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The Solomon Islands Quality Copra Oil Value Chain for the Domestic Market: The Chottu Coconut Products Case Study

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EUROPEAN UNION

CIDP
COCONUT INDUSTRY DEVELOPMENT FOR THE PACIFIC

PIFON

LRD
Land Resources Division

The Solomon Islands Quality Copra Oil Value Chain for the Domestic Market: The Chottu Coconut Products Case Study

Prepared by
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Pacific Community, Suva, Fiji, 2018

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Abbreviations and acronyms

APCC	Asian Pacific Coconut Community
AUD	Australian Dollar
CCP	Chottu Coconut Products
CEMA	Commodity Export Marketing Authority
CIDP	European Union-funded Coconut Industry Development for the Pacific Project
CNO	crude coconut oil from crushed copra
CTA	Technical Centre for Agricultural and Rural Cooperation
DFAT	Australian Department of Foreign Affairs and Trade
DME	direct micro expeller
FFA	free fatty acids
FJD	Fijian dollar
USP/IAS	University of the South Pacific Institute of Applied Science
PIC	Pacific Island countries
PIFON	Pacific Island Farmer Organization Network
$	Solomon Islands dollar (unless otherwise specified)
SME	small to medium enterprises
t	tonnes
VCO	virgin coconut oil
WB/RDP	World Bank/Rural Development Project
WHO	World Health Organization

Exchange rates

	USD	AUD	FJD
Solomon Islands dollar (SBD)*	0.13	0.16	0.26

*buying rates (as at 19/4/2018, according to the Central Bank of the Solomon Islands)
All currencies in this report are Solomon Islands dollar (SBD) unless otherwise specified.

Background to the value chain analysis

The process for identifying coconut value chains for detailed investigation

As part of the of the Pacific Community (SPC)/European Union (EU) Coconut Industry Development of the Pacific (CIDP) project, an overview study was conducted of the market for Pacific Island coconut products and the ability of the coconut products industry to respond. The Pacific Island Farmers Organization Network (PIFON) was commissioned to undertake the study, entitled 'An overview of the market for Pacific Island coconut products and the ability of industries to respond'.[1] The overview identified four priority coconut value chains for a detailed follow-up investigation. These were:

- virgin coconut oil (VCO) for the domestic market – the specific value chain case study selected was the Banaban VCO from (Rabi Island) in Fiji;
- small-scale, high quality copra oil for the domestic market – the specific value chain case study selected was Chottu Coconut Products (CCP) in Solomon Islands;
- coconut cream freeze/yogurt – the specific case study selected was the Samoa Coconut Cluster; and
- coconut timber veneer – the specific case study selected was the Valebasoga timber company in Labasa, Vanua Levu, Fiji.

The criteria used for selecting the priority value chains for detailed assessment included the following:

- The selected product should have strong market potential with an identified comparative advantage for Pacific Island countries (PICs).
- The value chain could be existing or emerging.
- The value chain should be inclusive of many smallholder farmers, including women and youth.
- The value chain should be replicable in multiple PICs.

The PIFON coconut product market study concluded that there needs to be more emphasis on domestic markets for edible coconut oil – be it VCO or food-grade coconut oil from crushed copra (CNO). The report notes that over the last decade VCO has transformed itself from a niche export product, which could readily command prices up to five times that of crude (not refined) coconut oil on global markets, to a commodity that secured a reasonable price premium, provided quality standards were met. These export price premiums are now often insufficient for meeting the additional cost of producing VCO by small enterprises in PICs. Thus, given that PICs are all large importers of vegetable oil, greater attention needs to be given to selling edible coconut oil on local markets – be it VCO or CNO.

The PIFON market study (2017:31) noted that:

'Fiji currently imports around 17,000 tonnes (t) of vegetable oil with a landed value of some FJD 20 million (Fiji Bureau of Statistics). If Fiji VCO

[1] McGregor A. and Sheehy M. 2017. Available at: https://lrd.spc.int/reportspublications/doc_download/2481-market-study

consumption reached 5% of total vegetable oil imports, this would represent a market of nearly 1,000 t, which is more than the total coconut oil exported in 2016.'

According to data supplied by the Solomon Islands National Statistical Office, in 2017 Solomon Islands imported 7,316 t of vegetable oil for a landed value of $57.5 million. This translates to around 12 kilograms (kg)/capita of imported vegetable oil compared with 19 kg/capita for Fiji. Thus, in both countries, there is a large unexploited edible oil domestic market available for edible coconut oil. VCO is generally regarded as superior in terms of taste. However, CNO is more than adequate as an 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, the CNO processing operation should be in a position to offer edible oil at a significantly lower price than a VCO operation. Per capita income in Solomon Islands is relatively low; thus, consumers can be expected to be particularly price conscious.

The Chottu Coconut Product (CCP) CNO value chain, located in western Guadalcanal, was chosen for the case study. It was seen as a particularly interesting value chain for investigation. The company uses a small-scale technology Indian-made oil mill for processing the copra, which is supplied by a network of surrounding small-holder farmers.

Small-scale, Indian-manufactured oil mills are not new to Solomon Islands. The Australian Aid agency's Solomon Island Small Holder Agriculture Study (vol 3, 2006:13), noted:

'A worthwhile innovation in the PIC coconut industries has been the introduction of Indian Tinytech cold press mills. If good-quality copra is used, then the oil quality is equivalent to that achieved with a DME [direct micro expeller]. Tropical Products operates this system at Ranadi, buying in copra. Smaller units are operated at Choiseul Bay and at Taalu on Malaita. The Malaita operation supplies Tropical Products with oil.'

The market study by McGregor and Sheehy (2017:31) highlighted that:

'The capital cost of Tinytech cold press mills are low. The mills are capable of handling around 600 kg of copra in a day. The oil extraction rate is somewhat lower than that of a conventionalcopra mill (around 52% oil). If high-quality copra is used with appropriate driers, the quality of the oil produced is equivalent to that derived from a VCO DME process in many of its uses. This copra oil could be used as a quality cooking oil for domestic markets - however, awareness campaigns and regulatory changes are required to significantly develop this market. Significantly, Tinytech mills use far less labour than DMEs (three people are required to produce around 300 litres of oil compared with six people to produce 45 litres from a VCO DME). Thus, the returns to effort can be higher, particularly in a lower price environment for VCO. Provided high quality copra is utilised, meeting oil quality standards is far less difficult than with a VCO DME mill. As with VCO DMEs, financial viability depends on achieving a reasonably high throughput. However, these mini copra mills can remain profitable at a significantly lower product price. A number of these mills were set up in Fiji as part of bio-fuel projects but are currently not being utilised.'

Similarly in Vanuatu, micro copra mills have been used to produce biofuel (leplus 2003). Thus, it is expected that a detailed value chain study for Chottu Coconut Products would be of interest to all PIC coconut industries.

The value chain methodology used for the Chottu Coconut Products case study

The CIDP value chain case studies follow the steps outlined in the PIFON value chain tool kit drawn from the Technical Centre for Agricultural and Rural Cooperation (CTA)-sponsored publication: 'Agricultural value chain guide for the Pacific Islands: Making value chain analysis a useful tool in the hands of farmers, trader and policy makers'.[2] This participatory approach used was in response to an assessment of the value chain support needs of African, Caribbean and Pacific (ACP) counties. The tool kit provides a practical resource on how to analyze and upgrade value chains. It has been deliberately adapted to the needs of participants in PIC value chains, as explained by the PIFON Manager at the Nadi Pacific Coconut Sector Value Chain Workshop in July 2017.

'The PIFON Value Chain (VC) analysis toolkit was written, so that VC could be understood and taught by anyone including its member farmers who came to hear of it and it wasn't something that was 'in the clouds' that people could not grasp or understand. Simple steps were developed to make the toolkit for value chain analysis easy to understand. Value Chain Analysis is a simple and systematic way of evaluating an existing chain and assessing if a chain is viable and what is required to improve it. The traditional agricultural extension model is that the technology is taken directly to the farmers but with PIFON's emerging agricultural extension model, the technology is taught to farmer organizations who then transfer that to their farmer members, thus allowing more to be taught and to be reached. VC analysis allows anyone to do VC awareness to provide some information to address the misinformation/ misconception and allow people to see where the weak links are along the chain so the focus is on those whilst capitalizing on strengths and what is required to improve the chain for the benefit of all the participants. This VC analysis is not only for the participants in the chain (farmers, processors, marketers and consumers) but also for policy-makers and funding agencies.'

The participatory value chain approach has six steps:

- **Step 1:** Drawing the value chain map
- **Step 2:** Putting facts and figures onto the map
- **Step 3:** Identifying what each actor contributes to the final product and the returns they receive
- **Step 4:** Assessing the market
- **Step 5:** Assessing strengths and weaknesses along the chain and identifying actions required
- **Step 6:** Developing a plan to improve the value chain

[2] Available at: https://publications.cta.int/media/publications/downloads/1837_PDF.pdf

Conducting the CCP value chain analysis

The facilitators of the CCP value chain analysis were Andrew McGregor and Moses Pelomo. Andrew McGregor is the co-author the PIFON Agricultural Value Chain Guide, while Moses Pelomo is the Chair of the Solomon Islands Kastom Gaden Association (KGA), which is a founding member of PIFON.

The participatory value chain mapping and data collection exercise was held at the CCP premises on 28 February 2018, and was followed by on-farm visits and meetings with wholesalers and other value chain actors. Moses Pelomo subsequently made follow-up visits to the actors to collect additional information and to verify data.

Twelve coconut farmers/copra makers and the CCP management team participated in the value chain mapping and data collection excise. It was notable that approximately half of the participants were women, reflecting the traditional matrilineal land ownership structure of the area. The strong female involvement in the CCP value chain network has been reinforced by Sophia Chottu (CCP Marketing Manager) through the Catholic Woman's Association.

Figure 1: Farmer and copra processor participants in Chottu Coconut Products value chain analysis meeting (credit Andrew McGregor).

Figure 2: Chottu Coconut Products value chain analysis meeting facilitator, Moses Pelomo (credit Andrew McGregor).

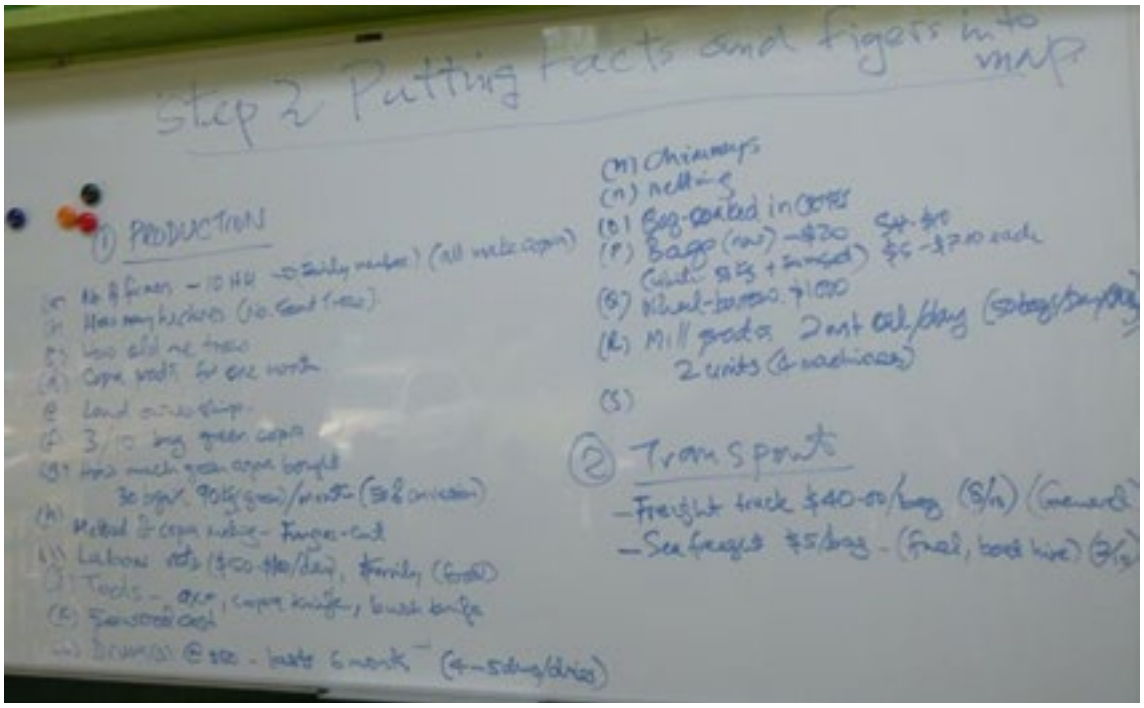
Figure 3: Chottu Coconut Products value chain analysis participants. (credit Andrew McGregor).

Step 1
Drawing the value chain map

MAIN ACTORS	SUPPORTING ACTORS
Farmers (producing wet copra) ↓ **Copra producers** (producing dried copra) ↓ **Copra oil producers** ↓ **Local wholesalers** (in the future exporters?) ↓ **Local retailers** (in the future export market retailers?) ↓ **Consumers** – local and, in the future, overseas consumers	• Agro-supply services (copra bags, drums and pipes, drier nets) • Transporters of copra to oil producers • Mill equipment and spare part suppliers (Tinytech mill agent) • Food quality drum and bottle suppliers • Transporters of oil to wholesalers • Quality testing services (Commodity Export Marketing Authority, USP/Institute of Applied Science) • Ingredient suppliers for skin products • Bottle and label suppliers • Transporter of oil to the retailers <u>For the future ?</u> Transporters of the oil to export markets Biosecurity (Solomon Islands Quarantine) and food safety certifiers HACCP (hazard analysis and critical control points)

Step 2
Putting facts and figures onto the map

Coconut farmers and copra makers



Number, location and land ownership

- Ten households and groups of households grow coconuts and make copra that is sold to CCP. These farmers form the CCP network, which meets on a monthly basis. Some of the copra makers also buy green copra from outside the group. There is a strong linkage between CCP and their copra suppliers through their church network.
- CCP also has its own copra plantation.
- All of the farmers have planted coconuts on their traditional land in western Guadalcanal (Fig. 4). The villages include: Naro, Reilonga, Vatusi, Marasa, Ngautu, Veruru, Ngalikasiu and Tarou. Most of the copra suppliers have good road access to CCP. One group, however, is located on the Weather Coast and must transport their copra by boat.

Figure 4: The Chottu Coconut Products (CCP) copra catchment area in western Guadalcanal, and the location of copra farmers (hand written) supplying the CCP facility at Pisei (credit Moses Pelomo).

- Coconut plantings range in size from 5 to 25 hectares (ha, with an average planting density of 160 palms/ha). Palms range in age from 30 to 50 years, with most planted in the late 1970s and early 1980s when a sizeable planting subsidy was paid.
- Maintenance of the plantations ranges from reasonable to poor. The coconuts that are intercropped with cocoa and betel nut tend to be better maintained, due to more efficient use of labour in weeding and cleaning.

Figure 5: Mono-cropped coconuts at Lucy Tuqale's farm in Ngaru Village (credit Andrew McGregor).

Figure 6 : Coconuts intercropped with betel nut at Albert Haikalea's farm in Ngautu Village (credit Andrew McGregor).

- The total annual copra production from the farms ranges from around 5–25 t, with the total annual copra production from the group estimated at approximately 140–150 t.
- Both household and hired labour is used to make copra. Hired labour is usually paid $50/day but can be as high as $100/day. Hiring labour is only done when making copra and is the main production cost. Household labour is not paid directly; rather they receive food, tobacco and betel nut and share in the final returns from selling the copra. Before the 2000 'ethnic tensions', labour was sourced from Malaita and were said to be plentiful and productive. There is now a significant labour supply shortage, which is a major constraint to copra production.

- Apart from hired labour, the main production costs currently incurred are the purchase of copra bags (new cost is $30 each; second hand bags $10) and the replacement of used drums for the driers ($50 each, which need to be replaced every six months. Copra drying wire netting needs to be replaced every few years (cost is around $500). Axes, copra knives and bush knives are also required (annual replacement cost is estimated at $500). A number of farmers identified the need for a robust wheel barrow to increase labour efficiency (estimated cost is $1,000 each, with an expected life of three years).
- CCP's current copra buying price is $4/kg farm gate (CCP collects the copra). The buying price in Honiara is $3.50/kg, with farmers having to pay cartage ($50/85-kg bag). However, at times, CCP is not able to buy the copra that is available due to cash flow constraints. Farmers who are in need of immediate cash then tend to sell their copra in Honiara at a lower price.
- The standard of the copra driers used was generally similar to those found throughout Solomon Islands (see Fig. 7). These are usually below the standard needed to produce good-quality edible copra oil. Some of the short-comings observed were:
    - **Leaking drums, resulting in smoke contamination.** The fuel drums are often not replaced within the required six months. To produce the quality of copra required there is a need to replace used fuel drums with welded steel pipes, with a chimney (Fig. 8 and discussed in Annex 2). The welded steel drums manufactured in Honiara come in two lengths: 4 x 200 L drums (16 ft.) at $16,400; and 3 x 200-L drums (12 ft) at $11,800. Larger copra-producing operations will need the 16' welded steel drums although they could start with a smaller (12') welded steel pipe and process copra more frequently. Further improvements in quality and efficiency could be achieved with a combination of solar and steel-piped wood drier (Fig. 9 and discussed in Annex 2).

Figure 7: The type of drier commonly used by Chottu Coconut Product suppliers (credit Andrew McGregor).

Figure 8: Steel pipes with chimneys available in Honiara (credit Andrew McGregor).

Figure 9: A combination solar and steel pipe drier found in Bougainville (credit Andrew McGregor).

- **Poor containment of heat in drier.** This has resulted in higher-than-desirable moisture rates and lower efficiency. There is a need to have copra bags soaked in concrete around the sides to help retain the heat.
- **Copra is cut into finger-cut pieces for drying.** This is the normal practice on Guadalcanal and Malaita (Fig 9), rather than halves for drying, which is the standard practice in Western Province (Fig. 10). Halved copra pieces result in more efficient and better drying due to better hot air flow. However, it requires more labour input.

Figure 10: Finger-cut copra. Smaller pieces tend to prevent air from flowing evenly through the copra. This creates drying problems when the volume is large and the depth of the layer of copra is high (credit Moses Pelomo).

Figure 11: Halved copra pieces allows for more space between the kernels, which means results in hot air flowing evenly through the copra (credit Moses Pelomo).

This is because the half-cup allows more space in between the kernels for hot air to flow through while with the smaller finger-cut method, the smaller pieces tend to block air going through. Instead the hot air flows under and out from the sides. This is a problem when the volume is large and the depth of the layer of copra is high.

Annex 2, prepared by Moses Pelomo, provides a detailed discussion of copra quality in the Solomon Islands and the requirements for its improvement to produce quality edible coconut oil for the domestic market.

Summary profiles of selected coconut farmers and copra makers

To obtain more detailed information, site visits were made to four CCP copra makers. These were: Lucy Tuqale (Ngaru Village), Albert Haikalea (Ngautu Village), Peter Kope (Ngalikasiu Village) and John Rava (Tarou Village). Summary profiles of these four coconut farmers and their copra operations are presented below.

Lucy Tuqale (Ngaru Village, west Guadalcanal)

Figure 12: Lucy Tuqale's family home (credit Andrew McGregor).

Figure 13: Lucy's best performing coconut block (block 3) (credit Andrew McGregor).

Figure 14: Lucy Tuqale with Sophia Chottu (CCP Marketing Manager) and the study team (credit Andrew McGregor).

HOUSEHOLD BACKGROUND

Lucy is a widow with eight children (four boys and four girls). The household includes two other adults. Her husband worked for a construction company and built a substantial family home in the village. Children are now all married, with one son working on the farm with Lucy.

PLANTATION AND DRIER

There are three coconut plots:

BLOCK A (planted in 1978) is 15 ha and is furthest from village (about 1.5 km) and is where drier is located. The plantation is poorly maintained, with coconuts rarely sourced from it.

BLOCK B (planted in the mid-1980s) is 8 ha. Needs weeding, with coconuts occasionally sourced from it.

BLOCK C (planted in the mid-1980s) is 2 ha and is the plot closest to the village and in reasonably good condition. Most of the coconuts to make copra are sourced from this block

A rough tractor road serves the three plantations.

The drier needs improvements and to be enlarged if quality copra is to be produced.

- Some drums leaking and need to be replaced.
- Drier needs to be lined with copra bags soaked in cement to retain heat.

Firewood hard to collect. Need to plant firewood plot close to drier.

COPRA PRODUCTION AND COSTS

COPRA PRODUCTION

Copra is made approx. every 2 weeks. Each batch is an average of 10 bags (85 kg/copra bag). Around 23 t of copra are produced per year. Production is low due to:

- Low yield from poorly maintained plantations.
- Labour shortage. Before the 2000 ethnic tensions, there was an ample supply of hard-working labour from Malaita. There are prospects of this being restored by intermarriage.

LABOUR INPUTS AND COSTS

Operating costs are almost entirely for labour to harvest coconuts and making copra. Hired labour is used for maintenance.
It takes around four days to make copra (collecting coconuts, one day; copra cutting, one day; and drying two days).

Five people are involved in making copra: two are hired labour and three are from the household. Hired labour is paid $50/day (plus food). Family members receive food, tobacco and betel nut, and share earnings.

NON-LABOUR PURCHASED INPUTS INCLUDE:

Copra bags (new $30 each; second hand $10 each)

Fuel drums for drier (four drums need to be replaced every six months @ $50/each)

Copra knives, axes, etc. ($400/year)
Needs to invest in a wheel barrow ($1,000)

MAJOR CONSTRAINTS IDENTIFIED:

- Labour shortage was identified as a major constraint. Lucy still wants to engage workers from Malaita if she can. One of her sons has just married a woman from Kwoio Malaita. This may allow some of her relatives to come and work the plantation and bring the plantation back to its production potential (a three-fold increase is seen as feasible).
- Copra drier needs substantial upgrading.

MARKETS AND MARKETING

Lucy sells to CCP and sometimes to Honiara.
Selling price (Feb 2018)

- CCP $4/kg farm gate
- Honiara buyer $3.50–3.80/kg delivered

MARKETING COSTS

Freight is $30/bag to CCP (CCP collects at the village), $50/bag to Tanagi on the outskirts of Honiara. Ngaru village is accessible by a good road that links to Honiara. The bus fare to Honiara is $30/person and to CCP is $15/person. Lucy sells to Honiara only when CCP cash flow is low and she needs immediate cash.

Albert Haikalea (Ngautu Village, west Guadalcanal)

Figure 15: Albert Haikalea (left) with his well-maintained block of coconuts intercropped with cocoa (credit Andrew McGregor).

Figure 16: Albert's coconuts intercropped with betel nut (credit Andrew McGregor).

Figure 17: Albert's drier is used for both copra and cocoa (credit Andrew McGregor).

HOUSEHOLD BACKGROUND	PLANTATION AND DRIER	COPRA PRODUCTION AND COSTS	MARKETS AND MARKETING
Household of 12: 8 children (3 girls and 5 boys) plus 2 adopted. 6 children at home, 1 daughter in Samoa (training to be a nun), 1 married and on Savo Island. 1 in form 1 and 1 pre-school The extended family also includes 2 sisters and 2 brothers with 4 children. This extended family works together on copra, cocoa production and now increasingly, betel nut.	Has four plots of coconuts, each with ~200 palms each (5 ha). • One plot planted in 1970 and two other plots planted in 1986,encouraged by the substantial coconut planting subsidy. • One plot may have been planted in early 2000s. Significant intercropping with cocoa and more recently, betel nut palms. The coconut plots are well-maintained and the palms are bearing well. Intercropping has provided for more efficient use of labour, particularly for weeding. There is a good supply of household labour. Drier is located close to the main road. Currently, cocoa and copra are dried on the same drier, which is not recommended. Drier needs improvement similar to that described for Luci Tuqale.	Production is 8–10 bags (85 kg/bag) per batch. Approx. 18 t of copra are produced per year from 5 ha. This is a significantly higher yield than from Lucy Tuqale's farm, and is explained by better maintenance and greater labour supply. A batch takes 4 days to produce: • collection coconuts takes 1 day and requires 3 people); • making copra (cutting copra for drying) takes 3 days and requires 4 people. Mostly household labour is used. Hired labour is paid $50/day. Family labour receives meals, tobacco and betel nut, and shares in copra proceeds **MAJOR CONSTRAINTS IDENTIFIED** Copra drier needs upgrading and should not be used to dry cocoa.	Sold copra to Honiara recently to an exporter at $3.80/kg. Freight to Honiara is $45/bag. He sells to Honiara when CCP has working capital problems and the household needs immediate cash. He receives $4/kg from CCP and buys at farm gate (saves $0.54/kg when he is able to sell to CCP).

Peter Kope (Ngalikasiu Village, Doma)

Figure 18: Peter Kope's driers are in poor condition and need to be upgraded if quality copra is to be produced (credit Moses Pelomo).

HOUSEHOLD BACKGROUND	PLANTATION AND DRIER	COPRA PRODUCTION AND COSTS	MARKETS AND MARKETING
Located 10 minutes (by vehicle) from CCP. There are 5 members of his immediate family, plus 25 relatives (2 families)	Located at the back of the Doma plantation (100 ha of which was offered to the University of the South Pacific to establish its fourth campus in Solomon Islands. Has 1,500 coconut palms, of which 500 have already been attacked by rhinoceros beetle. The giant African snail thrives in the area. The palms are mainly hybrid (Malaysian Dward x Rennell Tall), which seem to be more susceptible to rhinoceros beetle. The plantation is intercropped with cocoa so is relatively clean. Palms are 40–50 years old. The copra drier is in poor condition and is temporary in nature. Needs to be replaced if quality is to be improved.	Processes 2,000–4,000 coconuts per month, which equals about 5–10 bags of copra/month or around 9 t of copra per year (thus, productivity is low). Also purchases green copra from other farmers and sells green and dry coconuts at the market. Coconuts are also used as pig feed. **LABOUR REQUIREMENTS FOR COPRA PRODUCTION:** Usually involves 10 people: • collecting coconuts takes 1–2 days • cutting takes 1 day • drying takes 2 days and 1 night Labour charges range from $50 to $100 per day. Family uses 40 coconuts/ month for cooking, and 100 coconuts/month to feed pigs.	Sells a range of coconut products: • copra to CCP for $4/kg at farm gate • Copra to Honiara, $3.50/kg (freight $40/85-kg bag) • dry nuts to market @ $1– 3/coconut • germinated nuts @ $1/coconut • drinking nuts @ $5coconut Buys green copra @ $1.40 to $1.50/kg. Does not produce coconut oil for sale.

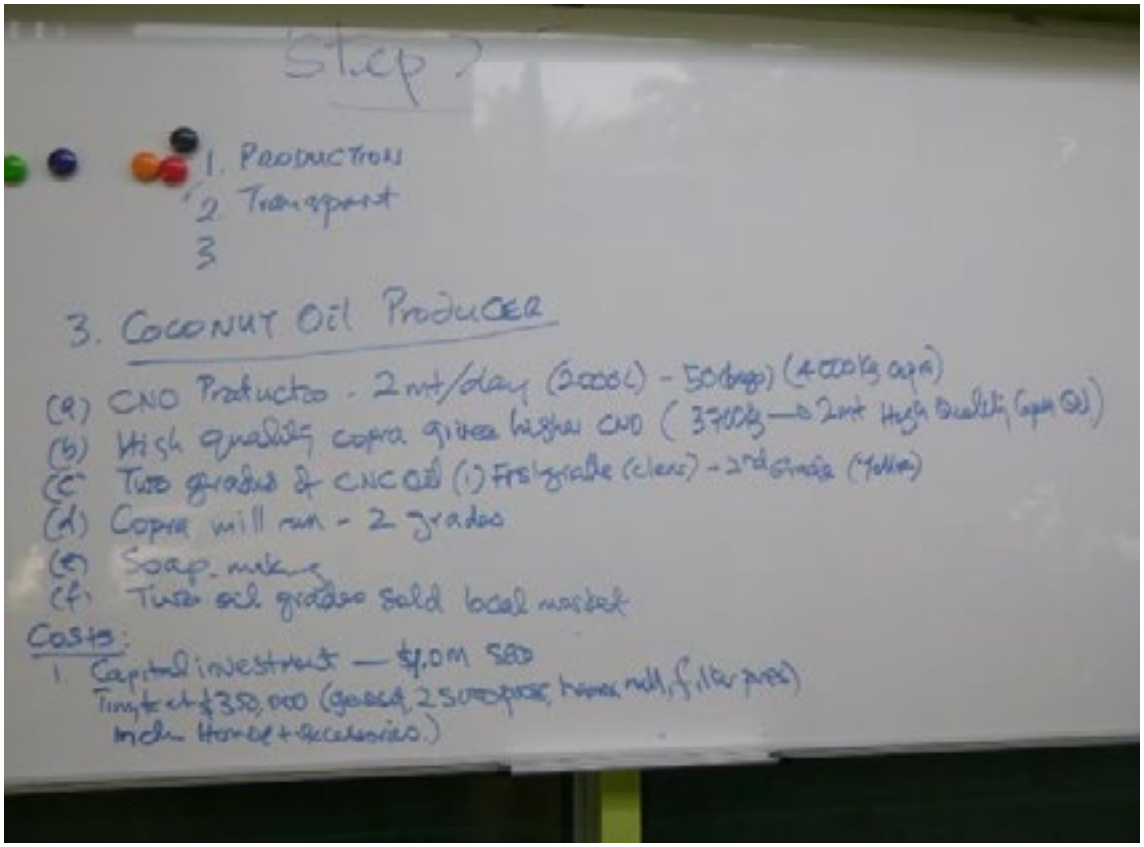
John Rava (Tarou Village, Doma)

Figure 19: John Rava's drier is in good condition (credit Moses Pelomo).

Figure 20: A productive block of coconuts intercropped with cocoa (credit Moses Pelomo).

HOUSEHOLD BACKGROUND	PLANTATION AND DRIER	COPRA PRODUCTION AND COSTS	MARKETS AND MARKETING
Located 20 minutes from Chottu Coconut Products. John Rava represents a community of 7 households, with a population of 40. These households work closely together in producing copra and cocoa.	This is a relatively large coconut plantation, totaling about 20 ha. The palms are 40–50 years old and are high bearing. Most plantations are intercropped with cocoa. Plantation is well maintained. Two households (Cornelia and Jackson) are used as model cocoa plantations in the area. Have a communal drier with three lined firing kilns, but which needs repairs made. One individual copra drier (Jackson) is in better condition but still needs improvement. There is also a kava nursery, with most plants planted out already. No sign of rhinoceros beetle but the plantation is heavily infested with giant African snail. Has a solar drier for cocoa. A similar type of drier could be built for copra. The coconut plantations of this community are in excellent condition because they are interplanted with cocoa, which is their key cash crop.	Copra making involves household members, with hired labour rarely used. More than 2,000 coconuts are processed monthly (producing around 5 t of copra per year). Each family takes turns on the community drier in which two families at a time can dry their copra. Copra processing (5 bags): collection takes 3 days for 2 persons; cutting takes 2 days for 6 people; drying takes 3–4 days, including 3 nights of firing. Processing cycle for family plots is every 3 weeks. A wheel barrow was requested as the most important piece of equipment needed to enhance productivity.	Sells copra to CCP @ $4/kg with free transport. Sometimes sells to Honiara. Freight to Honiara is $40/bag.

The coconut oil processor: Chottu Coconut Products



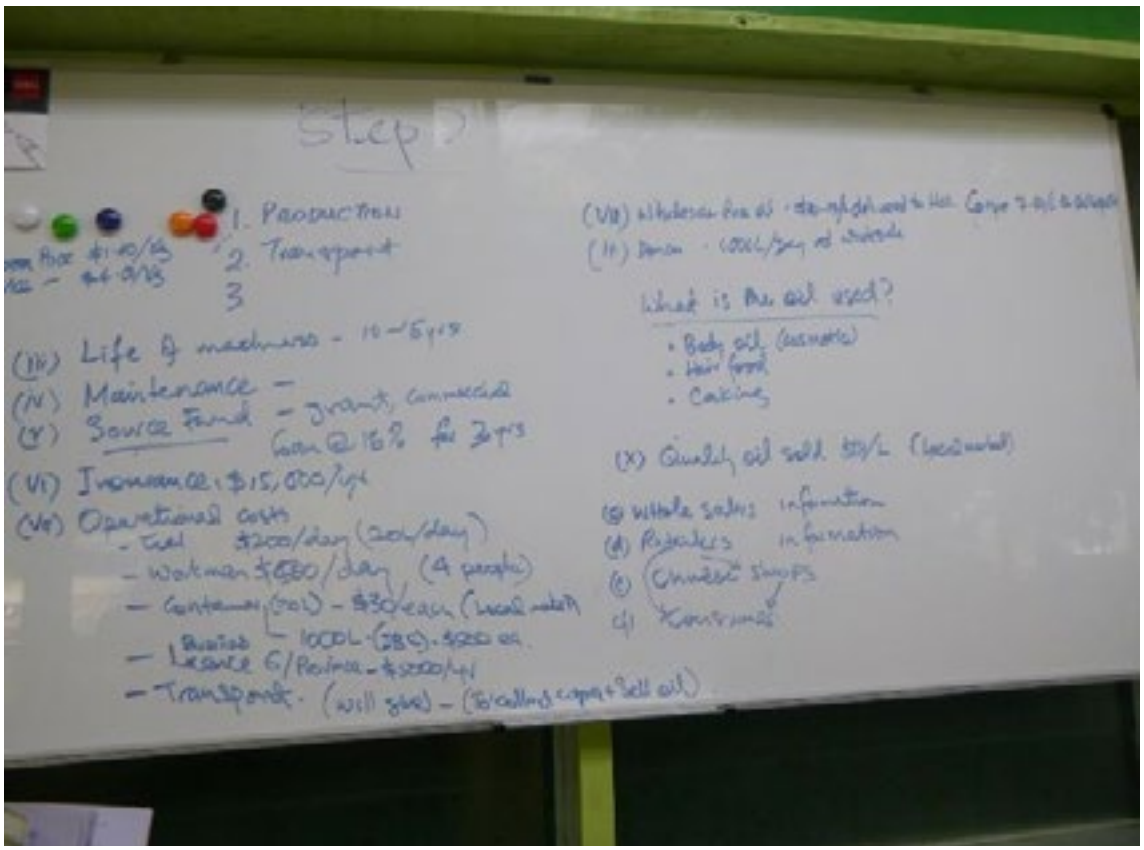


Figure 21: Inside CCP's Tinytech copra oil processing facility (credit Andrew McGregor).

Figure 22: Dried copra awaits processing through the CCP's Tinytech oil mill (credit Andrew McGregor).

Figure 23: CCP's filter press (credit Andrew McGregor).

Figure 24: Jack Chottu checks the oil quality extruded from the filter press (credit Andrew McGregor).

CCP's Tinytech oil mill

In 2017, CCP invested in an Indian-made Tinytech mini cold press oil mill unit (a genset with two oil presses, a hammermill, and filterpress). Tinytech copra mills were first introduced to Solomon Islands more than a decade ago. The mills are supplied by Solomon Tropical Products Ltd, which has been the sole supplier of these mills to Solomon Islands since their introduction. Ten mini Tinytech mills have been sold throughout the Solomon Islands. However, CCP's Tinytech mill has been one of the few that was able to operate satisfactorily for an extended period. Thus, more overall technical support is needed if these mills are to have a greater overall impact.

CCP's Tinytech unit complements the SK Goya processing unit (another brand of Indian mini cold press oil mill), which CCP had been using for several years. Both mills have a combined capacity to produce 2,200 ltres (2,400 kg)[3] of CNO per day from 4,000 kg of copra (equal to 50 bags of copra). All of CCP's coconut products (CNO, soap and copra meal for livestock) are sold on the local market. The main wholesale buyer reports that CCP's CNO is well regarded by Honiara Market consumers.

CCP produces three grades of CNO based on visual apperance (see Figs. 24 and 25). While this subjective visual measure is indicative of quality it is far from conclusive.

Figure 25: Chottu Coconut Products immediately after producing grade 1 coconut oil on the right and grade 3 on the left (credit Andrew McGregor).

Figure 26: Chottu Coconut Products Oil after bottling: Grade 1 (left), Grade 2 (centre) and Grade 3 (right) (credit Moses Pelomo).

[3] An approximate specific gravity of 0.925.

The standard objective measures of oil quality – free fatty acid (FFA) and unsaponifiable matter levels – are required to measure impurity levels and the level and rate of rancity expected after heating. Specifically:

- the FFA content is a measure of the extent to which fatty acids have become separated from the triglycerides, and indicates the damage that has occurred during the extraction process; and
- unsaponifiable matter gives a measure of the non-oil content and is, thus, a guide as to the contaminants present in the oil.

Quality analysis of oil samples provided by CCP

Quality testing was undertaken by food scientist Dr Richard Beyer on three CNO samples provided by CCP. These samples had been desigated as grade 1 by CCP. Dr Beyer's full report is provided in Annex 1.

Dr Beyer reports that the oil has intrinsic discolouration (approximately 4/10 on a subjective scale). It has a slight odour of coconuts, which can be described as slightly sour coconut oil (approximately 5/10 on a subjective scale).
The samples were taken to the University of the South Pacific, Institute of Applied Sciences (IAS) Analytical Laboratory to obtain their FFA and unsaponifiable matter content. The USP/IAS results are presented below and analysed in detail by Richard Beyer in Annex 1.

The average results from the three samples were:

- FFA as lauric acid 2.2 g/100 g
- FFA as oleic acid 3.1 g/100g
- unsaponifiable matter or residue 0.2 g/100 g

The FFA content was found to be somewhat high, which indicates that the fatty acids have been seperated from the glycerol molecule. High FFA levels will eventually impinge on the taste characteristics of the oil after repeated use. FFAs are often removed from triglycerides during high temperature treatments of copra or at some stage during processing or even from the oil after extraction. It is often catalyzed (accelerated) by impurities; therefore,it is important to establish at what stage this contamination is occurring.

The expectation is that the quality of the copra is the major contributing factor to the laboratory results obtained. Clean well-dried copra (moisture not exceeding 7%) is a necessary condition for good quality edible CNO.

The unsaponifiable matter reading was within the standard of the Asian and Pacific Coconut Community (APCC) but it does indicate that the impurities are on the high side. It is desirable to reduce this if possible once the source and nature of the impurities are know. It is important to establish objectively the factors that are contributing to these impurities.

Both FFA and unsaponifiable matter can be removed after extraction, and this is common practice in large commercial vegetable oil producers (refiners) so that frying oils have a high purity value and can safely be reused. However, for small-scale operators, such as CCP, there are a number of simple 'cleaning' techniques that are less expensive but can achieve significant positive effects on oil quality. It is recommended that technical assistance be provided to CCP, under the CIDP, for the adoption of these practices.

Capital investment in the processing facility

The total capital investment in the CCP processing facility was approximately $1 million, and includes buildings, milling equipment and a truck. The cost of the Tinytech equipment was $350,000, which was funded by a combination of a grant and a commercial loan at 16% rate of interest, repayable over three years.

Copra supply and CNO output

Copra is supplied by:

- The CCP nucleus plantation, which supplies approximately 30 bags or 2.5 t/month (about 30 t/year).
- The farmer and copra makers that are part of the CCP network. This farmer network currently produces around 150 t annually, of which about 100 t is sold to CCP. Some of this copra is sold to buyers in Honiara at times when CCP does not have the liquidity to purchase copra and the farmers need immediate cash. The network can be expected to sell all of its copra to CCP, provided the company has the liquidity to buy their copra as soon as it is available. It is estimated that the CCP farmer network could supply up to 300 t of copra annually from its existing coconut plantings, provided that:
    - the necessary investment was made in plantation rehabilitation and in labour productivity improvements;
    - sufficient labour is available to harvest and process all of the coconuts; and
    - CCP always had sufficient working capital available to purchase copra from the network as soon as it is available.
- Surrounding farmers who sell wet copra to CCP. Approximately 2,000 kg of wet copra are produced per month, which results in around 700 kg of copra, or 10 t/year.

The total copra processed annually is estimated to be around 150 t/year, with 150 t of copra producing around 77 t of CNO.

CCP's current capacity for copra is 4,800 kg/day, which produces around 2,640 L of CNO and 1,650 kg of copra meal. The 150 t of copra could be processed in less than 40 days if the plant operates at full capacity. Thus, CCP has considerable capacity available to expand the market.

Market and marketing CCP CNO

- Wholesale CN0 is sold in 30-L containers to Honiara-based buyers (the cost of each container is $30). The oil is mainly used as body and hair oil, with a small amount sold for cooking. Wholesalers are mainly based in the Honiara Market. Sophia Chottu is responsible for CCP marketing. The Catholic Women's Association has proven to be an important network for marketing. Wholesalers report that the colour and smell of CCP CNO is superior to other sources.
- CCP currently sells an average of 1,500 L of CNO per week at $14/L delivered (a weekly gross revenue of $21,000, and an annual gross revenue of around $ 1.1 million). This could readily be increased to 2,000 L/week if there were no cash flow constraints to the timely purchase of copra. It is noted that the quantity that can be purchased by the wholesalers in any particular week is also limited by liquidity constraints. Total gross revenue also includes the sale of copra meal (currently $2/kg). CCP is prepared to sell CNO at a bulk price of $13/L as sales increase.

Cost of copra

From the CCP network the purchase price or copra is $4/kg plus an estimated $0.30/kg for transport (or $4,300/t of copra purchased). Thus:

- CCP is currently spending around $645,000 annually on the purchase of 150 t copra from its network. The cost of CCP's own copra is imputed at the network's buying price of $4/kg (the total imputed cost is $120,000/year). Thus, the current total annual cost of copra for CCP is estimated at $765,000.
- If CCP were able to purchase all of the estimated copra the network was selling (i.e. 200 t), the cost would be approximately $860,000 annually, plus the imputed cost of CCP's own copra.
- If CCP purchased all of the copra that the network currently has the capacity to produce (i.e. an estimated capacity to produce 300 t/year), the annual cost would be $1.3 million.

Processing variable costs

The operating cost to process 4,800 kg of copra to produce 2,400 L of CNO and 1,560 kg of meal (the maximum daily capacity) is approximately $1,405 ($0.30/kg for CNO). The breakdown of the main costs is as follows:

- 45 L of diesel for the generators = $405
- wages for four people = $500
- Repair and maintenance = $500

Marketing and transport costs

- 30-L containers for CNO = 73 @ $30 each = $2,200
- bags for copra meal = 30 bags @ $7/bag = $210

CPP uses its own transport for the collection of copra and the delivery of CNO to wholesalers. The transport operating cost associated with processing 4,800 kg of copra to produce and market 2,400 L of CNO and 1,560 kg of meal is estimated to be around $1,600 (i.e. fuel, wages, repair and maintenance, wheel tax).

The estimated gross margin from a full day of operation at full capacity

The total gross revenue is estimated to be $37,000 and the total operating cost at around $25,000, yielding a gross margin of about $12,000, of which the owners need to be rewarded for management and supervision. In addition, the processing business has substantial overhead (fixed) costs (listed in Table 1 below) that need to be taken into account.

Table 1: Gross margin from processing 4,800 kg of copra to produce 2,400 L of CNO and 1,650 kg of copra meal.

GROSS REVENUE	
CNO sales@ $14/L	33,600
Copra meal sales @ $2/kg	3,300
Sub total	**36,900**
OPERATING COSTS	
COST OF COPRA	
buying of copra $4/kg@ farm gate	19,200
PROCESSING COST	
fuel for generators	405
Wages for 4 people	500
Provision for repair and maintenance	500
Sub total	**1,405**
MARKETING COST	
30-L bottles for CNO @$30/each	2,200
Bags for copra meal @$7/each	210
Sub total	**2,410**
VECHICLE COSTS (BOTH FOR COLLECTION OF COPRA AND DELIVERY OF CNO)	
Fuel	400
Repair/R&M/wheel tax	1,600
Sub-total	**2,000**
Total operating cost	**25,015**
Gross margin	**11,885**

Overhead (fixed) costs

- Interest (16%) on loan acquired to purchase Tinytech mill
- Insurance at $15,000/year – first installment paid in advance to secure commercial loan
- Business license at $5,000/year
- Depreciation on processing machinery (expected life of 10–15 years). Minimum annual allowance on a $350,000 Tinytech machine is $25,0000

These overhead costs need to be paid regardless of throughput. Thus, longer term viability will depend on increasing throughput.

Identified constraints

- Insufficient throughput to minimise costs and to fully develop market opportunities;
- Insufficient liquidity to buy all the copra available from the CCP network; and
- Quality of copra supplied often not up to the standard required to produce quality edible copra oil.

Wholesalers

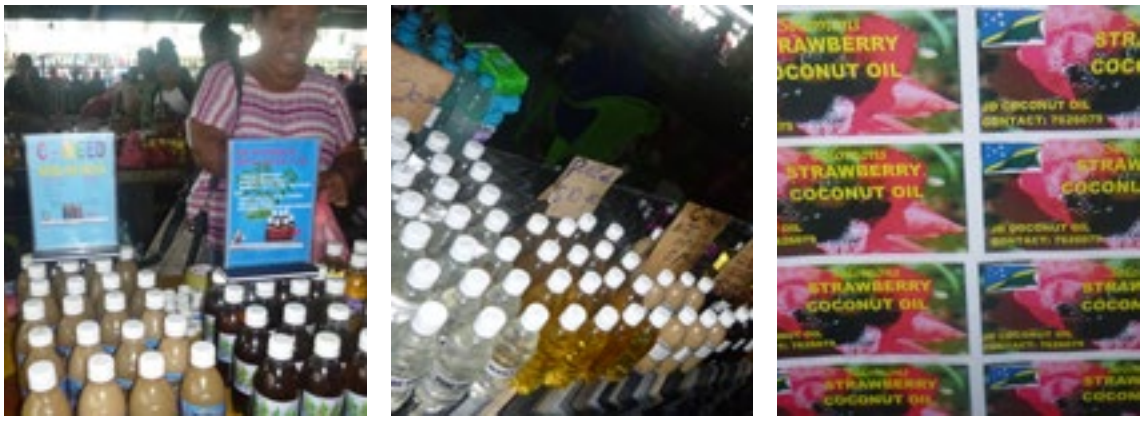


Figure 27: CCP main wholesaler Dorothy Ngro at the Honiara Market (credit Andrew McGregor).

CCP's CNO is purchased by wholesalers who are mainly located in the Honiara Market. The main buyer is Dorothy Ngro from Small Malaita (Fig. 27).

Products and prices

Dorothy buys 30-L containers of CNO from CCP and repacks into 5-L and 20-L, and 300-ml bottles to on-sell to retailers. The selling prices to retailers are:

- 300-ml bottle = $10 (retailed by the wholesaler)
- 5-L bottle = $80 (sold to retailers)
- 20-L bottle = $320 (sold to retailers)

The oil is sold either as pure coconut oil or has neem[4], or various scents and perfumes, added for use as skin and hair products. A 20% to 50% margin is added for scented products.

Dorothy sells to around 20 women retailers at the Honiara Market and also has her own retail business at the market. The various products are retailed in 300-ml bottles. Prices range from $10

Figure 28: Coconut oil (with neem added) sold in the Honiara Market (credit Andrew McGregor).

[4] Neem oil is pressed from the fruits and seeds of the neem tree (Azadirachta indica), an evergreen tree that is endemic to the Indian subcontinent. Neem oil has multiple uses, including as an organic pesticide. In Solomon Islands, it is mainly mixed with coconut oil as a skincare product.

to $20/300-ml bottle, depending on the additives used. The cost of the plastic bottles is:

- $0.50 for collected used bottles, and
- $2.50 for new bottles purchased from the soft drink factory.[5]

In the opinion of Dorothy (and other coconut oil retailers that were met), the main CNO demand is currently for skin and hair care products. However, these retailers have seen increasing interest in good quality CVO for cooking. Dorothy reported that CCP CNO is regarded as good quality by buyers in terms of colour and smell.

An indicative gross margin for a wholesaler purchasing 2,400 L of CNO from CCP is presented below. It is estimated that the gross margin is around $5,000 (Table 2).

Table 2: Gross margin for a wholesaler selling 2,400 litres of CNO.

GROSS REVENUE	
CNO sales	
- 20% 300 ml bottles retailed @$10 each	16,000
- 40% 5-L bottles @ $ 80 each	15,360
- 40% 20-L bottles @ $ 300 each	14,500
Gross revenue	**45,860**
OPERATING COSTS	
Cost of buying CNO@ $ 14/L	33,600
COST OF BUYING BOTTLES AND LABELS	
- 1600, 300-ml bottles@ $ 1.50 each	2,400
- 192, 5-L bottles @ $ 9 each	1,728
- 48, 20-L bottles @ $ 25 each	1,200
Sub total	**5,328**
Labels for 25% of the bottles	500
Perfume and other additives for 25% of bottles	500
Labour for rebottling (7 days @ $100/day)	700
Other operating expenses (e.g. transport, electricity, communications)	500
Total operating cost	**41,128**
Gross margin	**4,732**

[5] Kokonut Pacific Solomon Islands provided the following cost for their imported bottles: 50-ml = $1.80; 125-ml (amber) = $1.50; 125-ml (clear) = $1.30; 250-ml = $1.00; 500-ml = $1.95; 1,000-ml = $2.86. The company also provided the following prices for imported labels: 50-ml labels = $1.30; 125-ml labels = $1.30; 500-ml labels = $3.90; 1,000-ml labels = $1.59–5.20.

Demand for CCP CNO

Dorothy buys an average of 1,000 L of CNO per week from CCP. The current readily available market is said to be around 1,500 L/week. However, she cannot increase her purchases because of liquidity constraints. Thus, both the CNO local market supply and demand is constrained by cash flow.

Retailers

Currently, all retailers are small-scale market vendors, and are mainly located in the Honiara Market. They can also be found in other markets such as at Henderson Airport. As yet, locally produced CNO is not sold in supermarkets and other stores although some supermarkets do sell small amounts of locally produced VCO. Substantial expansion of the local market for CNO will depend on retail supermarkets and stores selling the product as cooking oil.

Step 3
Identifying what each actor contributes to the final

This analysis is based on the processing of 4,800 kg of copra to produce 2,400 litres (L) of CNO and 1,650 kg of copra meal for sale on the local market.

MAIN ACTOR (PARTICIPATING IN THE CNO VALUE CHAIN – BUYING AND SELLING THE PRODUCT ALONG THE CHAIN)	WHAT THE ACTOR CONTRIBUTES TO THE FINAL PRODUCT
Farmers/copra maker (4,800 kg of copra shared by 4 or 5 farmers or copra makers) 	Produces coconuts and transforms coconuts into copra Harvests the coconuts and makes approx.4,800 kg copra (56, 85-kg bags of copra)
CNO processor (CCP the only processor) 	Transforms the copra into usable oil. Processes 2,400 L of CNO and 1,650 kg of copra meal to on-sell to the wholesalers

product and the returns they receive

	THE COST OF THE ACTOR'S CONTRIBUTION	THE REWARD THE ACTOR RECEIVES – THE SHARE OF THE FINAL SELLING PRICE (2,400 L OF CNO SELLS FOR $80,000 OR $33/KG OF COPRA USED)	ACTOR RISK
	The cost of labour to: • maintain the plantation (2 days x $50 = $100) • Harvest and make copra (35 days x $50 = $1,750 Replacement of tools and drums = $200 Total = approx. $2,050	The reward to the farmer/ copra maker is the farm gate value of the copra, minus the cost of labour and other inputs. Estimated at $19,200- $2,050 = $17,150 **Estimated farmers' share of the consumer purchase price = 21%, to be shared among farmers**	LOW TO MODERATE: • Pests such rhinoceros beetle. • Labour not available to make the copra. • CCP does not having cash available to purchase the copra as soon as it is made. However, has the option of selling to Honiara at a lower price.
	• Makes a substantial investment in processing equipment. • The cost of buying the copra, operating the processing facility, developing the market and marketing to the wholesale buyers. • The main operating costs are: buying copra; transporting copra from farm; processing costs (fuel; wages; repair and maintenance); bottles for CNO and bags for meal); oil transporting. Total operating cost estimated to be $25,000 • Fixed overhead, including debt servicing, insurance, depreciation	The reward to the processor is the wholesale selling of CNO and copra meal, and less production and marketing costs. Estimated at $36,900–25,015 = $11,885(from which the processor should be awarded for management and supervision and fixed overhead costs met) Estimated processor share of the customer purchase price @ 15%	MODERATE TO HIGH: • Insufficient amounts of copra are purchased due to working capital constraints. • Substantial debt servicing obligations for commercial loan taken for capital investment in processing equipment.

MAIN ACTOR (PARTICIPATING IN THE CNO VALUE CHAIN – BUYING AND SELLING THE PRODUCT ALONG THE CHAIN)	WHAT THE ACTOR CONTRIBUTES TO THE FINAL PRODUCT
CNO wholesalers (2,400 L of CNO handled by one wholesaler) 	Creates the link between the processor and the retailer. Purchases 2,400 L of CNO in 30-L containers and repacks in smaller bottles for on-selling to the retailer (some with perfume and skincare additives) to on-sell to retailers in Honiara and other markets
Retailers (2,400 L of CNO expected to be handled by ~ 10 market vendors) 	Makes CNO products readily available to the consumer in useable small volumes
Consumers 	The 'queen' (i.e. the buyer) at the end of value chain

	THE COST OF THE ACTOR'S CONTRIBUTION	THE REWARD THE ACTOR RECEIVES – THE SHARE OF THE FINAL SELLING PRICE (2,400 L OF CNO SELLS FOR $80,000 OR $33/KG OF COPRA USED)	ACTOR RISK
	The major operating costs are: buying the CNO ($34,000); bottles and labels ($5,800); value- adding with neem, perfumes, etc. ($500); labour for re-bottling and retailing ($700). Total operating costs around $41,000	The reward to the wholesaler is the selling of CNO products to retailers – less cost of CNO and value-adding and marketing costs. Estimated at ~ $46,000–41,000 = $5,000 (from which the wholesaler should be awarded for management and supervision and fixed overhead costs met). Estimated wholesaler share of the customers share of the consumer purchase price: 6%	LOW TO MODERATE: Sometimes unable to purchase sufficient CNO to meet demand due to working capital constraints.
	The costs for the retailer are: purchased on bottles of CNO from the wholesaler ($46,000); empty bottles (mainly used) ($3,000); labels $1,000; perfumes and other additives ($1,000); market levies and other changes – $500 Total $51,500	The reward to the retailer is the selling of 300-ml bottles CNO products to consumers – less cost of purchasing CNO and from the wholesaler and marketing costs. Estimated at ~ $80,000–51,500 = $28,500 Estimated retailers share of the consumer purchase price: 35% to be shared amongst the market vendors	LOW: Provided the product sells within a few months as it nonperishable and self-stable. However, market vendors are a low income group whose wellbeing depends on a steady cash flow
			INSIGNIFICANT: If the customer does not like the product, she/he does not need to buy again and will tell their friends

A summary of the distribution of shares along the Solomon Islands CNO domestic value chain

ACTOR	ACTOR SHARE OF THE FINAL PRICE TO THE CONSUMER (%)
Farmer/copra maker	21%
Processor	15%
Wholesaler	6%
Retailer	35%
Input suppliers (e.g. transporters, packaging suppliers, equipment suppliers)	22%
Total	**100%**

Step 4
Assessing the market

The current marketing structure based on selling through market vendors

All of the CNO currently produced by the CCP value chain is sold by small vendors mainly located in the Honiara Market.. Discussions with Dorothy Ngro, the main wholesaler, indicate that this market is currently under-supplied. She currently sells an average of 1,500 L of CNO per week. This could be readily increased to 2,000 litres if she had the supply. Wholesalers are constrained by available cash flow to buy the required supply to meet the demand. If all of the wholesalers are taken into account, the current demand is estimated to be around 4,000 L/week (assuming sufficient buyer cash flow), or 200,000 L/year of CNO. This would require a copra supply of around 365 t. A total of 200,000 L/year of CNO is well within CCP's processing capacity of 2,640 L/day.

Significant scope for market expansion is identified within the existing marketing structure (retailing through small market vendors). This is based on the following considerations:

- There is increasing interest in CNO by market vendors outside the Honiara Market. For example, during the field work in early February, CCP received an order for 200 L/ week of CNO from a wholesaler servicing the Henderson Airport Market. Interest has also been shown by White River suppliers located on the western side of Honiara.
- As bulk orders increase, the wholesale price of CNO is expected to fall. CCP has indicated its willingness to lower its wholesale price to $13/L for bulk orders. It can be expected that the product has a reasonably high price elasticity of demand among local consumers.
- It is apparent that most CNO products is used inskin and hair products, and not for cooking. It can be expected that the demand for edible CNO sold by market vendors will increase significantly as:

    - more quality CNO becomes available; and
    - more consumers become aware of the taste, and the nutritional and health benefits of cooking with good quality edible CNO. This will require an active promotion and educational campaign, including cooking demonstrations. As is common throughout the Pacific islands, coconut oil is generally regarded as inferior cooking oil. This attitude needs to be reversed, with quality edible CNO product being available and promoted.

It would be reasonable to expected that within the next few years, the CCP value chain could sell up to 8,000 L/week of CNO (requiring 7,300 kg of copra) through the retail market vendor structure. This would require around 400,000 L/ year of CNO, which would mean processing approximately 700 t of copra. This would exceed the current estimated copra production capacity of the farmers that belong to the CCP network but still within CCP's current processing capacity.

The market for edible vegetable oil at retail shops and supermarkets

Solomon Islands, as with other PICs, imports large quantities of vegetable oil for cooking purposes. According to data supplied by the Solomon Islands National Statistical Office, 7,316 t of vegetable oil were imported in 2017 for a landed value of $57.5 million (or $7.34/kg). This was an increase from 2016, when 4,171 t (landed $32.4 million) were imported. The imports are dominated by low-priced palm oil and soya bean oil that are sourced mainly from Malaysia and Indonesia. The following retail cooking oil prices were recorded in Honiara supermarkets in February 2018:

- Palm oil from Indonesia = $9/500-ml bottle ($4.80/250-ml bottle)
- Soya bean oil from Malaysia = $23/500-ml bottle
- Sunflower oil = $30/500-ml bottle
- Rice bran oil = $45/500-ml bottle

Figure 29: Imported cooking oil available in a major Honiara supermarket (credit Andrew McGregor).

Small quantities of coconut oil were available in the larger supermarkets, largely marketed as a skin product in the toiletry section. Locally produced Kokonut Pacific VCO was found in both the vegetable oil and toiletry sections of supermarkets, retailing for $75/L and $50/450 ml. The only CNO that was found in the supermarkets (toiletry section) was from Fiji (Ocean Soap Ltd) retailing for $28/300 ml.

Figure 30: Fijian CNO selling in the cosmetic and skin section of a supermarket (credit Andrew McGregor).

Figure 31: Local Kokonut Pacific Solomon Islands product found in the edible oil section of a supermarket (credit Andrew McGregor).

Table 3 below provides an indicative comparison of the retail price for various vegetable oil products that retail in Honiara supermarkets. It reveals that palm oil sold in supermarkets sells for around half the price of the CCP CNO sold in the in the Honiara Market. However, it is notable that CCP CNO is already price competitive with soya bean oil, the other mainstream cooking oil used. CCP CNO is clearly much cheaper than the niche market oils such as sunflower and rice bran, and sells for less than half the price of the locally produced VCO sold in retail stores. It is also, surprisingly, less than half the price of the CNO imported from Fiji. Thus, if achievable, quality standards can be achieved and there is scope for significant market expansion.

Table 3: The retail price of vegetable oil in a Honiara supermarket.

	PRICE (S)	CONTAINER SIZE (ml)	S/300 ml
CCP retalling in Honiara Market	**10.00**	**300**	**11.00**
Palm oil (Indonesia)	9 ..00	500	500
Palm oil (indonesia)	4.80	250	5.76
Soya bean oil (Malaysia)	23.00	500	13.80
Sunflower	30.0O	500	18.00
Rice bran oil	45.00	500	27.00
VCO (Kokonut Pacific)	75.0O	1000	22.50
CNO (Ocean Soaps) Fiji	28.0O	300	28.00

Quality edible CNO (in terms of taste, appearance and shelf life) is seen to be superior – in terms of health and nutritional considerations – than palm oil. Coconut oil is a vegetable oil high in lauric acid (lauric acid content ~ 50%); another oil with high lauric acid content is palm kernel oil (not to be confused with the palm oil the main cooking oil imported into Solomon Islands).[6] Oils high in lauric acid are characterised by their medium chain fatty acids (MCFA), which are regarded has having particular digestive health advantages.

[6] Lower-value palm oil is derived from the mesocarp of palm fruits, which like most other vegetable oils is low in lauric acid.

'It is only in recent years that the health value of lauric oils has been recognised and promoted. This has been able to offset the consumer resistance to tropical oil generated by the American Soybean Association (ASA) starting in the 1980s. Klurfeld (1991) notes that changes in dietary intake of fats and oils which occurred over the past century comprised an increasing consumption of saturated and partially hydrogenated trans-fats which can increase the risk of coronary heart disease by raising levels of "bad" cholesterol and lowering levels of "good" cholesterol. It was on this basis the claim was made that tropical oils, such as coconut oil, were harmful to public health and such erroneous claims continue to be made. Yet, the chemical composition of lauric oil is neutral in terms of cholesterol. Therefore, it is now widely accepted that the consumption of palm kernel and coconut oil as a source of dietary fat does not pose any additional risks for coronary artery disease when consumed in realistic amounts, as part of a healthy diet.' (McGregor and Sheehy 2017:9)

Thus, a significant substitution of coconut oil for the currently imported vegetable oils would bring with it public health benefits to Solomon Islands. According to the World Health Organization, noncommunicable diseases (NCDs) are now the leading cause of death in Solomon Islands as they are in most PIC (WHO 2010). This substitution would also bring with it significant economic benefits. If high-quality CNO was able to capture 20% of the imported vegetable oil market, it would represent a market of over 1.5 million litres, with a wholesale value of approximately $20 million. To meet this demand would require a substantial increase in the number of copra producers with the capacity to supply quality CNO. CCP would also need to make significant additional investment in processing capacity, if it was to supply this amount of CNO.

To achieve an objective of replacing 20% of the current vegetable oil imports with locally produced CNO would require three necessary developments to occur:

1) A modest fall in prices of CNO (both wholesale and retail).
2) A significant increase in consumer appreciation of the positive features of quality CNO (health and nutrition, together with suitability for cooking). This would require a substantial education and promotion effort.
3) A significant increase in the consistent availability of quality CNO. The quality standard of the CNO produced by CCP is seen to be superior to the CNO generally produced in Solomon Islands. However, objective quality testing by the University of the South Pacific laboratory of a CNO sample provided by CCP indicates that further improvement will be required to substantially expand the domestic market demand. The main problem appears to be the quality of the copra that is being supplied for processing, although some changes to CCP's processing procedures are likely to be necessary.

The determinates of domestic market demand for the CCP CNO product

WHAT THE CONSUMER CARES ABOUT	Performance of the CCP value chain in meeting demand and why (1 is the lowest score, while 10 is the highest)
PRICE	7 – Most Solomon Islands consumers have low cash income and are, thus, very price conscious. The current retail price for CCP CNO in the Honiara Market is seen to be reasonably price competitive with most imported vegetable products, except palm oil (the major imported vegetable oil product).
QUALITY	9 –CCP's CNO is generally regarded to be of good quality by buyers in the Honiara Market. However, it is mainly sold as a skin and hair product. Overall, copra oil is regarded as an inferior product for cooking purposes. The current CCP product is seen to be of better quality, but probably still not up to a consistent quality standard to achieve a substantial expansion in demand. The problem is seen to liewith quality of the copra being processed, with some adjustments CNO processing likely to be necessary.
HEALTH BENEFITS	4 – Substantial health and nutritional benefits exist for using CNO as a cooking oil rather than oil palm and soya oil. However, these are hardly recognised by consumers. This needs to change if there is to be a substantial increase in demand for quality edible CNO.
PACKAGING AND LABELING	5 – The packaging and labeling of the CCP CNO sold by Honiara Market retailers is seen as reasonable. However, there will need to be a significant upgrading if the product is to compete with imported vegetable oils sold in supermarkets and stores. There will be no place for using recycled bottles. Bulk imports of suitable containers, or the establishment of a plastic bottle manufacturing plant in the Solomon Islands, will be needed. It will also be necessary to improve labeling to the standard of Kokonut Pacific Solomon Islands VCO, or Ocean Soaps CNO imported from Fiji.

Future export markets for CCP CNO

CCP reports enquiries for edible CNO from buyers in Fiji, Papua New Guinea and Vanuatu. However, the company did not have a sufficient supply to send requested samples to these markets. It is unlikely that these Pacific Island markets would be sustainable. While all three countries, like the Solomon Islands, import large volumes of vegetable oil they all have significant copra industries. And all three countries have processing enterprises that are involved in, or are looking at, supplying the local edible oil market. Fiji (Ocean Soaps) is already exporting retail packs of CNO to Solomon Islands.

In the future, when a significant and consistent supply base for quality CNO is established, niche export markets in Australia offer a realistic opportunity. This opportunity is being created by the falling price of VCO in recent years as a result of the large increase in supply from the Philippines and Sri Lanka.

'Over the last decade VCO has transformed itself from a niche product, which readily commanded prices up to 5-times that of crude coconut oil on global markets, to a commodity that secured a reasonable price premium, provided quality standards are met. Pacific island VCO producers are now having to adjust to this market reality. Nature Pacific Ltd., the largest Australian based importer of Fiji VCO, notes that there are still unrealistic price expectations amongst many Pacific island VCO producers and promoters. Previous fob prices such as AUD 12/litre are no longer feasible if markets are to be maintained let alone expanded. The company believes that current realistic prices for good quality VCO to allow market expansion are: Non – organic AUD $ 3.50/litre; and, Organically certified AUD $4.00 – AUD 4.50/litre. At these prices around 60,000 litres (3 container loads) a month, of PIC VCO could readily be sold in Australia. Organic certification is now generally regarded as a necessary condition for the successful marketing of VCO – which imposes a significant cost burden for VCO producers who rely on high cost external third-party certification.' (McGregor and Sheehy 2017:29)

However, as the Market Study points out, approximately half of the VCO produced globally is used in the nutraceutical and functional food uses – with the balance used in a range of natural oleo chemical products such as hair and skin care products and aromatherapy and massage oils. For most non-food uses, high quality copra oil is a suitable substitute for VCO and can be produced at much lower cost by a small-scale processing enterprise (a Tinytech cold press mill).

'The capital cost of Tinytech cold press mills is low. The mills are capable of handling around 600 kg of copra in a day. The oil extraction rate is lower than that of a conventional CNO copra mill (around 52% oil). If high-quality copra is used with appropriate driers, the quality of the oil produced is equivalent to that derived from a VCO DME process in many of its uses. This copra oil could be used as a quality cooking oil for domestic markets - however, awareness campaigns and regulatory changes are required to significantly develop this market. Significantly, Tinytech mills use far less labour than DMEs (three people are required to produce around 300 litres of oil compared with six people to produce 45 litres from a DME). Thus, the returns to effort can be higher, particularly in a lower price environment for VCO. Provided high quality copra is utilized, meeting oil quality standards is far less difficult than with a VCO DME mill. As with VCO DMEs, financial viability depends on achieving a reasonably high throughput. However, these mini copra mills can remain profitable at a significantly lower product price.' (McGregor and Sheehy 2017:29)

[7] The fresh-dry direct micro expeller (DME) is the most common technology used in virgin coconut oil processing in the Pacific Islands. It is a highly labour-intensive operation involving the following (Bawalan 2011:22):

- pre-selection of mature nuts;
- husking the nuts;
- splitting the husked nuts in half;
- grating the fresh kernel into fine particles using a motorised DME grater;
- drying the freshly grated kernel on a flatbed drier to 10–11% moisture content in batches of 3.0 to 3.5 kg. utilising two people;
- loading the dried grated kernel into the DME cylinder press to extract the oil; and
- Letting the oil settle to remove the fine particles of dried kernel.

The processing capacity is about 300 nuts in an eight-hour day, involving around four people.

Stacey King, Managing Director of Nature Pacific, has expressed keen interest in sourcing high-quality CNO from the Pacific Islands to be used as a substitute for the higher priced VCO in the company's skin care, aromatherapy and massage oils products. Once CCP has established a significant production base of quality oil supply in the local market, such niched export markets should be actively explored.

Step 5
Assessing strengths and weaknesses along the

MAIN ACTOR PARTICIPATING IN THE CNO VALUE CHAIN	STRENGTHS AND OPPORTUNITIES
FARMER 	• Experienced copra producers • Most of the coconut trees are still of a reasonably productive age, having been planted in the late 1970s and early 1980s as part of a subsidised coconut planting programme. • Most farmers are in reasonably close proximity to the CNO processor, and with a reasonably good main road. • A strong network of farmers linked to the processor that holds regular meetings; the network is strengthened by their church association. • Strong representation of women in the network.
THE CNO PROCESSOR – CCP 	• A well-respected, long standing locally based west Guadalcanal enterprise, with considerable experience in the coconut industry. • Substantial two generations of family involvement provides a basis for sustainability and minimises the risk of key person dependency. • Proven ability to successfully operate the Tinytech processing equipment. • Able to achieve a high recovery rate of good quality CNO, provided the necessary condition of good quality copra (clean, smoke free and 7% moisture). • Closely linked to copra suppliers (holds regular monthly meetings) and wholesale buyers. Church network has been important. • Markets have been identified that will require a significant increase in quality CNO throughput from the processor.

chain and identifying actions required

WEAKNESSES AND THREATS	ACTION NEEDED
• Insufficient copra being produced to meet projected demand. • A significant number of plots are poorly maintained. • Labour shortage • Rhinoceros betel pest. • Some driers are not up to the standard required to produce the quality copra required (7% moisture and no smoke contamination).	• Encouragement of intercropping (cocoa, betel nut) for more efficient labour utilisation in weeding. • Assistance with sourcing appropriate wheel barrows to increase labour productivity (could be a suitable World Bank Rural Development Program activity). • Projects such as the World Bank's Rural Development Program and Australia's Department of Foreign Affairs and Trade 'Strong in Business', to assist with the provision of improved copra driers (with steel pipes and chimney) that are already being manufactured in Solomon Islands. • Providing farmers with appropriate field moisture meters.  • A demonstration solar drier and/or combination hotair be established at CCP. • Kastom Gaden Association (Moses Pelomo) to provide training in high-quality copra making. • A country-wide subsidised coconut replanting programme needs to be established, CCP farmers being one of the demonstration focus groups. • The CCP farmer network needs to be actively involved in rhinoceros beetle mitigation programmes.
• Inadequate copra supply to minimise unit processing costs. • Insufficient working capital to be able to always buy the copra on offer. • High debt servicing due to high interest loan for the initial purchase of equipment. • Quality of CNO is dependent on the quality of copra supplied by farmers. • Other copra buyers, less concerned with quality, are attracting supply and are a disincentive to make good quality copra.	• Increase the copra supply base: initially within the existing farmer network; expand the farmer network in west Guadalcanal; and eventually beyond Guadalcanal (e.g. Choiseul). • Working capital support through the banking and financial system. • Project support for major capital investment items to minimise debt servicing constraints. • A concerted programme to improve copra quality, as listed above for farmers. Demonstrations to be provided at the CCP nucleus. Technical assistance to CCP to improve its processing procedures so that CNO quality can be improved. • The development of a contract farming system, including practical value chain training. The foundation has already been laid with the monthly meetings of the CPP supply network. This should be extended to include the wholesale buyers on the CNO.

MAIN ACTOR PARTICIPATING IN THE CNO VALUE CHAIN	STRENGTHS AND OPPORTUNITIES
CNO WHOLESALERS 	• Several active entrepreneurial wholesalers purchase CCP CNO, and are strongly linked through the Catholic Women's Network. The wholesalers in turn have strong linkages with women retailers selling in the Honiara Market and other markets. • Have successfully developed a range of value-added skin and haircare products. • Opportunities have been identified to readily expand sales through a market retail vendor structure.
RETAILERS 	• A significant number of market vendors sell a range of CNO value-added products. They have also been innovative in developing new hair and skin products (such as coconut oil with neem) • It is a highly competitive marketing system that has kept prices down for consumers, which has helped expand the market.
CONSUMERS 	• Long-established tradition of using CNO for skin and hair care and a willingness to accept new value-added products based on coconut oil. • A large number of consumers buy CNO products from the Honiara Market.

WEAKNESSES AND THREATS	ACTION NEEDED
• Insufficient working capital to always buy CNO from CCP when it is required by the market. • Have not developed market linkages with supermarkets and other stores. • Not in a position to develop export markets	• Working capital support through the banking and financial system. • Support with improved labeling and packing to facilitate the development of markets for edible CNO in supermarkets and stores. This would include the bulk import of appropriate bottles as well as their local manufacture. • Encouraging the entry of new wholesalers who focus on the supplying local super markets and possibly eventually niche export markets. • Niche markets in Australia and New Zealand need to be developed once sufficient consistent supplies of quality CNO become available. For this market, organic certification will probably be necessary.
• Only a small proportion of the CNO sold in markets is labeled and promoted as an edible product. This has to substantially increase if there is to be significant increase in local demand for CNO. • Market vendor retailers do not have access to bulk supplies of bottles and labels. A high percentage of second hand bottles are used, which is not appropriate for edible product. • Supermarkets and stores are currently not involved in selling locally produced CNO. This will need to change if coconut oil is to obtain a modest share of the sizeable local edible oil market.	• More high-quality CNO has to be made available to market vendors so they can market it as cooking oil. • Market vendors need to be convinced of the virtues of quality CNO for cooking so that they, in turn, will promote the product. • Market vendors need access to bulk supplies of new bottles to develop the market for edible CNO. • Supermarkets and stores need to be persuaded of the value of selling quality locally produced CNO for cooking.
• Consumers generally regard coconut oil as an inferior cooking product and would prefer to use imported palm oil and soya bean oil. • Difficult to compete price-wise with imported palm oil although CNO is already competitive with other imported oils. • The reputation of CNO as a cooking oil will be spoiled by the selling inferior-quality CNO as a cooking oil. This is difficult to control.	• Education is needed regarding the health and nutritional benefits of using quality CNO for cooking rather than imported palm and soya bean oils. • Demonstrations should be made of the positive taste achieved from cooking with quality CNO. • With increased production (thus lower unit cost), there is a need to decrease the retail price of edible CNO.

Step 6
Developing a plan to improve the value chain

ACTOR	SHORT-TERM PLAN	LONGER-TERM PLAN

FARMER 	• Training in:
	  • copra quality improvement;
	  • the CNO value chain held at CCP; and
	  • farm-level rhinoceros beetle mitigation.
	• Assistance in:
	  • establishing improved copra driers and demonstration units at CCP;
	  • supplying copra moisture meters;
	  • supplying appropriate wheel barrows to increase labour efficiency.
		• The design and implementation of a Solomon Islands-wide coconut replanting programme, with CCP being one of the demonstration focus groups.

THE CNO PROCESSOR – CCP 	• CCP to expand its copra supply sourced from: i) its own plantation; ii) the existing farmer network; and iii) extending to other farmers on Guadalcanal.
	• Providing access to a working capital financing facility for key value chain enterprises such as CCP.
	• Technical assistance for:
	  • CCP to improve CNO quality, together with quality testing and certification (see Annex 1)
	  • CCP to diversify the product line to achieve better utilisation of the processing plant and to enhance viability.
	• The development of a contract farming system supported by practical value chain training for the CCP network.
		• CCP to extend its copra supply sources beyond Guadalcanal to areas such as Choiseul.
		• Assistance for:
		  • replacing and expanding equipment and other infrastructure; and
		  • organic certification.
		• Identify and develop niche export markets.
		• Encourage the development of CNO refining to expand the local edible market.

ACTOR	SHORT-TERM PLAN	LONGER-TERM PLAN
CNO WHOLESALERS 	• Wholesalers extending their buyer network to supermarkets and other stores. • Providing access to a working capital finance for key strategic value chain enterprises such as CCP. • Assistance for bulk imports of bottles and labels.	• Encourage wholesalers to develop niche export markets.
RETAILERS 	• To increase the quantity of quality CNO that is made available to retail market vendors and sold as edible oil. • Educate retail market vendors on the commercial opportunities for selling quality CNO as cooking oil and to provide assistance with appropriate labeling. • Facilitate the availability of reasonably priced food grade bottles for retail market vendor. • Encourage the entry of supermarkets and other markets into the sale of quality CNO as high cooking oil.	• Establish grading and labeling standards for the retailing of cooking oils in Solomon Islands.

CONSUMERS 	• Changing the negative attitude of consumers through:
	  • consumer awareness campaigns (media and schools) on the health and nutritional benefits of cooking with quality coconut oil compared with imported oils; and
	  • cooking demonstrations using quality CNO.
		• Establish grading and labeling standards for the retailing of cooking oils in the Solomon Islands.
		• Review the tariff structure on imported vegetable with a view to encouraging domestic edible oil production.

Annex 1

Crude coconut oil quality testing by the University of the South Pacific's Institute of Applied Sciences Food Laboratory on a crude coconut oil sample provided by Chottu Coconut Products: A report by Dr Richard Beyer

Background

In April 2018, A sample of coconut oil (CNO) produced by Chottu Coconut Products (CCP) in Solomon Islands was submitted to the Suva-based University of the South Pacific (USP) Institute of Applied (IAS) to test its suitability for local edible oil markets. As such, it is likely that it will find many uses. For use as a cosmetic, the quality features are not particularly stringent. However, it is possible that it will be used for cooking and hence repeat frying. Oil comprises triglycerides that are three fatty acids that are chemically bound to the tri-alcohol – glycerol. In this form, the oil is relatively stable with much of the deterioration occurring along the fatty acid chains, particularly in the case of those fatty acids with double bonds between carbon atoms – so called unsaturation. Coconut oil contains very little unsaturated fatty acids and, hence, it is relatively stable and less prone to becoming rancid and forming hazardous reaction products, such as trans-fatty acids.

However, other naturally occurring contaminants, including free fatty acids and other components resulting from deficient extraction techniques, can accelerate oil breakdown, especially during repeated frying. As the oil deteriorates, accelerated by undesirable components, the oil's shelf life is compromised as seen by excessive foaming and undesirable odours and tastes (e.g. soapy and bitter). The benefits of careful oil extraction are usually more that recompensed through cost savings due to quality maintenance during extended usage.

Over 40 tests are commonly available for identification and quality assessment. Many are expensive but will give a very clear indication of all contaminants. In this case, only two indicator tests were chosen because they are relatively inexpensive and give a clear understanding quality.

Unsaponifiable matter gives a measure of the non-oil content and is, thus, a guide as to the contaminants present in the oil.

Free fatty acid content is a measure of the extent to which fatty acids have become separated from the triglyceride and indicates the damage that has occurred during the extraction process. Both free fatty acids and unsaponifiable matter can be removed after extraction. This is common practice in large commercial oil producers so that frying oils such as soybean, canola (low erucic acid rape seed oil) and safflower oil have high purity. However for smaller operators, there are a number of simple 'cleaning' techniques that are less expensive but can achieve a significant effect on the oil quality. These will be recommended as the project proceeds.

Analytical results and comment

Results

i. Free fatty acids (as oleic acid)

Sample 1	Sample 2	Sample 3	APCC (max)
2.2	2.2	2.3	2.0

ii. Unsaponifiable matter

Sample 1	Sample 2	Sample 3	APCC (max)
0.2	0.2	0.3	0.2

Comment

The oil has intrinsic discolouration (approximately 4/10 on a subjective scale). It has a slight odour of coconuts, which can be described as slightly sour coconut oil (approximately 5/10 on a subjective scale.

The free fatty acid (FFA) content is high and indicates that the fatty acids have been removed from the glycerol molecule. The value is high and will eventually impinge on the taste characteristics of the oil after repeat use. Fatty acids are often removed from the triglyceride during high temperature treatments of copra or at some stage during processing or even from the oil after extraction. It is often catalyzed (accelerated) by impurities. It is important to establish at what stage this is occurring.

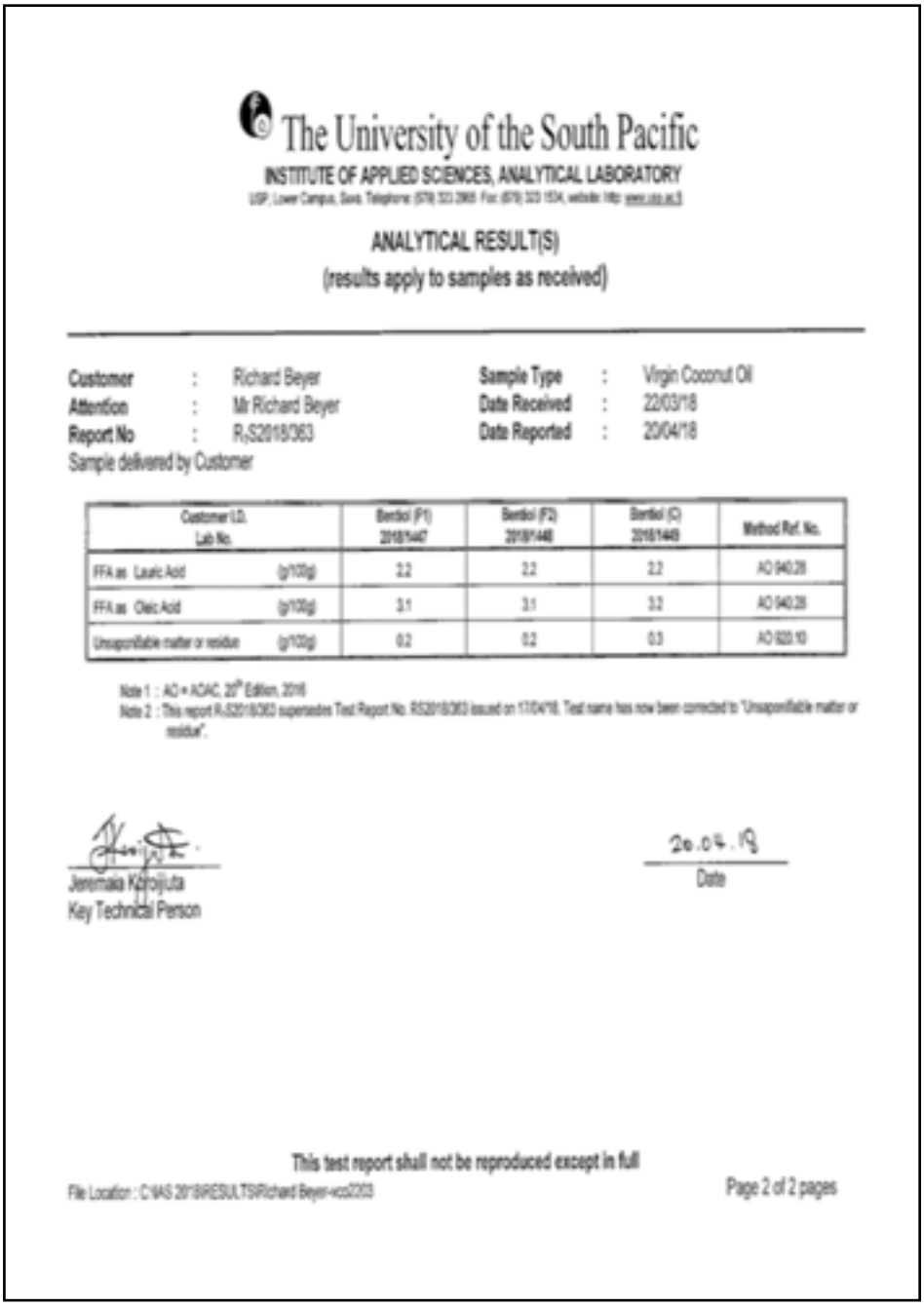
The unsaponifiable matter is within APCC standard but indicates that the impurities are on the high side. It is desirable to reduce this if possible. Once it impinges on quality maintenance since the nature of the impurities is unknown and may contribute deterioration. Again it is important to establish what factors are contributing to these impurities.

Mitigation

Commercial techniques for purification of oils will be out of the question for SMEs. However a number of simple techniques such water washing, settling and so on may be appropriate. Some simple purification techniques may be possible if they are not currently in use. Cost benefit of purification techniques will be assessed.

Terms of reference for a follow-up technical assistance

1. Undertake a full evaluation of the current practice for the production of coconut oil by Chottu Coconut Products including copra production and transport.
2. Assess the hazards in the process and the risk they represent to the finished product.
3. Suggests modifications to the existing process that is likely to result in quality improvement in relation to the agreed market.
4. Conduct trials on oil purification.
5. Assess the cost-benefit of implementing purification procedures in relation to the target market.
6. Prepare a comprehensive report including recommended process modifications suitable for the processor Chottu Coconut Products.



The University of the South Pacific

INSTITUTE OF APPLIED SCIENCES, ANALYTICAL LABORATORY

ANALYTICAL RESULT(S)

(results apply to samples as received)

Customer : Richard Beyer
Attention : Mr Richard Beyer
Report No : RJS2018/363
Sample Type : Virgin Coconut Oil
Date Received : 22/03/18
Date Reported : 20/04/18

Sample delivered by Customer

Customer I.D. / Lab No.		Bertiol (F1) 2018/1447	Bertiol (F2) 2018/1448	Bertiol (C) 2018/1449	Method Ref. No.
FFA as Lauric Acid	(g/100g)	2.2	2.2	2.2	AO 940.28
FFA as Oleic Acid	(g/100g)	3.1	3.1	3.2	AO 940.28
Unsaponifiable matter or residue	(g/100g)	0.2	0.2	0.3	AO 920.10

Note 1 : AO = AOAC, 20th Edition, 2016

Note 2 : This report RJS2018/363 supersedes Test Report No. RS2018/363 issued on 17/04/18. Test name has now been corrected to "Unsaponifiable matter or residue".

Jeremaia Karoijuta
Key Technical Person

20.04.18
Date

This test report shall not be reproduced except in full

File Location : C:\IAS 2018\RESULTS\Richard Beyer-vco2203

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Annex 2

Producing high quality copra for the production of edible high quality copra oil for the Solomon Islands domestic market–Key considerations and procedures: A report prepared by Moses Pelomo

Background

The coconut palm has served the Solomon Islands and its people from time immemorial and will no doubt do so even in the future. Initially, coconut provided food security and practical implements and medicinal products for the people in their subsistence living. Much later, in the 20thcentury, it also provided income for the people and the nation, mainly as copra for trading both at the domestic and export level. It provided the opportunity for growers, traders and exporters to earn money and the country to earn foreign receipts and trade with other countries. Now, in the 21st century, coconut continues to have the opportunity to further increase its benefits to the people of Solomon Islands through the proper exploitation of it potential diverse marketable products and markets. As indicated in Figure 1 below, the coconut industry has developed to such an extent that it benefits the country, the key stakeholders who are the growers (at least 75,000 rural householders), copra traders, virgin coconut oil (VCO) producers, exporters, millers as well as those that provide direct and indirect support services to the industry.

One of the ways to achieve this is to reduce the proportion of copra being exported and venture more into value-adding and exporting higher valued coconut products and derivatives. Further gains can be made by producing value-added products that can be sold domestically as substitutes for imports and thereby help improve the country's trade balance.

Edible high-quality coconut oil is one such example. There is already potential demand for this product at the domestic market for entrepreneurial cottage industry level in the cosmetic products, particularly for body lotions, medicinal medium and soaps. A recent study by McGregor and Sheehy (2017), commissioned by the Pacific Community–European Union Coconut Industry of the Pacific (CIDP) project, identified the production of cooking oil from high-quality coconut oil from high-quality copra as a potential product, initially for the domestic market and hence, the subject of further value chain analysis.

Quality considerations

Producing edible high-quality coconut oil for cooking oil depends on having high-quality/grade copra as the input. Thus, the current practices of copra making are discussed, and where appropriate, improved methods, practices and technologies are recommended. The approach taken is strategically two-pronged:

1. health considerations (food safety for the consumers); and
2. business considerations (commercial viability for the growers, millers and traders).

This is summarised in Figure 1.

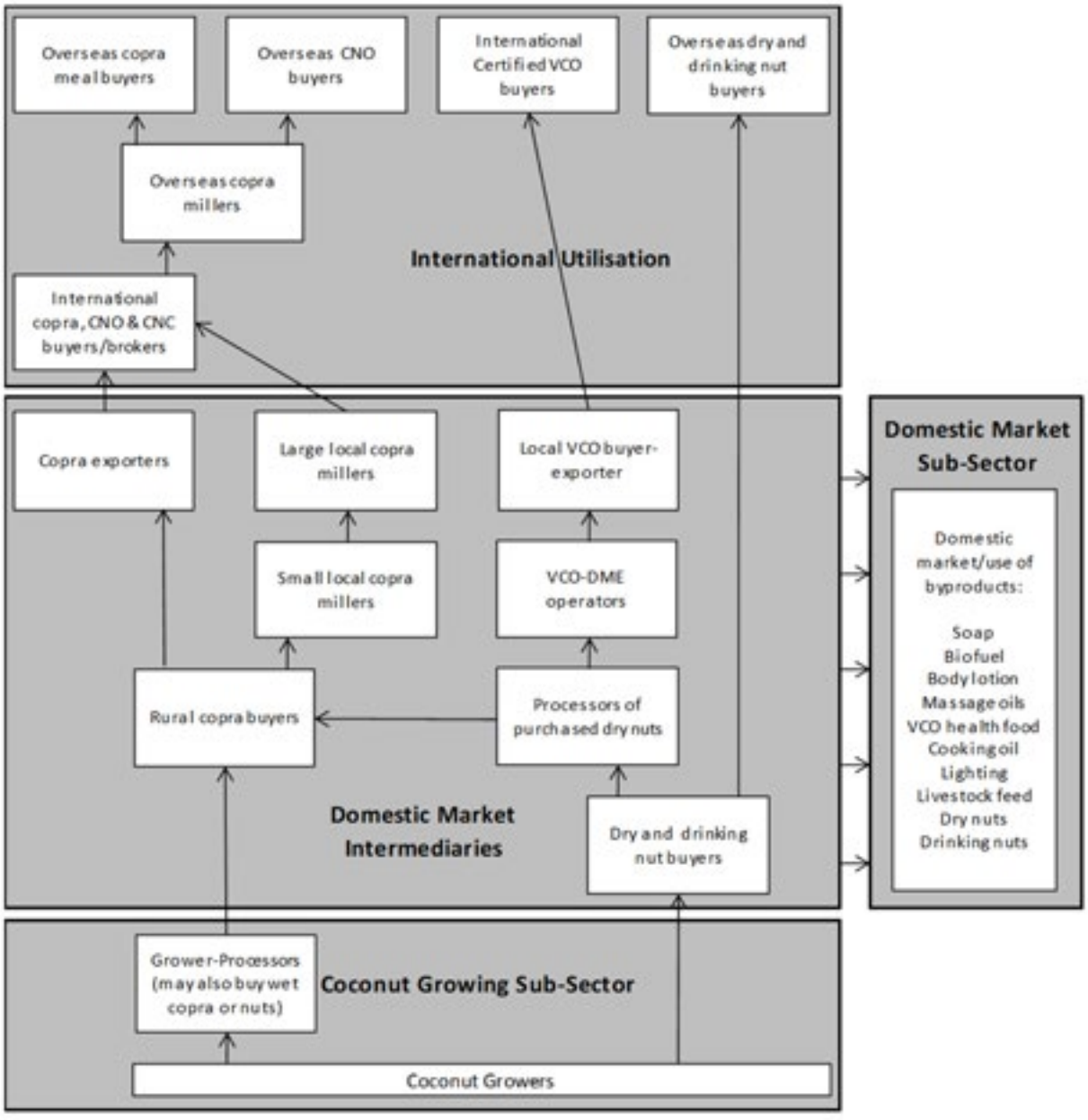


Figure 1: The Solomon Islands coconut market value chain.
Source: Young D., Pelomo M. 2014. Solomon Islands Coconut Value Chain Analysis. World Bank, Washington, DC.

Table 1: Key factors affecting the quality of copra considered for the production of high-quality coconut oil for cooking oil.

Health considerations (food safety and health)	Business considerations (profitability)
No external foreign matters or dirt	No foreign matters and dirt
No presence of germs, bacteria or other disease-causing agents, such as molds	No presence of germs, bacteria or other disease-causing agents, such as molds
No contamination of poisonous matter (biological or chemicals) aflatoxins, insect and rat droppings	No contamination of poisonous matter (biological or chemicals) aflatoxins, insect and rat droppings
No Adverse effects on flavour, smell and taste	No adverse effects on flavour, smell or taste
Appealing to sight (e.g. colour)	Low moisture content – maximum of 7%
Not infested with insects, weevils or rats	Not infested with insects, weevils or rats
No rancid oil	No rancid oil
	High coconut oil content of 50–60%

Some of the key factors that affect the quality of copra (i.e. health and business considerations) – based on current situations and practices – are further highlighted below:

- **Aflatoxin** – Aflatoxin is a poisonous byproduct from fungi that often grows on grain, coffee, maize, cocoa and even copra. If molds, particularly *Aspergillus* spp., grow in the copra it will produce aflatoxin as a byproduct in the copra and will contaminate the resulting coconut oil, copra cake or copra meal during milling. Aflatoxin is known to cause stunted growth in animals and is cancer-causing, which obviously makes it a health issue. At the same time, the growth of molds in copra reduces the oil content of the copra and hence its commercial value. The international copra trading industry has set acceptable levels of aflatoxin in copra. For instance, when Solomon Islands was trading copra into Europe and Japan in the early 1990s, the quality of its copra had to be less than 2 parts per billion (ppb). Thus, grading had to be very strict. Solomon Islands stopped exporting copra to Europe in 1992, and entered the more lucrative markets in Southeast Asia, which has its own standards.

Presence of aflatoxin-causing fungus (*Aspergillus* spp) on different grades of copra. None on well-dried solar-dried copra (A), some on hot-air dried copra (B), and a profuse amount of growth on incompletely dried solar-dried copra (C).

- **Copra Inspection and grading** – Through regulations, the Commodity Export Marketing Authority (CEMA) is responsible for the maintenance of copra standards for international trade and grading of copra that is exported. This worked well when the Solomon Islands Copra Board and, later CEMA, had a monopoly over the trade. When copra trading was removed from the CEMA monopoly and into the hands of private traders and exporters, grading for quality was more difficult and even absent because buyers in Asia, particularly the Philippines lowered their standards for copra because of high competition for copra, any copra, from their mills. On the other hand, CEMA standards (see Table 2) were designed for copra to be milled to produce 'industrial coconut oil', or CNO, which is further refined, bleached and de-odorised (RBD) by CNO in order to meet their local consumers' requirements. If edible high-quality copra oil is to be produced in-country for the domestic market as cooking oil, and without going through the RBD process, new standards and stricter grading system and standards must be in place.

Table 2: CEMA copra standard

Dust and dirt	Tick	Colour and smell	Max. Score Points	Tick	Score	Grade
Less than 1% dust and dirt (40 points)		White (sun-dried), grey, light brown, no smell of smoke	60 points		100	First
Less than 3% dust and dirt (20 points)		Brown, no smell of smoke	30 points		70/80	Second
		Dark brown and smokey	10 points		30/50	Third

Reject grade depends on any or combination of these reasons; a) presence of mold, b) too wet (more than 7% moisture content), c) spoiled by insects, d) dusty and/or dirty, e) black and/or burned, and f) high percentage of germinated nuts.

- **Contaminants** – Contaminants include solid foreign matters such as soil, pebbles, husks, cement dust or chemicals such as fuel, fertilisers, pesticide spillage, and other odourous materials as well as rat and insect droppings. Contaminants often occur during transportation (mix cargoes) on ships, vehicles and canoes as well as through soils, which can be source of fungi when unsanitary practices occur during cutting or splitting of nuts to extract the kernel for drying. This may also occur when potential contaminants are stored with the copra after drying

- **Quality of nuts used for copra** – Quality copra can only be produced from mature dry nuts that have not yet germinated. Some varieties of coconuts have more oil than others. It was confirmed by overseas copra millers that Solomon Islands Local Tall variety have more oil than hybrids and 'decorative' small yellow dwarfs often planted to decorate villages. Immature nuts are rubbery when dried and also have less oil. Germinated nuts that are advanced have less lauric oil as they changed into other forms of oil high in glycerin. Inclusion of nuts that were already split because they were left in direct sunlight over a few days before cutting or splitting to be dried

- **Copra cutting or splitting stage** – Unsanitary working environment where cut kernels or split nuts are not prevented from soil and dirt.

- **Copra making methods and practices** – Solomon Islands use two methods of making copra. The Western Region (Western and Choiseul provinces use the 'half-cup' method. This involves de-husking the nuts and then drying them using whatever drying methods they use before removing the drying kernel shell from the shell. The Eastern Region (the rest of the country) uses the 'finger cutting' method. This involves splitting the nuts with an axe and then scooping out the fresh kernel with a special 'copra knife' before transferring to the drier for drying. Both methods have their distinct pluses and minuses. The last method involves lesser tasks than the former but may affect quality because it the kernels are in too many pieces that may expose to more oxidation, reduction of oil content and inefficient drying because it will not allow hot air to freely move through the copra to dry it if the layer of copra is thick. It also results in the 'barbequed copra' where the lower copra layer is charred and/or burned compared to the top layer. To get good drying, the copra must be turned more regularly and/or reduce thickness of the copra layers on the drying bed. In the case of 'half-cup' method, drying is more efficient and surface area exposed to oxidation is relatively less than the other method. Feedback from Philippine copra crushers indicate that they prefer this method because it gave them more oil per tonne of copra crushed. However, it also has its down sides as well. It involves more activities handling heavier 'kernel-in-shell' (K-I-S) and then removing of the shell after 2 days of firing. In fact, it adds an extra 5.4 days of labour (for a total of 41.4 days) to produce a ton of copra compared to 36 days of labour are needed by the 'finger-cutting' method for a tone of copra. The other problem is that the miller will add another activity or machine to cut the dried 'half-cup' copra into smaller pieces for his chopping machine.

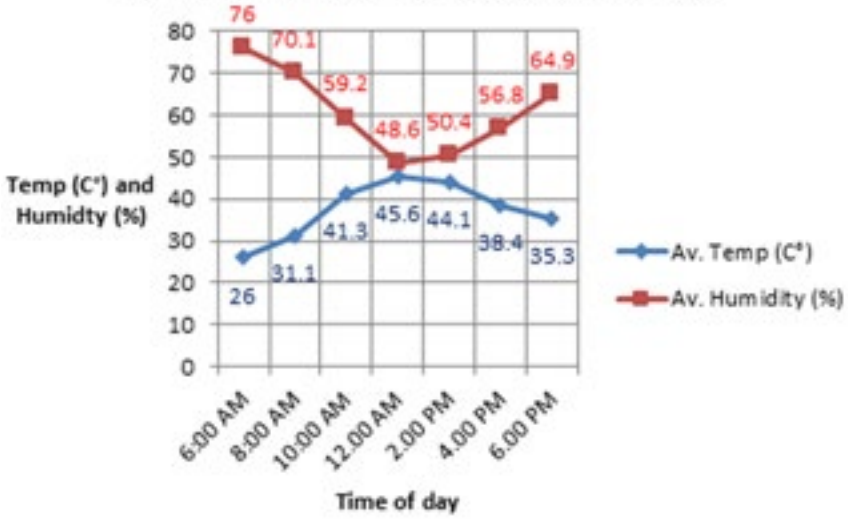
- **Copra driers and drying** – Solomon Islands copra producers use many methods and drier designs to dry their copra. They also combine the various methods and drier designs as well. The quality of their copra depends very much on the methods and drier design they use as well as the incremental incentives they receive for the perceived quality they think they produce. The main types of drying methods and drier designs used are summarised in Table 3.

Table 3: Drying method and drier designs used for copra making in Solomon Islands.

Drying method	Drier design used	Associated advantages and challenges
1.Sun-drying	(a) Freshly cut 'green copra' or split 'kernel-in-shell' (K-I-S) are placed in hot sand (as in Ontong Java and other atolls);	*Product is usually first grade under CEMA grading standards. Islands that have continued to achieve this are Ontong Java (Malaita outer islands), Lokuru and Baniata of Rendova Island in Western Province and to some extent, atolls in Temotu anda few other provinces.
	(b) Onto hot black volcanic graveled beaches on Rendova Island or other similar islands;	* Environmentally friendly – no firewood used *No smoky smell *White colour

Drying method	Drier design used	Associated advantages and challenges
	(C) Raised platforms with iron sheet flooring or even concrete slabs as in commercial plantations or medium sized communal holdings 	*Too dependent on how much sun-hours per day, no. of continuous sunny days (4–5 days at least) *Depends on the 'bedding material' (i.e. black volcanic gravel is more efficient than white porous, finer coral sand beaches. * At the mercy of rain * needs to be covered or moved to shelter during rain or at night-labour intensive.
2. Solar-drying  	Assisted sun-drying where special plastic is used to cover designed frame by manipulating the temperature and humidity within the drier to dry the copra. 	*Potentially high-quality first grade copra can be produced. *No firewood used *No smokey smell *white coloured copra *Expensive for small holder. In the case of cocoa, it costs $17,800 to the provinces, including freight and local costs. *Does not work well as the first 2 days of firing crucial for drying and prevention of mold. *Return to high humidity within the enclosed solar drier (see Figure 1) below. *May be used to finish off drying after 2–3 days after initial drying on hot-air drier.

Figure 1: Av. Temp and Humidity solar drier for 9 days



Drying method	Drier design used	Associated advantages and challenges
3.Copra 'motu' (umu)	This involves building a fire over stones. When the flames go out, trays or racks are put over the heated embers. Half-cup nuts are placed above the trays. Then the whole umu is covered with leaves. After a day or so the umu is opened and the copra kernels are separated from the shells. Then the 'motu/umu' process is repeated until the copra is dried. This method was first used by farmers from Gizo, Simbo and Ranongga in Western Province when CEMA stopped buying smoked copra in the 1980s.	*The end product is usually first grade and while coloured. Relatively no smoke. *Downside is that it can be done for small volumes, 1–3 bags (200–300 kg) at a time. *It is laborious and uses a lot of banana leaves and firewood.
4.Los Banos charcoal drier	This type of drier originated in the Philippines (Universty of Los Banos). It involves a drying bed about the size of 'kukum drier' but does not have the drum fire flue. Instead 2–4, 20-litre drums are used in which wood charcoals are burned and placed under the drying bed. The drying process continues until the copra is dry. To avoid charring or burning of copra during the drying period, flat iron sheets are hang above the burning drums. The charcoal drums are also moved from their positions regularly. The hanging flat iron also spreads the heat throughout the drier.	*Finished product is usually first grade and white although the copra still has a smoky smell. *Making charcoal to fill the drier is a challenge to producers.
5.Lauru charcoal drier	This method was used by some farmers on Choiseul Island. It is very similar to the Los Banos drier but differs because producers on this island use the half-cup method. Instead of making charcoal from wood, they burn the coconut shells in 2–4 half drums (200-L drums) and outside of the drier until the flames are gone. Then they move the charcoal embers filled half drums into under the drying beds. They repeat the process until copra is dry.	*Usually clean white copra – first grade. *Small batches of 1–3 bags (100–300 kg) batches. *Must reserve enough shells to start the next batch *High incidents of missing coconut shells!

Drying method	Drier design used	Associated advantages and challenges
6.Hot-air drier 	Many designs with different sizes. The most common design is the 'kukum' design, basically, using rejected 200-L drums as the fire kiln. Proper design includes jack-roof and walling of fire-box with bags soaked in cement and lined with black river stones on the flow to generate and conserve heat. 	*Relatively cheap and affordable for smallholders. *If well-constructed, properly oriented in layout, and drums regularly maintained, can produce first grade copra as well as other grades fit for export. Drums only last 6 months. *Key default is replacement of drums or use more expensive welded, thicker steel fire tube that can last at least 10 years. Cost, however, just for the welded fire pipe (16' long) is from $16,434–and11,800 for 12' long. *As with all driers, the volume of copra for the capacity that the drier is designed for must be maintained.
7. Modified CLIP cocoa drier 	Works on hot-air drier principal but is smaller and may be exposed to sunlight (roof-less). Uses welded, thinner steel piping for fire box. Has chimney. 	*Caters for small amounts of copra (i.e. 2–3bags at the most). * No smoke. * Can get first grade copra. *Welded piping not readily available. 

Drying method	Drier design used	Associated advantages and challenges
8.Others driers previously used in Solomon Islands for making copra but no longer used	*Ceylon drier uses line of coconut shells snaking on the floor under the drying bed. One end of the shell line is lit and the fire continues until the line is complete. (May be the manufacturers of mosquito coils stole the idea from our copra producers!) *Diesel fueled with hot-air blowers.	*Ceylon – Some smoke taint and smell and usually Grade 2 in Solomon Standards. Took more days to dry except when the drier housing is designed properly and constructed well. *Diesel fueled – Went out of fashion when large expatriate plantation closed. Usual first, second or even third grade, depending on thickness of green copra being dried and turning regime.
Recommended driers to produce high-quality copra to produce high-quality copra oil	The type and design of driers and the methods of drying affect the quality of copra and, subsequently, the quality of coconut oil that will be extracted. For high-quality copra for edible coconut oil, it is recommended that a combination of well-constructed kukum hot-air driers be used during the first two days of drying, followed by using a sun-drier orsun-assisted drier (solar drier) for the remaining days until the moisture level drops to 6–7%, or when the water line on the copra is lowest or absent.	

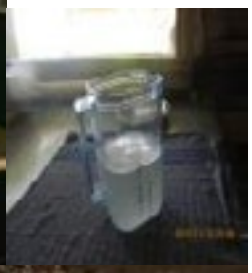
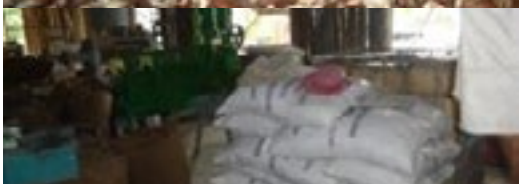
Copra quality assurance and management system

As was alluded to in the discussions above, the quality of coconut oil extracted at the mill depends very much on the quality of copra that is crushed to produce the oil and this depends on the drying methods and drier design used. However, other activities, inputs and investments by the stakeholders along the value chain also contribute to high quality coconut oil at the end. Therefore, any systematic ways or procedures that will assure quality for the next player along the value chain must involve the combined mutually beneficial efforts of all: from the growers, primary copra processors, traders, transporters, millers, wholesalers to retailers in the process of changing the products at their respective level. This is summarised in Table 4.

Table 4: Copra quality assurance for high quality edible coconut oil management system along the value chain.

Activity Level/ Stage	Actor(s)	Factors contributing to or considered to ensure quality copra and quality edible coconut oil	Illustrations (good and bad practices)
Farm or plantation	Growers	*Plant high-yielding, oil-rich coconut varieties; *Regular maintenance of plantation to get more; *Application of fertiliser or organic matter; and *Pest and disease management.	High yielding palm (L) and well maintained plantation 
Harvest and collection	Growers	*Collect only fully mature nuts for copra making; *No germinated nuts (sprouts); and *Monthly harvest cycle to prevent sprouts.	ungerminated nuts (L) and germinated nuts (R) 
Cutting or de-husking and splitting	Growers or nut buyers	*Ensure cut green copra or split half-cup nuts are placed on clean surfaces of banana leaves, fronds or plastics *Separate immature and germinated nuts from other mature nuts *Transfer green copra or split half-nuts to the drying bed within 8 hours of being cut *Green copra from germinated nuts are to be dried separately by partitioning on same drier or separate drier to be sold to bulk copra market	Split nuts on covered ground (L) and (R) on bare gound contaminated by dirt 

Activity Level/ Stage	Actor(s)	Factors contributing to or considered to ensure quality copra and quality edible coconut oil	Illustrations (good and bad practices)
Drying (depending on drier type)	Grower or nut buyer processor	*Ensure drier does not have leaky drums *Chimneys to draw smoke out *Enough firewood at hand to dry the copra *Green copra or half-cups should be stacked to depth and heights that allow efficient hot air-flow through the product *Firing cycle include cooling period between firing times * Turn the drying copra between firing times *In the case of half-cups, shells should be easy to remove from shell at day 2 or 3, depending on volume and firing *Check for dryness by water line level or with a moisture meter (probe) * Once dry, allow time to cool off before bagging	Drying copra smothered with smoke from drier without chimney  "Finger"-cut copra 
Bagging	Grower/ Processor	*Grade own copra (remove over-burned copra) *Use new clean jute bags or other suitable containers *Weigh dried copra as on farm weight	"Barbecued" copra- high moisture mixed with dirt 
Farm storage	Grower/ Processor	*Store in well-designed storage- well ventilated, permanent materials, secure, pallets, rat and insect proof	
Marketing/ Trading	Copra trader	*Grade copra and pay differential price for quality	
Transporta-tion	Transport provider	*Cover copra against rain, sea-spray or dust *Do not store or carry with other poisonous contaminants such as fuel, cement, chemicals	Copra transported to Honiara from provinces on ships 
Copra buyer	Miller	*Grade and pay price differential for quality *Use moisture meter to test moisture level *Weigh, pay and maintain record of each seller for future reference *Proper storage *Clean mill work floor *Use of pallets *Monitor consistency of quality from each seller, producer and grower	A simple moisture meter (probe) useful for measuring dryness of copra at the producers' farm 

Activity Level/ Stage	Actor(s)	Factors contributing to or considered to ensure quality copra and quality edible coconut oil	Illustrations (good and bad practices)
Copra crushing and milling	Miller	*Do not mix quality copra with low grade copra oil *Do not use same machine for low grade copra unless thoroughly cleaned of the inferior oil contamination *Use special oil storing containers to keep oil before selling or further value-adding *Proper filtration or sedimentation procedures in place *Grading and food safety certification of product such as hazard analysis and critical control points (HAACP) for product and premises *Product content labeling *Monitor moisture content, free fatty acid, afflatoxin and colour grade *Monitor quality of other byproducts of milling such as copra cake and copra meal	 Chottu 2 oil grades (left), virgin coconut oil (right) below.   
Additional value-adding or bulk selling to wholesalers	Miller	*Integrity of product labeling and branding *Use proper containers that does not allow oxidation of the oil *Monitor quality feedback on demand and complaints with the product from direct clients (wholesalers) and indirect clients (consumers)	
Repackaging and sale to retailers	Whole-salers and retailers	*Use proper and 'catchy-shaped' containers that will protect the quality of product *Use clean containers, not ones previously used for other products. Containers must be secure against leakage or contamination *Use attractive and informative label with specifications required by regulations *Labeling should include origin of oil *Include a 'use by' date *Include instructions on how to use and for what purpose *Keep records of purchase and sales of batches to monitor demand and monitor quality	

Activity Level/ Stage	Actor(s)	Factors contributing to or considered to ensure quality copra and quality edible coconut oil	Illustrations (good and bad practices)
End-user feedback	Consum-ers	*Compare price and quality of similar products from different sellers to get best value for money *Actively interact with seller by providing feed-back on quality products, packaging and effectiveness of claims made on the labels * Compare quality and demand between batches and let seller know	 Sophia Chottu visiting her wholesale buyer, Dorothy Ngaru at the Honiara Market

Agents and agencies that can facilitate copra and coconut oil quality improvement in Solomon Islands

While actors along the value chain are expected to maintain collective, mutually beneficial, self-regulatory action regarding quality of copra and coconut oil, other agents and organisations (and even programmes) exist from time to time, or are established permanently, in the country to help all actors along the value chain. This is summarised in Table 5.

Table 5: Copra and coconut oil quality standards and financing and development agencies and agents in Solomon Islands.

Agents and agencies	Services provided or ones that can facilitate
1.Ministry of Agriculture and Livestock	*General extension information and practical assistance to types of coconut to plant, husbandry, pest and disease control *Advice on design of driers, construction and use of drying procedures *Provide training on relevant courses to farmers, traders and millers *May have programs that directly assist actors and supporters along the value chain
2.Ministry of Commerce Industry Employment and Immigration	*General national guidelines policy on trading, manufacturing and exporting *Support /facilitation of SMEs and entrepreneurships *Facilitate registration of private companies, community companies, Cooperatives, associations, joint ventures, foreign investment through Company Haus *Market developments and promotion in the region and internationally *Labour, immigration matters and trade disputes settlements *Linkages with land purchase cooperatives to increase copra production *Facilitate registration of driers in collaboration with CEMA
3.Commodities Export Marketing Authority	*Responsible of quality standards for copra, coconut oil and other prescribed products as coconut is a prescribed commodity *Conduct inspection and grading of copra and coconut oil quality * CEMA lab can provide analysis for moisture, free fatty acid, colour bond for traded samples *Conduct copra quality and drier construction courses to farmers and traders *Advice on coconut product prices, potential buyers *Issue export licenses for coconut products *Provide domestic data on production by provinces Facilitate drier registration in collaboration with the Ministry of Agriculture and Livestock

Agents and agencies	Services provided or ones that can facilitate
4.Solomon Islands Chamber of Commerce and Industry	*Apex body for all businesses in Solomon Islands through membership *Assist with promotional links at regional and international trade fairs *Provides representation for industries in developing industry interests with Solomon Islands Government *Often entry and focal point for donor funded private sector development support
5.Ministry of Health and Medical Services	*Responsible for food safety policy and administration for processed or value-added food products *Food Safety Division is the internationally recognised Competent Authority for food products for export *Issues certificates for food safety, covering products and facilities *National collaborator for HACCP certifications for locally produced food products intended for export and domestic trade
6.National Laboratory	*Operated by the Ministry of Health and Medical Services to conduct medical and quality analyses for health and commercial purposes
7.PHAMA Program (DFAT) and New Zealand	*Australian regional market access opportunities for agricultural commodities including coconut products *Facilitate certification for food safety (HACCP) for food products and biosecurity access to importing countries to private businesses *Support promotion and market opportunity research for new coconut products in the region and elsewhere *Expected to extend for another phase (PHAMA Plus) for another 4 years starting July 2018 because of its current success
8.World Bank/DFAT Rural Development Program	*The program's agriculture component provides supports the supply component by linking and strengthening actors along the value chain with their lead partner (top actor) along the chain *Assist with tools, improved seed nuts, new or replanting for growers and transport, machines and facilities for the lead partner. * Assist entrepreneurs and local companies access commercial loans by under-writing the equity component of the loan proposal though its Support Equity Funding, which helped local companies to venture for their first loan with the commercial banks *Capacity building on all aspects of business and managing agricultural business is always included in any proposal to the project * Program phase ends by end of 2019 but is expected to be extended because of its success
9.Strongim Bisnis Project (DFAT)	*New 4 year Australian funded program focusing on 3 economic growth sectors, namely, Coconut, Cocoa and Tourism *Provide business support to private companies involved in the 3 sector industries
10.Commercial banks	*Provide normal commercial banking services including finance companies and entrepreneurs in developing the coconut industry *Partner with other donor funded programs to allow the 'less bankable' to access financial loans
11. Central Bank of Solomon Islands	*Administers the Solomon Islands Government's Small Business Guarantee Scheme in collaboration with commercial banks. The scheme underwrites 80% of the equity contribution expected from the applicant by the commercial banks

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