compared to day 23 in the Control group.

The level of CRP in the VCO group dropped much more rapidly and completely compared to the Control group. By day 14, the CRP level in the VCO group had fallen below the 5 mg/L, and this continued to show a decreasing trend at day 28. In comparison, the CRP level in the Control group fell slowly to 5 mg/L at day 14 and stayed at this level until day 28.

These two indicators showed that VCO can be used to treat mild COVID-19 cases. More studies are being undertaken on mild hospitalized patients. Other beneficial effects of VCO were noted from the blood assay:

- HDL-cholesterol ("good cholesterol") increased
- LDL and triglycerides remain within normal range
- Fasting blood sugar (FBS) decreased

These results show that VCO, indeed, is a healthy oil.

A more holistic approach

It was already noted that the purely pharmaceutical approach is inadequate. The pharma approach is designed only to cure disease, but not to maintain health. A more holistic approach is described in Figure 2.

- We should start with wellness: comorbidities, such as diabetes, obesity, and inflammatory conditions, should be addressed, and the immune system should be strengthened.
- Vaccines are used to prime the immune system against specific viruses, in this case COVID-19. It would be good to know if these vaccines will work even better with coconut oil!
- If one is infected, the use of antiviral drugs should help address the infection. The VCO clinical study showed that it alleviates symptoms and decreases C-reactive proteins more rapidly.
- If COVID becomes more serious, antiviral and anti-inflammatory drugs are administered. The efficacy of VCO for serious COVID conditions needs to be studied.
- Treatment for post-COVID conditions needs to be done. Although anti-inflammatory drugs may be administered, their long-term use is not yet established. VCO may provide post-COVID treatment, but this must be studied.
- Finally, when one is back to wellness, VCO should become part of the new normal of maintaining our health and immune system.

THE ICC SOLIDARITY TRIAL

The International Coconut Community can launch its own Solidarity Trial around the use of the coconut diet or VCO. Three possible studies are proposed.

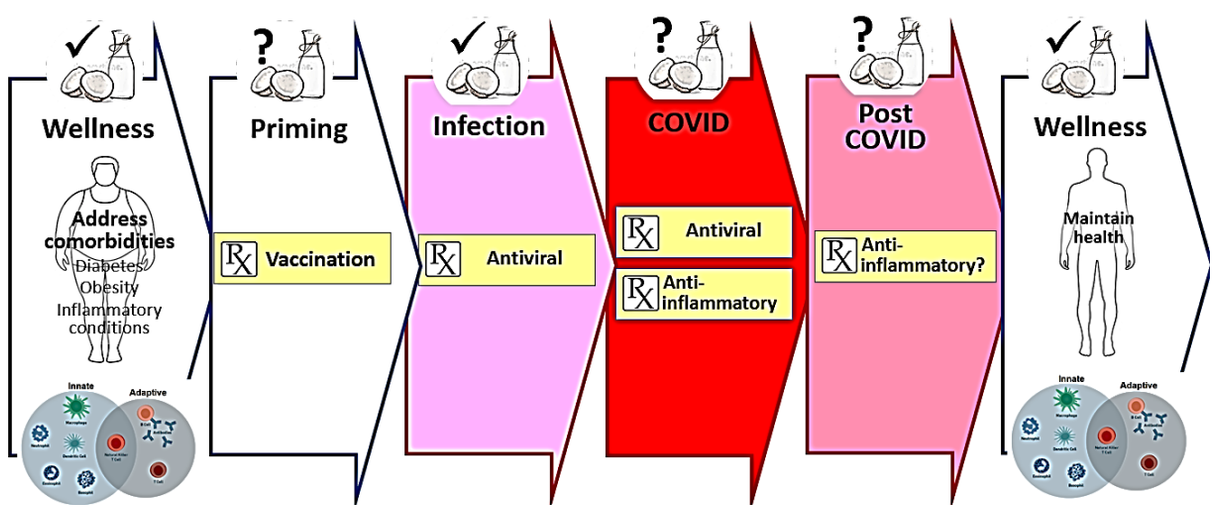

Figure 2. A more holistic approach to address the COVID-19 pandemic. There should be a bigger focus on maintaining good health as a means of preventing disease

1. Observational Epidemiological Survey
   To retrospectively assess the relationship of dietary coconut intake with incidence of COVID-19 in a population. Method:
   a. Estimate amount of dietary coconut intake through survey & market data.
   b. Obtain health statistics & data on COVID-19 incidence.

2. Coconut Dietary Intervention
   To assess the relationship of dietary coconut intake with incidence of COVID-19 in a population. Method:
   a. Recruit study participants
   b. Provide coconut mixes to prepare meals. Estimate coconut consumption.
   c. Conduct health survey & statistics on COVID-19 incidence before and after feeding period: 6 to 12 mo.

3. RCT on VCO vs. COVID-19
   To determine efficacy of VCO against COVID-19. Method:
   a. Double-blind, placebo-controlled.
   b. Determine number of subjects, inclusion and exclusion factors, including co-morbidities.
   c. Select parameters to monitor and endpoint.
   d. Provide VCO in prepared meals.

This effort can be a major contribution of the ICC to global health.

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[1] *Professor, Ateneo de Manila University, Philippines & Chairman, Scientific Advisory Committee on Health, ICC.*
(Paper presented in 49th International Cocotech Conference)

REFERENCES

Angeles-Agdeppa, I., Nacis, J. S., Capanzana, M. V., Dayrit, F. M., & Tanda, K. V. (2021). Virgin coconut oil is effective in lowering C-reactive protein levels among suspect and probable cases of COVID-19. *Journal of Functional Foods, 83*, 104557.

Kupferschmidt, K. (2021) New SARS-CoV-2 variants have changed the pandemic. What will the virus do next? Science Magazine, Aug. 19, 2021.

WHO. visited on: Aug. 24, 2021. https://www.who.int/countries/#V

POTENCY AND CHALLENGES OF COCONUT MICROPROPAGATION

Steve Adkins[1], Zhihua Mu[1], Eveline Kong[1], Amirhossein Bazrafshan[1], Quang Nguyen[3], Gabrielle Persley[1], Glen Boyle[2], Greg Kennish[2] & Sundaravelpandian Kalaipandian[1]

Coconut (*Cocos nucifera* L.) is often referred to as "the tree of life" because of its many uses in the food, beverage, medicinal and cosmetic industries. Currently, more than 50% of the world's palms are senile and need to be replaced to ensure production levels meet the present and increasing demand for these coconut products. This immediate replanting requirement will not be met by traditional seed propagation methods alone. Recent opinions have suggested that in-vitro micropropagation via. somatic embryogenesis is one of the most promising approaches for the large-scale production of new coconut planting materials. This paper describes a process in which the steps of selecting coconut varieties for clonal propagation, the rudiments of the cloning and acclimatization procedures to create plantlets, and the role of the public-private sector in developing process for the mass generation, then delivering of the coconut clones to farmers. The paper will evaluate the expected potency of such a pathway and discuss the challenges of delivering appropriately selected micro-propagated plantlets to farmers.

INTRODUCTION

Coconut (*Cocos nucifera* L.) is grown in most tropical and some subtropical regions of the world. It provides food, shelter, and an income to millions of people through the hundreds of commodities it produces (Foale, 2003; ICC 2018). Demand for its products has increased five-fold in the last 10 years; however, production has not kept pace with this growing demand (Rethinam, 2018). Apart from a decline in fruit yield due to palm ageing, coconut production currently faces several other major constraints. Coconut is predisposed to attack from several pests (coconut rhinocerous beetle, red palm weevil) and diseases (lethal yellowing diseases, phytophthora, cadang-cadang), and production can be further diminished by certain climatic conditions (heat and drought stress, cyclone activity) that are becoming more frequent under a changing climate (Suriya, 2016).

Very little or no replanting of coconut palms has been undertaken in most production countries in recent years, and there are now reports of regions carrying more than 70% senile palms (Salum, *et al*., 2020). Replanting efforts are constrained by the lack of good quality and true-to-type planting seed nuts. Due to this lack of appropriate seed nuts, and because coconut has no vegetative propagation methods for plantlet production (Batugal, *et al*.

2009), micropropagation technology has been advanced as the only attractive method for the mass production of coconut planting materials.

In vitro culture has the potential to rapidly multiply a chosen genotype to produce numerous clonal plantlets. Ideal application could result in the mass production of early-bearing, disease-free and resistant palms that have high productivity or other valuable characteristics (Pérez-Núñez, *et al*., 2006; Salum, *et al*., 2020). Somatic embryogenesis (Fernando, *et al*., 2010; Nguyen, *et al*., 2015), and more recently organogenesis (Kong, *et al*. 2021) have been identified as the most feasible techniques for the large-scale production of high-quality coconut plantlets. The process of somatic embryogenesis involves firstly, the induction of an embryogenic callus, followed by the formation and development of the somatic embryos, their maturation, germination, and finally the acclimatization of the clonal plantlet formed (Biddle, *et al*., 2020).

During somatic embryogenesis, the dedifferentiated explant cells regain their epigenetic and biochemical competence to form somatic embryos that progress through a series of developmental stages like zygotic embryogenesis (Fehér, *et al*., 2002). Somatic embryogenesis in coconut was first described in 1977 (Eeuwens, *et al*., 1977), but scaling up the process to produce large numbers of clones hasn't been easy (Nguyen, *et al*., 2015). At every stage in the SE approach, from somatic cells to whole plantlet formation, numerous factors have been found to play a crucial role in success including the genotype of the donor plant, the explant type cultured, the media and plant growth regulators (PGR) used, and the acclimatization procedures applied to the germinated plantlets.

In addition to developing improvements in the pathway for clonal plant production, other steps for utilizing the clonal plants will also need to be resolved. It will be necessary to determine which varieties of coconut should be cloned first and why. If cloned and distributed to farmers, how will these varieties fit into the present farming systems and will there need to be an appropriate value chain in place to enable their products to get to market. Moreover, there will need to be a a strategy to enable the cloned plantlets to be taken from the bio-factory to the farming community, and an important aspect of this is the involvement of industry partnerships.

This paper therefore describes a process in which the steps of firstly deciding which varieties of coconut could be cloned and why, then the further development of the clonal procedures. The paper next looks at a role for an industry partner in designing a bio-factory-like process for creating, then delivering the clones to farmers. The paper will evaluate the expected potency of such a pathway and discuss the challenges of delivering appropriately selected micro-propagated plantlets to farmers.

VARIETIES AND VALUE CHAIN

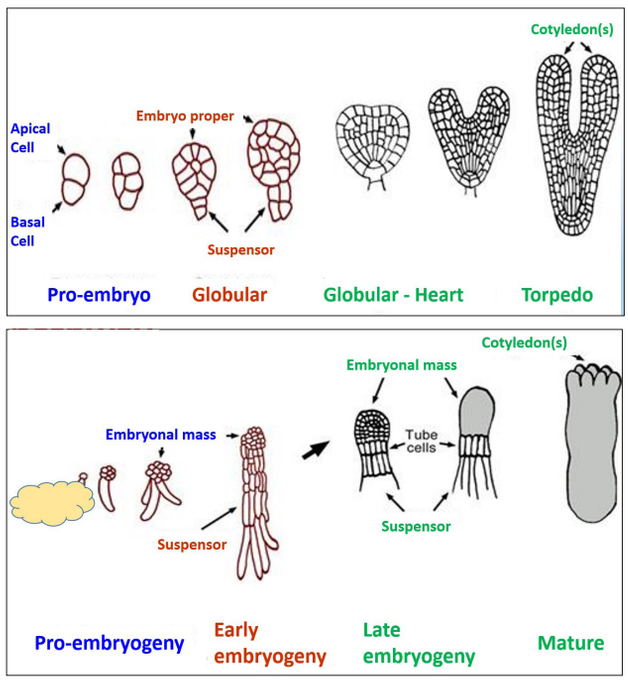
There is a need to identify the preferred coconut varieties to initially start the clonal propagation work on. Preferred varieties will need to be identified within the countries that will plant them, during stakeholder consultations, when countries are looking at ways to revitalise their coconut industries. The variety selection process to identify the initial suite of preferred varieties in each country will need to be based on information collected on farmer preferences, product demand, pest and disease resistance, and yield and vigour of the varieties. This information could be compiled by developing "product profiles" for each of the preferred varieties, profiles that identify the key traits in varieties that meet farmer and market preferences. This approach could be based on the principles and practices of demand led breeding (www.demandledbreeding.org).

Stakeholder and community engagements will need to be undertaken in the various coconut growing regions of the world to develop a better understanding of farmer needs, market needs and the obstacles and enablers to improved variety adoption. It will guide the development of new partnerships and lead to the identification of the product profiles of suitable coconut varieties as identified by coconut farmers and other value chain participants within each country; and facilitate the greater uptake of locally adapted and elite varieties, which will in turn lead to increased incomes for coconut farmers."

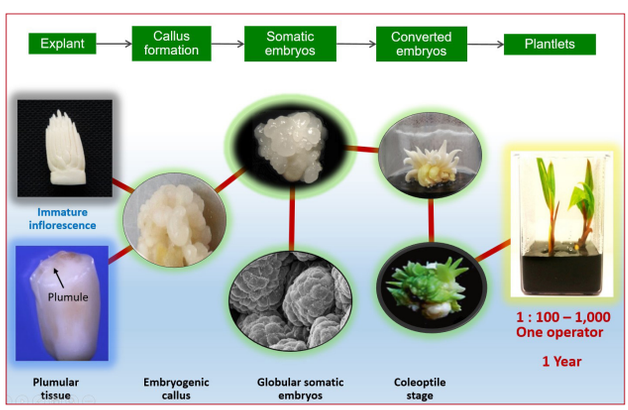
COCONUT MICROPROPAGATION VIA SOMATIC EMBRYOGENESIS

Micro-propagation is defined as the multiplication of plant tissues under an in vitro environment to acquire a large number of plants that can be acclimatized in the field (Lidder & Sonnino, 2012). In general, micro-propagation could be performed via. shoot culture, meristem culture, nodal culture, direct or indirect shoot organogenesis from axillary or adventitious tissues, and by direct and indirect somatic embryogenesis (George *et al*., 2008). As for coconut, it has been micro-propagated via zygotic embryo culture, somatic embryogenesis (Blake, 1990), and the potential via shoot organogenesis has been highlighted (Kong *et al*., 2021).

Micro-propagation of coconut via somatic embryogenesis is the most promising among all methods in achieving a large-scale production of palms with desired traits in a relatively short period of time (Sáenz-Carbonell *et al*., 2020). As with most micro-propagation processes, it is critical to determine the most suitable explant to provide the best outcomes. Explants such as stem slices (Branton and Blake, 1983), embryos (Gupta *et al*., 1984; Karunaratne & Periyapperuma, 1989), embryo slices (Samosir *et al*., 1999), plumules (Chan *et al*., 1998; Fernando *et al*., 2004; Sáenz *et al*., 2018), immature inflorescences (Hornung & Verdeil, 1999; Oropeza *et al*., 2018; Verdeil *et al*., 1994), and ovaries (Perera *et al*., 2007) have all been used in an attempt to create a functional somatic embryogenic protocol for coconut. Among all tried, plumule explants are seen as the most promising to produce somatic embryogenic callus and further subculture of this kind of callus has resulted in the production of large numbers of plantlets (Sáenz-Carbonell *et al*., 2020). In most protocols the addition of 2,4-dichlorophenoxyacetic acid (2,4-D) to Eeuwens Y3 medium is critical to induce embryogenic callus



Zygotic and somatic embryogenesis pathway



In vitro *regeneration pathways*

formation, whereas other plant growth regulators (PGRs) such as 6-benzylaminopurine and abscisic acid with a reduced 2,4-D concentration are important for somatic embryo maturation and germination (Nguyen *et al*., 2015). Other important additives such as polyamines (putrescine, spermine, and spermidine), osmotic agents (polyethylene glycol), brassinosteroid (22(S),23(S)-homobrassinolide), and other PGRs (gibberellic acid) have been used to improve the somatic embryogenic protocol (Adkins *et al*., 1999; Azpeitia *et al*., 2003; Montero-Córtes *et al*., 2010; Samosir *et al*., 1999).

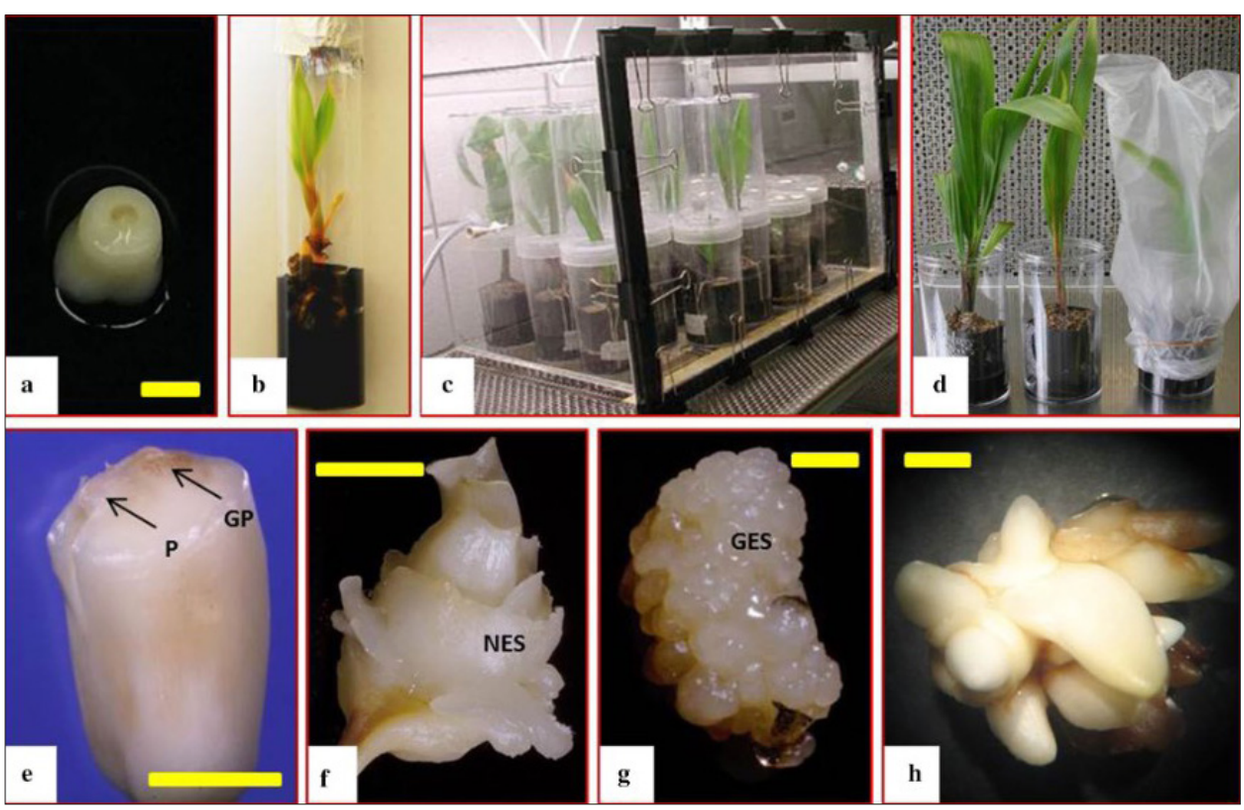
Nevertheless, achieving a fully functioning and affordable somatic embryogenic system is often a difficult task due to a range of technical and operational challenges. An initial problem was the selection of an explant type from which the

embryogenic callus was more likely to be produced (Sáenz-Carbonell *et al*., 2020). Research has also shown that physiological maturity of the starting materials can also play a critical role when it comes to either callus induction or its multiplication (Nguyen, 2018; Oropeza *et al*., 2018). To ensure this early phase of the somatic embryogenic process is undertaken correctly, it is necessary to have suitable training in the selecting, sterilising, and the isolation of explants. In addition, optimal production of embryogenic callus is highly dependent on long-term maintance of vigorous callus lines. As there are no significant differences in terms of the culture media used and conditions applied in this multiplication stage when compared to callus initiation, enhanced efficiencies are more likely to result from the proficient ability in distinguishing somatic embryogenic callus from non-embryogenic callus under a stereo microscope (Nguyen, 2018).

Even though the production of an abundance of somatic embryos has become largely manageable, their maturation and conversion into germinating plantlets still remain a bottleneck. Communications with different coconut institutions, suggest that the plantlet conversion rate in coconut is fairly random. Therefore, greater attention should be given to advancing critical aspects of this latter stage of plantlet propagation. In this regard, the application of cytokinin alternatives such as meta-Topolin are being considered. As the somatic embryogenic system is variety-dependent, an adaptive approach to protocol development is recommended. A further component to the functionality of the micro-propagation pathway for coconut is the acclimatization process that is applied to the germinating somatic embryos (Figure 1).

ACCLIMATIZATION AND GENETIC FIDELITY OF TISSUE CULTURE-DERIVED PLANTLETS

As the delicate coconut plantlets produced by somatic embryogenesis need to be planted in the field, they must undergo a period of acclimatization. Acclimatization is the process of adaptation of the laboratory-produced, tissue cultured plantlets to

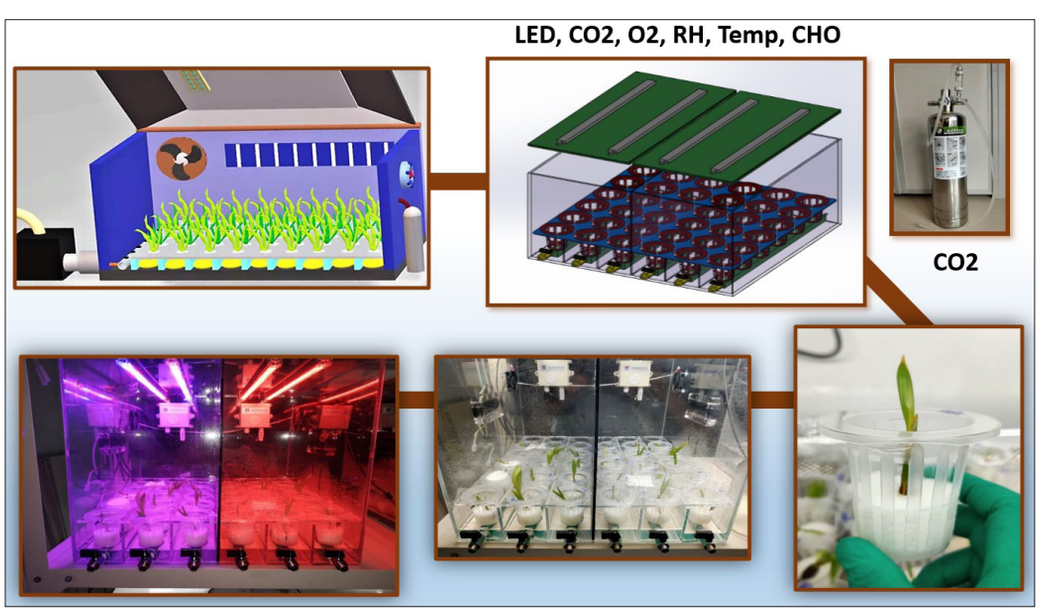


Images of the steps used for coconut plantlet acclimatization (a-d) and somatic embryogenesis (e–h). a) Initiation of a zygotic embryo culture using Y3 medium, MW Vitamins, activated charcoal and agar, b) Further development of shoot and roots on an embryo cultured plantlet. c) Photoautotrophic system (CO2 enrichment growth chamber) developed to improve plantlet growth, d) comparison between an acclimatized plantlet grown in a CO2 enrichment environment and one covered by conventional plastic bag, e) Plumule tissue emerging from a zygotic embryo and subsequently used as the initial explant for callus induction, f–g) different responses on a callus induction media supplemented with different concentrations of 2,4-D, h) Maturation of somatic embryos in a reduced 2,4-D medium, (these photos are reprinted from Quang et al. 2015, with permission) (P plumule, GP germ pore, NES non-embryogenic structures, GES globular embryogenic structures). Bar a, e, f—5 mm; g, h—1 mm.

field conditions. This is the final and arguably the most important step in the production of successful ex vitro growing plantlets. Appropriately developed acclimatization processes increase the survival rate of the in vitro-derived coconut plantlets to ex vitro soil conditions (Samosir and Adkins, 2014). Several factors need to be considered for the successful acclimatization of the plantlets including the growth stage the plantlets are at, the light and temperature conditions, the growth substrate being used, and the culture vessel environment in terms of its oxygen and carbon dioxide concentration and relative humidity (Fki *et al*. 2011; Irsyadi, 2021). Tissue culture-derived plantlets with good sized stems, several leaves and a well-developed root system will be easier to adapt to the ex-vitro environmental conditions than younger plantlets (Irsyadi, 2021).

In coconut, tissue culture-derived plantlets need to have at least two to three photosynthetically active leaves and a well-developed root system if they are to successfully survive ex vitro (Fernando *et al*. 2004). Light is one of the significant factors in their survival, and exposure to high light intensity during in vitro growth stages can increase the field survival of coconut plantlets. It has been reported to be more important than the incubation temperature used (Talavera *et al*. 2007). A reduction in the sucrose concentration present in the growth medium, coupled with a high atmospheric CO2 concentration, has been found to positively influence the development of in vitro-derived coconut plantlets (Samosir and Adkins, 2005, 2014). Relative humidity is another important factor that affects the survival of tissue culture plantlets during acclimatization. By using a mini-growth chamber, it was possible to create a high relative humidity around the acclimatizing coconut plantlets and to improve their ex-vitro survival (Magdalita *et al*. 2010; Sisunandar *et al*. 2018). Recently, a semi-automated chamber has been developed for the acclimatization of coconut plantlets. This chamber can integrate the control of relative humidity, light (photoperiod, intensity, and quality), CO2 concentration, incubation temperature and can allow for easy substrate replacement (Mu *et al*. 2020). Early studies using this apparatus indicate that an optimization of environmental factors is crucial for improving the survival rate of in vitro-derived coconut plantlets to ex vitro field conditions. Since many aspects of acclimatization are poorly understood in coconut, it is important that further studies are undertaken to enable the large production of clonal plantlets. Once a full understanding of the acclimatization process is developed, then the tissue cultured clones, developed in the bio-factories can be transferred to a multitude of locations using mobile growth chambers (MGC). This will allow for the separation of the clone production step from the in-country acclimatization process which will increase the survival rate of in vitro-derived plantlets and reduce the cost of the plantlets for farmers.

There is an anticipation that following further improvement of the somatic embryogenesis and acclimatization processes many coconut plantlets will be produced via. tissue culture: however, it is important that the genetic fidelity of these plantlets is confirmed before using them in commercial cultivation. Molecular marker studies so far undertaken indicate that the tissue culture processes used do not change the genetic fidelity of coconut plant (Bandupriya *et al*. 2017). Currently, the whole genome sequence of coconut is available, and

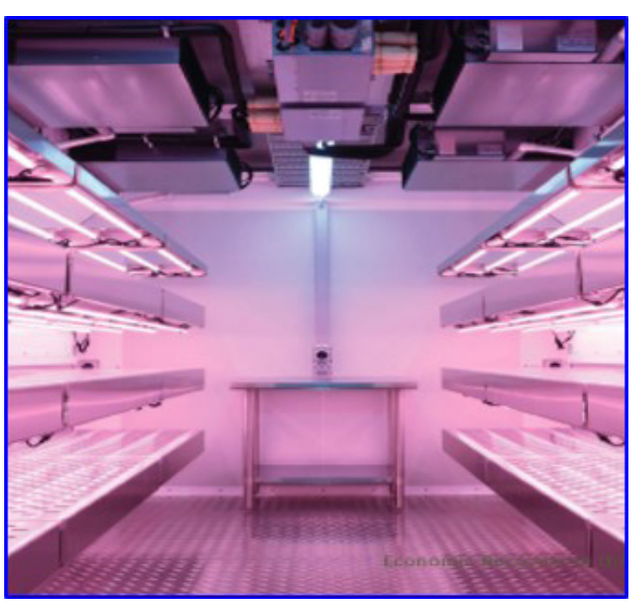


Improved Acclimatization

several molecular markers will be employed to further confirm the true-to-type nature of plantlets. This will provide further confidence to farmers to plant micro-propagated coconut plantlets in the field.

THE ROLE OF A COMMERCIAL PARTNER TO INITIATE SCALE UP TO MEET DEMAND

In Australia the KokoNiu Group Pty Ltd (KokoNiu) was established in 2019 to commercialise the somatic embryogenesis technology, to mass propagate coconut plantlets through a proven tissue culture protocol for coconut growers internationally. To commence their operations, KokoNiu is collaborating with the University of Queensland (UQ) on a project called the "COVID to Coconuts - Coconut Revitalisation Project", to commercialise the end-to-end process, and to propagate many plantlets in Australia for planting overseas. This commercialisation project will consist of an initial phase to set up a Rapid Deployment Plant (RDP), the first of its kind in Australia. UQ will provide facilities for the RDP consisting of an existing coconut tissue culture laboratory and culture rooms.



KokoNiu's Mobile Growth Chamber

The Project is a public-private partnership between UQ and KokoNiu with the goal to take the existing coconut micro-propagation technologies developed by UQ to scale and demonstrate that it is a technology ready for commercialisation. One of the innovations to be explored, is in the conversion of shipping containers into MGC, which could be transported to partner countries and used on farms as part of the replanting program in that country, to grow plantlets through to a stage when they can be acclimatised and transferred to the field. A protype will be developed and tested at the RDP at UQ to demonstrate its potential to be used as a mobile growth facility, for use in the upscaled delivery of planting materials to partner countries for their replanting programs. KokoNiu aims to modify and adapt shipping containers (12 m) into portable MGC that can be delivered and set up in partner countries.

Each MGC will be a controlled environment designed to sustain such precise conditions. They will have remote monitoring and the ability to have inter-chamber connectivity if multiple MGC's are required. They can be located both outdoors or indoors and can be transported via. integrated forklift slots at their base or via. ISO container corner castings. The MGC will be designed to monitor; temperature, humidity, lighting (LED), carbon dioxide, air flow, nutrients and water/irrigation while providing security and external control systems. Shelving will be designed to accommodate LED lighting, be adjustable and allow for bench-top space. An anteroom to include a pressurised airlock would provide high level protection from the internal environment upon entry, removing the risk of contamination if required. An integrated control system would be used to provide web-based access to all parts of the chamber(s), sending alarms and push notifications (email and text message) via Ethernet and/or Wi-Fi.

PROSPECTS

Due to the poor genetic stocks used 70 years ago to establish the present-day coconut plantations, fruit production has been inherently low (Punchihewa, 1999). Coupled with devastating pest and disease outbreaks and through increasing environmental stresses due to climate change, coconut yields have fallen far below that of the market demand. Today, a time when replacing these aged palms

One site in northern Australia being considered for the scale-up coconut tissue culture laboratory

is desperately needed, replanting needs to be done with selected high yielding varieties with proven desirable market traits and of known genetic superiority. The traditional methods of seedling production from fruit are not sufficient any longer to meet the numbers of seedlings that are required, and they are unable to provide the genetic superiority required. Therefore, clonal propagation via. somatic embryogenesis has become the preferred alternative method for plantlet production. This technology can produce rapidly, true-to-type, early bearing, pest, and disease resistant plantlets, in large quantities. However, the success of this approach will be dependent on firstly the careful identification of appropriate, market-desired genotypes, with a known value chain, and with the involvement of a public-private partnership that has the capacity to raise clonal production to a commercial scale and deliver the plantlets directly to the farmer. So far, one bio-factory facility for coconut plantlet production has been established in Mexico using the available cloning protocol (Sáenz-Carbonell, et al., 2020) and trials have shown the clones to perform well in the field with early fruit production. Further bio-factories are now need, to be set up in different parts of the world, producing micro-propagated plantlets of the locally desired varieties with appropriate market traits and of known genetic superiority.

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(Paper presented in 49th International Cocotech Conference)

REFERENCES

Adkins, S. W., Samosir, Y. M., & Godwin, I. D. (1999). Control of environmental conditions and the use of polyamines can optimise the conditions for the initiation and proliferation of coconut somatic embryos. *Current Advances in Coconut Biotechnology*, 321–340. https://doi.org/10.1007/978-94-015-9283-3_24.

Azpeitia, A., Chan, J. L., Sáenz, L., & Oropeza, C. (2003). Effect of 22(S),23(s)-homobrassinolide on somatic embryogenesis in plumule explants ofCocos nucifera(L.) Culturedin Vitro. *The Journal of Horticultural Science and Biotechnology, 78*(5), 591–596. https://doi.org/10.1080/14620316.2003.11511669.

Bandupriya, H. D. D., Iroshini, W. W. M. A., Perera, S. A., Vidhanaarachchi, V. R. M., Fernando, S. C., Santha, E. S., & Gunathilake, T. R. (2017). Genetic fidelity testing using SSR marker assay confirms Trueness to type of micropropagated coconut (Cocos nucifera L.) plantlets derived from unfertilized ovaries. *The Open Plant Science Journal, 10*(1), 46–54. https://doi.org/10.2174/1874294701710010046.

Blake, J. (1990). Coconut (Cocos nucifera L.): Micropropagation. *Biotechnology in Agriculture and Forestry*, 538–554. https://doi.org/10.1007/978-3-642-74448-8_26.

Branton, R. L., & Blake, J. (1983). Development of organized structures in callus derived from explants of Cocos nucifera L. *Annals of Botany, 52*(5), 673-678. http://www.jstor.org/stable/42757266.

Batugal, P., Bourdeix, R., and Baudouin, L. (2009). Coconut breeding. In: Jain S. M., Priyadarshan P. M. (eds) Breeding Plantation Tree Crops: Tropical Species. Springer, New York, NY. https://doi.org/10.1007/978-0-387-71201-7_10.

Biddle J., Nguyen Q., Mu Z.H., Foale M., Adkins S. (2020). Germplasm Reestablishment and Seedling Production: Embryo Culture. In: Adkins S., Foale M., Bourdeix R., Nguyen Q., Biddle J. (eds) *Coconut Biotechnology: Towards the Sustainability of the 'Tree of Life'*. Springer, Cham. https://doi.org/10.1007/978-3-030-44988-9_10.

Chan, J. L., Saénz, L., Talavera, C., Hornung, R., Robert, M., & Oropeza, C. (1998). Regeneration of coconut (Cocos nucifera L.) from plumule explants through somatic embryogenesis. *Plant Cell Reports, 17*(6-7), 515–521. https://doi.org/10.1007/s002990050434.

Eeuwens, C., & Blake, J. (1977). CULTURE OF COCONUT AND DATE PALM TISSUE WITH A VIEW TO VEGETATIVE PROPAGATION. *Acta Horticulturae, 78*, 277–286. https://doi.org/10.17660/actahortic.1977.78.35.

Fehér, A., Pasternak, T., Otvos, K., Miskolczi, P., & Dudits, D. (2002). Induction of embryogenic competence in somatic plant cells: a review. *Biologia, 57*, 5–12.

Fernando, S. C., & Gamage, C. K. A. (2000). Abscisic acid induced somatic embryogenesis in immature embryo explants of coconut (Cocos nucifera L.). *Plant Science, 151*(2), 193-198.

Fernando, S. C., Weerakoon, L. K., & Gunathilake, T. R. (2004). Micropropagation of coconut through plumule culture. In *Cocos* (Vol. 16, pp. 1-10).

Fernando, S. C., Vidhanaarachchi, V. R. M., Weerakoon, L. K., & Santha, E. S. (2010). What makes clonal propagation of coconut difficult? *Asia Pacific Journal of Molecular Biology and Biotechnology; 18*, 163–165.

Fernando, S. C., Weerakonn, L. K., & Perera, P. I. P. (2004). Genetic fidelity and ex vitro performance of tissue cultured coconut plants. In *Proceedings of the international conference of the coconut research Institute of Sri Lanka-Part II. CRI, Lunuwila*.

Fki, L., Masmoudi, R., Kriaa, W., Mahjoub, A., Sghaier, B., Mzid, R., ... & Drira, N. (2011). Date palm micropropagation via somatic embryogenesis. *Date palm biotechnology*, 47-68.

Foale, M. (2003). *Coconut Odyssey: The Bounteous possibilities of the tree of life*. Australian Centre for International Agricultural Research. ISBN 1-86320-370-2.

George, E. F., Hall, M. A., & De Klerk, G. J. (Eds.). (2007). *Plant propagation by tissue culture: volume 1. the background* (Vol. 1). Springer Science & Business Media.

Gupta, P. K., Kendurkar, S. V., Kulkarni, V. M., Shirgurkar, M. V., & Mascarenhas, A. F. (1984). Somatic embryogenesis and plants from zygotic embryos of coconut (Cocos nucifera L.) in vitro. P*lant cell reports, 3*(6), 222-225.. https://doi.org/10.1007/BF00269297

Hornung, R., & Verdeil, J. L. (1999). Somatic embryogenesis in coconut from immature inflorescence explants. In *Current advances in coconut biotechnology* (pp. 297-308). Springer, Dordrecht. ISBN 978-94-015-9283-3.

Hornung, R., & Verdeil, J. L. (1999). Somatic embryogenesis in coconut from immature inflorescence explants. In *Current advances in coconut biotechnology* (pp. 297-308). Kluwer Academic Publishers, Dordrecht. ISBN 978-94-015-9283-3.

International Coconut Community. (2018). *Coconut Statistical Yearbook*. International Coconut Community.

Irsyadi, M. B. (2021, February). Factors That Effect of the Optimal Plantlet Growth from Tissue Culture on the Acclimatization Stage. In *Proceeding International Conference on Science and Engineering* (Vol. 4, pp. 100-104).

Karunaratne, S., & Periyapperuma, K. (1989). Culture of immature embryos of coconut, Cocos nucifera L: callus proliferation and somatic embryogenesis. *Plant Science, 62*(2), 247-253. https:// doi.org/10.1016/0168-9452(89)90087-3

Kong, E. Y., Biddle, J., Foale, M., Panis, B., & Adkins, S. W. (2021). The potential to propagate coconut clones through direct shoot organogenesis: A review. *Scientia Horticulturae, 289*, 110400. https://doi.org/10.1016/j.scienta.2021.110400

Lidder, P., & Sonnino, A. (2012). Biotechnologies for the management of genetic resources for food and

agriculture. *Advances in genetics, 78*, 1-167. https://doi.org/10.1016/b978-0-12-394394-1.00001-8.

Magdalita, P. M., Damasco, O. P., & Adkins, S. W. (2010). Effects of medium replenishment and acclimatization techniques on growth and survival of embryo cultured coconut seedlings. *Philipp Sci Lett, 3*, 1-9.

Montero-Cortés, M., Sáenz, L., Cordova, I., Quiroz, A., Verdeil, J. L., & Oropeza, C. (2010). GA 3 stimulates the formation and germination of somatic embryos and the expression of a KNOTTED-like homeobox gene of Cocos nucifera (L.). *Plant cell reports, 29*(9), 1049-1059. https://doi.org/10.1007/s00299-010-0890-0.

Mu, Z., Guo, X., Biddle, J., Foale, M., Li, Z., & Adkins, S. (2020). A Newly Designed Chamber for the Acclimatization of Coconut Plantlets Coming from In Vitro. *In Vitro Cellular & Developmental Biology-Animal, 56*(SUPPL 1), 44-44.

Nguyen, T. Q. (2018). Clonal propagation of coconut (Cocos nucifera L.) for elite seedling production and germplasm exchange.

Nguyen, Q. T., Bandupriya, H. D., López-Villalobos, A., Sisunandar, S., Foale, M., & Adkins, S. W. (2015). Tissue culture and associated biotechnological interventions for the improvement of coconut (Cocos nucifera L.): a review. *Planta, 242*(5), 1059-1076. https://doi.org/10.1007/s00425-015-2362-9.

Oropeza, C., Sandoval-Cancino, G., Sáenz, L., Narváez, M., Rodríguez, G., & Chan, J. L. (2018). Coconut (Cocos nucifera L.) somatic embryogenesis using immature inflorescence explants. In S*tep Wise Protocols for Somatic Embryogenesis of Important Woody Plants* (pp. 103-111). Springer, Cham. https://doi.org/10.1007/978-3-319-79087-9_8

Perera, P. I., Hocher, V., Verdeil, J. L., Doulbeau, S., Yakandawala, D. M., & Weerakoon, L. K. (2007). Unfertilized ovary: a novel explant for coconut (Cocos nucifera L.) somatic embryogenesis. *Plant Cell Reports, 26*(1), 21-28. https://doi.org/10.1007/s00299-006-0216-4.

Pérez-Núñez, M. T., Chan, J. L., Saenz, L., González, T., Verdeil, J. L., & Oropeza, C. (2006). Improved somatic embryogenesis from Cocos nucifera (L.) plumule explants. *In Vitro Cellular & Developmental Biology-Plant, 42*(1), 37-43. https://doi.org/10.1079/IVP2005722.

Rethinam, P. (2018). International scenario of coconut sector. In *The Coconut Palm (Cocos nucifera L.)-Research and Development Perspectives* (pp. 21-56). Springer, Singapore. ISBN 978-981-13-2754-4. 4.

Sabana, A. A., Rajesh, M. K., & Antony, G. (2020). Dynamic changes in the expression pattern of miRNAs and associated target genes during coconut somatic embryogenesis. *Planta, 251*(4), 1-18. https://doi.org/10.1007/s00425-020-03368-4.

Sáenz-Carbonell, L., Nguyen, Q., López-Villalobos, A., & Oropeza-Salín, C. (2020). Coconut Micropropagation for Worldwide Replanting Needs. *In Coconut Biotechnology: Towards the Sustainability of the 'Tree of Life'* (pp. 227-240). Springer, Cham. https://doi.org/10.1007/978-3-030-44988-9_11.

Sáenz, L., Chan, J. L., Narvaez, M., & Oropeza, C. (2018). Protocol for the micropropagation of coconut from plumule explants. In *Plant cell culture protocols* (pp. 161-170). Humana Press, New York, NY. https://doi.org/10.1007/978-1-4939-8594-4_9.

Sáenz-Carbonell, L., Montero-Cortés, M., Pérez-Nuñez, T., Azpeitia-Morales, A., Andrade-Torres, A., Córdova-Lara, I., ... & Oropeza-Salín, C. (2016). Somatic Embryogenesis in Cocos nucifera L. In *Somatic Embryogenesis: Fundamental Aspects and Applications* (pp. 297-318). Springer, Cham. https://doi.org/10.1007/978-3-319-33705-0_18.

Salum, U., Foale, M., Biddle, J., Bazrafshan, A., & Adkins, S. (2020). Towards the Sustainability of the "Tree of Life": An Introduction. In *Coconut Biotechnology: Towards the Sustainability of the 'Tree of Life'* (pp. 1-15). Springer, Cham. ISBN: 978-3-030-44988-9.

Samosir, Y. M., & Adkins, S. (2014). Improving acclimatization through the photoautotrophic culture of coconut (Cocos nucifera) seedlings: an in vitro system for the efficient exchange of germplasm. *In Vitro Cellular & Developmental Biology-Plant, 50*(4), 493-501. https://doi.org/10.1007/s11627-014-9599-z.

Samosir, Y., & Adkins, S. W. (2005). The use of a CO2-enrichment system for the improved establishment of embryo-cultured coconut seedlings. In *Proceedings of the Australian Branch of the International Association for Plant Tissue Culture and Biotechnology* (pp. 252-260).

Samosir, Y. M. S., Godwin, I. D., & Adkins, S. W. (1999). The use of osmotically active agents and abscisic acid can optimise the maturation of coconut somatic embryos. In *Current advances in coconut biotechnology* (pp. 341-354). Springer, Dordrecht. https://doi.org/10.1007/978-94-015-9283-3_25.

Samosir, Y. M. S., Godwin, I. D., & Adkins, S. W. (1997, September). An improved protocol for somatic embryogenesis in coconut (Cocos nucifera L.). In *International Symposium on Biotechnology of Tropical and Subtropical Species Part 2 461* (pp. 467-476).

Samosir, Y. M. S., Rillo, E. P., Mashud, N., Lien, V. T. M., Kembu, A., Faure, M., ... & Adkins, S. W. (2006). Revealing the potential of elite coconut types through tissue culture. In *Coconut Revival – new possibilities for the 'tree of life', Proceedings of the International Coconut Forum held in Cairns, Australia*. (pp. 43–48). ACIAR Proceedings, Volume 125.

Sisunandar, A., Husin, A., Julianto, T., Yuniaty, A., Rival, A., & Adkins, S. W. (2018). Ex vitro rooting using a mini growth chamber increases root induction and accelerates acclimatization of Kopyor coconut (Cocos nucifera L.) embryo culture-derived seedlings. *In Vitro Cellular & Developmental Biology-Plant, 54*(5), 508-517. https://doi.org/10.1007/s11627-018-9897-y.

Suriya, A. (2016). Coconut. In: Gupta, S. K. (ed.) *Breeding oilseed crops for sustainable production*. Academic Press, San Diego, 201-216.

Talavera, C., Contreras, F., Espadas, F., Fuentes, G., & Santamaría, J. M. (2005). Cultivating in vitro coconut palms (Cocos nucifera) under glasshouse conditions with natural light, improves in vitro photosynthesis nursery survival and growth. *Plant Cell, Tissue and Organ Culture, 83*(3), 287-292.

Verdeil, J. L. H uet C, GrosdemangeF, Buffard-Morel J (1994) Plant regeneration from cultured immature inflorescences of coconut (Cocosnucifera L.): evidence for somatic Embryogenesis. *Plant Cell Rep, 13*(2), 18-21. https://doi.org/10.1007/BF00239896.

COCONUT OIL AS FEEDSTOCK OF SUSTAINABLE AVIATION FUEL: POTENTIAL, CHALLENGES AND STRATEGIES FOR FUTURE DEVELOPMENT

Suyoto Rais[1]

ICAO (International Civil Aviation Organization) has defined Sustainable Aviation Fuel (SAF) as alternative fuel that will become mandatory to all international flights from now on. Cooperating with companies and institutions in Indonesia and Japan, Indonesia-Japan Business Network (IJB Net) have been trying to develop SAF from non-standard coconuts. That are the coconuts that have been rejected in the markets due to cracked, small size, coconuts with a shoot grow, rotten coconuts, and immature coconuts (excluded young coconuts). IJB Net are going to develop and produce SAF by using these coconuts which are commonly found in production sites. Indonesia has 3.5 million ha of coconut plantation area, which produce 14.4 million coconuts per annum. Estimated, around 30% of coconuts in Indonesia, or more than 4 million ton of nuts, could be classified as non-standard coconuts. Coconut oil has content of hydrocarbon C-12, C-14, C-16 higher than other oils, that are ingredients that similar to kerosene. Its mean, coconut oil is potential feedstock to make SAF. To reduce production cost, can use all of coconut waste, such as husk and shell, that have higher calorie than palm kernel shell, to operate biomass power plant. And, coconut water to be liquid fertilizer, nata-de-coco or other liquid products. Through these activities, can give additional jobs to coconut farmers to sustain the supply of feedstocks.

SAF (sustainable aviation fuel) demand will increase

ICAO is concerned on sustainability of aviation, including the use of Sustainable aviation fuels (SAF). According ICAO, SAF defined as alternative aviation fuels that "(i) achieve net GHG [greenhouse gas] emissions reduction on a life cycle basis; (ii) respect the areas of high importance for biodiversity, conservation and benefits for people from ecosystems, in accordance with international and national regulations; and (iii) contribute to local social and economic development, and competition with food and water should be avoided" (ICAO 2018).

Based on the market-based mechanism developed under ICAO, IATA member airlines and the wider aviation industry are collectively committed to ambitious emissions reduction goals. Sustainable Aviation Fuels (SAF) have been identified as one of the key elements in helping achieve these goals. Many countries already set the target of using SAF in their flights. For example, Finland = 30%, France = 5%, Germany = 2%, Netherlands = 14%, Norway = 30%, Sweden = 30% (by 2030).

Figure 1 shows that up to 10.9 Mt (13.6 billion litres) per year of SAF production capacity may be available by 2032. However, there is significant uncertainty on the share of this capacity that will be directed to SAF compared to other fuels. The main issues will be in supply of feedstocks, cost and technologies.

Indonesia have set the target of using SAF up to 5% in 2025, or equivalent 320 million litre per annum. Japan haven't set the target of SAF ratio, but they have committed to achieve carbon neutral in 2050. In case Japan will set the SAF ratio same as Indonesia, that's equivalent to 500 million litres of SAF per year. To providing SAF in a large quantity, some Japan companies have been developing SAF both in Japan and outsides, including this project.

Cooperating with Japanese and Indonesia companies/ institutions, IJBNet proposed to use non-standard coconuts to develop and produce SAF. Indonesia companies mainly will provide CCO collaborated with farmers supported by government and related institutions. On the other hand, Japan companies will become off-taker of CCO. They will build new SAF plants both in Indonesia and Japan, include use existing oil refinery plants. IJBNet has conducted feasibility study in coconut production areas, and ensured that we can provide enough feedstocks without threaten food security and fit to ICAO's requirements.

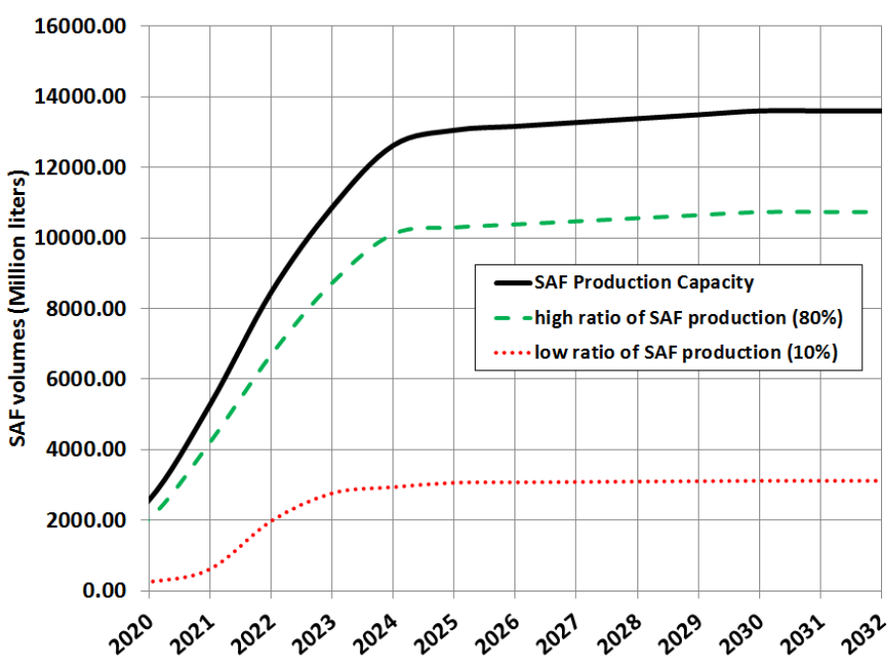

Figure 1. Projected scenarios of SAF production by ICAO

Coconut oil can be proposed as feedstock of SAF

There are 3 reasons to use coconut as raw material of SAF.

(1) Hydrocarbon content of coconut oil is similar to kerosene as shown in figure 2. That's mean make SAF from coconut oil (CCO) is easier than the other oils. While, palm oil (CPO) and tallow (animal fats) are suitable to make bio-diesel.

(2) Consumption of coconut oil is very low, compare the other cooking oils. As shown in figure 3-top, share of coconut oil in global edible vegetable market is only 2.1% (3.15 million MT per annum), while palm, soya and rapeseed oils are 77% of market. Figure 3-bottom also shows that most of the application of coconut products is cosmetics, and total of food and beverages is only 32%.

(3) In many areas in Indonesia, found that around 30% of coconuts rejected by markets (figure 4), as "non-standard coconuts" and commonly found at many production sites. These coconuts are very well used to produce SAF. Table 1 shows exported quantity of coconut products from Indonesia. Around 50% of nuts in Indonesia are "un-exported coconuts" (edited based on Statistics Indonesia 2020). Usually, "un-exported coconuts" mean "not good quality" and are not used by the consumers in Indonesia.

Beside that work, IJB Net also do have plan to replanting the old trees. According statistic data of MOA (2018), there are

(1) Hydrocarbon of coconut oil is suitable to make SAF (kerosene).

→ Coconut oil (CCO) and palm kernel oil (PKO) have much hydrocarbon that need to make kerosene (CCO = 81%; PKO = 77%).
→ Palm oil (CPO), tallow (animal fats) and others are suitable feedstocks for bio-diesel.

Oil Types	Hydrocarbon (carbon-chain)										
	C8	C10	C12	C14	C16	C18	C18:1	C18:2	C18:3	C20	C22
Coconut	8	7	48	17	9	7	2	1			
Palm Kernel	4	5	50	15	7	1	15	2			
Palm				2	42	5	41	10			
Tallow				4	30	19	40	5	1		
Soya					8	4	28	53	6		
Rapeseed (low)					4		54	28	8	2	3
Sunflower					6	4	28	61		1	

Source: http://www.lipico.com/processes_fat-splitting.html
http://oilandgasproductionhandbook.blogspot.com/2014/01/refining.html

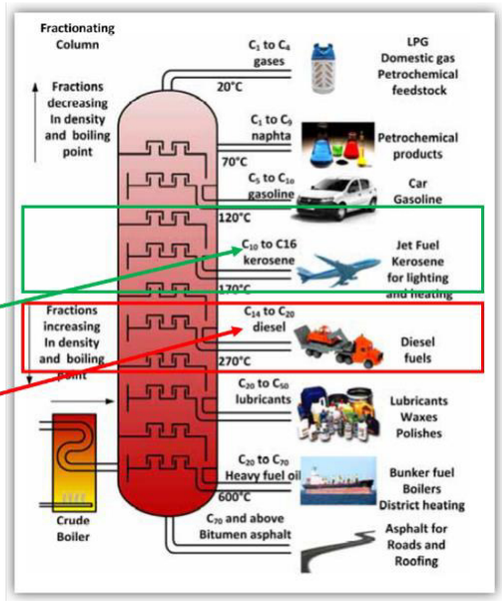

Figure 2. Hydrocarbon content of coconut and other oils

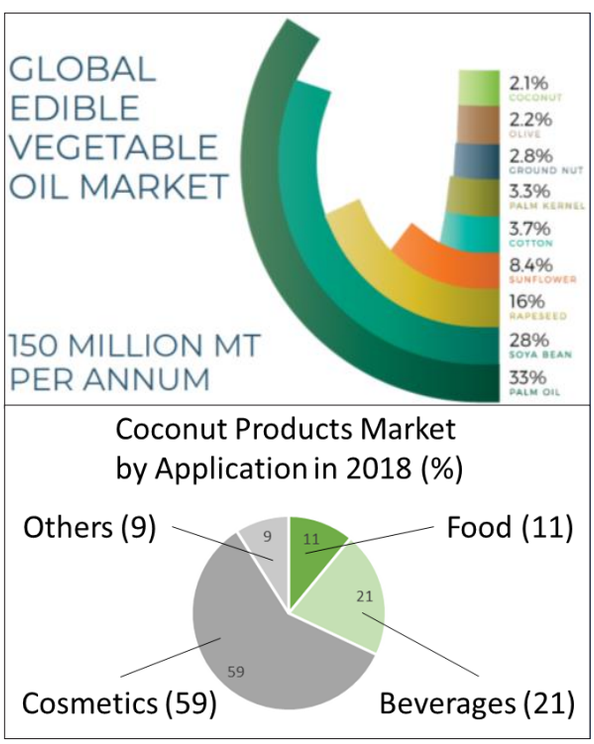

Figure 3. Market share and application of coconut products

more than 400,000 Ha of old coconut plantations in Indonesia that need to replanted. These old plantations also have effect to decrease productivity as currently, only 4.1 ton/ Ha per annum. By using good varieties and good practices of plantation collaborate with experts, we are optimist can improve productivity of to at least 10 ton/ Ha.

With the above reasons, it is sure that use of coconut oils as feedstock of SAP will not have conflict at all with the requirements of ICAO, and able to avoid threaten to food security.

Scheme of Products Development and Business Collaboration

Based on statistic of MOA (2018), Indonesia has 3.5 million Ha of coconut area and produce 14.4 million ton/ year. IJB Net have conducted feasibility study in potential areas and found that more than 30% of coconuts rejected by food industries and markets, due to their capacities and un-matching quality. These coconuts will be used to make SAF as main product, and the wastes can be made to sub-products such as biomass, animal feed and liquid products.

The candidate areas as shown in figure 5. The areas here divided in two, that's are area 1 (Sumatera island and surrounding) and area 2 (Sulawesi island and surrounding). Will get supply from both existing plantations, and replanting as needed.

Partner companies from Indonesia ensured that they can get supply of non-standard coconuts around 1 million ton per year, and provide CCO as feedstock of SAF around 125 thousand ton per year in each area. Production plan will be discussed after COVID-19 become better and Indonesia-Japan partners able to go together to sites.

Figure 4. Samples of non-standard coconuts (too small, too old, germinated)

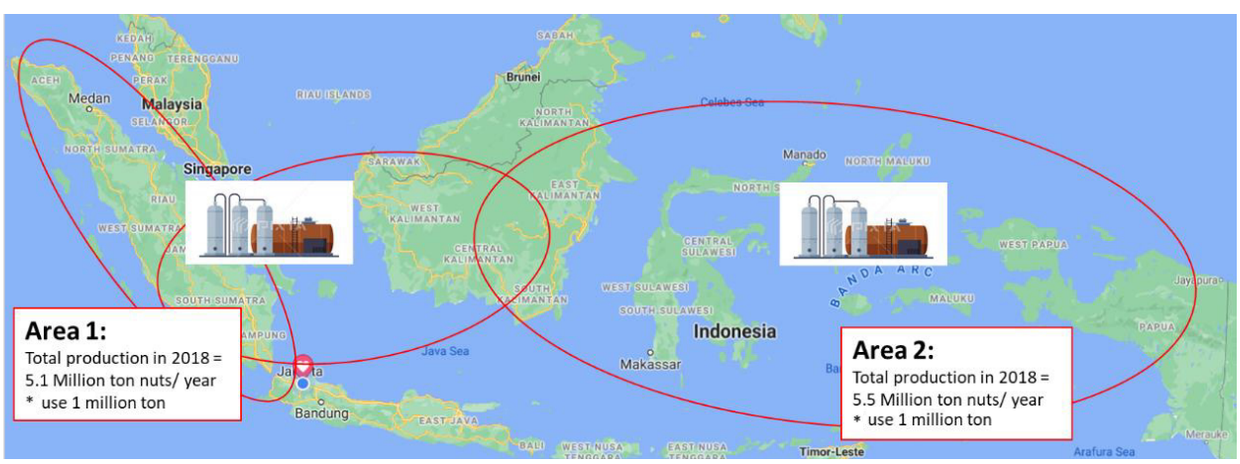

Figure 5. Two areas of the proposed production in Indonesia

No	Exported Products (2018)	Quantity (ton)	Whole-nuts (ton) *	Yield Ratio*
1	Copra	12,511	62,555	5
2	Crude Coconut Oil	302,994	2,423,952	8
3	Coconut Oil - Unrefined	297,807	2,382,456	8
4	Coconut Oil/VCO - Refined/ RBD	1,504	12,032	8
5	Dried Desiccated Coconut/ DC	78,974	1,026,662	13
6	Fresh Desiccated Coconut/ DC	129,390	698,706	5.4
7	Unhusked Nuts	404,547	606,821	1.5
8	Cake Oil and related products	221,879	Not to be counted	
9	Coconut sugar	42,058		
10	Charcoal shell	86,633		
11	Raw Coir of Coco Fiber	12,704		
12	Product of Coco Fiber	15,787		
Total of exported coconut (ton)			7,213,184	50%
Total of "un-exported" coconut (ton)			**7,231,607**	**50%**
Total production of coconut (ton)			14,444,790	

* Yield ratio calculated based on survey results and quotation of machine makers.

Table 1. Total of coconut product exported from Indonesia in 2018 (BPS-2020)

How to minimize cost and make the farmers happy to collaborate with

Another crucial issue of this project is how to minimize production cost and make the coconut farmers happy to collaborate with the Network. The Network will purchase coconuts from farmers cheaper than the price of food industries. It is not only due to coconuts quality, but also to make this project not to compete with food industries. However, also have to make the farmers get better income to stabilize supply of coconuts. The Network will

offer additional job opportunity for them, such as make shell and husk to biomass and coconut water to liquid fertilizer or other liquid products. Also support the machines and give training as needed, for marketing of products. By these collaborations, are sure able to get enough raw materials and will growing together with coconut farmers.

As shown in Figure 7, IJB Network wanted to develop integration of coconut industry that can be harmonious with environment, farmers, cows, sheeps etc. to grow together. Coconuts can be made as edible products, SAF, biomass and other products, without conflicts at all.

[1] *Chairman, Indonesia-Japan Business Network. (Paper presented in 49th International Cocotech Conference)*

References

ICAO: https://www.icao.int (visited on August 25, 2021).

IATA: IATA Sustainable Aviation Fuel Roadmap 1st Edition (2015).

MILT-Japan: Discussion Paper to Reduce CO2 in Aviation Industry (2021).

MOTR-Indonesia: Discussion Paper Regarding Indonesia Aviation Fuel (2017).

MOA-Indonesia: Tree Crop Statistic of Indonesia 2017-2019 (2018).

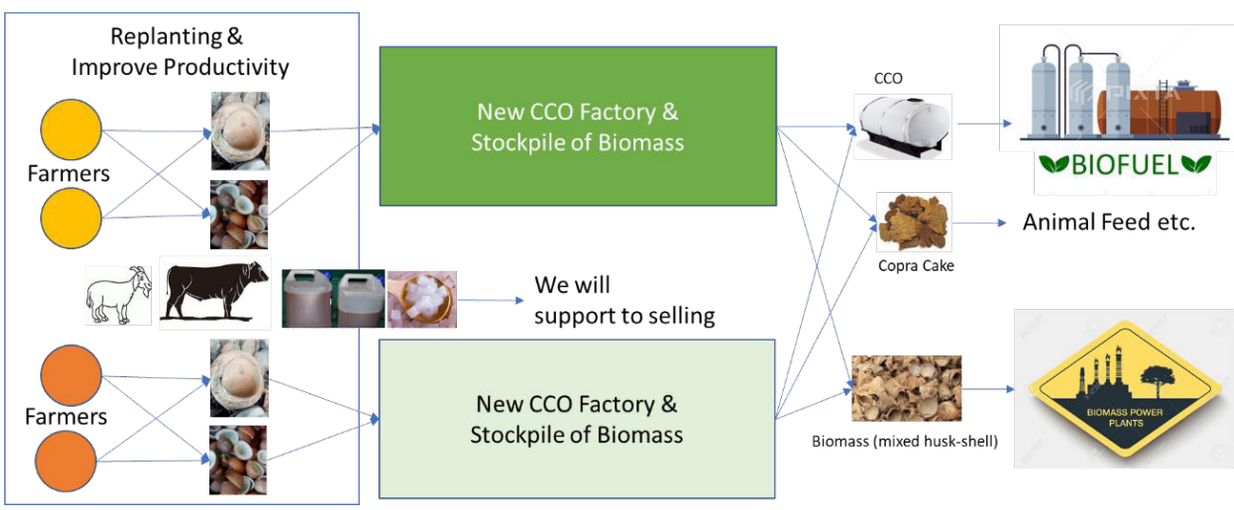

Figure 6. Growing together with farmers to minimize production cost

Figure 7. Image of harmonized coconut industry for all

BUILDING A SAFE, INCLUSIVE, RESILIENT AND SUSTAINABLE COCONUT COMMUNITY AMID COVID-19 PANDEMIC & BEYOND: WORLD SCENARIO

Jayakumar S.

Coconut, is known as the 'tree of life', *Kalpavriksha*, 'tree of abundance' and 'nature's supermarket, cultivated in more than 92 countries worldwide, and provides livelihood security to millions of people in the Asia and Pacific regions. Coconut is the environment friendly smallholder palm of the tropical environment covering 12.28 million hectares in 92 countries with an annual production of 68.3 billion nuts providing USD$7.76 billion per annum to global coconut industry (Fig. No.1). Out of this production yields 6 million tons of coconut oil equivalent annually and 70% is produced by Philippines, Indonesia, and India. The coconut industry, which traditionally relied upon copra and coconut oil and to some extent of coir, is presently experiencing tremendous transformation towards product diversification, high-value product development, by-product utilization and more importantly as a health benefited beverages & food substitute. In the modern era coconut products appears in global market dynamics of organic coconut water, virgin coconut oil, functional foods and health drinks from coconut including Neera, coconut sugar, cosmeceuticals, oleo chemicals and biofuel/ biolubricants in the consumer's market. Hence the global export and import of coconut products such as coconut oil, copra meal/copra cake, fresh coconut, desiccated coconut, coconut milk, cream, milk powder, coconut shell charcoal, activated carbon, coir and coir products are also elaborated. It obvious the diversification results increase in demand naturally, when the demand increases the supply of product also to be proportionately amplify by regular and uninterrupted production and supply. Up to this area is controllable and various tools are available for prediction or to interpret and regulate as and when required as per desired results and activities by technical Management or Research sectors etc. Even though there is a downward fall

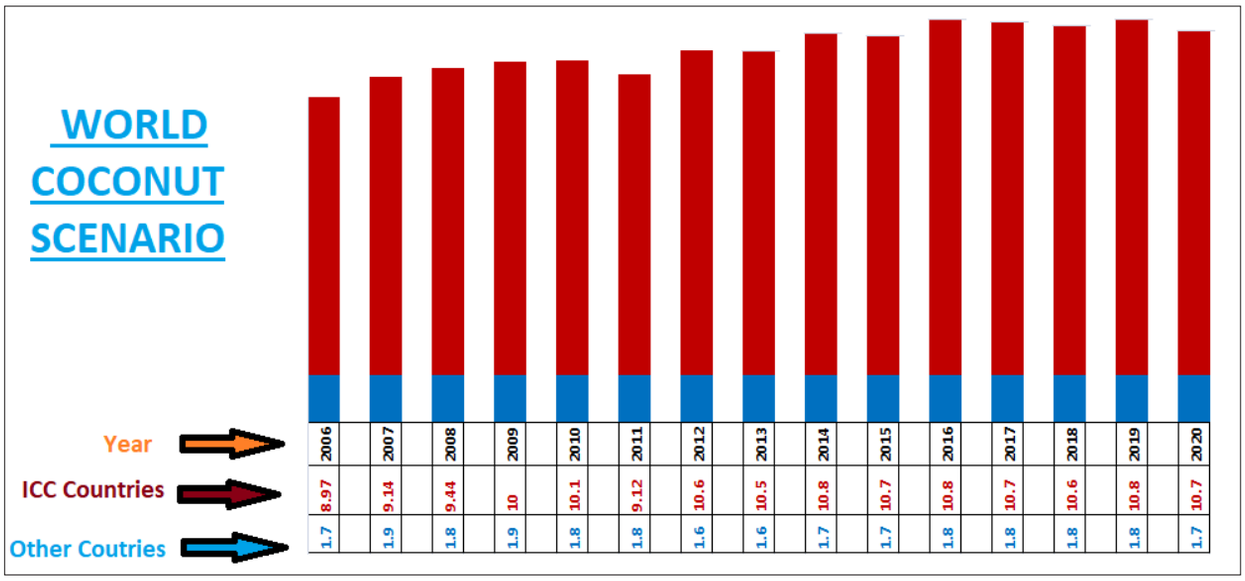

Figure 1. World Area of Coconut Cultivation

or decelerate all everywhere starts from farming sector linking to the coconut industry too especially during the COVID-19 pandemic situation raised in the world around. As become aware to the day -to-day increase in demand on coconuts and in the form of value-added products are shows the realization of importance of this crop and its identical relation to the mankind in the world. Consequently, it is also necessary to accelerate the coconut farming for ensure the well performance of the connected coconut industries in the world. Hence it is become inevitable to outline suitable action plans for "Building a Safe, Inclusive, Resilient and Sustainable Coconut Community amid COVID-19 Pandemic & Beyond" by implementing suitable approaches need to face present and future global challenges to transform coconut industry into a successful venture globally ahead.

In order to precede further it is required to have an overall idea about the factors which are influencing both positively and negatively on coconut industry and farming sector and also those areas need to pay more attention for enhance benefits or advantages from this challenging situation. Proper understanding of this problems and draw the best apt solutions is presently required for decision making and launching of onward course of actions.

Accordingly for a self-evaluation SWOT analysis method is attempted in order to ascertain various factors related to coconut farming and industry in worldwide to switch on to a realistic and balance with production, processing including marketing of coconut and its value-added products for a brawny and uphold coconut industry for all coconut farmers as well as all the stake holders within the coconut industry in long run manner (Table No.1). The reasons were collected are generally not similar situations in all countries even though resemble issues can be affecting in any of these formats in almost all coconut growing countries. In the light of the above it is realized to examine the relevant field's which are required ample attention and care for an awakening strategy formulations.

Consequently, it was observed the major sectors like Production, Processing and Market promotions areas are in need of certain inclusion, reform, strengthen, upgrade actions with a synchronization among all together for to catch a boost-up momentum for solid and safe growth during the future era.

PRODUCTIVITY MANAGEMENT

Improved agro-techniques have been standardized, through research conducted over several decades, to achieve sustainable productivity and profitability form of coconut farming for maximization of economical gains. Adoption of refined nursery techniques Poly bag nursery enables production of quality planting material. technique with bio-priming of biofertilizers formulations helps in production of superior quality seedlings. Good management practices validated to improve the productivity in adult coconut palms include integrated nutrient management, green manuring/ cover cropping, soil and water conservation measures, weed management, irrigation, fertigation and cropping/farming system approach. Fertigation helps to increase the fertilizer use efficiency, saves fertilizer costs, reduces labour requirement and

SECTOR	STRENGTH	WEAKNESS	OPPORTUNITIES	THREAT
FARMING	Geographical specialty on Farming (Traditional & Nontraditional areas or cultivable and non-cultivable areas)	Less awareness for economical farming	Maximum utilization of suitable land for coconut production by adopting other inter & multi-layer crops adopting scientific methods in an enterprising method	Lack of all infrastructure and natural recourses.
	Existing plantation and regularized productivity	About 25% senile and below average or unproductive old plantations.	Schemes for rejuvenation & replantation with deserving incentives and compensations, assistances to the farmers.	Lack of Quality planting materials and drastic financial impact on the farmer. In sufficient compensations through the schemes from Govt.
	Long Run Crop with lengthy life span,	Steadiness in income of farmers Production declining trend	Adoption of inter multi-layer cropping system	Laps of renovated timely logistic – marketing system.
	Uniform maintenance of the farming causes avrage productivity.	Less productivity causes falling interest, following of traditional methods	Adoption of innovative new scientific production technologies.	Fluctuations of demand price due to unbalanced market supply & market competitions. lifestyle changes
	Scientific method of farming	Maintenance cost hike & less productivity, for old plantation declining productivity. Changes in government policies.	Group farming by organizing FPOs within the farming community and cost-effective farming operations. Conversion into Plantation concepts	Climate Change Impacts on Coconut Production, Global changes, Trade reforms, revoke of pests/diseases, changes or decline natural recourses and continuing natural calamities
	Supportive schemes from the Coconut Development authorities of each country to the farmers.	Lack of Admn & organizational and organizing laps. Requirement for innovated technologies for farming and processing. The trend authorities reducing subsidy factors for farmers	Organic IPM INM, Biological control method and demand for Organic farm produces, insurance schemes, Organic certification.	Cost hike on inputs and price fluctuations on coconut. Absence of logistic –marketing system. Threat and encouragement for other oil crop farming (palm Oil)

SECTOR	STRENGTH	WEAKNESS	OPPORTUNITIES	THREAT
PROCESSING	Scope for product diversification, value addition Field level Processing, scope of health benefit.	Lack of Innovative processing process, awareness on coconut products, and proper availability.	Opportunity for options for FPOs in the field level at least minimal processing developing management skills.	Intermittent market supply due to absence proper managerial co ordinations.
	Developing advanced Integrated processing Technology.	Innovative cost effect production technologies Lack of Financial encouragements	Project base technology development through recognized research agencies. Zero Wastage processing	Market development and conquering market promotion
	Un interrupted supply of cconut for processing	Production/ price fluctuations including harvesting transportation hurdles.	Backward integration with farmers for the supply of coconut as raw material without interruption.	Lack of knowledge & guidance in time operational activities both in the farming and marketing facilities
	Advanced processing	Limited availability of Organic production	Health Cosmetic orientation of the product and production, Export oriented units	Must follow international standards and uninterrupted supply.
PROMOTION	Versatility and potential of coconut product	Lack of proper projection in awareness	Diversification of the coconut products, by projecting health benefit aspect, Organic production exploiting the nontraditional area demand, with developed logistic scopes	Global competition and less awareness on benefit of coconut products on health aspect and its acceptability.
	Market Segmentation	Finding segmented groups and appropriate market promotion activities	Product wise categorized into food, beverage, cosmetics, and others different segmented groups	Alternate products
	Potential for health-conscious value-added Coconut products	Lack of awareness	Modern fast reaching medias, social medias	Ensure prompt market availability
	Health benefits to mankind and it acceptance	Lack of availability in market laps in promotional activity.	Branding, Social media coverage's, authentic events such seminars, exhibitions & research conferences	Lack of coordination and attention by the Govt. Agencies

SECTOR	STRENGTH	WEAKNESS	OPPORTUNITIES	THREAT
MARKETING	Trend towards product acceptance and search	Proper marketing strategies	Domestic-international-Global market opportunities	Rising quality standards of markets and competing countries,
	Health conscious in processing and products	Availability of Organic products	Production of demandable products on health conscious preferably organic standards. Consortium of processors	Improve quality and food safety to meet growing world quality standards and price
	Marketing of health-conscious coconut products (health benefited beverages & food substitute)	Marketing Networks	Advanced marketing strategies and network marketing, Online sales. Growing positive attitude towards health benefited products.	Competition and Alternate products. Taste habit constraints
	Find the customer-oriented need for the coconut product Advantage of Product range	Highly diversified value addition Need of product customer use are different.	Concentrated production on high demand coconut product and its production with all quality standards. Preference to natural healthy products	Competition and Alternate cheap products Substitutes and lack of availability of desired products.
GENERAL	Country based Coconut Developmental agencies and International agencies for coconut industry development	International Coordination, and inter govt supports, freedom of in involvement due to rules of each country	International Agency for any international coordination and monitoring	Limitations in support and financial constraints

Table 1. SWOT analysis of various factors related to coconut farming and industry in worldwide

ensures continuous nutrient supply in tune with crop requirement. Sustainable cropping system models are evolved to optimize utilization of natural resources and to enhance the economic viability. Integrated farming in the interspaces of coconut and integration of animal husbandry enterprises offer significant ecological and economic benefit including optimum utilization of the land resources, waste management etc. Effective formulations of agriculturally important microorganisms such as nitrogen fixers, plant growth-promoting rhizobacteria and arbuscular mycorrhizal fungi have been developed as valuable inputs for sustainable crop production. Lignocelluloses residues from coconut plantations can be converted into brown, granular vermin composting using earthworms. Organic farming practices with focus on building soil biological fertility foundations through integrated application of organic and bio-inputs including recycling of waste biomass, in situ cultivation and incorporation of leguminous cover crops and biofertilizers of *Azospirillum* and *Bacillus* and other cultural practices are combined with micro-irrigation techniques mulching to obviate

moisture stress and enable sustainable coconut production, in an environment-friendly way.

Accordingly integrated approach with GAP correlated with INM & IPM (preferably adopting more biological control methods) right from community level may be introduced as the productivity improvement program with utmost quality in order to achieve the maximum coconut production in anticipation to the increasing upcoming demand proportionate to world population needs. In order enhance the productivity various innovative steps should be introduced focusing with organic concepts to certain extent. The coconut farmers also conscious to establish maximum required or possible area cover with coconut farming with scientific and economical means of cultivation in order to prevent intrude of other oil crop like "Oilplam" etc.

Rejuvenation and replanting & plantation development

When the plantation attains senility and starts decline the productivity, rejuvenation is a basic requirement of any plantation crop in order to maximize profit from a given land area. However, it is an exception in the coconut sector that growers are reluctant to uproot a palm even when it attains senility and becomes less productive. This is due to the fact that coconut has a long juvenile phase and therefore the benefit from coconut takes long time. In general, the economical life of a coconut can be divided into growth, optimum and decline periods as shown in (Fig No. 2). However, the knowledge of effective way of carrying out the replacement of senile coconut plantation is very important to maximize profit and minimize problems related to replacement. Here it is to provide farmers proper awareness with reasonable compensative support and assistance to encourage them in replacing the old and senile coconut plantation under the Rejuvenation and replanting process of coconut plantation.

In order to consider the economical factors an appropriate approach should be framed to attract the farmers come forward for the rejuvenation of their plantation including small holders. Attractive schemes with compensative components should be designed by the authorities in order to achieve this goal as per the target. The responsible authorities of each country should take in to account that the agriculture is every nation's stabilizing essential investment with private participation enable the population to meet their prime need of food and employment to a great extent in addition to the contribution to nation's economy. Hence it is required to process this in a project implementation approach proper phased manner and ensuring new plantation or minimizing the duration by under planting, etc. in order to maintain minimum impact to the revenue- production status of farmers as well as in the whole coconut industry.

Production of quality planting materials with high productivity – new propagation methods – and production seed/seedling sharing

It may also consider the gradual reformation of the coconut farming sector to a enterprising plantations through the collective farmers group organizations by hand in hand will be highly opportune in order to monitor and assist for healthy coconut plantations as a whole by development agencies, extension workers from government authorities of any country. In this the task to arrange the farmers in time with good, quality planting material considering the most important

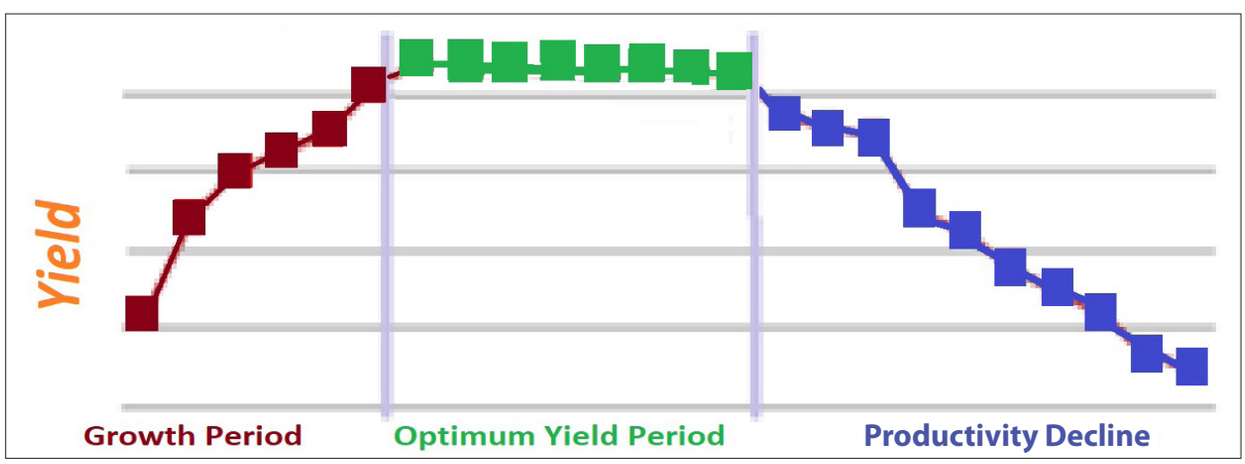

Figure 2. Three distinct phases of coconut trees' productivity

basic factor of all achievement such as build up productivity, establishment of healthy long run coconut plantation moreover for the growth of the coconut processing and value additions in main coconut farming countries. The requirement of the coconut seedling not only for new planting but also bring a demand where there the rejuvenation and re plantation programs in hasten. It is believed that this immense task cannot be accomplished by traditional propagation through seed. It is required a gear up initiation in order to conclude the ongoing research on propagation methods by necessary synchronization and cooperation among the research missions of different countries. Therefore the biotechnological alternatives such as Clonal Propagation of Elite Coconut Cultivars, **in vitro** Micro propagation, **Somatic Embryogenesis**, **Plumule Rachilla**, with its great propagation capacity, is an optimistic approach to develop highly efficient and commercially viable protocols in short, which will hopefully create a internationally sharing and assure the availability of seed/planting materials, since this is expected to result simplified transport options in secure storage condition with minimal phytosanitary hurdles. Hence in the time being production of quality assured coconut seedling should be continued by following maximum yardsticks in this field right from seed selection, distribution and planting.

Development of scientific cultivation suitable for inter/multi species crops: Coordination of international research

Further the new planting of each coconut to be adopt scientific methods of farming and possibly in organic concept in order to make each farm coconut produce itself as a Brand with competitive qualities and suitably acceptable with the health and environmental concerns of the each and every end user of society. The authorities may formulate suitable schemes with attractive, encouraging and assuring scheme components in order to maximize the area of coconut farming in every country. It can ensure the maximum suitable land brings under coconut farming with required additional production proportionate to increasing global consumption gradually in future. Considering the consistency of the land recourse it is advised to proper spacing with relevance of varieties enable to enterprise farmer to adopt required inter/ multi species crops not only for income generation to farmer but also for production of other food/fruit produces with zero wastage of the land recourses including other sharable inputs including the recycling usage of farm wastes in the respective territory for a balancing ecosystem with achievable reliable food reserve for society. *Achieving self-sufficiency particularly in produce or products which are essential for primary need to human life can reduce the import by any country that helps the accumulation of reserves and also assure stability in existence*. is the only way to the coconut cultivation is to be preferably promoted as a plantation mode gradually through collective farmers organizations in concentrated feasible areas or nearby localities will expedient to implement GAP operational activities by collective Farmers Produce Organizations (FPOs) and also for the development of processing and value addition activities since it will ensure the availability of raw farm produces or in raw material form by benefitting both the farmers and traders.

Further ensure the quality and possible organic production of coconut growing countries to formulate and revise time to time package of practices with INM, IPM measures suitable to the geo climatical aspects of each and every territory. A research correlation is highly appreciated among all the countries in all possible areas for to share the innovative inventions and solutions with cooperation mainly in adoptable technologies

in coconut cultivation as well as in post harvesting technologies. The farmers should properly monitored by the development or extension agencies time to time for updating the technologies including solving the field level issues will be more effective if the FPOs were make more communicative and interactive in confidence as and when required. The authorities ensure the sufficient compensation to the farmers on their losses occasionally happens due to natural calamities or severe and massive pest disease attacks engaging advanced technologies such as observance through drone applications including the application of Plant protection Chemicals/organic solutions etc. particularly at the top/bottom of the coconut crown parts and for harvesting to be developed and kept ready among community based operations with the FPOs through well trained taskforces. In generally the organized pattern of agricultural activities through collective farming will lead to success and upgrade the status of farmers as well as farming jobs and opportunities will definitely attract the young upcoming generations.

Further developing a communication strategy to increase farmers knowledge regarding coconut reproductive biology and breeding methods, including training tools, video guidelines, media communication, and an approach for marketing of genetic resources along with scientific cultivation aspects will also change the face of world coconut industry to a certain extent. The preservation of a world germplasm collection of identified cultivars in respective of each country also may be useful for future research when further productivity improvement purposes.

INTEGRATED PROCESSING AND VALUE ADDITION

The area of processing and value addition is an important role in this present scenario. There should be efficient and economical and modern processing technologies should be assumed for the value addition of the coconut products to reach in desired form of product to the end users by assured quality and quantity. The FPOs can adopt the field level minimal processing as an additional primary activity of value addition. In the next stage the FPOs were united together to Coconut Producing Federations (CPFs) and further CPFs joins to registered Coconut producing Companies (CPCs) registered under company acts and rules of the respective country, will be the uppermost collective form of organization can engage major integrated coconut processing ventures on coconut as per demand and fluctuations or any influencing factors. In continuation to the reforms by WTO and GAAT agreements there is an unavoidable situation demands for well unity among the interested groups especially among farmers. In an integrated from of processing with different divertible production lines for different value-added products can effectively balance the production or value addition as per the demand and influences of the seasonal and geographical and market elements. For example, the falls in consumption of coconut oil due it's solidified feature in the peak winter season should be accounted and the production should be regulated with feasible market elements such as suitable package or may be diverted or regulated the oil production line to any other product till the

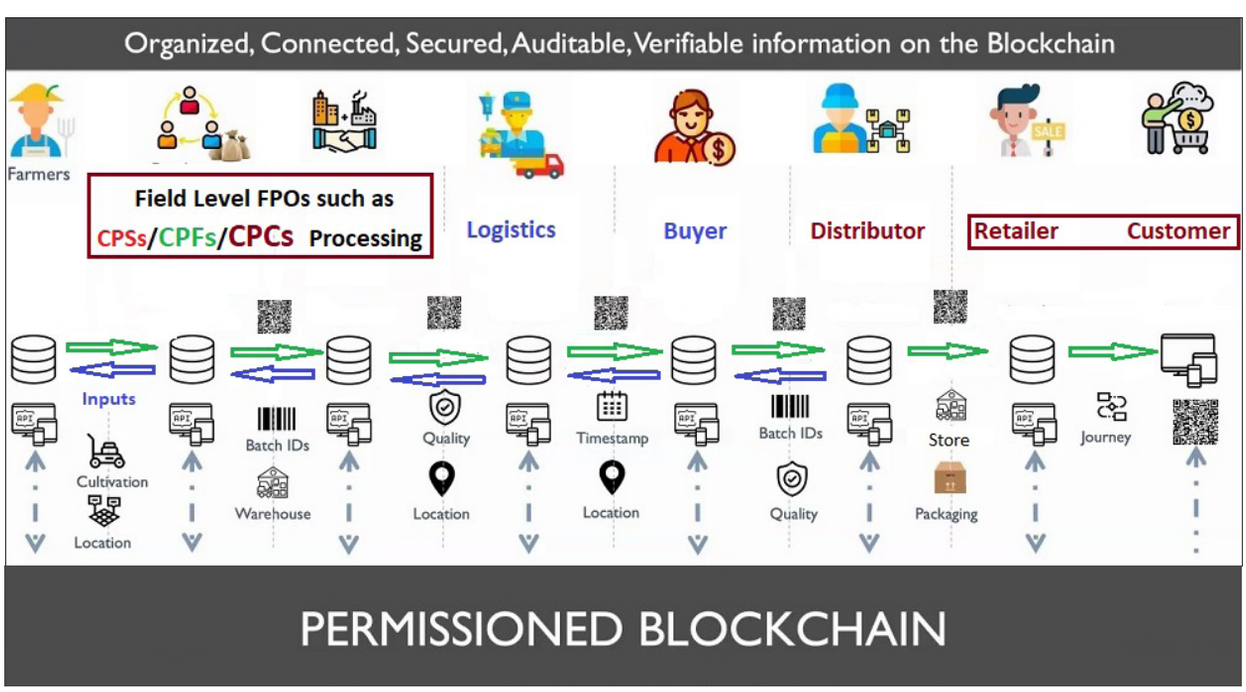

Figure 3. Supply chain, opportunities and possibilities

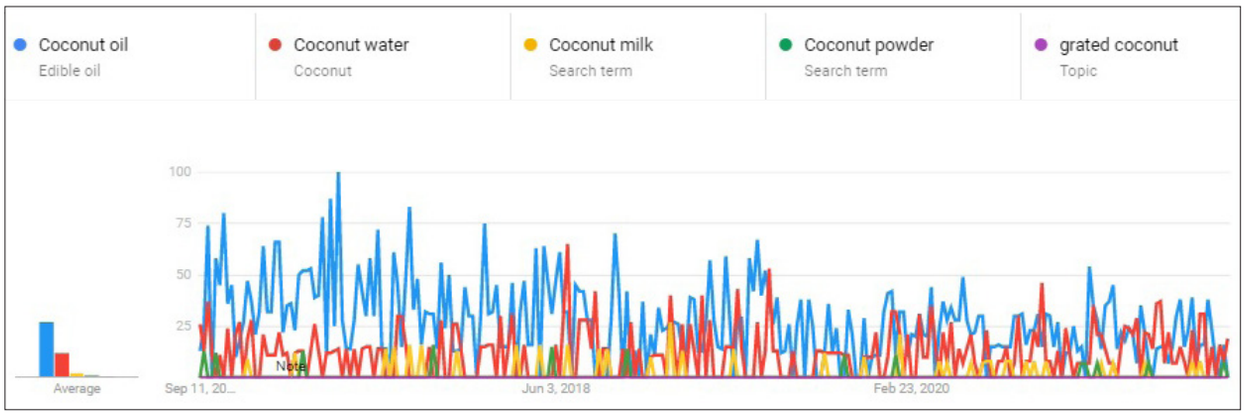

Figure 4. World web search on coconut products for the last 5 years

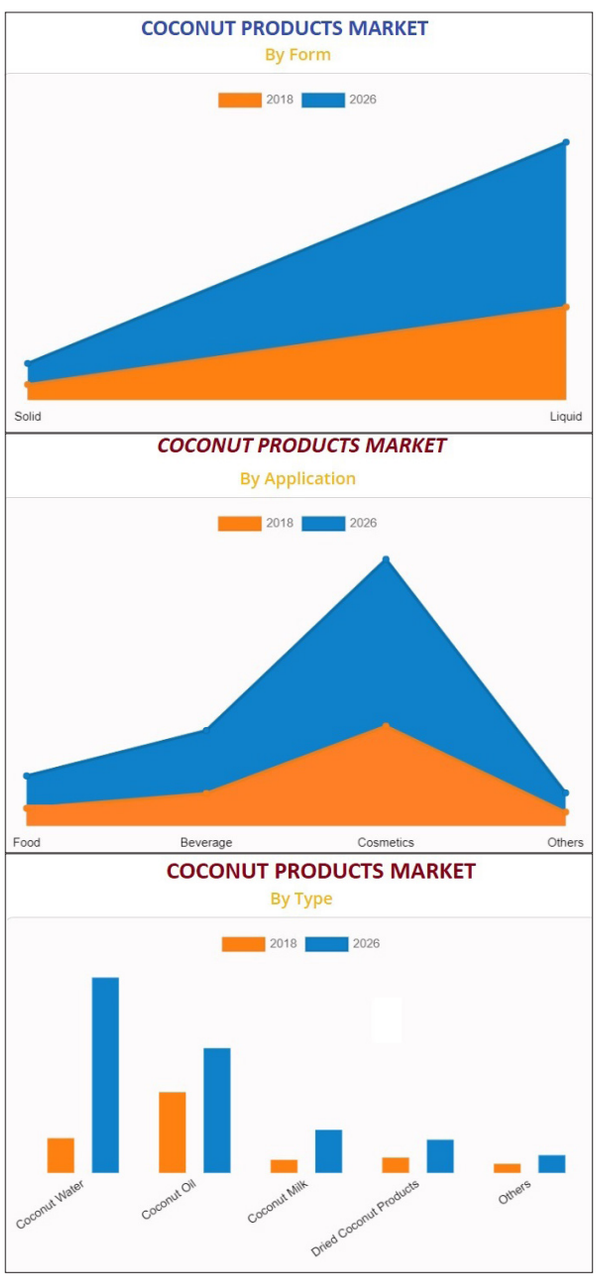

Figure 5. Coconut products market by form, application and type

period demands for change. Zero wastage is another important factor which can be achieve to a maximum extent by this integrated processing units with multi production lines. In case of the production of virgin coconut oil many parts of the coconut is remain to be processed to avoid the wastage such as the husk in to fibers and coir pith, the shell in to shell powder and shell charcoal or activated carbon, coconut water in to vinegar/squash/nata de coco etc are become cash products and become profitable in long run process by a moderate initial investment. In this area an effective Value Supply Logistic chain should establish for a balanced and cost-effective farming – postharvest & procurement – transportation - inventory management - production process in coconut sector. It is also convenient to have the cold chain logistic for advanced production and processing of coconut products. The government authorities of many countries providing this facility of transportation is may be exploited as and when required during processing & marketing (Fig. No. 4).

The research organizations and agencies should assist the industry by developing technologies for health-conscious products, preservation methods, including packing for the products in globally acceptable product developing combinations. Since the quality and quantity influences the customer above than the price factor due to the growing health consciousness of the society should properly uphold.

AWARENESS, MARKETING AND PROMOTION

According to the statistics, the global coconut products market size was at $11.5 billion in 2018 and is anticipated to reach $31.1 billion by 2026, with a Compound Annual Growth Rate (CAGR) of 13.6% during the forecast period. The market is expected to exhibit an incremental revenue opportunity of $19.7 billion from 2018 to 2026. Out of this coconut

oil segment was valued at $6.1 billion and is expected to grow with a CAGR of 5.6% from 2019 to 2026, to reach $9.4 billion by 2026 (Fig No. 5). Market growth is propelled by the rise in demand for coconut water as an energy drink. Health conscious consumers cause the shifting their preference towards natural alternatives to caffeinated and sugar-based energy drinks. Hence, the demand for coconut water as a natural energy drink is growing rapidly due to its nutritional and health properties which are expected to drive the coconut products market growth. Increase in use of coconut-based products in food and beverage applications is expected to drive the market for coconut products in the future. Coconut products are widely used as ingredients in variety of processed food products such as cookies, cakes, pies, soups, salads, milkshakes, and ice cream. The growth in consumption of processed food products, owing to the rise in urban population, the demand for coconut products is expected to grow at a significant rate in near future. The coconut products market is segmented on the basis of type, application, form, and region. Based on type, the coconut products market is categorized into coconut water, coconut oil, coconut milk, dried coconut products, and others. Coconut oil is widely used in cosmetics industry and is one of the prime products in hair care, thus is expected to influence the overall coconut products industry. After all, the marketing of the product is an important aspect for the well-balanced existence of the industry right from coconut farming to consumer or the end user. Coconut and its products have an advantageous constraint that farming of coconut depends geographical and climatical factors and this is an opportunity for export or trading of coconut and its value-added products. The beginning of any product or service is as per the wish and need of customer / consumer.

Here arises the necessity of an apt marketing strategy formulation with a well deliberate manner in all means. Further it can be redefined that "Marketing is all about identifying and meeting the customer needs with profitably". There are two types of markets are available in new and existing needs separate strategies. The new market penetration with low pricing policy is for new and existing products to attract larger number of buyers and a larger market share. This strategy increases the product sales in the company's present markets through an aggressive marketing mix. The product portfolio of coconut industry can be made if applicable in case of coconut value added products since the crop with its versatility. Communication to the respective market segmentation is a direct access of awareness to the desired groups regarding the coconut product. Health benefits to the health sector, cosmetics to the young generation, are some of the examples to this. Seminars, conferences exhibitions, B2B, B2C programmes are very essential for the well and absolute awareness about the coconut products and its wellness & health aspects.

The markets for high-value coconut products are currently expanding, strongly driven by coconut water and Virgin Coconut Oil (VCO). This is also indicates world web data leads the maximum search for Coconut oil and water through internet (Fig. No. 5). In the future these markets will become more and more competitive and selective so that the producers, processors and exporters will have to differentiate by distinguishing factors on their product. The way coconut palms are cultivated in respect to environment and health of consumers, the special characteristics of the varieties which are cultivated, and the notions of "terroir" or "branding by origin" will become increasingly important in marketing coconut products. Formation of consortium of processors in each territory (country) will be expedient to integrated formation of policy initiatives such as market analysis, supply schedules, efficient resource mobilization and logistics increased strength of bargaining and market presence etc.

Geographic Segmentation	Demographic Segmentation
• Country • State • County • City	• Age • Sex • Family size • Education • Ethnicity • Nationality
Psychographic Segmentation	**Behavioral Segmentation**
• Social Class • Lifestyle • Personality	• Occasions • Benefits • User status • Usage rate

Figure 6. Segmentation of consumer markets

Formation of a marketing strategy for coconut value-added products

In general, the success in marketing comes from knowing who your customers are and being able to fulfill their needs, so the marketing should be customer oriented and targeting and defining of marketing is the preliminary process of marketing. Before entering the market or marketing the awareness on market as well as know your competitor in the territory are the important to be well studied initially. The markets can be define such as consumer, industrial and government markets. Further each market defines to segments called market segmentation. Geographical, Demographical, Physiographical and Behavioral segments are the main segments (Fig No. 6).

Figure 7. Implementation of mix marketing
*(Source: **Marketing Management**, Philip Kotler, p. 15)*

Here comes the selection of target the required geographic territory market and the choice of the segment depend on the on the attributes of the product or vice versa. Defining of market objectives and the marketing mix such as **product**, **price**, **promotion**, and **place** are the next strategic steps in the process of marketing. Then it moves the above four factors one by one or simultaneously.

Product should be suitable and generally acceptable to whole mankind by following the quality, quantity standards acceptable are to mainly marketing by projecting its richness of health friendly properties. Packed Tender Coconut Water, Virgin Coconut oil, Coconut Milk, Neera etc are primary golden products from coconut industry to be projected. The health benefits of these products itself a marketing tool within many market segment. Promotion is the mix of a company uses to reach their distribution channels and target customers. Promotional activities can be initiated simultaneously after pricing along with placing and finding the people for selling and customer/ consumers. Pricing strategies such as marketing, cost based, and stato-quo is mainly adopting to fix any of the Flexible, Static, Penetration and Skimming prices for the product considering the cost and competition status in the market under selection. In continuation to this setting up of distributors, stockiest for selling process to the targeted places such as Malls, Hospitals, Educational Institutions, Hotel & Restaurants etc by feasible transportation. Meanwhile the promotion mix could be implemented adopting suitable or combine form of promotional tools like advertising, Personal selling, Sales promotion, Public relation and social media etc. (Fig. No. 7) Effective execution of marketing strategy led to achieve a stable market linkage and resulting significant market share among the competitors.

In the light of the above facts, it is to expect an increasing demand for coconut products will be elevating resilient Covid -19 Pandemic period. According to this set up all obligatory preparations not only to meet the expecting demand in a healthy manner with sufficient

supply ensuring availability to all corners of the globe with stipulating with international standards of quality, quantity and packaging etc. but also for to establish a cognizant adoption of coconut products in the mankind enable to convey this deem as a necessary commodity to the upcoming generation. This can be achieved only when an equilibrium production, processing and marketing right from farming sector to processing/manufacture sector with strategically effective established marketing process. Finally, four basic growth alternatives are indentified marketing activity, the strategies for market development and product development are initiated for the safe business operations (Fig No. 8,9,10) in due course.

Figure 8. Market development process

Before concluding it is necessary to appreciate the vital role playing by ICC for remarkable and predominant activities to the vision of "improved socio-economic welfare of farmers and other industry stakeholders in a vibrant Coconut Sector". Finally, it is expected that the ICC and allied groups could enable to instigate much unambiguous strategies for swift acceleration for the coconut industry corresponding to day-to-day changing global challenges with hand in hand cooperation with the member countries.

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[*] *Prize winning article of the competition conducted by ICC, Writing Category, during World Coconut Day Celebration 2021.*

Figure 9. Market development stages

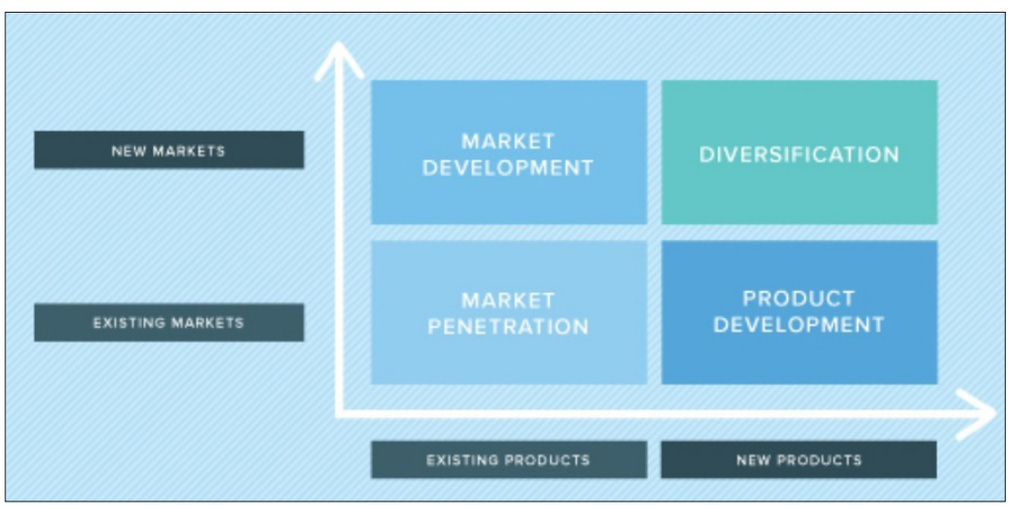


Figure 10. Ansoff matrix of market-product development relation

HIGHLIGHTS OF THE 49TH INTERNATIONAL COCOTECH CONFERENCE AND EXHIBITION 2021

Otniel Sintoro[1] & Mridula Kottekate[2]

International COCOTECH Conference and Exhibition is the largest technical conference conducts once in every two years dedicated solely to showcase the different development activities in the coconut sector. This conference is organized by the International Coconut Community (ICC) together with the ICC member country who offers hosting facilities. Many ICC member countries that have experienced hosting this event physically in earlier years are India, Indonesia, Malaysia, Philippines, Samoa, Sri Lanka, Vanuatu, Vietnam, and Thailand.

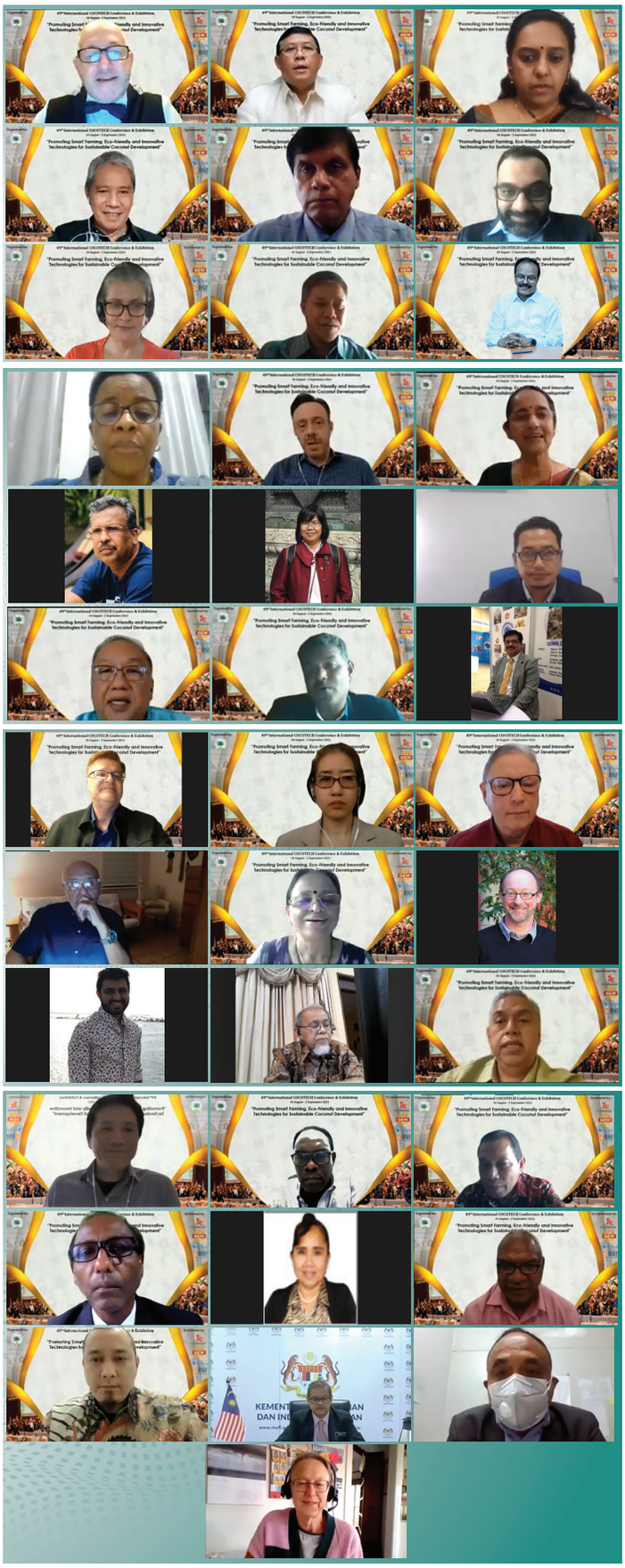
Hon. Mr. Airlangga Hartarto
Coordinating Minister of Economic Affairs
Republic of Indonesia

Hon. Mr. Syahrul Yasin Limpo
Minister of Agriculture
Republic of Indonesia

Hon. Mr. John Simon
Minister of Agriculture & Livestock, Papua New Guinea
ICC Chairman 2021

For the first time in its history, the 49th International COCOTECH Conference & Exhibition was held virtually from 30th August - 2nd September 2021 hosted by ICC Secretariat in Jakarta, Indonesia.

It was officially inaugurated by H. E. Hon. Airlangga Hartarto, Coordinating Minister of Economic Affairs, Republic of Indonesia. In his inaugural remarks, the honorable minister emphasized, "The Indonesian government will continue to support the coconut sector and the ICC secretariat in Indonesia. He added that other member countries of the International Coconut Community (ICC) can also continue to support sustainable coconut development in their respective countries considering the large



Chairs of Session, Resource Speakers, Country NLOs, ANLOs & Observers in the Conference

contribution of coconut not only from the economic aspect but also from the social and environmental aspects."

Dr. Jelfina C. Alouw, Executive Director, ICC delivered the welcome speech. She mentioned, "Productive deliberations are expected from the conference and can come up with policy recommendations that would be implemented for supporting the resilient and sustainable coconut sector for the benefit of small scale farmers, industries and other stakeholders".

The 49th International COCOTECH Conference was well attended by over 700 participants from 42 countries virtually which was the mode of participation. The theme of the Conference were ***"Promoting Smart Farming, Eco Friendly and Innovative Technologies for Sustainable Coconut Development"***.

The 4-days conference covered seven technical sessions by 26 eminent resource speakers, where they have shared their ideas, knowledge, and experience with the latest technologies and development. The subjects covered during the Conference assisted in preparing farming communities to counter the challenges and maximize benefits from the opportunities that are presented.

The Sessions were on: Policies & Programs Promoting Sustainable Coconut Development Session; Recent Scientific Evidence on Health Benefits of Coconut Based Products Session; Enhancing Competitiveness of Coconut Base Products in the Era of Volatility, Uncertainty, Complexity and Ambiguity (VUCA); Advanced Technologies for Supporting Adequate Supply of Raw Materials to Meet Current and Future Demand for Coconut Based Products; Strategies for Ensuring Sustainable Demand for Coconut as Functional Foods, Nutraceutical, Pharmaceutical, Cosmeceutical and Environmental Friendly Products; Smart Farming and Adaptation Strategies to Climate Change for Sustaining Coconut Production and Increasing Farm Productivity; Innovative Strategies for Preventing Economic Losses Caused by Pests and Diseases. Each Session was followed by an open forum and discussion coordinated by the Session Chairman. The queries raised by the participants were well-attended by the resource speakers.

Aerial view of the virtual exhibition

A virtual exhibition was also included. The cutting-edge digital technology has enabled a virtual exhibition conducted in a 3D virtual reality tour, which could transform a physical booth into a virtual booth. The virtual exhibition offered a one-stop platform to MSMEs, big coconut industries, suppliers, coconut associations, and coconut research institutes to show the latest technologies/ industry trends, coconut products, machinery, build brand proximity, network, and conduct business. 45 exhibitors from 9 countries participated in the exhibition, which includes Fiji, India, Indonesia, Kenya, Malaysia, Philippines, Sri Lanka, Thailand and Vietnam. Visitors could virtually walk around the hall, visit the exhibitor booths, and interact with the exhibitors.

The recommendations emanating from COCOTECH were endorsed by the plenipotentiary delegates, session chairs, and resource speakers from the countries for implementation by the member countries. Amongst the emergence of new knowledge and the development of innovative technologies shared at the Conference are the introduction of mobile apps technology under Internet of Things (IoT) for smart irrigation systems for coconut plantations sustainable development; new online tools for visualizing and analyzing trade integration using RIVA to understand any country's involvement in global value chains developed by UN-ESCAP; innovative micropropagation method as an alternative to the clonal propagation method that relies on somatic embryogenesis; and the use of coconut oil as feedstock of Sustainable Aviation Fuel (SAF).

Many International partner organisations, research institutes, and commodity boards of the member countries participated in the Conference, they were United Nations Economic and Social Commision Asia and The Pacific (UN-ESCAP),

LIST OF EXHIBITORS
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APEX COCO AND SOLAR ENERGY LIMITED
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GROUP OF EXPORT ORGANIC FRUIT PRODUCT (ORGANIC AROMATIC COCONUT)
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KRAMBIL IDJO JOGJA, PT.
LUONG QUOI COCONUT CO., LTD.

Non-Aligned Movement-Center for South-South Technical Cooperation (NAM-CSSTC), Coalition of Coconut Producing Districts (KOPEK), The Pacific Community (SPC), Centre de Coopération Internationale en Recherche Agronomique Pour le Dévelopment (CIRAD), Coconut Development Board (CDB) of India, Indonesian Palm Crops Research Institute (IPCRI), Philippine Coconut Authority (PCA),Coconut Development Authority (CDA) of Sri Lanka, Coconut Research Institute (CRI) of Sri Lanka, Coconut Cultivation Board (CCB) of Sri Lanka, Centre de Investigaci'on Cienti'fica de yucat'an (CICY) of Mexico, University of Queensland (UQ) and Conservation and Development of Coconut Oil Forum of Thailand (CDCOT), International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA-FAO),International Trade Center (ITC), Commonwealth Scientific and Industrial Research Organization (CSIRO), Caribbean Agricultural Research and Development Institute (CARDI), and Australian Cetre for International Agricultural Research (ACIAR).

LIST OF EXHIBITORS
MELLON CREATIVE AGENCY (BANK NEGARA INDONESIA)
MEZHUKKATTIL MILLS
MIRACLE LENGIS
MUGNI KARYA AGRITEK, CV.
NATURA HARVEST CO., LTD.
NUTS AND OIL CROPS DIRECTORATE, KENYA
RAVI INDUSTRIES LIMITED
S&P INDUSTRIES SDN. BHD.
SOK FARM CO., LTD.
T & I GLOBAL LIMITED
TENASIA CORPORATION SDN BHD
THAI COCONUT PUBLIC COMPANY LIMITED
TRIMATARI BIOPERSADA RECOVERY, PT. (COCONA CARE)
TROPICANA OIL CO., LTD.
TROPICOIR LANKA (PVT) LTD.
VICO BAGOES
WEALTH DRAGON COCONUT COSMETICS JSC

[1] *Information & Publication Officer, International Coconut Community*

[2] *Assistant Director, International Coconut Community*

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THE WORLD COCONUT DAY 2021 OBSERVED DIFFERENTLY

Otniel Sintoro[1] & Mridula Kottekate[2]

Each year, 2nd September is celebrated as World Coconut Day (WCD), to commemorate the formation of the International Coconut Community (ICC). The WCD 2021 Celebration coincided with the concluding day of the four-day virtual 49th International COCOTECH Conference and Exhibition, 30th August - 2nd September 2021. The theme for WCD 2021 was: ***"Coconut: Promoting Health, Creativity, and Resilience Amid and Beyond COVID-9 Pandemic"***. To observe the WCD and to promote all coconut-related activities which sustain the lives of millions of small-scale farmers as well as those engaged in the production, processing, and marketing of coconut products amid COVID-19 Pandemic, the ICC Secretariat, in collaboration with ICC member countries and other international organizations, hold programs and activities.

ICC Secretariat conducted different competitions to commemorate the day. The competitions included 4 categories: Videography, Writing, Photography, and Creative Social Media Competitions. Enthusiastic participants from coconut stakeholders in the ICC member countries participated and submitted their creative and inspiring entries to the competition. The entries were received from Ghana, Guyana, Indonesia, India, Kenya, Sri Lanka, Thailand and the Philippines. The various competitions organized by ICC Secretariat encouraged millennials and older generations to take part in sustaining the sector and to promote creativity amid Covid-19 pandemic and elevate the positive attributes of coconut products.

Dr. Jelfina C. Alouw , Executive Director, delivered the introductory remarks. She said that there are things we must do to develop a much better preparedness and response plan, and to create the space to be more creative and resilient, explore areas to be more supportive to coconut farmers, vulnerable communities, and countries in addressing challenges. Many countries have

Hon. Minister John Simon, M. P. during his speech

celebrated World Coconut Day by organizing various festivals, capacity building, webinars, and other programs to recognize and appreciate the benefit experienced by communities and countries due to coconut and the industries.

His Excellency Hon. Minister John Simon, M.P., Minister of Agriculture and Livestock, Papua New Guinea, and ICC Chairman, delivered the opening remarks. He said that the main objective of celebrating Coconut Day was to create awareness across the world about the importance of coconut and its many benefits to human life. Despite the covid pandemic, the community continues to celebrate the day. The theme highlights the significant roles of coconut for small farmers and global consumers. The wide range of coconut products underlined the importance of coconut in our culture and society, to fulfill the continuously increasing global demand. Further strategies within coconut stakeholders are needed to increase production and meet this growing demand. Collaboration is also needed to support value addition, processing, and marketing of high-value coconut products, as well as structured effort in replanting to address senility and low productivity, to meet the increasing global market demand, and to improve coconut farmer's livelihood. He encouraged all the coconut stakeholders to consider the development drive specially to help marginalized coconut farmers in improving their livelihoods.

The Winners of the competitions were announced during the function. The favorite winners of photography and videography were determined by the number of "likes" in the ICC's social media accounts. The award-winning video of the M/s Chiwadi Products, Thailand, was played during the function.

WINNERS OF WCD COMPETITION 2021		
PHOTOGRAPHY	1ST	Biko Wesa
	2ND	Dennyse Diaz
	3RD	Ida Santosa
	FAV	Shafa Salsabilaa Zahirah
VIDEOGRAPHY	1ST	M/s Chiwadi Products
	2ND	Nicole Kevin B. Tagudin
	3RD	Siska Utami
	FAV	Nurjanah
WRITING	1ST	Jayakumar S.
	2ND	Muhammad Safrudin
	3RD	Liberty H. Canja
CREATIVE SOCIAL MEDIA	1ST	Nikky Yu Montesclaros
	2ND	Micole Delos Santos
	3RD	Rizal Ramdhani

[1] *Information & Publication Officer, International Coconut Community*

[2] *Assistant Director, International Coconut Community*

HIGHLIGHTS OF THE 57TH ICC SESSION AND MINISTERIAL MEETING

Mridula Kottekate[1]

ICC Session & Ministerial Meeting is the highest decision-making body of the Community and is held annually to discuss, deliberate and take policy decisions on the activities to be undertaken by the Community for the sustained development of the global coconut sector. The countries are represented at the Session by the Honourable Ministers of Agriculture/Trade/ Commerce, Plenipotentiary Delegates authorized by the National Governments and Senior Officials from the concerned Ministries.

The three day long 57th ICC Session and Ministerial Meeting conducted virtually from 26th -28th October. The Government of Papua New Guinea held the Chair of International Coconut Community (ICC) for the CY 2020-2021 and was host for the 57th ICC Session & Ministerial Meeting. For the second time continuously Session & Ministerial Meeting convened virtually amid Covid-19 pandemic.

The inauguration is an Official Opening Ceremony and was organized by the host Government of Papua New Guinea. Mr. Alan Aku, Managing Director, Kokonas Indastri Koporesen delivered the Greeting Remarks followed by The National Anthem of Papua New Guinea and Prayer of Thanksgiving by Reverend Walter Kaumi.

Hon. Mr. John Simon, M. P., ICC Chair & Minister of Agriculture & Livestock, Government of Papua New Guinea welcomed the delegates and official

Hon. Prime Minister James Marape, M. P., delivering his speech

Hon. Mr. John Simon, M. P., chairing the Session

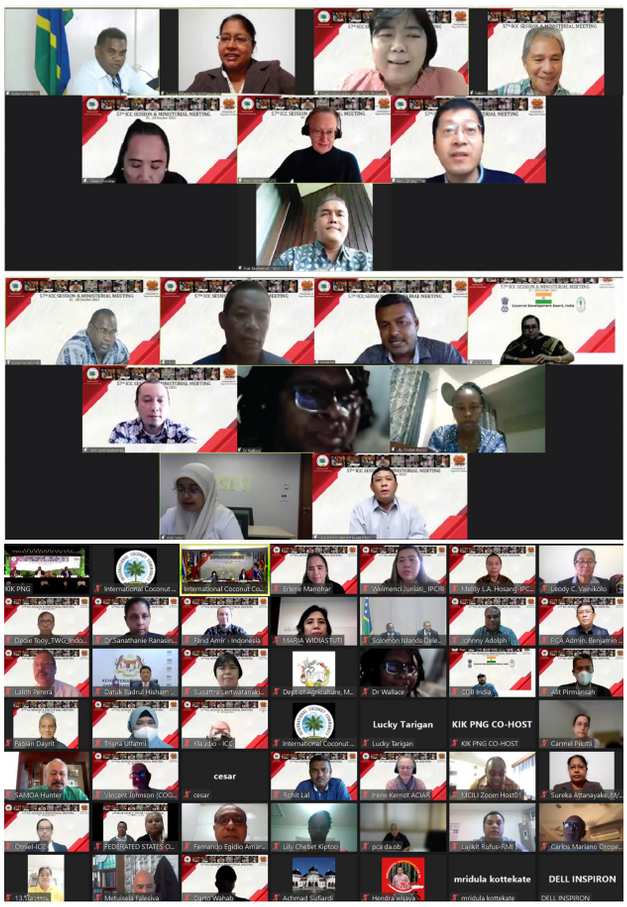
opening of the session was done by Hon. James Marape, M. P., Prime Minister Independent State of Papua New Guinea as Chief Guest. Introductory Remarks delivered by Dr. Jelfina C. Alouw, Executive Director, ICC. She mentioned that this pandemic reminds us how we can use this turning point into history, not only to recover from the pandemic, but how we can build forward better.

The 57th ICC Session & Ministerial Meeting was attended by National Ministers from host country Papua New Guinea and Solomon Islands. Delegates and participants included Senior Government Officials of ICC member countries and Official Observers from the Centre for Agriculture and Bioscience International (CABI), The Pacific Community (SPC), Centre de Investigacion Cientifica de Yucatan (CICY), Australian Centre for International Agricultural Research (ACIAR), French Agricultural Research Centre for International Development (CIRAD), International Treaty on Plant Genetic Resources for Food & Agriculture (ITPGRFA), Bioversity International, Non Alligned Movement Centre for South South Technical Cooperation (NAM-CSSTC) and International Trade Centre (ITC). The Governments of Guyana, Marshall Islands, Kiribati, Vanuatu and Vietnam were not represented.

Country Papers - Gateway for Exchanging Ideas and Programs

The session meeting started with the country paper presentation by member countries gave a brief update on the policies and programs for coconut development undertaken by National Governments including the legislations to promote the development of the sector. The delegates presented the status of coconut production, processing and export in their countries. Presented the updates on the coconut replanting, new planting and rehabilitation programs. The status of the research and development activities , policies and programs implemented in the country to enhance farm productivity and increase the farmers income were also shared with the member country delegates. The constraints faced by the sector and suggested road map for the way forward for the coconut sector were briefed by the delegates besides impact of Covid-19 on the coconut industry. The country papers helped in understanding the developmental activities undertaken by the countries and helps to idnetify the replicable models for customised implementation in other countries. It also helped in exchange of ideas and technology and paved way for possible collaborations between member countries.

Glimpse of country papers presented by ICC member countries



Participants of the Session

Observer Organizations

The International partner organisations attended and presented the nature and extent of their involvement in the Coconut sector with refrence to collaboration with community are Bioversity International; Centre de Investigaticion Cientifica de Yucatan (CICY); French Agricultural Research Centre for International Development (CIRAD); CAB International (CABI); The Pacific Community (SPC); Australian Centre for International Agricultural Research (ACIAR); International Treaty on Plant Genetic Resources for Food & Agriculture (ITPGRFA); Non Aligned Movement Centre for South South Technical Cooperation (NAM-CSSTC); and International Trade Centre (ITC).

The other agendas discussed were ICC Annual Report which included highlights of 2020, update of activities of 2021. The report was presented by Dr. Jelfina C. Alouw, Executive Director with the global scenario of Coconut. The Session also discussed the various programs and projects proposed to be undertaken by ICC during CY 2022.

During the year 2020 and 2021, amid COVID-19 pandemic, ICC's activities as planned could not be implemented physically. All the major ICC program, including the 49th International COCOTECH Conference & Exhibition, International Pest Management Symposium, International Certificate Course for Coconut Development Officers, have postponed to the year 2021, and have been conducted virtually. Despite the Pandemic situation, ICC managed to conduct several webinars, workshops, online training program in collaboration with NAM-CSSTC, CRI and ITC.

International COCOTECH Conference

Theme and Venue for the 50th International COCOTECH Conference was approved by the Session. The proposed theme of the Conference is ***"Climate Change Adaptation and Mitigation Strategy for a Resilient and Sustainable Coconut Agroindustry"*** and the Conference during 2022 would be hosted by Government of Malaysia.

The new structure of Technical Working Group (TWG) and revised Terms of Reference also endorsed by the Session. Mr. Benjamin Madrigal appointed as the new chair of the TWG.

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[1] *Assistant Director, International Coconut Community*

EXPERTS' FINDING
ON THE HEALTH BENEFITS OF COCONUT

Prof. Dr. Rabindarjeet Singh
Lifestyle Science Cluster, Advance Medical and Dental Institute, Universiti Sains Malaysia, Penang, Selangor, Malaysia

Coconut water is sterile at source, very rich in potassium, and contains sodium, chloride, magnesium and carbohydrates, making it a healthier alternative to carbonated drinks including isotonic sports drinks. Apart from the lower calories due to lower sugar content, the non-carbonated coconut water is also a great source for replacing the electrolytes lost during sweating when compared to carbonated drinks. Clinically, coconut water may be used as an oral rehydration aid to replace fluids loss from the gastrointestinal tract in children and adults suffering from diarrhea-induced dehydration, and some cases of constipation as it aids the digestive system. The low-sugar containing coconut water is also a better choice as a flavoured beverage with cardioprotective properties for those with diabetes as well as hypertension. The anti-aging compound cytokinins and other antioxidants found in coconut water may promote cell division and healthier ageing.

Source: XLVI Cocotech Conference 7-11 July 2014, Bandaranaike Memorial International Conference Hall, Colombo, Sri Lanka

Dr. Bruce Fife
Certified Nutritionist and Doctor of Naturopathic Medicine, and Director, Coconut Research Center, based in USA

You cannot say LDL (low density lippoprotein) is bad and HDL (high density lippoprotein) is good. It is more complex than that. There are actually two types of LDL: one small and dense the other large and soft. The large LDL is a good cholesterol the type used to make bile, hormones, and vitamin D--it is essential to life! The small dense LDL is the type that becomes oxidized and can be harmful, as all oxidized lipids can be. Eating coconut oil (and other saturated fats) increases both HDL and the "good" LDL, thus lowering the risk of heart disease. This is one of the reasons why populations that eat a lot of coconut oil have the lowest heart disease rates in the world.

Source: Press Statement, APCC, 21 June 2017

EXPERTS' FINDING
ON THE HEALTH BENEFITS OF COCONUT

Dr. Fabian M. Dayrit

Chairman of ICC Scientific Advisory Committee on Health and Professor, Department of Chemistry, Ateneo de Manila University, Academician, National Academy of Science and Technology and President, Integrated Chemists of the Philippines

Upon ingestion, coconut oil produces lauric acid and monolaurin, two compounds that have been known for many years to have significant antiviral activity. Lauric acid is a medium-chain fatty acid that makes up about 50% of coconut oil; monolaurin is a metabolite that is naturally produced by the body's enzymes upon ingestion of coconut oil and is also available in pure form as a supplement. Two mechanisms have been proposed to explain the antiviral activity of lauric acid and monolaurin:

1. **Disintegration of the virus membrane.** Monolaurin was able to reduce the infectivity of 14 human RNA and DNA enveloped viruses in cell culture by >99.9%, and that monolaurin acted by disintegrating the virus envelope. During hand washing, soap effectively destroys bacteria and viruses by dissolving their lipid membrane or envelope.
2. **Inhibition of virus maturation.** The Junin virus (JUNV) is the causative agent of Argentine hemorrhagic fever. In a comparison among the saturated fatty acids from capric acid (C10) to stearic acid (C18) against JUNV infection, lauric acid (C12) was the most active inhibitor. From mechanistic studies, it was concluded that lauric acid inhibited a late maturation stage in the replicative cycle of JUNV.

Source: "The Potential of Coconut Oil as Antiviral & Immunodulatory Agent Against Covid-19", Cocoinfo International, Vol. 27 No. 1, 2020.

Dr. Mary T. Newport

Neonatologist, Spring Hill Neonatology, Inc.
Florida, USA

Coconut oil and its active metabolites, lauric acid and monolaurin have been shown to have immunomodulatory properties in vitro and animal studies. Coconut oil is able to modulate the adaptive immune system, in particular, by enhancing T cells. Dendritic cells treated with lauric acid showed increased capacity for activation of T cells in HIV patients. VCO is also able to modulate immune responses by upregulating neuroprotective factors and suppressing inflammation and oxidative stress. An added benefit of VCO is its antibacterial activity. This is an important feature since many viral infections are accompanied by bacterial infections as well. Bacterial co-infections have been observed in COVID-19 cases.

Source: "The Potential of Coconut Oil as Antiviral & Immunodulatory Agent Against Covid-19", Cocoinfo International, Vol. 27 No. 1, 2020.

EXPERTS' FINDING
ON THE HEALTH BENEFITS OF COCONUT

Dr. Amit Ghosh
Department of Physiology, All India Institute of Medical Sciences (AIIMS), Bhubaneswar, India

Several studies indicate the anticancer effect of Virgin coconut oil (VCO), especially in the colon, breast, lung, liver and oral cavity. Coconut oil was far more protective than unsaturated oil in chemically induced colon and breast cancer. VCO consumption during chemotherapy helped improve the functional status and global quality of life of breast cancer patients. It also reduces the symptom related to the side effect of chemotherapy. MCFA compositions are altered in breast cancer tissue. Lauric acid-induced apoptosis in a colon cancer cell by triggering oxidative stress. The protective role of coconut oil in colon cancer is induced by azoxymethane/ dextran sulfate sodium.

Comparative Toxicogenomics Database (CTD) curated and integrated data for more than 5,700 gene-disease and 2,000 chemical-disease relationship, by which VCO-disease direct relationship was explored. It found that SCFAs of VCO can target almost 17 cancer-associated proteins. Almost 50% of VCO is Lauric Acid which interacts with 18 genes and associated with several diseases among which cancer, digestive disease, metabolic disease, nervous system disease, and urogenital diseases are the top five. (VCO regulated the expression of several genes indicating VCO may have modulated disease pathology of cancer.

Source: Pruseth, B., Banerjee, S., & Ghosh, A. (2020). Integration of in silico and in vitro approach to reveal the anticancer efficacy of Virgin Coconut Oil. CORD, 36, *1-9. https://doi.org/10.37833/cord.v36i.415*

Dr. Narong Chomchalow
Chairman, Conservation and Development of Coconut Oil of Thailand Forum, Bangkok, Thailand

High level of cholesterol is not the cause of athero-sclerosis that leads to the deposition of plague in the artery, which ends up in having heart disease. The real cause of heart disease is the injury in blood vessel leading to the heart, which is caused by various factors, such as toxin, disease, high blood pressure and stress. If the blood vessel is injured, platelets will be circulated to cure the injury and deposited there to stop bleeding. Other substances such as protein, fats (particularly unsaturated fat such as VCO) and calcium also move there, but not cholesterol, in which only a small amount is circulated and deposited there to be used to constitute the membranes of the newly formed cells.

Source: The Truth about Good, The Bad and The Ugly Fats", Cocoinfo International, Golden Jubilee, Special Edition 2019.

BEARISH MARKET
OF COCONUT OIL IN THE FIRST HALF OF 2022

Alit Pirmansah[1]

As expected, price of coconut oil (CNO, CIF Rotterdam) considerably leveled up in 2021. The increase had been observed since the beginning of 2020. The price averaged in 2020 was at US$1,015/MT which steadily leveled up to the highest level at US$1,961/MT in November 2021. The price was higher by 43% as opposed to the price a year earlier. On average, price of CNO during 2021 was US$1,636/MT with price volatility of 35%. Similarly, price of palm kernel oil (PKO) in 2021 also showed an increasing trend. Price of PKO in December 2020 was US$1,225/MT and gradually went up to reach the highest level at US$2,050/MT in November 2021. The average price during 2021 was US$1,533/MT with price volatility of 34%.

It should be noted that in the last two months of 2021 price of palm kernel oil was higher than coconut oil. Price premium of palm kernel oil over coconut oil reached US$166/MT in December 2021. This price premium naturally brings about a shift in demand at the expense of palm kernel oil.

As the economic impacts of Covid-19 pandemic are lessening, international trade of commodities including lauric oils is improving. During January-November 2021, US import of coconut oil was recorded a significant upsurge to level of 771,459 MT meaning an increase of 62.4% compared to the volume a year earlier. At the same time, import of palm kernel oil rose by 57.4%% from 290,348 MT during January-November 2020 to 457,126 MT for the same period in 2021. Hence, total imports of lauric oils by US market rocketed to 1.23 million tons which was 60.5% higher than the previous year's volume.

An increase of shipments of the oils was also observed in European market. During period of January-August 2021, imports of lauric oils by European countries was 799,682 which was 2.7%

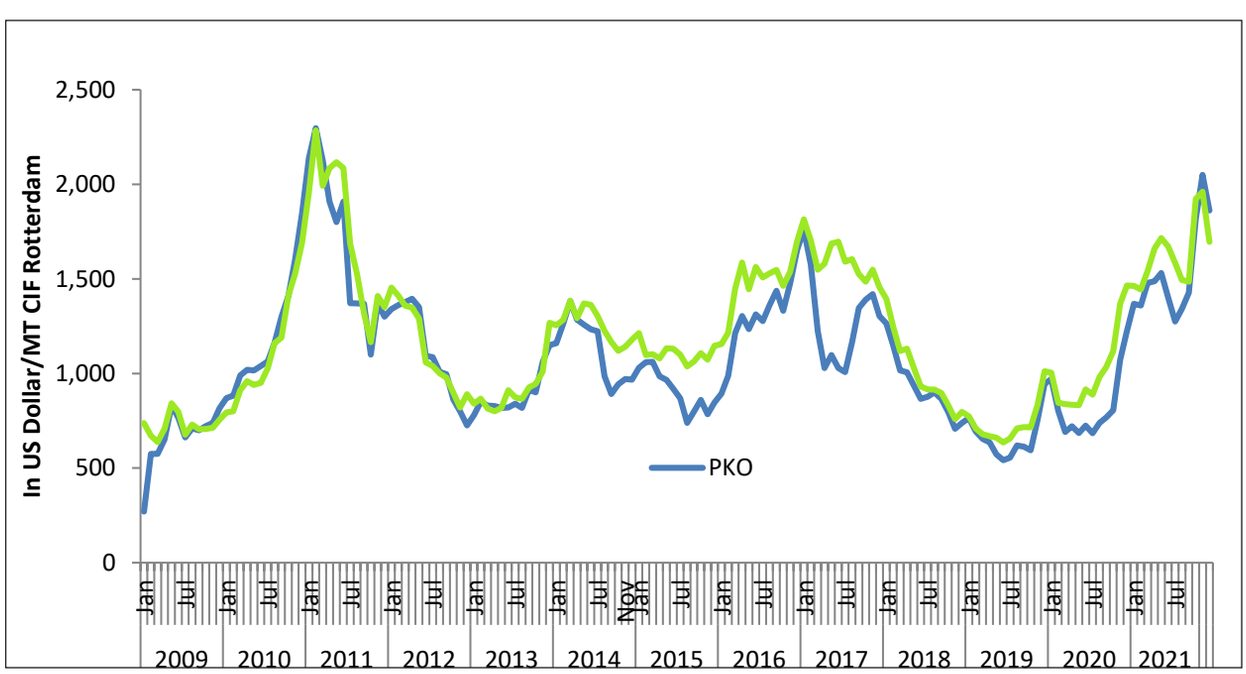

Figure 1. Price Trend of Lauric Oils, January 2009-December 2021 (USD/MT)

		Jan-Nov 2020	Jan-Nov 2021	Change (%)
CNO	Volume (MT)	475,000	771,459	62.4
	Value (USD'000)	403,921	434,788	7.6
PKO	Volume (MT)	290,348	457,126	57.4
	Value (USD'000)	345,805	356,053	3.0

Source: The U.S. Census Bureau, Economic Indicators Division

Table 1. US Imports of Lauric Oils, January-November 2020/2021

higher than the volume a year earlier. Import of palm kernel oil contributed to the higher import of the oils. Import volume of the oil rose by 8.8% during the period. Meanwhile, coconut oil import by European countries weakened by 1.2% during the period of January-August 2021. Moreover, demand of lauric oil is expected to continue recovering in 2022 following global economic recovery and higher production of the oils.

		Jan-Aug 2020	Jan-Aug 2021	Change (%)
CNO	Volume (MT)	472,753	466,905	-1.2
	Value (USD'000)	602,068	953,805	58.4
PKO	Volume (MT)	305,891	332,777	8.8
	Value (USD'000)	494,311	736,974	49.1

Source: ITC

Table 2. European Union (EU28) Imports of Lauric Oils, January – August 2020/2021

As coconut oil price premium over palm kernel oil was lessening, demand for coconut oil by Chinese buyers strengthened until the third quarter of 2021. Coconut oil shipments to China went up by 7.9% during January-August 2021 from 101,618 MT to 109,616 MT. Meanwhile, demand for palm kernel oil dropped from 409,178 to 342,463 MT leading to a drop of total imports of lauric oils by 11.5%. Shipments of palm kernel oil to China were even worse in 2020. China received only 742,424 ton of palm kernel oil or a reduction of more than 20% as opposed to 2019's volume. Combined imports of lauric oils by China in 2020 suffered a setback by almost 0.2 million tons from 1.1 million tons to only 0.9 million tons or shrank by 18%, reflecting a reduction of stocks and consumption. However, China is still the biggest importing country of lauric oils in the world.

		Jan-Aug 2020	Jan-Aug 2021	Change (%)
CNO	Volume (MT)	101,618	109,616	7.9
	Value (USD'000)	93,613	172,462	84.2
PKO	Volume (MT)	409,178	342,463	-16.3
	Value (USD'000)	299,826	440,424	46.9

Source: ITC

Table 3. China Imports of Lauric Oils, January – August 2020/2021

Moreover, global production of lauric oils is expected to continue improving in the first half of 2022 assuming the good weather condition and controllable COVID pandemic especially in The Philippines and Indonesia. Production of coconut oil during October 2021-September 2022 is forecasted to reach 2.95 million tons or level up by 11.3%. At the same time palm kernel oil production is estimated to go up by 4.5% to reach 8.28 million tons. Therefore, overall production of lauric oils in 2022 is expected to reach 11.23 million tons meaning an increase by 6.2% as opposed to the previous year's production.

Despite the challenges, Philippines' coconut oil is anticipated to recover in 2022. Production of the oil is estimated to increase by 14% to 1.15 million tons. Likewise, coconut production in Indonesia is projected to improve following expected better weather condition. Coconut oil production in Indonesia is expected to reach 815 thousand tons during 2022. Higher yield in 2022 is also projected in India, Sri Lanka, and Malaysia. Overall global production of coconut oil in 2022 is forecasted to reach 2.95 million tons which is higher by 11.5% compared to the previous year's production.

As supply of the coconut oil is expected to improve, global trade of coconut oil is expected to continue recovering in the coming year. Oil World forecasted that export of coconut oil from Philippines in 2022 will reach 1.05 million tons. This means an increase of 22% as opposed to the export volume a year earlier. The increase is also attributed the expected economic recovery, especially in China, US and Europe. Likewise, Indonesia is most likely to experience higher export of coconut oil in 2022. Export of coconut

oil from Indonesia is estimated to reach 640 thousand tons during the year.

With an expected increase in supply, coconut oil price will face a price pressure in the first half of 2022. However, a price premium of palm kernel oil over coconut oil will lead to a shift in demand in favor of coconut oil. Depending upon the magnitude of supply and price pressure, it is expected that a production surplus and recovery of stocks of coconut oil in the global market.

[1] *Market and Statistics Officer, International Coconut Community*

	2019	2020	2021[P]	2022[F]
Philippines	1.82	1.51	1.57	1.57
Indonesia	1.32	1.30	1.34	1.34
Other countries	1.62	1.56	1.68	1.68
World	4.76	4.37	4.59	4.59

Source: Oil World P: projected figures F: forecasted figures

Table 4. Copra Production, 2019-2022 (million tons)

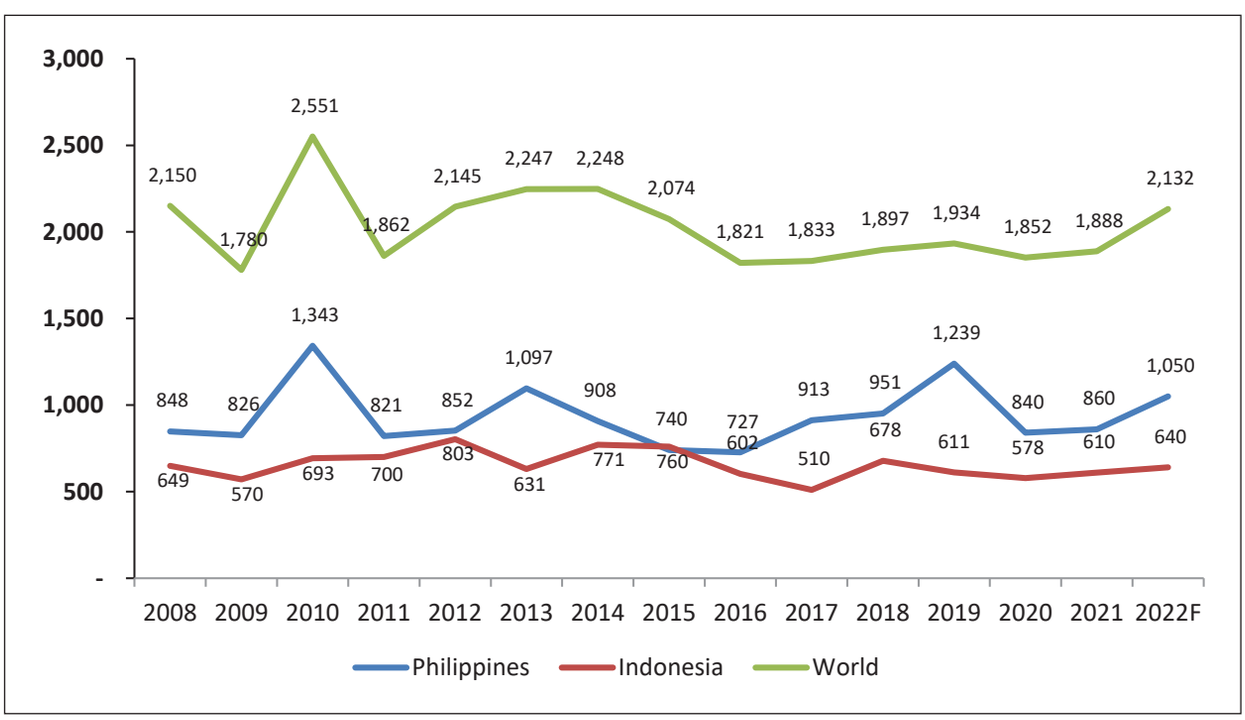

Figure 2. Exports of Coconut Oil from Philippines and Indonesia, 2008-2022

NARALI PURNIMA 2021: ALL HAIL VARUNA DEV, THE LORD OF OCEANS

When the entire country celebrates Raksha Bandhan with their families and loved ones, this day brings double delight for Maharashtrian Hindus who hail from the Konkan coast. Narali Purnima is observed and celebrated with great zeal in the state especially by Kolis.

Narali Purnima, also known as Coconut Day, is a major Hindu festival that falls on the full moon day, Purnima, in the holy Shravan month of the Hindu calendar. Hence this festival is also referred to as Shravan Purnima. Down south, this day is observed as Avani Avittam. Whereas the prominent states of North India like Uttar Pradesh, Madhya Pradesh, and Chhattisgarh will celebrate Kajri Purnima.

The importance of coconut: The word Narali Purnima is made of two words, Naral – which means coconut and Purnima – which signifies the full moon; hence the coconut holds an essential significance in festivities and rituals of Narali Purnima.

Rituals: During Narali Purnima, the devotees, meaning the Kolis and other fishing communities in the coastal regions, worship Lord Varuna, Varuna, who is hailed as the God of oceans and seas. On this day, devotees offer nariyal (coconut) to the God of the mighty waters, seek his divine blessings, and ask for a bountiful year ahead. The devotees pray to Lord Varuna and thank him for nurturing them and giving them a livelihood. They perform puja so that the Lord can save them from the dangers of mighty waters or other calamities that occur in oceans and seas. Upnayan and Yagyopaweet are the two popular rituals of Narali Purnima.

Since the entire auspicious month of Shravan is dedicated to Lord Shiva, devotees on Narali Purnima also worship Mahadev along with Varun dev. It is believed that the three eyes of coconut symbolises Trilochana, 'Three-eyed lord', Lord Shiva.

Thanking Nature: The fishermen observe fast and ask Lord Varuna to calm the seas and oceans during the turbulent monsoon season. Brahmins on this day keep a fast where they don't consume any form of grain. The tradition is called 'Shravani Upkarma,' but they eat coconut all day as 'phalahar.' Narali Purnima is also the day when people thank Mother Nature and plant coconut trees as a gesture of gratitude.

Fun & festivities: After performing the puja, the fishermen sail in the sea with their decorated boats. Along with their families, they soak in the festivities with zest and fervor. They sing, dance, eat and distribute special sweets made of coconut. This festival also marks the onset of the fishing season; hence on this day, fishermen hope to reap abundant fishes from the waters. The festival is also seen as an indication that the upcoming year will bring joy, happiness, and prosperity for all.

35TH NATIONAL COCO WEEK OF THE PHILIPPINES

Amidst the limitations and restrictions brought about by the COVID-19 pandemic, the Philippine Coconut Authority (PCA) virtually taken the stage again and celebrated the 35th National Coconut Week, on August 3, 2021.

Themed *"Negosyanteng Magniniyog: Kaagapay Tungo sa Maunlad na Ekonomiya,"* this year's month-long celebration aimed to increase coconut raw material utilization, provide additional income to farmers and farming communities, and target partnership between investors and coconut farmer organizations.

For the first time, a virtual trade fair conducted for potential consumers, buyers, micro, small and medium enterprises (MSMEs), investors, and other stakeholders who wished to participate and explore opportunities without leaving the comfort of their homes and offices. The virtual exhibition given exhibitors an innovative platform to get business leads as they virtually interact with visitors/clients just like in the traditional trade fair.

A series of investment fora had been hosted to allow government agencies, coconut farmer cooperatives, and the private sector to discuss investment prospects for the industry. Subsequently, a three-day business-to-business meeting also conducted wherein international buyers and investors were invited for a business matching session with local suppliers.

Likewise, PCA, banking on the success of last year's *"Coco-Kwentuhan sa Negosyo,"* inspired to continue the five-day online webinar series from August 23 to 27, showcasing the success stories and best practices of coconut-based enterprises, and highlighting the important role of partnership and convergence among coconut farmer organizations, LGUs, private sector, organized industry, and other stakeholders.

PCA Regional Offices also organized localized activities to celebrate the occasion.

An annual event of PCA, the Coconut Week celebration, mandated by Presidential Proclamation 142 signed by the late President Corazon C. Aquino in 1987, pays tribute and recognition of the benefits derived from the coconut industry and aims to establish a continuing awareness of its importance to the economy and society.

WEBINAR ON WORLD COCONUT DAY: COCONUT TO COIR TECHNOLOGIES

Coir Board organized a National Webinar on 'Coconut to Coir Technologies', on the World Coconut Day. It was inaugurated by Shri D. Kuppuramu, Chairman, Coir Board. Shri M.Kumararaja, Secretary, Coir Board delivered the keynote address.

Joint Secretary (ARI), Ministry of MSME Smt. Alka Nangia Arora in her presidential address emphasizedupon the need of giving importance to the publicity and supply chain management of the coir products. She said, suchwebinars are a good medium for the coir board to disseminate information about the products and technologies available in coconut and coir industries, which could attract new entrepreneurs to these fields.

The webinar was attended by 347 participants from all over the Country.Experts in various fields presented papers, opening prospects of coconut and coir technologies.

It was organised as part of Azadi Ka Amrit Mahotsav, commemorating the 75th Anniversary of its Independence .

MEMORANDUM OF UNDERSTANDING BETWEEN INTERNATIONAL COCONUT COMMUNITY AND UNIVERSITY OF SAM RATULANGI, MANADO

Memorandum of Understanding executed between Dr. Jelfina C. Alouw, Executive Director, International Coconut Community, and Ms. Elen Joan Kumaat, Chancellor, University of Sam Ratulangi Manado, on Monday the 31st May during the 61st anniversary (dies natalis) of the Faculty of Agriculture of the Sam Ratulangi University.

The main objective and purpose of this MoU are to strengthen cooperation between the two parties in supporting the government on the establishment of a coconut development policy and the implementation of the program and to formalize effective linkages between the two parties for efficient transfer of technology and capacity building on various aspects of the coconut sector for mutual goals.

The scope of the Memorandum is to strengthen the institutional relationship between the parties to be able to engage in efforts to support a safe, inclusive, resilient, and sustainable coconut community; conduct research and development in areas of mutual interest; and strengthen capacity development and publication.

The Memorandum of Understanding was signed in the presence of Mr. Olly Dondokambey, Governor of the North Sulawesi, faculties of the university, regents of North Minahasa, Central Minahasa, and South Minahasa, mayor of Tomohon city, and the invitees from the Ministry of Agriculture, Republic of Indonesia. The function was held in the auditorium of the university which was attended by more than 300 participants virtually and 100 participants physically. This is the beginning of the relationship between the ICC and the university and will collaborate for long-term cooperation for the welfare of the coconut farmers and industries in North Sulawesi, Indonesia, and can contribute to the development of the global coconut sector. *(ICC News)*

INTERNATIONAL JOURNAL PUBLISHES RESULTS ON VCO STUDY VS. COVID-19

Results of state-funded clinical trials on virgin coconut oil (VCO) in Santa Rosa, Laguna, which showed it was an effective "functional food" to help treat probable and suspect cases of COVID-19, has been published in an international journal. Science Secretary Fortunato dela Peña said the randomized, double-blind, controlled intervention study on VCO by Department of Science and Technology-Food and Food & Nutrition Research Institute, was published on May 25 in the *Journal of Functional Foods*.

Entitled "Virgin coconut oil is effective in lowering Creactive protein levels among suspect and probable cases of COVID-19", the study highlights were: (1) VCO emerged as a health supplement owing to its medium-chain fatty acid contents; (2) VCO is considered as GRAS (generally recognized as safe); (3) Coconut oil and its derivatives have been shown to be safe and effective immunomodulatory agent.; and (4) VCO improves COVID-19 prognosis by normalizing the C-Reactive protein level.

The study evaluated the effects of VCO in the biochemical markers of suspect and probable cases of COVID-19 on a 28-day randomized, double-blind, controlled intervention trial among 63 adults in two isolation facilities in Santa Rosa City, Laguna, Philippines. The participants were randomly assigned to receive either a standardized meal (control) or a standardized meal mixed with a predefined dosage of VCO. Changes in clinical markers were measured at three time points (day 0, 14, and 28), with daily monitoring of COVID-19 symptoms. Participants in the intervention group showed a significant decline in the C-reactive protein level, with the mean CRP level normalized to ≤ 5 mg/dL on the 14th day of the intervention. As an adjunct therapy, meals mixed with VCO was effective fostering faster recovery from COVID-19. *(UCAP Bulletin)*

INTERNATIONAL WORKSHOP ON QUALITY STANDARDS OF COCONUT PRODUCTS

ICC Secretariat conducted the International Workshop on Quality Standard of Coconut Products virtually on 13th-14th of July 2021. The main objective of organizing this workshop is to review and compile the national quality standard of various coconut products in ICC member countries and harmonize these national standards and come up with a Regional/ICC standards. The growing local and global market demand have forced the coconut Industries to optimize coconut added-value, thereby reducing poverty and stimulating economic growth. Increasing quality standards is essential to increase product quality, meet customer's expectations, avoid food adulteration, protect consumer's health, enhance global acceptability, increase export revenue, and make an important contribution to long-term revenue and profitability, and maintain higher prices. There were 46 participants including technical experts representatives of ICC member countries, private companies, research institutes like ICAR-CPCRI, CCRI, CRI, IAARD, ICAPRD, and industrial products certification institutes.

Dr. Jelfina C. Alouw, Executive Director, ICC, delivered the welcome remarks and rationale of the Workshop. She mentioned that one of the core missions of ICC, in line with the goals of the United Nation for sustainable development, is to help member countries in promoting product diversification and maintaining high product quality standards acceptable to consumers. Recognizing the importance of harmonized quality standards for coconut products, ICC conducted this two-day workshop to help member countries to upgrade product quality, access a new market, adapt and comply with international standards. The in-depth technical expert discussions, idea exchanges, and data validation by competent experts would be conducted after the workshop. The standards might be updated regularly and all the standards will be referred to as formal standards released by countries and international standards.

Mr. Farid Amir, Director General, APEC, and Alternate NLO, Indonesia, delivered the opening remarks and officially open the workshop. He appreciated ICC for hosting this workshop, and mentioned that as the 'Tree of life', coconut's role is not just as a food, but also used for religious, cultural, and handicraft purposes. The domestic and export of coconut products, and the world's demand is also increasing. He also emphasized the need to harmonize the coconut quality standard. The workshop will generate a quality standard for coconut products that can be used as a benchmark in general agreement and global trade. The Ministry of Trade, Government of Indonesia is committed to limiting the trade barrier of coconut products.

The first day of the workshop had two sessions. The first session began with ***'Understanding the Importance of Quality Standard'***. The first speaker, **Dr. Wahyu Purbowasito**, Director of Standards Development for Agro, Chemistry, Health and Halal Secretariat of the Codex Contact Point, The National Standardization Agency of Indonesia, presented ***'Codex and International Standard for Coconut Products'***. Codex Alimentarius is a collection of international food standards, codes of practice, and guidelines to protect the health of consumers and ensure fair practices in the food trade. Codex has 188 member countries, the Secretariat is at the FAO Headquarters, Rome. He explained the overview of Codex Alimentarius Commission, elaboration of Codex standards, and Codex Standards related to coconut products. Codex having standards for three coconut products.

Dr. C. Anandharamakrishnan, Director, Indian Institute of Food Processing Technology (IIFPT), Ministry of Food Processing Industries (MoFPI), Government of India, presented ***'Glycemic Index of Coconut and Its Products'***, in which he explained the changing consumer preferences, health effects of coconut, glycemic index metabolism process, factors influencing the GI of food products, stomach model, GI of coconut-based products, and the GI of different sweeteners, where the coconut sugar is relatively low.

The second session started with ***'Country Presentations: National & International Quality Standards for different Coconut Products'***. **Mr. Benjamin A. Madrigal (Jr.)**, Administrator, Philippine Coconut Authority, Philippines, presented definitions, concepts and principles, legislations & issuances related to standards for agriculture and products, the status of the regulatory system in the Philippines, issues, challenges, and way ahead. The

Philippines Nasional Standards (PNS) for food and industrial products was developed by the National Standards Body (NSB) and Standards Development Organizations (SDOs). There are 17 existing PNS for Coconut and Coconut Products.

Mrs. Deepthi S. Nair, Deputy Director (Marketing), Coconut Development Board of India presented the different standardizations bodies of India, namely Food Safety and Standards Authority of India (FSSAI), Indian Standards by the Bureau of Indian Standards (BIS), Agricultural Produce Grading and Marketing Act (AGMARK), National Standards for Organic Production (NSO), and Ecomark, with their standards, regulations, roles, activities, and processes. Having these standard bodies, India has the most standards for coconut products (19 products). In her presentation, she explained the comparison of 22 product standards according to BIS, FSSAI, ICC, and CODEX.

Mr. Nguyen Hoang Linh, Deputy Director-General, Directorate for Standards, Metrology, and Quality, Ministry of Science and Technology, Vietnam, presented general information about coconut in the world and Vietnam, system of national standards for coconut and coconut products of Vietnam, Orientation and solutions to complete the national standard system. Vietnam has 6 coconut product standards.

Dr. Chandi Yalegama, Head Coconut Processing Division, Coconut Research Institute, Sri Lanka presented national quality standards for different coconut products followed in Sri Lanka, in which she described the standards and regulations, the regulatory body of coconut products in Sri Lanka, standards specifications, specifications for different products, such as coconut oil, VCO, coconut oil, desiccated coconut, aqueous coconut products, oil cakes, coconut meal, coconut flour, and shell charcoal. Sri Lanka has developed standards for 16 coconut products.

Mrs. Supattra Lertwattanakiat, Senior Fruit Expert, Horticulture Research Institute, Thailand presented the Standards developed in Thailand for the different coconut products, and the agencies involved. Thailand has developed so far standards for 9 coconut products.

Mrs. Cheryl Lewis, Technical Officer, Specifications Development Quality Control & Certification, Barbados, National Standards Institution, presented ***'Quality Standard for Coconut Products developed by CARICOM'***. She mentioned that Regional Technical Sub Committee (RTSC) comprises representatives of nine member states: Antigua and Barbuda, Barbados, Dominica, Jamaica, Suriname, St. Lucia, St. Vincent & the Grenadines, Guyana, and Trinidad & Tobago. The CARICOM Specification is now developing the standard for packaged natural coconut water and which is in the draft stage. The Code of Practice contains standards from upstream to downstream, from harvesting, transportation, storage, processing, packaging, QC, to waste disposal.

Dr. Aida Hamimi Ibrahim, Deputy Director, Enzyme and Fermentation Program, Science and Food Technology Research Centre, Malaysia Agriculture Research and Development Institute (MARDI), Malaysia, presented national and international quality standards for different coconut products followed in Malaysia, in which she explained Malaysia coconut scenario, coconut varieties in Malaysia, regulation and Malaysian standard related to coconut. Malaysia has developed standards for 6 coconut products.

The second-day workshop was mainly focused on discussion for ***'Clarification and Harmonization of International Quality Standard for Coconut Products'***, The main speaker was **Dr. Fabian M. Dayrit**, Professor, Department of Chemistry, Ateneo de Manila University and Chair, ICC SACH. He presented ***'CNO, RBD oil, and VCO quality standards to be considered for human consumption'***.

The other categories of products discussed were coconut milk, coconut cream, desiccated coconut, coconut powder, coconut sugar & coconut honey, chaired by **Mr. Benjamin A. Madrigal (Jr)**, Administrator, Philippines Coconut Authority; coconut coir-based products, chaired by **Mrs. Sumy Sebastian**, Senior Research Officer, CCRI, Coir Board of India; coconut water, & nata de coco, chaired by **Dr. Prima Luna**, Researcher Centre for Agricultural Post Harvest Research & Development, IAARD, Indonesia; coconut shell charcoal & activated carbon, chaired by **Dr. K. Muralidharan**, Head, Social Science Division CPCRI, India.

There was an in-depth discussion on the criteria to be followed on finalizing the international standards and the queries raised by the participants were addressed by the speakers in the discussion session.

The closing statement was delivered by **Dr. Jelfina C. Alouw**, Executive Director, ICC. She addressed that in developing ICC's standard, it is necessary to focus on several key aspects such as the identity of the products, their unique characteristics, and potential contaminants. It is necessary to conduct regular training on food safety to increase compliance to the standard, form a quality standard committee whose main responsibility is to provide technical and policy advice and work on harmonizing the coconut product quality standards.

This workshop was just the beginning of the step taken by ICC to update and harmonize quality standards. In the next phase, the group of experts shall discuss the specific topic in forum group discussion for final validation and approval. She appreciated the distinguished speakers and the participants for their contributions. The two-day workshop was moderated by Ms. Mridula Kottekate, Assistant Director, ICC. *(ICC News)*

COCONUT INDUSTRY ROADMAP TO SERVE AS GUIDE FOR TRUST FUND

The Coconut Farmers and Industry Roadmap (Coco-FIRM) will serve as the basis for the development plan to be carried out under Republic Act (RA) No. 11524 or the Coconut Farmers and Industry Trust Fund Act, the Philippine Coconut Authority (PCA) said.

PCA Administrator Benjamin R. Madrigal, Jr. said in a mobile phone interview that Coco-FIRM points to the general direction of the action needed to improve the coconut industry and improve the lives of coconut farmers.

"Coco-FIRM will serve as the backbone of the Coconut Farmers and Industry Development Plan (CFIDP). Meanwhile, the CFIDP will complete the details and the parameters for evaluation, reporting and monitoring, and allocation under the Trust Fund," Mr. Madrigal said.

"Compared to Coco-FIRM, CFIDP will also focus on the roles of the various implementing agencies as provided in the law," he added.

According to Mr. Madrigal, the roadmap has seven thematic areas such as the promotion of coconut farmers' welfare and social protection; empowerment of coconut farmers' groups; increasing and sustaining coconut production programs; and the creation of hubs for coconut products.

He added that Coco-FIRM also aims to enhance the global competitiveness of traditional and non-traditional coconut products, expand trade and marketing, conduct innovative research and development, and improve institutional policy.

RA 11524, signed by President Rodrigo R. Duterte on Feb. 26, provides for the drafting of the CFIDP to serve as guide in deploying investment from the trust fund, which was funded by taxes collected from coconut farmers during the Marcos administration.

Under the law, the Bureau of the Treasury will transfer P10 billion to the trust fund in the first year, followed by another P10 billion in the second year, P15 billion in the third year, P15 billion in the fourth year, and P25 billion in the fifth year.

In a separate statement, Agriculture Secretary William D. Dar said the PCA is the first DA agency to have completed a commodity industry roadmap.

Mr. Dar added that the law allows for the modernization and improvement of the coconut industry, with assured funding of P75 billion over the next five years.

"We consider (the law) a 'game-changer' that will help transform the lives of 2.5 million coconut farmers and their families by turning low productivity into higher gains," Mr. Dar said.

According to the PCA, the Philippines is the top exporter of coconut products, generating average export revenue of P91.4 billion between 2014 and 2018. *(Business World)*

MOM'S LOVE LEADS TO VIRGIN COCONUT OIL BUSINESS

A virgin coconut oil (VCO) business was born out of a mother's love for her sick son and is thriving in the province of Antique. Dr. Clarissa Esmenos, a dentist and owner of Ariana Coco Products, said her son was suffering from skin asthma back in 2012, and their regular visits to a hospital in Iloilo City were draining their family's income. In one of these visits, however, a fellow patient recommended to her to try rubbing VCO on his son's skin which she took seriously.

From coconuts in their backyard, she researched and tried to make VCO. She found the VCO effective in treating her son's skin asthma until she made more batches of the oil and gave those to their relatives. "I was surprised that those I had given the VCO (to) kept coming back inquiring if they could still ask for more," Esmenos said.

In November 2013, upon the invitation of the Department of Trade and Industry, she joined a trade fair at a mall in Antique bringing with her only 15 bottles of VCO to see if they would sell. To her surprise, it was sold out. "As of now, we already have our production center and we are selling in outlets even in Iloilo City and Boracay island," she said of the business named after her daughter. *(UCAP Bulletin)*

GORONTALO EXPORTS FROZEN COCONUT MILK TO CHINA

Gorontalo Province exported 24.3 tons of frozen coconut milk to China through the North Gorontalo Orchid Port.

This coconut milk export is the result of the hard work of the Gorontalo Agricultural Quarantine which facilitates the certification of processed coconut products in the form of coconut milk.

"We noted that the production of processed coconut from Gorontalo over the last 2 years has increased productivity and quality is maintained, so that it is increasingly in demand in the world market," said Head of Gorontalo Agricultural Quarantine, Muhamad Sahrir when releasing the export of commodities from the plantation sub-sector belonging to PT MAS.

According to M Sahrir, in addition to the initial shipment, PT MAS is also listed as a new exporter which is facilitated by his side in exporting. This export product is packaged in 1,344 cartons in the form of frozen coconut milk.

In addition to the Gorontalo Agricultural Quarantine, which guarantees the health and safety of products to be exported, the Gorontalo Customs Office also facilitates Export Service Notes (NPE) and other facilitation support from relevant agencies at the Orchid Port.

Since the last two years, coconut milk from Gorontalo has been exported, recorded in 2020 as many as 146 tons of coconut milk with a value of Rp.1.8 billion belonging to PT RC for China and Thailand.

"Meanwhile, for 2021 to August this same exporter has recorded exports with a total volume of 749.4 tons with a value of Rp. 13.6 billion," said M Syahrir.

M Syahrir emphasized that the increase in exports was very significant, so he hoped that Gorontalo's coconut milk could penetrate other export destination countries, and he guaranteed that the Gorontalo Agricultural Quarantine Center would oversee it.

The shipping facilitator, Ikhlas and exporter Vishnu appreciated the government's support for his business.

This will increase the enthusiasm to continue to improve the export performance of agricultural commodities, which will lead to an increase in the welfare of Gorontalo farmers. *(Info Publik)*

INDIA ACCOUNTS FOR 34% OF GLOBAL COCONUT PRODUCTION

India leads the coconut growing countries in production and productivity though the area under cultivation is lower than other major growing countries, Narendra Singh Tomar, the Union Minister of Agriculture & Farmers Welfare has said.

In his inaugural address to commemorate the foundation day of the International Coconut Community, the Minister said production during 2020-21 was 21,207 million nuts which account for more than 34 per cent of the global production. The productivity has been recorded at 9,687 nuts per hectare which is the highest in the world. New products are brought into the markets, and coconut industries are growing, creating more employment opportunities for many farmers, adding that coconut has a strong influence on the national economy.

He said there are at present 9785 Coconut Producer Societies, 747 Federations and 67 Coconut Producer Companies covering 120 million palms belonging to 10 lakh coconut growers.

Ms. Shobha Karandlaje, the Minister of State for Agriculture & Farmers Welfare, called upon farmers to give a major thrust to product diversification and finding industrial utilization of various by-products and their value addition. Since the farmers are small and marginal, the future of the domestic coconut industry lies in the ability to aggregate and pool farm level coconut production, take up processing and value addition for better income realization.

Mr. Kailash Choudhary, the Minister of State for Agriculture & Farmers Welfare, said that the coconut processing sector offers immense potential for diversification of product basket and improved investments in traditional and innovative coconut products. Coconut can be made a part of the 'Make in India' campaign by increasing the production and export of value-added products.

Mr. Sanjay Agarwal, Secretary, Department of Agriculture & Farmers Welfare said Coconut Development Board is working with the mission to develop a globally competitive coconut sector that contributes to food security, health and nutrition, remunerative price for the coconut farmer and enhanced export earnings for the country and to make India the global leader in value addition and processing in coconut sector. Export of coconut products excluding coir products during the year 2020-21 touched 2,294.82 crore, recording an increase of about 30 per cent over the previous year.

The theme announced by ICC in 2021, for its 23rd edition of celebrations, is "Building a safe, inclusive resilient and sustainable coconut community amid Covid-19 pandemic and beyond". *(The Hindu Business Line)*

THE COCONUT COALITION OF THE AMERICAS IS LIGHTING UP LIVES FOR NATIONAL COCONUT DAY

In honor of National Coconut Day (June 26), the Coconut Coalition of the Americas (CCA) has launched its Lighting Up Lives initiative to raise funds to install solar panel lighting for coconut farmers. CCA, the non-profit organization serving as the united voice for the coconut industry, has partnered with Primex Isle de Coco Foundation to identify the farmers and install the solar lighting. Farmer families who have young children are eligible for this program, and the solar lighting will provide power for three light sources in the home.

"Coconut farmers are essential to the coconut industry," said CCA Executive Director Len Monheit. "Lighting Up Lives allows us to have a direct impact on these essential workers' quality of life. The solar lighting will allow the farmers' children to do their homework at night, for families to read together and do other activities that require light."

This program will benefit coconut farmers globally and the solar panel installation will take place from July to September.

CCA's core workplan is focused on growing the category, correcting coconut's allergen classification as a tree nut, changing the saturated fats narrative, supporting & enhancing sustainability practices, promoting quality standards, and defending the category against attacks. *(Tyler Morning Telegraph)*

NIGERIA TO ATTAIN COCONUT SELF-SUFFICIENCY BY 2030

The 2021 coconut planting season in the state was inaugurated by the Jigawa State chapter of the National Coconut Producers, Processors and

Marketers Association (NACOPPMAN). According to the coordinator of the association, Hajiya Sakina Muhammad, the gesture was aimed at having coconut self-sufficiency in Nigeria by 2027.

"The parent body of this association is the Federal Ministry of Industry, Trade and Investment. Coconut is a tropical plant that can grow anywhere under any condition, and Jigawa happens to be among the states in the North where the cultivation of coconut thrives," she told.

Hajiya Sakina said coconut had become a major foreign exchange earner for countries that produce it in large quantities. She quoted the Minister of Agriculture and Rural Development, Alhaji Sabo Nanono as saying that 653 billion nuts were produced in 2013 and Nigeria currently produces 265,000 tons. According to her, this makes Nigeria the 18th producer of coconut in the world. *(Fresh Plaza)*

PRESIDENT LAUNCHES 'DORIN DORATA KAPRUKA' NATIONAL PROGRAM TO PLANT 4 MILLION COCONUT SAPLINGS

President Gotabaya Rajapaksa inaugurated the 'Dorin Dorata Kapruka' National Program to plant 4 million coconut saplings at the Weliketiya Estate owned by the Chilaw Plantation Company in Bujjampola, Dankotuwa.

The program is expected to increase the annual coconut harvest from 2800 million nuts to 3600 million nuts, according to the President's Media Division.

To achieve this goal, the Ministry of Plantation, the State Ministry of State Ministry of Coconut, Kitul, Palmyra and Rubber Product Promotion and Allied Industrial Production and Export Diversification and the Coconut Cultivation Board are jointly organizing the "Door to Door Kapruka" National Program to plant 4 million coconut saplings islandwide.

For a long time, Sri Lanka's name was at the forefront of the international market for tea, coconut and rubber. The "Vision of Prosperity" policy statement focused on the promotion of coconut cultivation and related products, gaining that space in the future as well, President's Media Division said.

It is expected to achieve the target of planting 4 million saplings in the coming year, by giving one million coconut saplings for Samurdhi recipients and two million under subsidy while one million can be purchased and cultivated by anyone who wishes to join the program.

The President planted a coconut sapling at the Weliketiya Estate to mark its inauguration. Ministers and MPs also joined the President in planting coconut saplings.

In parallel to the national program, coconut saplings were planted and distributed throughout the island by all Ministries.

The President observed a barren paddy field land cultivated with coconut using organic manure.

The President also observed demonstrations of Organic Fertilizer Production Methods, Machinery, Soil Rehabilitation, Irrigation, Intercropping, Model Seed Coconut Nursery, Coconut Cultivation Diseases and Pest Clinics and Kapruka Society Members' Exhibitions aimed at enhancing the productivity of existing coconut lands.

The President then visited the Lunuwila Coconut Research Institute and observed demonstrations on preparation of coconut products and coconut milk products.

The President also symbolically distributed subsidies and agricultural equipment to 15 beneficiaries at a ceremony organized at the Coconut Research Institute premises in parallel to the program.

Jude Perera, Chairman, Chilaw Plantation Company, handed over to the President to credit the General Treasury with 10 million rupees earned by his company by 2020.

Minister Ramesh Pathirana, State Ministers Arundika Fernando, Sanath Nishantha, Priyankara Jayaratne, Members of Parliament Ashoka Priyantha, Chinthaka Mayadunne, Secretaries to Ministries and officials

of line agencies were also present at the occasion. *(Colombo Page)*

SRI LANKAN FIRM TO BANK ON KERALA TECH FOR COCONUT PRODUCTS

A Sri Lankan company has come forward to use the know-how from Kerala to start a new product line of coconut water and coconut chips at the 11th edition of FoodTech India. Further, two more concrete inquiries are there for using our technology in setting up businesses in neighbouring countries.

The FoodTech India, the region's premier food processing and packaging expo which is regularly held in Kochi and held virtually this year due to Covid.

"The expo generated concrete inquiries for joint ventures in coconut and dairy product sectors including two projects for setting up coconut drink/ chips and dairy and ice cream in Sri Lanka. Another of the query was for a milk and related beverages project in Bangladesh," said Joseph Kuriakose, director, Cruz Expos, organizers of the 3-day expo. Regarding the coconut drink project, he said, "A retired officer from the Kochi-headquartered Coconut Development Board will act as consultants for the Sri Lankan company's project".

The three-day expo attracted a total of 1350 trade visitors including 475 from abroad. "Most of the international visitors were from Saudi Arabia, UAE, Iran, Bangladesh, Nepal and Sri Lanka," Kuriakose said.

"Food processing industry is one of the least affected and the fast-recovering industries from the effects of covid and the response we received for the show stand testimony to this," he said. Though being held virtually, the show also provided all the business networking opportunities available as in a physical expo. And by being online, it was accessible from across the world," he added.

The 42 exhibitors who displayed their products and services this year included major packaging companies like Ace Finepack, Duropack Industries and Smartpac Engineering; sieves manufacturer Galaxy Sivtek, conveyor belt maker The Industrial Source; turnkey solutions company Goma Process Technologies, agar products maker Marine Hydrocolloids of Meron group; dairy processing machine manufacturer Repute Engineers , spices and other food products companies like Harley Carmbel Commodities , Wayanad Jack Fruits Development & Processing Society, Taste Heaven Chickens and Western India Cashew among others.

Joseph also said Kerala being home to a variety of spices and food crops, the food processing industry is one of the largest and fastest-growing industries in the state. The state has a total of 69,000 food processing units which form 23% of the total industrial enterprises in the state. In the district of Ernakulam alone, there are more than 4,500 agro-based units with a total investment to the tune of Rs 900 crore. The units in the district employ more than 40,000 people and have a total turnover of Rs 6,000 crore. "Considering these, we have been receiving increasingly encouraging responses to the expo for the past decade," he said. *(Times of India)*

VIRGIN COCONUT OIL: A HIDDEN JEWEL IN COCONUT SECTOR

The World Coconut Day is being celebrated on September 2 every year. Most of the times, the stakeholders in coconut sector focus more on coconut and to some extent on coconut oil.

Though there is scope for value-addition, it is yet to get momentum among the stakeholders in coconut sector in the country. The value-added products would help farmers get good returns for their crops and develop entrepreneurs in the coconut sector.

While people are aware of coconut oil — one of the major edible oils preferred in Kerala and coastal parts of Karnataka — virgin coconut oil (VCO), another product from coconut, is yet to gain momentum.

KB Hebbar, Head of Plant Physiology, Biochemistry and Post-Harvest Technology at the Kasaragod-based Central Plantation Crops Research Institute (CPCRI), told that VCO refers to the process of preparation of coconut oil from mature coconut kernel-derived fresh coconut milk by mechanical or

biological (microbial fermentation) processes with or without the use of heat. This process is devoid of refining, bleaching or deodorization (RBD) processes, which, a normal coconut oil undergoes.

Basically, VCO is extracted from the milk and not from the copra.

He said though there are various methods of VCO production, CPCRI has developed a hot process based VCO technology. This technology utilizes a double-jacketed cooker, developed exclusively for this purpose, which ensures uniform and controlled spread of heating to the coconut milk during the process of VCO production. Further, VCO produced following CPCRI's technology has relatively high content of polyphenols.

Till date, CPCRI has commercialised this technology to 55 entrepreneurs, he said. As of now, it is prepared in small scale when compared to other edible oils. But there is scope to explore its potential.

Health benefits

VCO preserves most of its inherent biochemical properties that accords it with immense nutraceutical and medicinal value, as it is produced in a wet process under controlled temperature conditions.

The sensory attributes of VCO reveals that it has aroma of roasted coconut, aroma of cooked coconut with sweet sensation, nutty and rancid aroma which adds to the increasing demand for it, Hebbar said.

SV Ramesh, Senior Scientist at CPCRI, said VCO has been recognized as a functional food and its demand continues to increase. Scientific studies have reported that VCO significantly reduces the bad cholesterol components, low density lipoprotein (LDL) and very low-density lipoprotein (VLDL) cholesterol along with increase in good cholesterol, high density lipoprotein (HDL) cholesterol of serum and tissues, he said.

Of late, clinical trials have been successfully conducted to explore the nutraceutical properties of coconut oil including its cardio-protective, neuroprotective (in the treatment of Alzheimer's' disease, dementia).

Potential

Anitha Karun, Director of CPCRI, told that VCO has a greater potential in the international market, especially in European countries. VCO and its derivatives (especially monolaurin) have been analyzed for effective and safe antiviral agents. It has got anti-bacterial and anti-fungal properties also. These factors are leading to the increase in its acceptance in the European market. VCO is now gaining acceptance in India also, she said.

The ODOP (one district one product) scheme of the Government has also given thrust on this particular product. The facilities include the subsidy for production related aspects, provision for common processing centres, packaging, branding and assistance for marketing, she added. *(The Hindu Business Line)*

Table 1. WORLD Exports of Coconut Oil, 2016– 2021 (In MT)

COUNTRY	2016	2017	2018	2019	2020	2021[F]
A. ICC Countries	**1,548,733**	**1,610,131**	**1,829,073**	**1,929,105**	**1,714,559**	**1,768,742**
F.S. Micronesia	0	87	57	0	0	0
Fiji	1,779	1,955	3,261	2,487	2,533	1,860
India	29,215	11,726	6,985	7,632	11,096	12,500
Indonesia	602,318	510,352	675,270	650,000	578,048	610,000
Jamaica	7	6	5	6	0	2
Kenya	252	55	36	30	30	30
Kiribati	2,220	1,359	1,851	3,547	1,200	1,500
Malaysia	115,969	102,735	121,914	223,077	203,362	220,000
Marshall Islands	1,239	809	2,229	1,085	1,115	2,000
Papua New Guinea	23,866	26,565	22,341	21,047	31,556	28,000
Philippines	726,827	912,632	954,107	980,000	840,073	860,000
Samoa	546	1,098	32	50	50	50
Solomon Islands	1,487	5,515	5,670	4,221	5,408	3,000
Sri Lanka	22,679	20,126	19,039	16,400	21,335	15,000
Tonga	900	900	0	0	0	0
Thailand	1,236	1,331	1,266	1,337	1,745	1,600
Vanuatu	654	2,543	1,226	1,659	1,367	700
Vietnam	17,539	10,337	13,784	16,527	15,641	12,500
B. Other Countries	**327,780**	**167,349**	**124,151**	**112,600**	**118,000**	**119,000**
TOTAL	**1,876,513**	**1,777,480**	**1,953,224**	**2,041,705**	**1,832,559**	**1,887,742**

F: Forcasted figures

Source: ICC, ITC and Oil World

Table 2. Prices of Coconut Products and Selected Vegetable Oils, January -December 2021 (US $/MT)

	2021											
Products	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Copra	607	543	519	536	540	585	592	600	632	665	848	920
Coconut Oil	1,062	875	834	840	831	920	886	954	1,034	1,105	1,380	1,459
Copra Meal[2]	257	224	193	231	252	261	231	205	206	209	259	281
Desicc. Coconut[2]	2,153	2,149	2,081	2,150	2,153	2,190	2,190	2,195	2,208	2,222	2,315	2,469
Mattress Fiber[1]	157	154	149	n.q.	136	107	110	111	111	111	109	107
Shell Charcoal[2]	316	327	324	361	371	369	376	381	390	396	418	447
Palm Kernel Oil	955	802	689	721	678	761	704	756	788	801	1,073	1,193
Palm Oil	835	729	635	609	574	652	659	703	741	758	918	979
Soybean Oil [r]	874	800	748	680	684	752	821	867	906	915	974	1,023

1: Sri Lanka (FOB); 2: Philippines (FOB); r: revised

Source: ICC, ITC and Oil World

Table 3. World Oil Balance 2019-2021 (million tons)

Oil/Year	Jan/Dec 2019	Jan/Dec 2020	Jan/Dec 2021[F]
Palm Oil			
Opening Stocks	15.30	13.57	12.09
Production	76.67	74.47	76.43
Imports	55.46	50.18	51.43
Exports	55.00	50.64	51.27
Disappear	78.86	75.48	76.26
Ending Stocks	13.57	12.09	12.43
Soybean Oil			
Opening Stocks	5.96	5.80	6.19
Production	56.89	58.64	60.02
Imports	12.04	12.91	13.17
Exports	12.24	12.91	13.49
Disappear	56.84	58.25	59.57
Ending Stocks	5.80	6.19	6.32
Groundnut Oil			
Opening Stocks	0.35	0.28	0.28
Production	3.99	4.19	4.38
Imports	0.33	0.38	0.42
Exports	0.34	0.43	0.37
Disappear	4.05	4.15	4.32
Ending Stocks	0.28	0.28	0.39
Sunflower Oil			
Opening Stocks	2.90	3.41	3.20
Production	20.78	21.30	18.91
Imports	12.17	13.58	11.51
Exports	12.35	13.64	11.32
Disappear	20.09	21.45	19.32
Ending Stocks	3.41	3.20	2.98
Rapeseed Oil			
Opening Stocks	3.28	3.00	3.10
Production	24.97	25.72	26.80
Imports	5.57	6.02	6.53
Exports	5.51	6.11	6.43
Disappear	25.31	25.53	26.73
Ending Stocks	3.00	3.10	3.27
Cotton Oil			
Opening Stocks	0.42	0.36	0.35
Production	4.58	4.60	4.39
Imports	0.17	0.17	0.15
Exports	0.16	0.17	0.14
Disappear	4.65	4.61	4.40
Ending Stocks	0.36	0.35	0.35

Oil/Year	Jan/Dec 2019	Jan/Dec 2020	Jan/Dec 2021[F]
Palm Kernel Oil			
Opening Stocks	1.31	1.35	1.25
Production	8.10	7.87	7.99
Imports	3.59	3.48	3.28
Exports	3.65	3.47	3.28
Disappear	8.00	7.98	8.00
Ending Stocks	1.35	1.25	1.24
Coconut Oil			
Opening Stocks	0.52	0.52	0.44
Production	2.91	2.61	2.75
Imports	2.05	1.91	1.95
Exports	2.04	1.87	1.89
Disappear	2.92	2.72	2.88
Ending Stocks	0.52	0.44	0.37

Source: ICC and Oil World F: forecast figures

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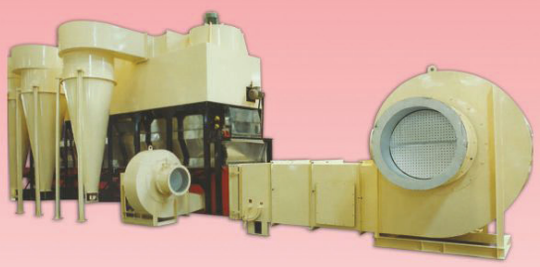

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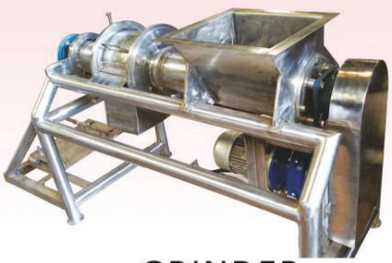

GRINDER

Output Capacity:
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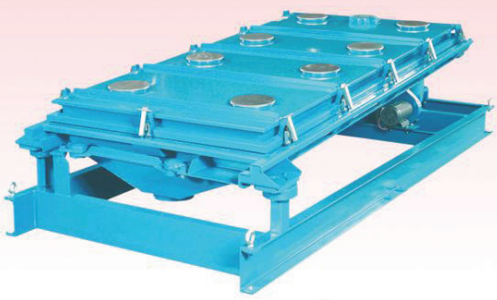
BLANCHER

Output Capacity :
1000 to 4000 Kgs/hr.



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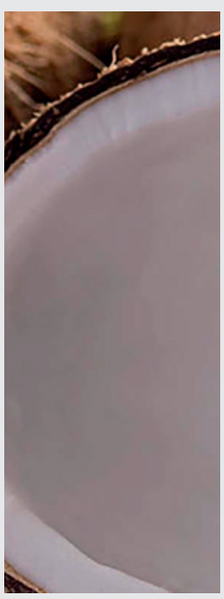

vco expeller

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