MODULE 7

REPLANTING COCONUTS FOR VIABLE CLIMATE CHANGE ADAPTATION

CLIMATICALLY, ENVIRONMENTALLY AND ECONOMICALLY SMART FARMING PRACTICES

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CONTENTS

1 THE RESILIENCE OF COCONUTS TO CLIMATE CHANGE AND THE NEED TO REPLANT

Coconuts (the 'tree of life') have been a very important food crop for centuries in Pacific Islands, well before coconut plantations were first established in coastal areas, more than a century ago, to produce copra for export to Europe. Even though copra and copra oil exports to Europe have largely ceased, coconuts remain an important crop for food security and livelihoods in the region and remain an export earner for most countries.

Overall coconuts are one of the most resilient of our traditional Pacific Island food crops. They are able to grow in low fertility saline coastal soil, withstand prolonged drought and survive neglect. However coconuts palms will, of course, be more productive if they are looked after and not neglected. A particular feature of the traditional tall coconut varieties that have evolved in the Pacific Island region is an inherent ability to endure cyclones. Provided they are not senile (> than some 60 years old), the palm will significantly bend in the face of a cyclone but usually it will not break. The flowers and most nuts will be lost – but the palm will flower and bear nuts again. However, when the palm becomes senile, this flexibility is lost and the palm becomes brittle and easily breaks, or becomes uprooted in the face of a cyclone, particularly a severe cyclone (Category 4 or above).

More than a decade ago senile palms in Fiji were estimated, by FAO/ Asia Pacific Climate Change Partnership (APCC), to account for around 60 per cent of all planted coconuts (Table 1). Since that time, significantly more coconut trees have become senile and thus low yielding. With the increasing intensity of cyclones as a result of climate change a growing number of these palms have been lost (see Module 1). The sooner senile palms are replaced the better – the alternative is declining coconut production and an eventual loss of the palms.

Senile Fiji talls near Savusavu (photo Andrew McGregor)

Broken coconut palms in the same area after TC Winston (photo Andrew McGregor)

Table 1: Estimated Senility of Pacific Coconut Palms[1]

	Fiji	PNG	Samoa	Solomon Is	Vanuatu
Est. area under coconut (ha)	62,000	221,000	1,584,400	59,000	92,000
Est, no of palms	6,200,000	22,100,000	9,902,500	5,900,000	9,200,000
Est. no of senile	3,720,00	11,050,000	1,584,400	1,180,000	4,600,000
% of senile palms	60%	50%	16%	20%	50%

1 Bulai Sairusi (2017). Converting logs from senile coconut palms into high quality veneer. Presentation to the CIDP Regional Value Chain Workshop, Nadi, Fiji, 11–13 July 2017

2 WHY SHOULD I BOTHER TO REPLANT MY SENILE COCONUTS PALMS?

Coconuts also offer significant income generating opportunities, as well as climate change resilience. As a farmer there are a number of good reasons why you should replant your senile coconut palms. These include:

- **Your coconut plantation will change from being highly vulnerable to climate change over time compared to one that is relatively resilient.** Several years after planting, a coconut palm will have firmly established it's rooting system. By then, because of the flexibility in its trunk, the palm will largely bend rather than break in the face of cyclonic winds and will only lose its nuts.
- **The fertility of the soil that has been planted to coconuts for 60 years has been severely degraded and replanting provides an opportunity to restore this fertility.** A lot of the land that is now under senile coconuts is located close to villages. A replanting program based on agroforestry and intercropping would bring with it substantial food and nutritional security benefits (see Module 3).
- **A rapidly growing market for coconut products – this is occurring at a time when world coconut production continues to fall** (see Section 3). Declining world coconut production is the result of the high and increasing percentage of coconut palms that have become senile.
- **The market for products obtained from the senile palms that are removed for replanting.** High value timber products, such as coco veneer used for premium quality flooring can be manufactured from senile palms.

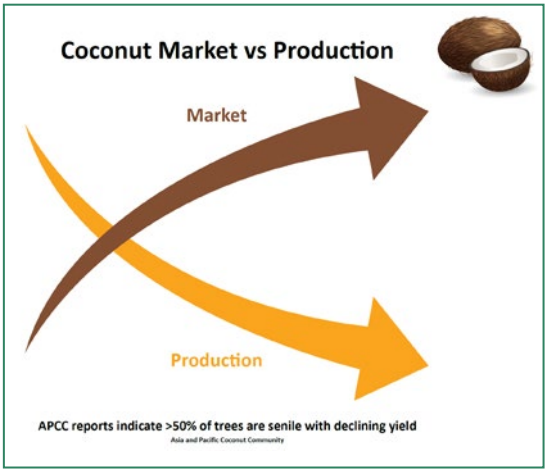


Fig 1 Declining yield of coconut palms [2]

Converting logs from senile coconut palms into high quality veneer (photo Sairusi Bulai)

2 APCC Secretariat, 2017, Global scenario of the coconut sector, Presentation to the Pacific Coconut Sector Value Chain Workshop, 11 July 2017, Nadi, Fiji

3 A RAPIDLY GROWING MARKET FOR PACIFIC ISLAND COCONUT PRODUCTS AT A TIME WHEN GLOBAL PRODUCTION IS FALLING

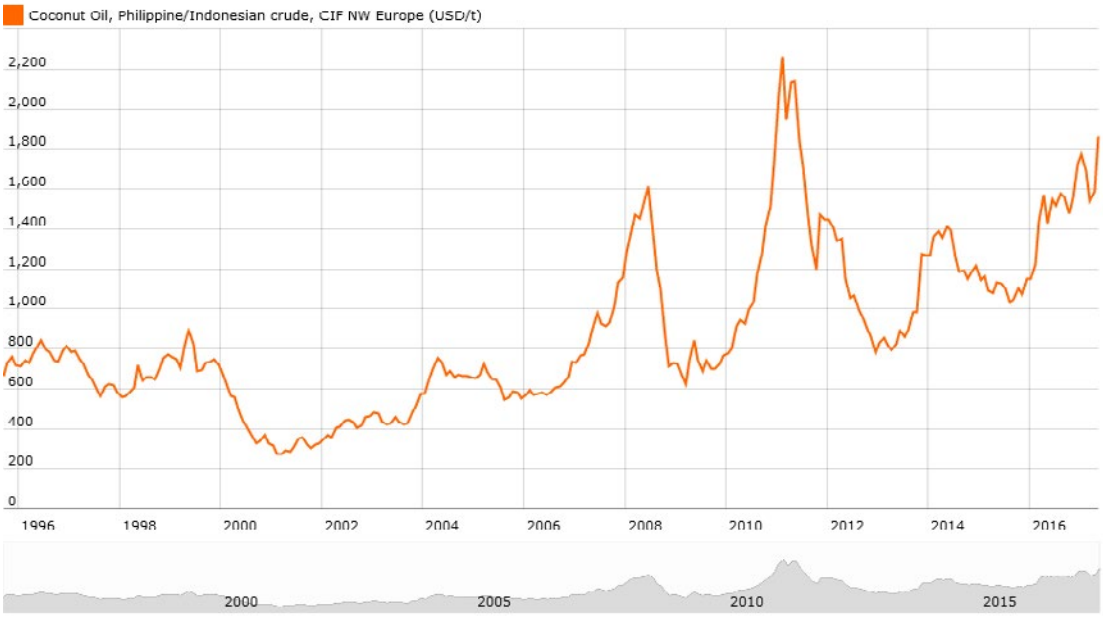
It is certainly good news for farmers, even with climate change, that once newly planted coconuts have established their rooting system, they can be expected to productively produce coconuts for at least another 50 years.

What sort of a market can be expected for the coconuts produced by these replanted palms?

3.1 The traditional export markets for copra and coconut oil

In the past, crude copra oil (CNO) and copra were major export earners for most Pacific Island countries (PICs). Today, only a few PICs (Papua New Guinea, Solomon Islands, Vanuatu, Fiji, Samoa and Kiribati), continue to export copra and CNO and even these exports are considerably less than they were in the past. The decline in these exports has occurred despite a significant overall increase in the world price of CNO and copra over the last two decades (see Fig 2). This upward price trend was due to increasing demand for vegetable oils, including coconut oil, for both food and industrial uses

Fig 2 Copra prices 1996-2016[3]



3 McGregor with Sheehy, 2017 An overview of the market for Pacific Island coconut products and the ability of industries to respond. Pacific Community/Coconut Industry Development Project https://pacificfarmers.com/wp-content/uploads/2018/02/CIDP_Report_Final_e-copy_resized.pdf

3.2 Why is it difficult for the PICs to take advantage of the improved export market for CNO and copra?

The recent decade has seen a more favourable market situation for the traditional PIC coconut export products of copra and coconut oil with prices reaching record levels. Historically, these products have been shipped to large scale processors in Europe – who still remain the dominant buyers. The best prices for CNO are obtained by shipping CNO to Europe. However, it has become increasingly difficult for PIC exporters to take advantage of this improved market because shipping directly to Europe-based buyers (mainly located in Germany and the Netherlands) has become largely uneconomical due to decreasing volumes and the reduction in the Europe-bound shipping. CNO and copra are now largely shipped to Asian markets – which receive a lower price. The nearby markets of Australia and New Zealand have ample shipping available, but the copra oil markets are small and require the oil to be refined, deodorized and bleached (RBD). The additional price received for RBD oil considering the current level of production and the size of the market, does not justify the investment required by Pacific Island copra millers to convert a CNO mill to an RBD operation[4].

3.3 The non-traditional markets for Pacific Island coconut products

As a consequence of declining production and difficulties accessing the higher price market, attention has now turned to niche coconut products for both export and domestic markets. With niche products, much smaller volumes are differentiated in the market, which enables them to receive a higher price, allowing for commercial viability on a smaller scale. Niche market products can be distinguished in the market by a range of factors. These include: specific quality features; their origin (where they come from); a certification (organic, fair trade or origin); or various combinations of these factors.

The focus for the PIC producers over the last decade has been on virgin coconut oil (VCO). However, there has been a very large increase in global demand for a wide range of coconut products – in particular coconut water and coconut milk/cream. PICs are starting to take advantage of some of these market developments

3.3.1 Virgin coconut oil (VCO): for export and domestic markets

VCO is derived directly from the fresh mature coconut kernel and thus bypasses the first stage of making copra before producing coconut oil. VCO is the purest form of coconut oil. There are two broad types of VCO processing technologies: i) fresh-wet fermentation processing (this traditional VCO processing originated in the Pacific Island atoll countries of Tuvalu and Kiribati); and, ii) fresh dry processing.

RBD oil and VCO have the same physical and chemical characteristics but have different sensory (smell, taste and feel) attributes. The major uses for VCO are as a hair and skin conditioner; an oil base for various cosmetic and skin care products; carrier oil for aromatherapy and massage oils; and as a nutritious food.

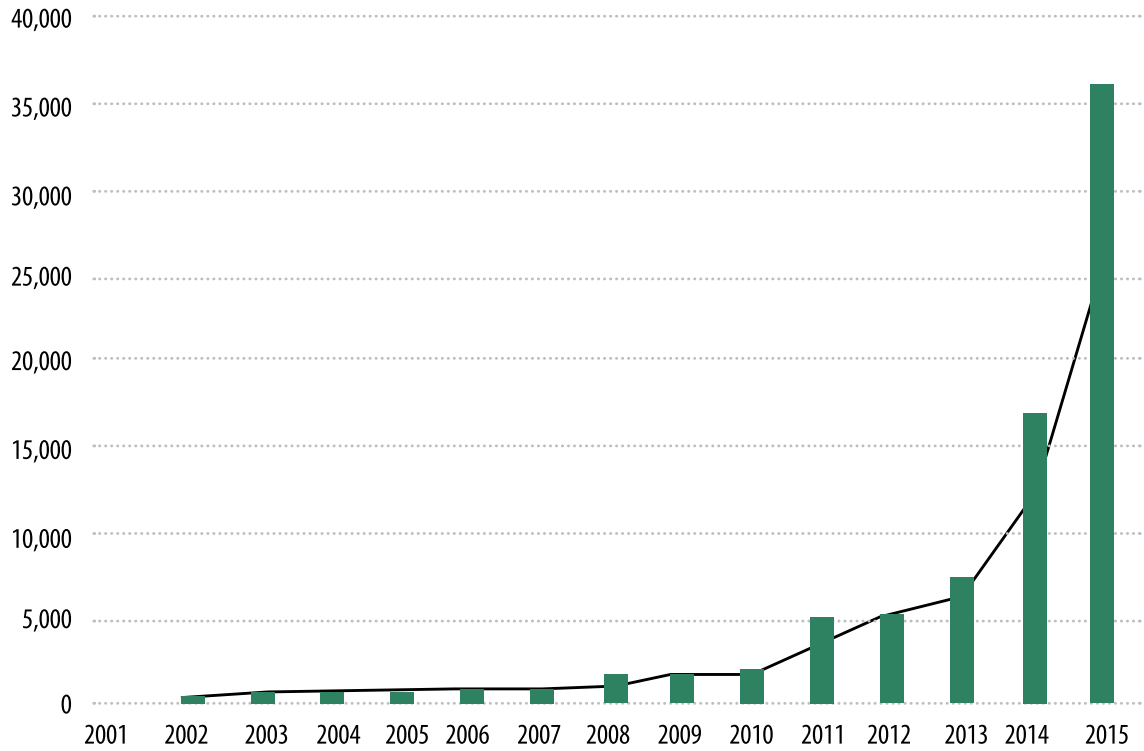
4 McGregor with Sheehy, 2017, An overview of the market for Pacific Island coconut products and the ability of industries to respond. Pacific Community/Coconut Industry Development Project https://pacificfarmers.com/wp-content/uploads/2018/02/CIDP_Report_Final_e-copy_resized.pdf

VCO being produced in various scale of production – ranging from a micro village enterprise in Tuvalu to industrial scale in Shri Lanka (photos Andrew McGregor and Dileepma Ratnayake)

VCO's transition from an exceptionally high priced niche market product to a commodity that receives a reasonable price premium

The Philippines was the first country to enter the international VCO market in the mid-1990s. This was on a very small scale (only 2 tonnes were exported in 2001). In those early years, VCO received a price that was five times more than that received for RBD. However, today the Philippines exports over 35,000 tonnes of VCO annually to 42 countries – for which a relatively modest price premium is received compared with RBD.

Fig 3 Philippines VCO Exports 2001-2015 (tonnes)[5]



5 APCC Secretariat, 2017, Global scenario of the coconut sector. Presentation to the Pacific Coconut Sector Value Chain Workshop. 11 July 2017, Nadi. Fiji

Sri Lankan VCO now readily available in Australian supermarkets (photos Andrew McGregor and Dileepma Ratnayake)

Fiji, Samoa and the Solomon Islands, were the early entrants into VCO export markets, taking advantage of the exceptionally high prices that were then available. Their main markets were Australia and New Zealand. However, the last decade has seen rapid growth in VCO exports from industrial scale producers in Sri Lanka to Australia and New Zealand. For Pacific Island producers, VCO has now transformed itself from a high-priced niche product, to one that can secure a reasonable price premium, provided quality standards are met. This price premium is often not sufficient for micro village scale operations. Some Pacific Island VCO enterprises have been able to adjust to this market reality through a combination of approaches:

- Producing premium quality VCO;
- High quality labelling that stresses the country and exotic location of the products' origin;
- 3rd party certification (organic, fair trade, origin or a combination of these) – however 3rd party certification imposes a significant cost burden for a small-scale producer; and,
- Increased emphasis on local market (as discussed below)

Pacific Island VCO producers are now giving greater focus on domestic markets

Vegetable oil for the Pacific Islands is one of the largest food imports - second only to rice and wheat flour. For example, Fiji currently imports around 17,000 tonnes of vegetable oil (landed valued of some FJD 20 million). If domestic coconut oil consumption reached 5 per cent of total vegetable oil imports, this would represent a market of nearly 1,000 tonnes which is more than the average annual export of coconut oil in recent years. Lessons can be learnt from the experience of the Philippines in this respect, where VCO is now a common food product that can be readily purchased from mainstream supermarket and chemists.

In the Pacific Islands, VCO has tended to be mainly available in speciality stores targeting tourists. In supermarkets and in stores catering for local consumers, the vegetable oil shelves have been largely dominated by imported vegetable oils (palm oil, soya bean, canola oils etc.). This is starting to change with VCO increasingly being seen on supermarket shelves however, VCO still faces a challenge in competing with imported vegetable oil in terms of price.

VCO retailing in a Manilla supermarket (photo: APCC)

Locally made VCO being sold in a Honiara supermarket (photo Andrew McGregor)

A move toward producing high grade edible copra oil for sale on domestic markets

Given the level of vegetable oil imports there is now a move toward producing high grade copra oil for the domestic market. In the past very little CNO was sold on the domestic market in the Pacific Islands. The CNO that was available was generally of poor quality and had an image as an inferior cooking and body oil product. This image was probably well justified given that most CNO being sold was made from inferior quality copra. However, CNO is a more than adequate edible product if it is cold pressed and made from clean, well-dried and stored copra with no smoke contamination. A CNO processing facility has a significant advantage over a VCO operation of comparable size in terms of production costs – it has a higher rate of recovery and requires significantly less labour. Thus, a processing operation, producing high grade CNO is in a position to offer edible oil as a price competitive substitute for imported vegetable oil.

High quality CNO can be produced in two scales of operation:

- **Relatively large scale**: Only requires investing in the necessary equipment to be incorporated into an existing CNO operation. This is the case of Savusavu -based Fiji Coconut Millers (FCM) Ltd (previously Copra Millers Fiji). In 2019 FCM installed a production line that could manufacture high grade CNO. A heavy duty steal hammer miller was imported together with a stainless steel coconut oil expeller from India. This line has the capacity to produce between 150 – 200 kg of CNO per hour

FCM's new processing equipment imported from India for the production of high quality CNO and the products produced for sale on the local market (photo: John Deo)

- **Small scale cold press operation:** Requires investing in an Indian technology – the Tinytech mill. The Guadalcanal-based Chottu Coconut Products (CCP) in the Solomon Islands is producing high quality CNO and copra meal entirely for the local market using this technology [6]. CCP purchases copra from surrounding small farmers and their output is sold wholesale locally. The operation is much more efficient than VCO production – with much higher throughput per day and lower labour input.

The owner of CCP, Jack Chottu, operating the Tinytech CNO mill (photo Andrew McGregor)

The three grades of CNO produced by CCP (photo Andrew McGregor)

- To produce food grade CNO it is absolutely necessary that the copra must be of the highest quality (well dried, clean and free of mould), and be processed using clean equipment. Meeting the copra quality standards will require farmers' investment in driers with steel pipes and a chimney rather than the used fuel drums.

The typical copra drier found throughout the Pacific Islands (photo Andrew McGregor)

A drier in Bougainville of the type required to produce the high quality copra necessary to produce food grade CNO (photo Andrew McGregor)

6 McGregor and Pelomo, 2018, The Solomon Islands Quality Copra Oil Value Chain for the Domestic Market: The Chottu Coconut Products Case Study. The Pacific Community/CIDP

3.3.2 Fresh coconut products

There are a number of significant markets for a range of fresh coconut eating or drinking products.

Drinking coconuts

Using young coconuts for their water is a major traditional use for coconuts in all the PICs. Selling young coconuts to urban markets and tourists has developed into an important micro enterprise industry in some countries, such as Samoa. As a result of the COVID pandemic, Fiji has seen a large growth in the number of people selling drinking coconuts (*bu*).

Selling bu on Suva Streets (photo Andrew McGregor)

Tonga, Samoa and to a lesser extent Fiji, have developed worthwhile exports of green drinking coconuts to New Zealand and Australia. For Tonga, green drinking coconuts represent by far the country's largest coconut product export. However, this fresh (in husk) drinking coconut market continues to be dominated by the Philippines and Thailand, but there is scope for the Pacific Islands to increase exports if the supply base is expanded through replanting.

By far the largest export market for coconut water is for the packaged ultra-heat treated (UHT) product. This product has emerged as the fastest growing coconut product market globally (USD 4 billion annually), - the largest supplier is the Philippines. The rapid growth in demand for coconut water has been driven by the recognition of the health benefits obtained with consuming coconut water, in particular, the sports drink market. It is notable that Australia is the third largest market for Philippine's coconut water with New Zealand being the sixth largest. PICs are not participating in this market and are unlikely to do so for the foreseeable future.

A selection of the wide range of coconut water now available on the market (Source: APCC 2017)

Why haven't the PICs participated in the large and expanding sports drink market?

There are a combination of three main reasons:

- Perishability of coconut water once it is removed from the coconut – thus the UHT facility must be located close to where the coconuts are planted;
- High capital investment required to preserve coconut water; and,
- Throughput requirements to make the large investment viable.

More recently a technology has been developed to compress coconut water under very high pressure. Through this process a three to five month shelf life is achievable. The capital cost is less than with previous technology and consequently smaller volumes are likely to achieve viability.

Green drinking coconuts, however, offer an immediate domestic market opportunity.

The two areas identified for expanding this market are school food programs and the tourist market

• **School food programs** – Drinking coconuts could be integrated into school programs in Pacific Island countries to promote a healthy alternative to sugary soft drinks. This has been done successfully in Samoa. Such a program is now part of the Tuvalu's market driven plan to rehabilitate the coconut industry

• **Tourist Market** - Making drinking coconuts an integral part of the visitor experience.

Coconut milk and cream

Coconut milk and cream are products with a rapidly growing demand, driven by an increasing appreciation of the health benefits from consuming these products. In particular, they are seen as alternative to dairy food and beverage products thereby addressing the increasing awareness of lactose intolerance amongst populations.

Samoa, amongst the Pacific Island countries, was an early pioneer in processing and exporting coconut cream. In 1997, Samoa exported nearly 1,500 tonnes of coconut cream to US, Australia and New Zealand. Since that time coconut cream exports have steadily fallen in the face of declining coconut supply, which increased unit processing costs. These increased costs made it difficult to compete with coconut cream from the Philippines despite the Samoan product being regarded of superior quality.

Samoan coconut cream (Source Samoan Poly Online Shopping Centre)

Coconut yoghurt produced by Coyo Australia (photo Andrew McGregor)

There are other products derived from coconut milk that have lesser scale constraints and can be efficiently made with small volumes. These are seen as probably offering the best niche market opportunity for PIC coconut products. Leading Pacific Island food processing expert, Dr Richard Beyer, identified coconut cream freeze and coconut yogurt as such products [7]. The micro states of Tuvalu and Kiribati already produce traditional coconut-based products such as red toddy syrup, coconut sugar and coconut jam all of which are derived directly from the coconut flowers. Such products offer significant niche export market opportunities for these small countries - particularly amongst their large and increasing diaspora in Australia and New Zealand. In these countries there is also a significant local market for coconut sugar as a substitute for the high level of imported sugar – which brings with it substantial health benefits to the community.

Fresh toddy juice being extracted from coconut flowers on Niutao atoll Tuvalu (photo Andrew McGregor)

Three grades of red toddy syrup produced on Tuvalu (photo Andrew McGregor)

7 McGregor with Sheehy, 2017, An overview of the market for Pacific Island coconut products and the ability of industries to respond. Pacific Community/Coconut Industry Development Project https://pacificfarmers.com/wp-content/uploads/2018/02/CIDP_Report_Final_e-copy_resized.pdf

3.4 The timber timber that can be obtained from the senile palms removed for replanting.

As previously discussed, the replanting of senile coconut palms offers an excellent climate change adaptation strategy. However, replanting will only be attractive to farmers, if they know that they will make money from the time and money they invest in the process. Using traditional tall varieties for replanting, it will take at least 5 years before any coconuts are produced. However, income can be earned if intercropping of short-term food crops becomes part of the coconut replanting program. The additional good news is that the timber that can be extracted from senile coconuts can provide an immediate source of income for the farmer.

From a timber quality perspective, the older the coconut palm, the better the quality of the timber. Senile, old palms (those over 60 years), have a higher percentage of the dense outer layer, and thus are more valuable.

Coconut timber has been used for a range of products, including posts, power poles, floor joists railings and furniture. In recent years technological developments have enabled high quality veneer to be efficiently extracted from coconut logs[8] at a time when native hardwood timber is becoming increasing scarce. It is expected that the harvesting of native hard forest timber will be prohibited by 2030 as part of the global response to climate change.

The soft centre of a coconut log cannot be used as timber. However, its value is now increasingly being recognized as an excellent raw material for producing compost and biochar charcoal to enhance soil fertility. This is a particularly important consideration for atoll countries with their infertile soils and lack of materials available for composting.

Fig 4 Procedures involved in the coconut timber value chain[9]

8 McGregor and Tawake, 2018, The Coco Veneer Value Chain: The Fiji Case Study http://opac.spc.int/cgi-bin/koha/opac-detail.pl?biblionumber=57255

9 McGregor and Tawake, 2018, The Coco Veneer Value Chain: The Fiji Case Study http://opac.spc.int/cgi-bin/koha/opac-detail.pl?biblionumber=57255

4 REPLANTING YOUR SENILE PALMS

4.1 What is a senile palm and why I need to replant?

Once coconut palms reach around 60 years of age, they become low yielding. The trunk becomes very brittle and so the palm is particularly vulnerable to breaking during cyclones, the intensity of which is expected increase with climate change (See Module 1). Once broken a coconut palm will no longer grow again and the palm dies. Thus, blocks of senile palms must be removed and replanted if a coconut plantation is to remain a viable and resilient enterprise that can take advantage of market opportunities.

Before replanting coconuts the land must be prepared. The extensive lateral root system resulting from coconut palms, planted for more than half a century, must be removed if you are going to successfully plant short-term crops between the rows of new coconut palms. Intercropping with short term crops, such as dalo, cassava, pineapple etc. is important to provide a source of income and food for the family before the replanted coconuts come into full production. As the lateral roots will have substantially reduced soil fertility over an extended period of time, the planting of a green manure cover crop, such as mucuna beans, is recommended to help to restore soil fertility.

Andrew McGregor, on a video made for Fiji 'Green Pillars' discusses replanting coconuts as a climate change adaption strategy here 

4.2 Replanting

4.2.1 What sort of seedling nuts should I plant?

There are three broad categories of coconut palms that can be used for replanting:

- The traditional tall varieties that evolved in the Pacific Islands.
- Dwarf varieties
- Hybrid varieties

Summary information on variety categories for replanting is provided below. More detailed information can be found on the SPC Coconut Industry Development Project (CIDP) blog[10].

Pacific Island tall varieties

Traditional tall varieties can grow to over 60 feet tall. They grow at a rate of around 50 cm annually and take 5-7 years from the time of planting before they starts bearing. They have an economic life of around 60-70 years, with an expected annual yield of 0.7 to 1.3 tonnes of copra per hectare. Once tall coconuts have their rooting system firmly established (at around six to seven years) they are highly cyclone resilient for the next five decades or so. The palms are flexible and bend in the face of a cyclone but usually don't break as they are well anchored to the ground by a widely extended root system.

10 See http:// replantcoconut.blogspot.com

A Fiji tall plantation on Vanua Levu and in cyclone (photo Andrew McGregor)

Dwarfs

Dwarf coconuts (Niu Leka) have a short thicker stem and wide leaflets. They come into production much quicker than tall varieties - flowering at 12 to 30 months after planting out in the field – but have a shorter economic life span of 30-40 years. They are particularly popular when the main products are fresh nuts for coconut water or coconut toddy (derived from the coconut flowers). Despite being significantly shorter than tall varieties the dwarf palms are less flexible and tend to be less cyclone resilient

Dwarf coconut palms planted around the house on the northern Tuvalu island of Niutao (photo Andrew McGregor)

Cutting coconut toddy in Tuvalu (photo Andrew McGregor)

Hybrids

Hybrid coconut palms are crosses between different coconut varieties that have been sourced from various locations around the world. The intention of coconut breeders is to capture the best characteristics of the parent varieties, such as: earliness of flowering, yield and nut quality. The recommended hybrid varieties can be expected to perform better than traditional tall varieties. However, they require a much higher level of management from the farmer – including the use of fertilizer and irrigation[11]. For this reason, the performance of hybrid coconuts in the Pacific Islands over the last few decades has been disappointing. Thus, for most farmers the replanting of traditional tall varieties remains the preferred option

Hybrid coconuts growing at the Mua research station on Taveuni (photo Andrew McGregor)

11 http://www.agritech.tnau.ac.in/expert_system/coconut/coconut/coconut_varieties.html

4.2.2 Where can I source my seedling nuts?

Wild sprouting coconuts (vara) should not be planted even though a large number are seen spread around the coconut growing areas. The nuts for planting must be sourced from a coconut seedling nursery, where some assurance of coconut type and quality can be given. In Fiji farmers can source their seedlings from the seven seedling nurseries managed either by the MoA or Fiji Coconut Products. The largest coconut seedling nursery is at the Mua Research Station on Taveuni.

The coconut seedling nursery at the Mua research station (photo MOA)

4.2.3 How many coconuts seedling will I need to replant one ha of coconuts?

Talls and tall hybrid crosses

For a hectare of talls you will need around 140 bearing palms and somewhat less for an agroforestry intercropping system. You can expect only around 80 per cent of the seedlings you first plant to germinate and you will need to replace at least 5 per cent of these during the first two years. Thus, you will need around 250 seed nuts to replant a hectare of talls or tall hybrid crosses. For more detailed information see the CIDP replant blog[12].

Dwarfs

Dwarf palms are usually planted somewhat closer together (around 180 palms/ha). The germination rate for dwarfs is lower for dwarfs than it is for tall (around 60%). Thus, you can expect to require around 280 seed nuts for every ha that is planted. For more detailed information see the CIDP replant blog.

12 http://replantcoconut.blogspot.com

4.2. 4 How should I remove the old palms and their extensive root system?

Removing the senile palms

Before replanting can begin, you must remove the old, senile palms. This will mean felling the senile palms and then digging out their extensive root systems. Old palms can also be injected with 50 ml of monosodium methylarsonate (MSMA) solution. Once the crown disappears the stems will remain upright and gradually rot. However, by using MSMA the opportunity to sell the senile palm as a coconut timber product is lost.

Specialized logging equipment is required if the senile palms are to be logged for their timber. Remember that the outside layer of an old coconut palm is very dense and a high-quality chain saw will be required. In Fiji the equipment needed for felling and logging would cost approximately FJD 3,600. With this equipment the senile palms can be felled and the logs cut for sale. The remnants of the palms should then be burned as they provide a fertile breeding ground for coconut rhinoceros beetle which is a particularly severe pest for coconuts as discussed below.

Newly planted coconuts intercropped with mucuna beans (Photo Mark Sheehy)

The most critical stages of coconut wood processing are from sawing to drying the boards. Coco timber's unique properties expose it to risk from: staining organisms after sawing; rapid moisture absorption when kiln dried; and, twisting during the drying process. Like many other conventional wood species, untreated freshly-cut lumber can be easily attacked by mould and staining fungi especially if the material is not properly stacked and is exposed to a humid environment during the air drying process. To minimize risks, logs should be transported to the processing site (be it for home/village or commercial use) within three days of felling.

Removing the extensive rooting system

The extensive wide spreading rooting system that these old palms have laid out over decades needs to be removed so that the fertility of the soil can be rehabilitated. The soil will then support the intercropping of short-term crops to generate income while the new coconut palms come into production. It will often be necessary to use machinery (bulldozers, backhoes etc.) to remove the extensive root system - using hand tools such as spades/forks etc. is ineffective and time consuming[13]

Restoring the fertility

The planting of green cover crops, such as mucuna beans or other leguminous species, can make a significant contribution to restoring soil fertility. The roots of mucuna beans are shallow with plenty of root nodules and can fix over 100kg nitrogen per ha per annum.

Quick establishment and coverage of the land in the first year of sowing is the attraction of mucuna beans. Seeds are small and the seed rate is 3 to 4.5 kg/ha.

13 http://replantcoconut.blogspot.com/2017/11/creation-of-new- coconut-plantation.html

Coconuts prefer alkaline soils. If you plant coconuts on acidic red soils, you must add ag-lime at the time of planting to achieve reasonable survival and growth.

Once your palm seedlings become established you should use leaf analysis to get an idea of the fertilizer needs of the new plantings into the future. Leaf analysis should be carried out annually to accurately determine fertilizer requirements in a well-managed coconut plantation, ideally at the beginning of the dry season. If you are in Fiji you should liaise with your local agriculture office to send your leaf sample to the Koronivia Research Station for testing.

Minimizing the spread of coconut rhinoceros beetles/seed weevils when removing my senile palms?

Coconut rhinoceros beetle (CRB) is currently the biggest pest risk to coconut production in the Pacific Islands[14] – particularly in the Solomon Islands. In removing your senile coconut palms, it is important that you don't encourage the spread of the beetle. Here are some points from the 'replant coconut blog' to remember to help minimize the spread of CRB[15].

- Do not move any coconut material or composting organic matter from CRB-affected areas. In the Solomon Islands it is likely that CRB spread from Guadalcanal to Malaita via movement of chicken manure (used to improve soil fertility in Malaita).
- Reduce the breeding habitat for adult beetles by breaking up coconut logs and stumps into small pieces which rot down quickly, burning woody debris and covering woody debris with gill netting.
- Regular inspection (every month) and removal of grubs from rotting trunks is also possible for areas were burning is either not feasible or allowed.

A number of agencies have been engaged in developing strategies for addressing CRB, including ACIAR [16] and New Zealand Aid[17]. Integrated Pest management is the recommended approach for controlling and preventing CRB infestation. You must act swiftly as invasion can be rapid, therefore the longer the delay, the greater the damage[18].

14 https://www.pacificislandtimes.com/post/rhino-beetle-infestation-a-growing-threat-to-pacific-islands-economies
15 http://replantcoconut. blogspot.com/2017/10/the-oryctes-and-scapanes-pests-of.html?zx=622a1003c4316bf4)
16 https://www.spc.int/updates/news/2017/09/aciar-pledges-aud-2-million-to-tackle-rhinoceros-beetle-threat
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4.2.5 How much replanting should I do annually?

It is better to phase your replanting program over a number of years to spread the workload and the risk from extreme climatic events. The first two years after replanting requires an intensive work effort. The undergrowth needs to be regularly cleared because coconuts are not competitive until they are on top of the undergrowth.

For the **first one to two years** the newly planted coconut palms can cope with severe winds. However, **for the next 5 or so years,** before they develop their strong and widely distributed root system, they are again vulnerable to severe winds as they can be blown over. **After about** 10 years the coconut's rooting system is firmly established and because of the palm's flexibility it will again be highly resilient to severe winds for the next five decades. Thus, to spread the work load and risk, the replanting program should be spread over, say, a 5-year period. Thus for a 5-ha plantation you would replant 1 ha per year.

4.2.6. A good drainage system needs to be in place before replanting.

Coconuts can't cope with continuous water logging. **Tidal action is OK – but water logging is not good.** How to build drains along the contours using the A frame system and how to use drop structures to improve drainage is discussed in detail in Module 4.

Planting techniques: traditional, classical and organic

The replanting program can commence once the land has been cleared of senile palms, their root systems removed and good drainage assured. You can plant your seedling nuts using traditional classical methods or incorporate more recently utilized organic methods. The main advice provided by the CIDP blog (http://replantcoconut.blogspot.com/2017/11/planting-technique.html) is summarized with the following dot points:

- It best to transplant your seedlings during the wet season
- Before you dig the planting holes for the seedling place two guide pegs at equal distance from the stake. This will show you the centre of the hole where the sprout of the seedling should be planted.
- The holes that you dig should be 50x50x50 cm in size. You need to start preparing your holes at least two months before bare-foot planting (planting field nursery seedlings without polybags). This planting should be done immediately or at the latest, three days after the seedlings are removed from the nursery. This will reduce the number of palms that die.
- Fertilizer mixed with soil should be applied to each hole before planting. For polybag seedlings, remove the polybag first before transplanting the seedling.
- The hole should be covered with loose topsoil, slightly firmed at the base of the crown.
- The top of the nut must be about 5-8 cm below the ground level. Deep planting might suffocate the bud while shallow planting might cause the planting material to bend, sway or lean during heavy rains and windy days. A slight depression towards the base of the crown must be provided to trap rainwater.

Organic methods of planting coconut seedlings use seaweed, coconut husks or any other organic materials, which are buried at the bottom of hole with the seedling nuts, and covered with soil leaving about one third free for the seedling nut to 'sit'. When using polybags two coconut husks should be added to the bag containing the seedling. The husks are rich in potassium and have the capacity to retain moisture.

4.2.7 Replanting your coconuts as part of agroforestry intercropping system

An important consideration is the replanting of your coconuts as an agroforestry system where other crops, such as dalo, cassava, pineapples and bananas, are intercropped between the rows of newly planted coconut palms. For many farmers this involves departing from a traditional coconut plantation mentality of letting coconuts takes care of themselves once planted/dumped on top of the land.

While a well-planned and implemented agroforestry system requires more effort and management it provides important benefits, including:

- **Increased and diversified farm income from the other crops that you grow.** It will be particularly important to generate income and food security while the newly planted palms reach an economic level of production (after 6 to 7 years).
- **Increased coconut production.** An increase in coconut production can be expected despite less coconut palms being planted in an agroforestry/intercropping system. This likely increase in coconut production is due to:
    - » Improved growth and yields of coconut palms due to the management of intercrops through weeding, the use of fertilizers (including agricultural lime) and the use of nitrogen fixing cover crops such as mucuna beans.
    - » Management of the intercrops makes it easier to find fallen coconuts thereby reducing the cost of having to remove wild germinated coconut seedlings (vara).
- **Improved microclimate provided by the coconut palms.** The canopy provided by the mature coconut palms improves the microclimate for the other crops by lowering the air temperature and increasing air relative humidity. This reduces evaporation from the soil and lowers crop transpiration rates maintaining a higher level of soil water availability for the intercrops.