

# Objective 2

## Guide to Community Development of Estate Coconut Renewal Plans in South Pacific Island Countries

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### Coconut Veneer project

*Development of advanced veneer and other product from coconut wood to enhance livelihoods in South Pacific communities*



Australian Government  
Australian Centre for  
International Agricultural Research



UNIVERSITY of  
TASMANIA



Queensland  
Government



SPC  
Secretariat  
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Community

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## Scope

Coconut plantations are a valuable economic and social resource from many communities and private estates in South Pacific Islands. There are established and growing markets for coconut oil health products and goods manufactured from the coconut husk. While future markets for coconut wood veneer are yet to develop, increasing demand for all coconut products is likely (PARDI, 2011) and the present area of coconut plantations will need to be maintained to supply domestic and international markets into the future.

However, many palms in South Pacific coconut plantations are old and have lost much of their vitality and productivity. Known as senile coconuts, these palms provide only low nut yields. For example, a 25-year-old coconut may produce up to 35 nuts a year while a 60-year-old senile coconut may only provide 4 nuts.

A community or estate owner who manages senile coconut plantations has options for their palms. They can: keep their senile coconuts; replace the senile coconuts with new productive palms; intercrop between the new or existing coconuts; or replace the coconuts completely and move to another crop.

However, before a community or estate manager can make informed decisions about the use of their coconut plantations, an estate coconut renewal plan needs to be developed, discussed and agreed. Once agreed, it can then be implemented.

This guide is designed to assist communities develop their estate coconut renewal plan.

## Objectives

This guide aims to provide communities with a resource to assist them make strategic decisions about the future use and development of their coconut plantations, based on the plantation's current performance. It includes

- A framework for developing an estate coconut renewal plan. This includes:
  - Establishing the structure of the existing coconut plantation estate
  - Assessing the performance of the coconuts in the estate.
  - Encouraging a structured process for establishing community priorities for their coconuts.
- Resource information to assist plantation managers decide whether to retain, renew or replace their senile coconut palms.
- Example worksheets and checklists.

This guide complements the *Guidelines for Harvesting Coconut Palms in South Pacific Island Countries*.

## Assumptions and limitations

This guide is designed to complement and support technical information provided by local Departments of Agriculture. Communities should seek advice from local Agriculture support and extension officers about their plantation estates regularly.

This guide focuses strongly on the assessment and renewal of plantation coconuts. However, the diversity of estates and their arrangement means this guide can only provide broad advice.

The guide has limitations. It only covers the result of communities changing their senile coconuts for new palms. It does not intend to give guidance on establishing new coconut plantations. Also, it does not provide detail on rehabilitation choices. Some alternative production cropping system options include: replanting of coconut palms; replanting of coconut palms with inter-row cropping,

or inter-row stock grazing pasture, monocrop conversion, stock grazing pasture and multicropping. The benefits of each option should be discussed with local Agriculture officers.

### **About this guide**

This guide is part of the ACIAR-funded CocoVeneer project *FST/2009/062: Development of advanced veneer and other product from coconut wood to enhance livelihoods in South Pacific communities.*

The project team includes researchers and collaborators from the University of Tasmania's Centre for Sustainable Architecture with Wood (CSAW), the Queensland Department of Agriculture and Fisheries (QDAF) Innovative Forest Products Team, the Pacific Community (SPC), the Fiji Department of Fisheries and Forestry, the Samoan Ministry of Natural Resources and Environment, the Solomon Islands' Ministry of Forestry and Research, and industry in Australia and Pacific Islands. The project supports economic development in Fiji, Samoa and the Solomon Islands and includes activity in market and value-chain assessment, log harvesting, veneer production and product manufacture, and the development of viable uses for coconut residues at the harvest site or the production facility.

More information about the project is available at [www.cocowood.net](http://www.cocowood.net).



**Figure 1: Senile coconut stand in Fiji.**



## Using this guide

This guide aims to help community and estate managers develop a renewal plan for the coconut blocks on their estates. It has three sections:

### Section 1: Developing an estate plan for coconuts

This section describes the steps for establishing a renewal plan for the coconuts on the estate. It includes steps on:

1. Assembling the planning team and resource information.
2. Mapping the current estate.
3. Assessing existing coconut production.
4. Estimating the effects of renewing the coconut plantations.
5. Establishing community priorities.
6. Planning any harvest.

### Section 2: Resource information

This section provides resource information useful in understanding the behaviour of coconut palms and developing an estate plan for them. It includes parts on:

- Coconut palm productivity.
- Modelling of the impact of renewing coconut plantations.
- Finding additional information.

### Section 3: Worksheets

This section provides example worksheets and checklists that can be useful in developing the estate plan.



**Figure 2: Senile coconut stand in Samoa.**

## Section 1: Developing an estate plan for coconuts

There are six key steps to developing an estate plan for renewing coconut palms. These are to:

1. Assemble the planning team and resources
2. Map the current estate.
3. Assess existing coconut production.
4. Estimate the effects of renewing the coconut plantations.
5. Establish community priorities.
6. Plan your harvesting.

### Step 1: Assemble the planning team and resource information

A team of people needs to take responsibility for assembling the map, assessing the coconut blocks on the estate, discussing options, and presenting the result of this work to other members of the community. The team should include people of diverse age and with a range of skills.

### Step 2: Map the current estate

A useful plan for the coconut plantations on an estate needs to be based on a realistic evaluation of the structure of existing blocks of coconuts and factors that may influence future activity. The most effective tool for this is to prepare a drawn map of the estate. This map can be used to identify:

- The blocks of coconut palms.
- Areas of other crops, pasture and forest.
- The locations of roads, electricity lines and other service infrastructure.
- Areas important to the community for social and other reasons.

### Step 3: Assess coconut production

The number of nuts that a coconut palm produces changes with its age. Old or senile palms produce very few nuts each year. To estimate if particular coconut blocks are old and unproductive, the condition of the coconut palms on the estate need to be assessed for age and current productivity. This assessment can identify:

- The number of healthy and senile palms on the estate.
- The distribution of each type on the estate.
- The current productivity of nuts.
- Areas of pest or disease that can impact on production.

### Step 4: Estimate the effect of renewing the coconut plantations

Renewing a coconut plantation or block has impacts. Old coconuts have to be harvested, logs sold and the harvesting residues handled before new coconuts can be planted. The new palms then have to mature for long enough to produce useful nuts. These impacts have to be balanced against the benefit that younger, vigorous coconut palms can provide in increased nut productivity in the future. Using information in the Resource section of this guide, this step allows for an estimate to be made of:

- The number of logs available for sale at regular intervals.
- The likely impact (and increase) of nut production from the renewed estate.

## **Step 5: Establishing community priorities**

Coconut plantations are a community resource, and the community's priorities for this resource needs to be established and accommodated in any renewal plan. Community members have to discuss and agree to any process of harvesting and renewal. Surrounding communities may have the same opportunities and issues as your community. Areas of mutual issues should be discussed. Then, those responsible for action have to be appointed, the decisions recorded and kept safe.

## **Step 6: Planning any harvest and coconut renewal**

After community agreement, a draft harvesting and renewal schedule can be developed in a way that minimises impacts and maximises benefits. The first items in the schedule can then be implemented.





**Figure 3: Mature coconuts in Samoa**

## Step 1: Assemble the planning team and resources

A team of people needs to take responsibility for assembling the map, assessing the coconut blocks on the estate, discussing options for them, and presenting the result of this work to other members of the community. The team should include people of diverse age and with a range of skills. Involve local Agricultural extension officers in the process if they are available to help.

### Assemble the planning team

The planning team needs people of diverse age and with a range of skills who can work together to produce the estate coconut renewal plan. Ideally, separate groups of people can be assigned to:

- Collect the available resource information and prepare the map.
- Make the ground assessments of the coconut blocks and the surrounding land and infrastructure.
- Assess the results and brief other community members.

The community should choose the members of the overall planning team and appoint a *job captain* from the teams for each major task area. It is the *job captains'* responsibility to ensure that tasks in their area are conducted efficiently and completed on time.

### Establish deadlines

It is the community's responsibility to establish deadlines for preparing the estate coconut renewal plan and ensuring that these deadlines are kept. The length of time given to individual task should reflect the difficulty of the task, the size of the estate, and other responsibilities that the team members have. Deadlines should be realistic, reviewed regularly, and if needs be, flexible.

### Collect available resource information

Government agencies, private organisation, member of the community and those who have been associated with it may all have useful information about the estate. For example, land maps probably exist. Also, older members of the community may remember when coconut blocks were planted or have old photos of the estate. Others outside of the community may have been involved in coconut establishment or other activities on the estate and remember when things happened.

This information needs to be collected from wherever it is available and, if possible, copied or scanned. It is then available to use in the follow steps. Recollections from community members should be recorded in *Estate notes*. A standard *Estate note* is included in Worksheet 4.



**Figure 4: Productive coconuts in Fiji**

## Step 2: Map the current estate

A useful plan for the coconut plantations on an estate needs to be based on a realistic evaluation of the structure of existing blocks of coconuts and of other factors that may influence future activity.

The most effective tool to support this evaluation is a drawn map of the estate. This map can be used to identify:

- The blocks of coconut palms.
- Areas of other crops, pasture and forest.
- The locations of roads, electricity lines and other service infrastructure.
- Areas important to the community for social and other reasons.

Notes on the condition of plantations and other infrastructure can support the map and the planning. This map also provides much of the information and detail required to plan harvesting and other important activity about the estate.

### Preparing a map

Draw a map of the estate either by hand on paper or using a suitable computer program.

- The map should be no bigger than an A3 piece of paper. This size can be easily handled and copied.
- The map needs to be large enough to work with and show useful information, but small enough to handle and copy easily.
  - If the estate is large or in separate sections, make separate maps for each section.
- The map does not need to be exactly to scale, but some indication of scale, such as a scale bar, should be provided.
- Make drafts of the map first. Only start the final map when information about the features of the estate has been checked on the ground.
- It is possible to draw a base map first, copy it several times, and then put different type of information on separate copies. For example, one copy of the map may just show the roads and tracks, and another the coconut stands.

### ***Base information for the map***

Collect the base spatial information for the map by any combination of the following techniques:

- Measure the estate and draw the results.
- Obtain a hard-copy lands map of your area and adapt it. Vary the scale of this map by:
  - Expanding or shrinking the map on a photocopier.
  - Scanning the map and varying the scale in a suitable computer program.
- Searching for the estate on Google maps and capturing the screen image. This image can then be used or traced to provide a base map.
- Using geographic information system (GIS) software packages. These can produce customized maps of the estate with useful information included on overlays.

### ***General map inclusions***

The map should show the major areas of activity on the estate. It should be detailed enough to show the main estate features and be used to reference more detailed information about items such as blocks of coconuts palms. The map can show:

- Legal boundaries.
  - This should include the boundary of community land, and boundaries around community housing areas and between each coconut plantation, or farm block.

- Waterways.
  - This should include any beaches, lagoons, streams, ponds, dams, drains and designated catchments areas.
- Water crossing points.
  - This should include bridges, and stream and major drain crossing points.
- Roads, tracks and footpaths.
  - This should include public and private roads, service tracks and major footpaths.
- Reserved areas.
  - This should include any roadside, coastal vegetation, beach and forest reserves.
- Services and other infrastructure.
  - This should include underground water and sewage lines and overhead services lines, such as electricity and phone lines.
- Plantation and other cropping areas.
  - This should include their general areas, fence lines and access points.
- Buildings and yards
  - This includes areas for buildings, sheds, gardens and landscaping, and service yards. It is generally not necessary to show individual buildings.
- Areas with special ground conditions.
  - This is areas that are too steep or too wet or boggy to farm or drive on.
- Other areas important to the community.
  - This includes areas of historical or archaeological significance or features of community importance.

Ensure that each plantation coconut block is given an individual number on the plan. This will be used as a reference number in *Estate notes*, described below. Take photographs of the plantation blocks or items such as bridges, reserves and waterways to provide additional context for the map.

A checklist for the map (or maps) is included in Worksheet 5.

### ***Check the map***

Check the content of the map regularly against items as they appear on the ground.

- Official maps and Google images may be out of date or wrong.

### ***Protect the map***

Protect the draft and final map against damage. They are very valuable summaries of information.

- If it is a hand-drawn map, have the drawing scanned and then only use copies for day-to-day activities.
- If it is a computer drawn map, make copies of the master file and store these in a safe location. Then only use copies of the master file for day-to-day activities.

## **Estate notes**

*Estate notes* are simple written notes that record recollections or observations about the condition of important parts of the estate, such as plantations, a bridge, an access road, or a beachside reserve. They can provide more information about key parts of the estate than can be drawn on the map. They can also include photographs.

*Estate notes* should be referenced to items numbered on the map. For example, each coconut block on the plan should have a unique number. This number then becomes the reference for *Estate notes* about that coconut block.

A standard *Estate note* is included in Worksheet 4.

### Step 3: Assess coconut production

The number of nuts that a coconut palm produces changes with its age. Old or senile palms produce very few nuts each year. To estimate if particular coconut blocks are old and unproductive, the condition of the coconut palms on the estate need to be assessed for age and current productivity. This assessment can identify:

- The number of healthy and senile palms on the estate.
- The distribution of each type on the estate.
- The current productivity of nuts.
- Areas of pest or disease that can impact on production.

#### ***Before the assessment***

Before assessments begin:

- Each stand should be numbered and shown on the estate map. Where possible, the map should show surrounding roads and any service infrastructure.
- The assessment team should discuss and agree with other team members on how to count the individual palms. Generally, a corner palm is chosen as the place to start the count. Then, palms are counted in a set pattern: from either left to right, in a zig zag pattern (up one line and down the next), or in some other simple sequence.
  - Mark the start palm. This is important as another team may have to assess the block in future and want to start at the same spot.



**Figure 5: Preparing to access a coconut stand**

Before an individual assessment begins:

- The stand's performance should be discussed with community members who know it well. Often, a stand's senility and yield are only known by those who live nearby or who have been harvesting the coconuts. Two key points to determine during these discussions if possible are:
  - When the stand was planted (its age)
  - How many nuts are currently being produced during the year (its productivity).



- The assessment team should have copies of the plantation assessment form and draft maps of the stands and surrounding infrastructure.

## Assessing the coconut stands

Two people should conduct the assessment working together: one to assess the palms and the other to confirm the assessment and record it. They should change roles regularly.

### Confirm the details of the block

- Confirm that local boundaries, streams and reserves match the details on existing maps or on the prepared draft maps.
  - Note anything that is incorrect on the map so that it can be changed.
- Establish the initial plant-out dimension and pattern of the block and mark it on the map.
  - Plantation coconuts were generally planted in lines and at regular spacing.
- If the block is large, divide it into manageable sub-blocks and assess each separately.

### Assess the palms on the block

Assess each coconut block on the estate, using the Plantation assessment worksheet in Worksheet 3.

- Start the assessment at the agreed corner and progressing from palm to palm in the agreed patterns. Mark the start tree with paint or flagging tape.
- Assess each palm as one of the following types.
  - A **productive palm** is a growing palm or a mature palm, generally straight, with a crown of fronds and producing more than 20 coconuts every year.
  - An **ageing palm** is a mature palm, generally straight, with a crown of fronds and producing between 5 and 20 coconuts every year. These palms may be senile in 15-20 years.
  - A **senile palm** is a very mature palm, generally straight, producing about 5 coconuts or less every year.
  - A **fallen palm** may be standing but damaged or broken off and without a crown, lying on the ground or completely missing.
- Mark its conditions on the worksheet.
- Note and record any locations of significance, or areas and infrastructure that needs to be protected by a buffer zone or a reserve.
  - Mark these on the draft map.
- Check for areas of pest infestation or disease damage.
  - Mark any palms that are clearly pest or disease affected.
  - Note areas of pest and disease on the draft map.
  - Report any pest or disease outbreak to the local regulatory authority covering coconut pests and diseases.
- Complete other parts of the assessment checklist as required.

Lastly, photograph any important detail of the road and equipment access areas, and any services infrastructure. If necessary, complete an Estate note on each.



**Figure 6: Coconut stand with ageing and fallen palms**  
**Fallen palms include stems without fronds and those completely fallen over.**



**Figure 7: Record the condition of bridges and roads as they impact potential stem harvest.**

## **Summarizing the results**

Once each coconut block has been assessed, the results can be collected together and analysed.

- Enter the results of the individual block assessments in the table in Worksheet 1c.
  - Calculate the total number of palms of each type and total nut production in this table.
- Use the table in Worksheet 1d to calculate the percentage of low productive coconuts on the estate.

The estimated number of nuts per palm on a block with mostly productive palms should be higher than the estimated number of nuts per palm on blocks with a high number of ageing and senile palms. If they are not, check the blocks again.

## Step 4: Effect of renewing coconut plantations

Renewing a coconut plantation or block has impacts. Old coconuts have to be harvested, logs sold and the harvesting residues handled before new coconuts can be planted. The new palms then have to mature enough to produce useful nuts. These impacts have to be balanced against the benefit that younger, vigorous coconut palms can provide in increased nut productivity. Using information in the Resource section of this guide, this step allows for the community to:

- Plan a preferred replacement period
- Estimate the likely impact (and increase) of nut production from the renewed estate.
- Estimate the number of logs available for sale at regular intervals.

This step can occur at the same time as Step 5: Establishing community priorities.

- Community priorities will influence the choice of the replacement period and impact changes in log and nut production. The benefits of increased log and nut production will also influence community priorities.

### ***Before planning and estimating impacts***

Remember that this guide only provides broad advice on what will happen on any individual estate.

- The conditions and arrangement of the estate influences the final outcomes and this varies considerably from one estate to another.
- The quality of the information in the Resource section is limited to the quality of available research results.

Communities should seek advice from local Agriculture support and extension officers about their plantation estates regularly.

### **Plan a preferred replacement period**

Chose a replacement period for senile and other low productive palms that provides the community with the greatest benefit over time.

- The choice of a useful replacement period depends on the percentage of senile and other low productive palms on the estate.
  - The chosen replacement period influences the pattern of nut and log productivity into the future.
- Table 1 provides some guidance on useful replacement periods. It shows the replacement periods assumed for the estimates included in Section 2. In all cases, a percentage of the original amount of senile and fallen palms is assumed to be harvested every 5 years.
- Replacing all senile and other low productive palms at once is likely to impact nut production significantly and disrupt other important community activity, especially if the percentage of these palms on the estate is high.
- During the replacement period, some ageing palms will become senile, and some productive palms will start to behave as ageing palms. This means some unproductive coconuts will have to be replaced regularly to maintain a healthy and productive estate.

**Table 1: Modelled replacement periods for estate**

Percentage of estate palms senile	Modelled replacement period	Harvest frequency	% of low productivity palms harvested each occasion*
60	50	5 years	9%
60	25	5 years	15%
40	40	5 years	8%
40	20	5 years	13%
20	30	5 years	9%
20	15	5 years	12%
16	30	5 years	6-9%
16	15	5 years	11%

*Note. The percentage of senile palms harvested allows for the orderly harvest of palms that are currently senile and those that will become senile over the replacement period.*

## Estimate likely impact on nut production

Estimate the likely impact on nut production on your estate using:

- The summary information for total nut production for the estate in Worksheet 1c.
- The chosen replacement period and the change factors from the tables in Section 2.
  - For an estate with about 60% of senile palms, use the information in Table 7.
  - For an estate with about 40% of senile palms, use the information in Table 8.
  - For an estate with about 20% of senile palms, use the information in Table 9.
  - For an estate with about 16% of senile palms, use the information in Table 10.
- The table in Worksheet 2a.
  - Completing this table will provide a projection on the change in nut production.

A change factor in the table is the percentage decline or increase in nut production each year compared to the current production. For example, if current production is 200 nuts a year, and the change factor for the estate's production in 15 years is 1.13, the expected production in 15 years will be 225 nuts.

## Estimate likely log availability

Estimate the likely log available from your estate for each five year period using:

- The summary information for low productive palms for the estate in Worksheet 1d.
- The chosen replacement period and portions of palms harvested from the relevant tables in Section 2.
  - For an estate with about 60% of senile palms, use the information in Table 7.
  - For an estate with about 40% of senile palms, use the information in Table 8.
  - For an estate with about 20% of senile palms, use the information in Table 9.
  - For an estate with about 16% of senile palms, use the information in Table 10.
- The table in Worksheet 2b.
  - Completing this table will provide a projection of the number of logs available for harvest every 5 years.

To inform community discussion, repeat the process for other possible replacement periods.

## Worked example

Bale's community has a coconut estate near Savusavu in Fiji. It has 8 blocks of coconut palm. All eight blocks were originally planted with 150 coconut stems in each block in the 1960s. In 3 blocks, the coconuts were pulled out in about 1995 but then replaced with new coconut palms. The same stocking rate was used. These coconut palms are now only 20 years old.

Bale's community wanted to improve nut production and a team assessed the palms in each block. The summary of this assessment is included in Table 2 below. This table is also included in Worksheet 1 in Section 3 of this guide.

**Table 2: Summary of palm assessment on Bale's community estate**

Block No.	Number of palm on the block by type				Estimated no. of nuts /palm*	Estimated no. of nuts on the block / year
	<i>Productive</i>	<i>Ageing</i>	<i>Senile</i>	<i>Fallen</i>		
1			120	30	4	480
2			129	21	5	645
3	145			5	30	4,350
4	146			4	30	4,380
5	148			2	32	4,736
6			122	28	6	732
7			126	24	4	504
8			115	35	7	805
<b>Total</b>	<b>439</b>	<b>0</b>	<b>612</b>	<b>149</b>		<b>16,632</b>
Total standing palms on the estate <i>Add the number of productive, ageing, senile palms together.</i>				1,051		
Total palms on the estate <i>Add the number of standing and fallen palms together.</i>				1,200		

Given these results, the amount of low productivity palms on Bale's community estate can be estimated. This is shown in Table 3 below. The table is also included in Worksheet 1 in Section 3 of this guide.

**Table 3: Summary of low productivity palms on Bale's community estate**

Palms types	% Palms in the estate	
Percentage senile palms	51.00	<i>Divide the number of senile palms in the table above (612) by the total number of palms (1,200) then multiply by 100.</i>
Percentage ageing palms	0.00	<i>Divide the number of ageing palms in the table above(0) by the total number of palms (1,200), then multiply by 100.</i>
Total percentage of low productive palms standing	51.00	<i>Add the percentage of senile, and ageing palms together.</i>
Percentage fallen palms	12.42	<i>Divide the number of fallen palms in the table above (149) by the total number of palms (1,200), then multiply by 100.</i>
Total percentage of low productive palms	63.42	<i>Add the percentage of senile, ageing and fallen palms together.</i>



Bale and her friends want to know the change in nut and log production if their community agrees to replace all the senile and fallen coconut on the community's estate over a 25 year period. This means harvesting and replanting one block of coconuts every five years.

They use the table in Worksheet 2 in Section 3 of this guide and the change factors in Section 2 to calculate the likely change in nut production. Since the estate is 62% senile, they use the information in Table 7.

**Table 4: Likely change in nut production on Bale's community estate.**

Period	Projected change in nut production <i>Write the change factor for each period below.</i>	Estimated nut production <i>Multiply the change in nut production in each period by current nut production.</i>
Current est. production	1.00	16,632
After initial harvest	0.95	15,800
After harvest: Year 5	0.92	15,301
After harvest: Year 10	0.96	15,967
After harvest: Year 15	1.13	18,794
After harvest: Year 20	1.50	24,948
After harvest: Year 25	2.01	33,430
After harvest: Year 30	2.55	42,412
After harvest: Year 35	2.99	49,730
After harvest: Year 40	3.16	52,557
After harvest: Year 45	3.05	50,728
After harvest: Year 50	2.76	45,904



**Figure 8: Assessing a senile coconut stand**

To calculate the likely log availability, Bale and her friends use the table in Worksheet 2 in Section 3 of this guide and the change factors in Section 2 to calculate the likely change in nut production. Since the estate is 62% senile, they use the information in Table 7. Initially 15% of all palms will be harvested each year, equal to about one full block.

**Table 5: Likely log availability on Bale’s community estate**

Period	Portion of palms harvested <i>Write the portion of palms harvest for each period below.</i>	Log availability <i>Multiply the portion of palms harvest for each period by the current number of palms.</i>
Total standing palms		1051 currently standing
At initial harvest	16%	168 harvested
At harvest: Year 5	15%	158
At harvest: Year 10	15%	158
At harvest: Year 15	15%	158
At harvest: Year 20	15%	158
At harvest: Year 25	3%	32
At harvest: Year 30	3%	32
At harvest: Year 35	3%	32
At harvest: Year 40	3%	32
At harvest: Year 45	3%	32
At harvest: Year 50	3%	32

From this work, Bale and her friends know that there will be very little change in coconut supply during the first 15 years, but after that, coconut supply will increase each year to reach over three times current production. Also there will be about 150 logs produced every 5 years. These can be sold for processing or used in the community.

They can discuss these results with the rest of their community.



**Figure 9: A partially harvested block before rehabilitation**

## Step 5: Establishing community priorities

Coconut plantations are a community resource, and the community's priorities for this resource needs to be established and accommodated in any renewal plan. Community members have to discuss and agree to any process of harvesting and renewal.

### Inform the discussion

Collect the key information for the discussion. This should include:

- A map showing the coconut blocks and other major characteristics of the estate.
- The summary of the estate's productivity. This should include *the number and percentage of productive, ageing, senile and fallen palms*.
  - *The percentage of senile and fallen palms is particularly important.*
  - *The location of blocks with a high number of senile palms is also important.*
- Estimates of increased nut production and log availability for planned replacement periods.

Circulate the key information in a way that is easy for community members to understand.

- Make copies of the results and circulate those.
- Protect the final map and original calculations against damage.

Appoint a member of the planning team to record the discussions and decisions.

### Agree on the key points

The way things are discussed will vary between communities. Discussions may take a long time and additional information may be required.

Key points that should be agreed in each community include:

- The benefits of adopting an estate coconut renewal plan.
- The preferred replacement period.
  - This is the length of time taken to remove senile palms and establish a healthy and productive estate.
- The priority for renewing individual coconut blocks.
  - Only the first blocks for renewal need to be agreed initially.
- Areas on the estate that are important to protect during any harvesting operation.
- The members of the community responsible for further action.

The community may also consider the need to handle the increased productivity of nuts from renewed stands in the medium term.

### Discuss issues with surrounding communities

Surrounding communities may have the same opportunities and issues as your community. Areas of mutual issues can include:

- Protection or improvement of the waterways, reserves, roads or other infrastructure that services both communities.
- Sharing equipment and expertise.
- Coordination of log harvesting and marketing.
- Opportunities for joint processing of the additional coconut supply or harvesting residues.

These issues should be discussed early in the decision-making process.

## **Recording the decisions**

Record the community's final decisions.

- Update the estate map to show areas that are to be protected or reserved
- Note the preferred replacement period, the priority for block renewal, the community members responsible for further action, and other important decisions in the table in Worksheet 1e.

## **Step 6: Planning for harvesting**

After community agreement, a draft harvesting and renewal schedule can be developed in a way that minimises impacts and maximises benefits. A template is provided in Worksheet 1f.

The first items in the schedule can then be implemented.

## Section 2: Resource information

This section includes information on:

- The reported condition of coconut estates in three Pacific countries: Fiji, Samoa and the Solomon Islands.
- Assumed coconut palm productivity
- Modelling estate-scale changes.

### Pacific coconut estate condition

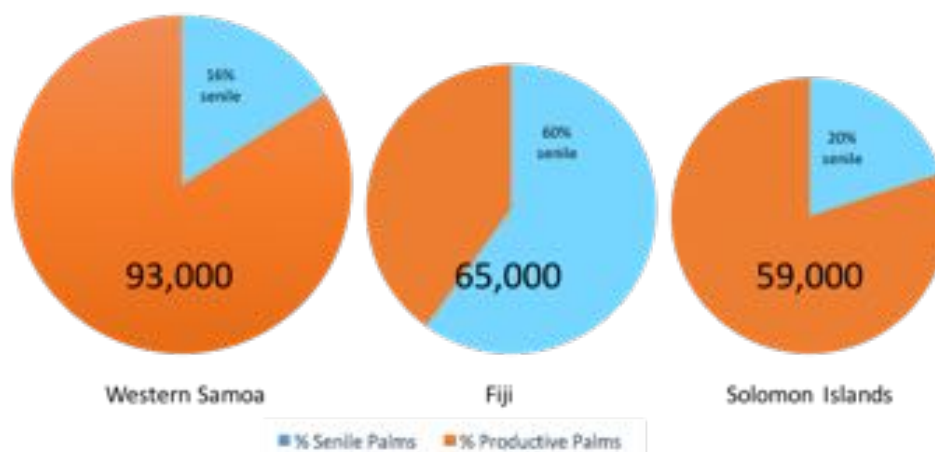
According to the most recent estimates in a report by the Food and Agriculture Organization (FAO) of the United Nations (2014):

- Fiji's coconut area is approximately 64,000 hectares of which approximately 60% or 39,000 hectares are already senile or over-mature.
- Samoa's coconut area is approximately 93,000 hectares and as these are relatively recent plantings only approximately 16% of the total estate is considered senile.
- The Solomon Island's coconut area is approximately 59,000 hectares. It is estimated that approximately 20% of the total Solomon Island's estate is now senile.

These figures are summarised in Table 6 and shown in Figure 1.

**Table 6: Estimated total areas of all and senile coconut palms in three Pacific countries**

	Fiji	Solomons	Samoa
Total area of coconut plantations (ha)	65,000	59,000	93,000
Percentage area of senile palms (%)	60	20	16
Total area of senile palms (ha)	39,000	11,800	14,880



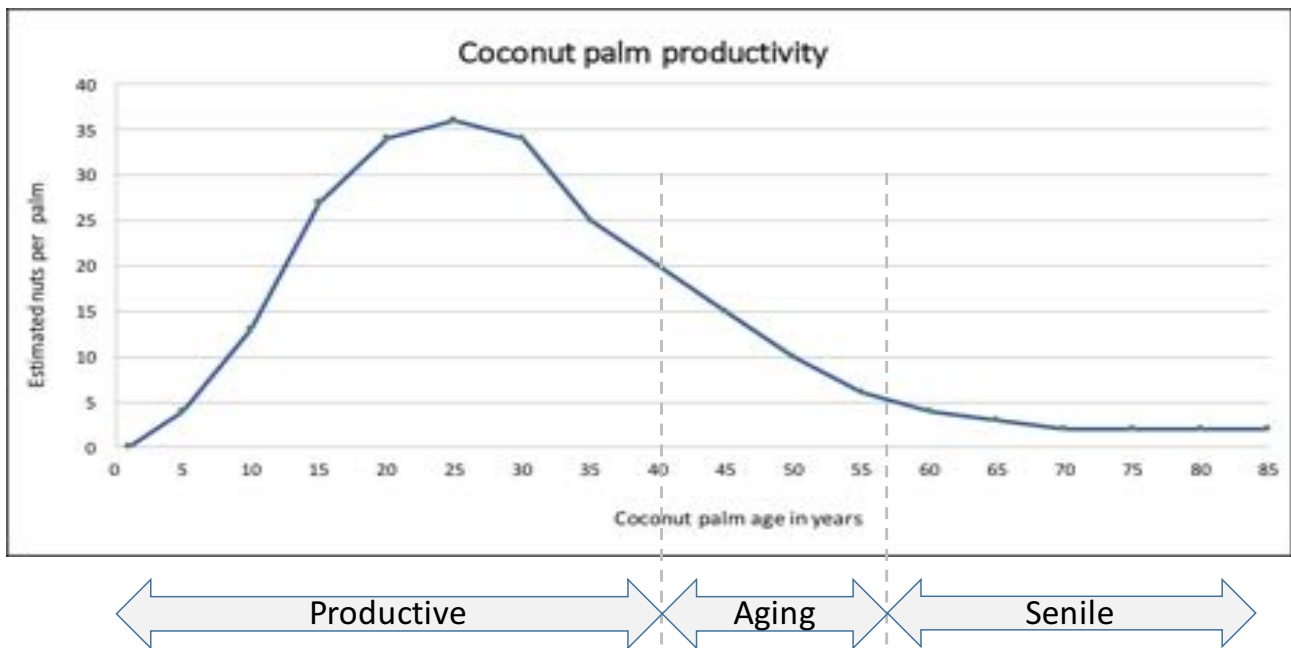
**Figure 10: Estate size and senility in three Pacific countries**

### Coconut palm productivity

Coconuts, like any living organism, have growth and productive, ageing and senile periods in their lives. Coconuts produce varying quantities of nuts during each of these periods.

While the actual nut productivity will vary with the coconut variety, site conditions and other factors, this report uses the estimated trend of coconut nut productivity published by Forstreuter (SPC, 2013) in its calculation. This trend is shown in Figure 11. This figure also shows the delineation used in the report between productive, ageing and senile palms.





**Figure 11: Trend of coconut nut productivity yields with palm age. Source: Forstreuter, SPC 2013.**

## Modelling estate-scale changes

Changes in nut and log production for estates with characteristic levels of senility and assumed renewal periods have been modelled, based on the coconut nut productivity trend shown in Figure 11. The conditions modelled were estates:

- 60% senile, with replacement periods of 50 and 25 years - matching Fiji
- 40% senile, with replacement periods of 40 and 20 years.
- 20% senile, with replacement periods of 30 and 15 years - matching the Solomon Islands
- 16% senile, with replacement periods of 30 and 15 years - matching Samoa

The estimated annual nut production and log production in a 5 yearly period in a standardised 20 hectare estates are shown graphically in the following figures. The modelling was also used to generate change factors for nut production and portions of logs harvested in a 5 yearly period. These results are included in the following tables

Key assumptions in the modelling include:

- Harvest events occur at 5 yearly intervals.
- Productive coconut palm plantations have a 60-year rotation period.
- 1/12<sup>th</sup> of palms in an estate will become senile every 5 years.
- All senile palms will be replaced with those of the same original productivity.

## Projections for 60% senile estates – 50 and 25-year replacement periods

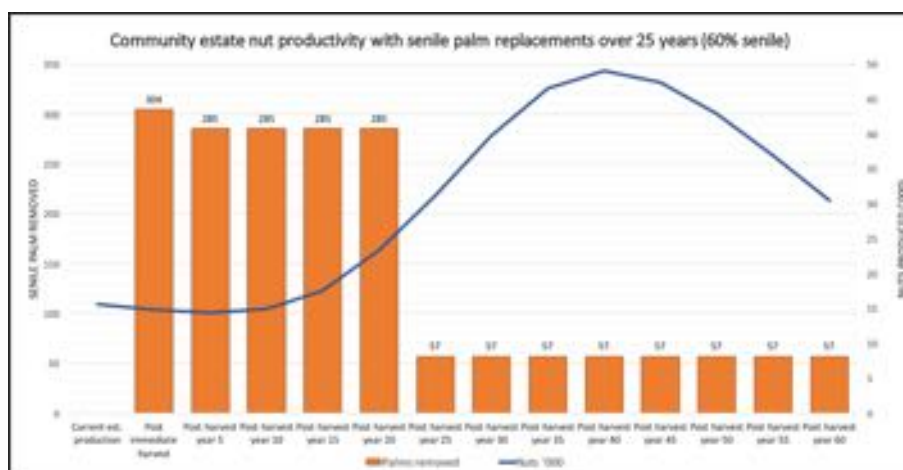


Figure 12: 20 ha plantation with 60% senility addressed over 25 years – matches Fiji.

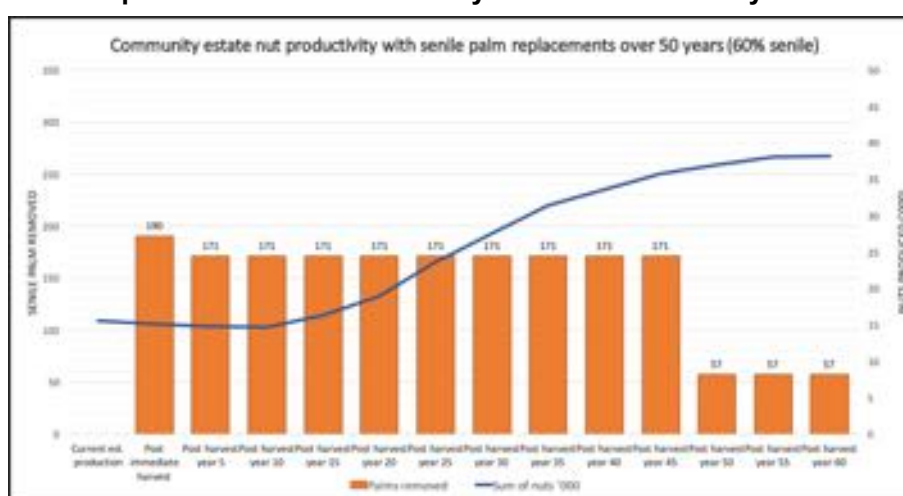


Figure 13: 20 ha plantation with 60% senility addressed over 50 years renewal – matches Fiji.

Table 7: Change factors and portion of palms harvested for 60% senile stands.

Period	Change factors for nut production		Portion of palms harvested	
	50 year replacement	25 year replacement	50 year replacement	25 year replacement
Current est. production	1.00	1.00		
After initial harvest	0.97	0.95	10%	16%
After harvest: Year 5	0.95	0.92	9%	15%
After harvest: Year 10	0.94	0.96	9%	15%
After harvest: Year 15	1.05	1.13	9%	15%
After harvest: Year 20	1.22	1.50	9%	15%
After harvest: Year 25	1.52	2.01	9%	3%
After harvest: Year 30	1.78	2.55	9%	3%
After harvest: Year 35	2.02	2.99	9%	3%
After harvest: Year 40	2.16	3.16	9%	3%
After harvest: Year 45	2.30	3.05	9%	3%
After harvest: Year 50	2.38	2.76	3%	3%
After harvest: Year 55	2.45	2.37	3%	3%
After harvest: Year 60	2.46	1.96	3%	3%

## Projections for 40% senile estates – 40 and 20-year replacement period



Figure 14: 20 ha plantation with 40% senility addressed over 20 years

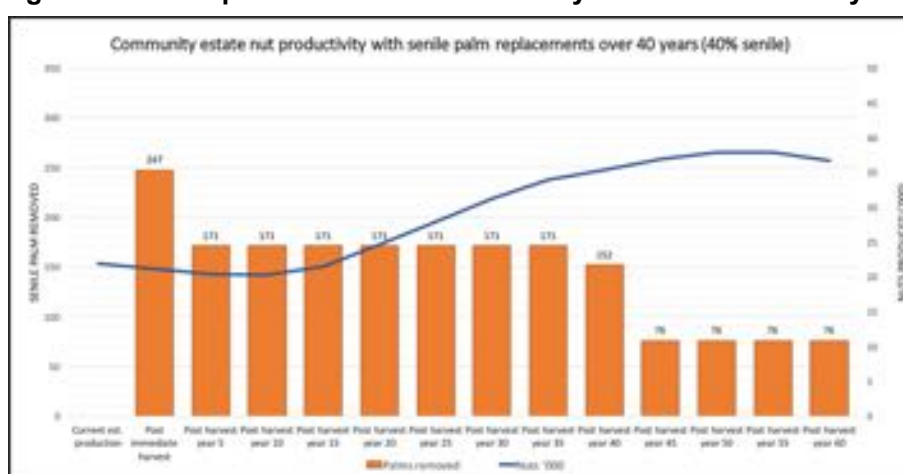


Figure 15: 20 ha plantation with 40% senility addressed over 40 years in a continuing 60 year coconut palm rotation – matches Solomon Islands.

Table 8: Change factors and portion of palms harvested for 40% senile stands.

Period	Change factors for nut production		Portion of palms harvested	
	40 year replacement	20 year replacement	40 year replacement	20 year replacement
Current est. production	1.00	1.00		
After initial harvest	0.97	0.97	13%	13%
After harvest: Year 5	0.93	0.92	9%	13%
After harvest: Year 10	0.93	0.93	9%	13%
After harvest: Year 15	0.98	0.98	9%	13%
After harvest: Year 20	1.13	1.15	9%	13%
After harvest: Year 25	1.28	1.40	9%	5%
After harvest: Year 30	1.43	1.68	9%	5%
After harvest: Year 35	1.55	1.91	9%	5%
After harvest: Year 40	1.62	2.01	8%	4%
After harvest: Year 45	1.69	1.98	4%	4%
After harvest: Year 50	1.73	1.86	4%	4%
After harvest: Year 55	1.73	1.68	4%	4%
After harvest: Year 60	1.68	1.46	4%	4%

## Projections for 20% senile estates – 30 and 15-year replacement period

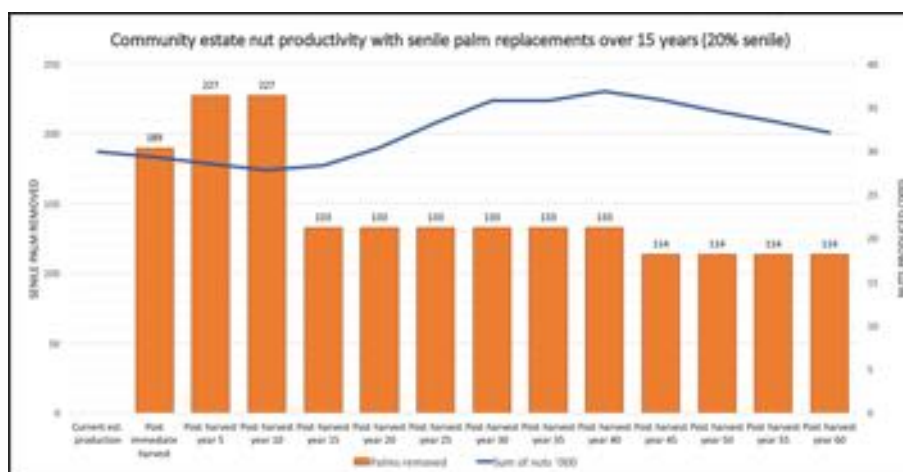


Figure 16: 20 ha plantation, 20% senility addressed over 15 years – matches Solomon Islands.

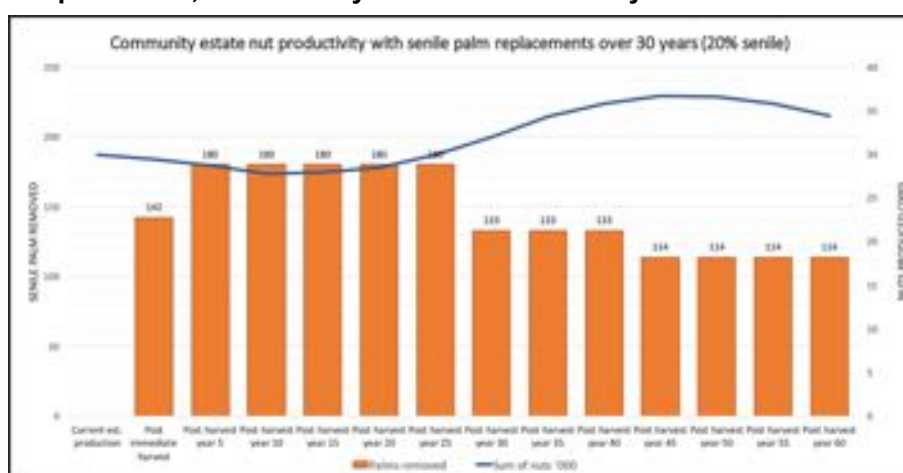


Figure 17: 20 ha plantation, 20% senility addressed over 30 years – matches Solomon Islands.

Table 9: Change factors and portion of palms harvested for 20% senile stands.

Period	Change factors for nut production		Portion of palms harvested	
	30 year replacement	15 year replacement	30 year replacement	15 year replacement
Current est. production	1.00	1.00		
After initial harvest	0.98	0.98	7%	10%
After harvest: Year 5	0.96	0.95	9%	12%
After harvest: Year 10	0.93	0.93	9%	12%
After harvest: Year 15	0.93	0.95	9%	7%
After harvest: Year 20	0.95	1.02	9%	7%
After harvest: Year 25	1.00	1.11	9%	7%
After harvest: Year 30	1.07	1.20	7%	7%
After harvest: Year 35	1.15	1.20	7%	7%
After harvest: Year 40	1.20	1.23	7%	7%
After harvest: Year 45	1.23	1.20	6%	6%
After harvest: Year 50	1.22	1.15	6%	6%
After harvest: Year 55	1.20	1.12	6%	6%
After harvest: Year 60	1.15	1.07	6%	6%

## Projections for 16% senile estates – 30 and 15 year replacement period

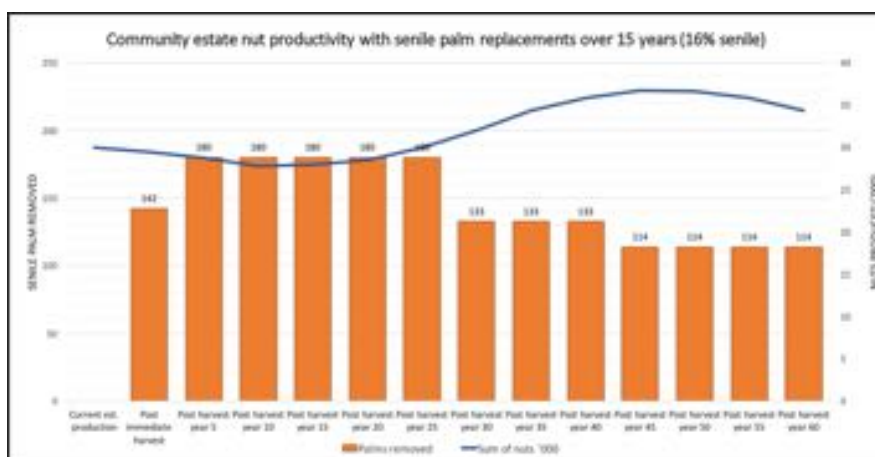


Figure 18: 20 ha plantation with 16% senility addressed over 15 years – matches Samoa.

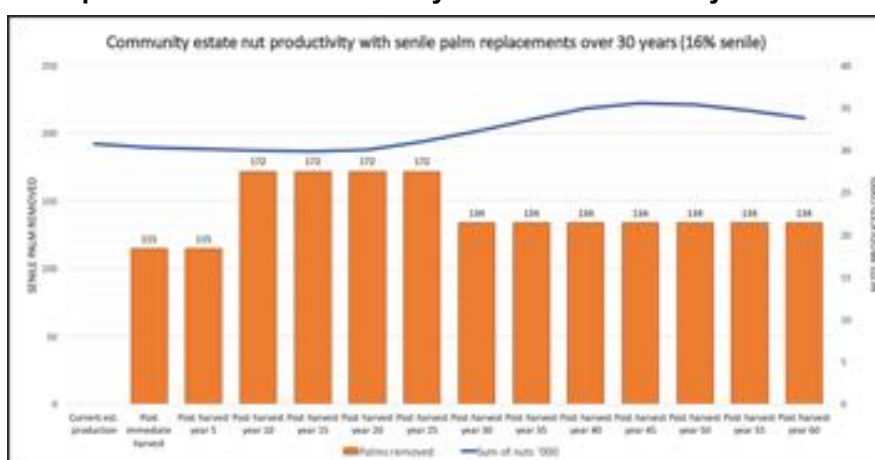


Figure 19: 20 ha plantation with 16% senility addressed over 30 years – matches Samoa

Table 10: Change factors and portion of palms harvested for 16% senile stands.

Period	Change factors for nut production		Portion of palms harvested	
	30 year replacement	15 year replacement	30 year replacement	15 year replacement
Current est. production	1.00	1.00		
After initial harvest	0.99	0.98	6%	8%
After harvest: Year 5	0.98	0.98	6%	11%
After harvest: Year 10	0.97	0.97	9%	11%
After harvest: Year 15	0.97	0.99	9%	7%
After harvest: Year 20	0.98	1.03	9%	7%
After harvest: Year 25	1.01	1.09	9%	7%
After harvest: Year 30	1.05	1.14	7%	7%
After harvest: Year 35	1.09	1.16	7%	7%
After harvest: Year 40	1.14	1.16	7%	7%
After harvest: Year 45	1.15	1.13	7%	7%
After harvest: Year 50	1.15	1.09	7%	7%
After harvest: Year 55	1.13	1.06	7%	7%
After harvest: Year 60	1.10	1.04	7%	7%



## Section 3: Worksheets

This section provides example worksheets that can be useful in developing the estate coconut renewal plan. The provided worksheets are:

- **Worksheet 1: Estate coconut summary.**  
This worksheet summarises the key information and results for the estate. It includes tables for the estate location, the condition of coconut stems and the decisions the community has taken about coconut renewal.
- **Worksheet 2: Modelling nut and log production impacts**  
This worksheet provides tables for modelling the impact of coconut estate renewal on coconut and log productions.
- **Worksheet 3: Block assessment worksheet**  
This worksheet can be used when assessing any block of coconut palms. It includes tables for information about the stand, the assessment of each palm and a summary of results.
- **Worksheet 4: Estate note**  
The worksheet provides a sample of an *estate note*. Use estates note to record recollections about the estate, or the condition or other information about roads and other infrastructure.
- **Worksheet 5: Map inclusion checklist**  
Use this worksheet to check the item on the estate map against the list of things that may be important.



Figure 20: Productive coconut stand in Fiji

## Worksheet 1: Estate coconut summary

This worksheet summarises the key information and results for estate. It includes tables for the estate location, the condition of coconut stems and the decisions the community has taken about coconut renewal.

### 1a: Estate name and location

Enter the name, address and other features about the estate below.

Item	Description
Estate name	
Community name	
Address	
Town	
Region / country	
Postal address	
Contact phone no.	

#### Additional information and notes


### 1b: Planning team member

Complete the list below with the names and roles of people in the planning team.

Role	Person
Planning team leader	
Assistant team leader	
Job captain: Mapping	
Job captain: Coconut assessment	
Job captain: (Other)	
Team member	
Team member	
Team member	
Team member	

### 1c: Summary of palm types and nut production on coconut blocks

Complete the table below with the results from the assessments of coconut palms and nut production on each coconut block.

Block No.	Number of palm on the block by type				Estimated no. of nuts /palm*	Estimated no. of nuts on the block / year
	Productive	Ageing	Senile	Fallen		
1						
2						
3						
4						
5						
6						
7						
8						
<b>Total</b>						
Total standing palms on the estate <i>Add the number of productive, ageing, senile palms together.</i>						
Total palms on the estate <i>Add the number of standing and fallen palms together.</i>						

### 1d: Percentage of low productive coconut palms.

Calculate the percentage of low productive palms on the estate using the figures from the table above.

Palms types	% Palms in the estate	
Percentage senile palms		<i>Divide the number of senile palms in the table above by the total number of palms then multiply by 100.</i>
Percentage ageing palms		<i>Divide the number of ageing palms in the table above by the total number of palms, then multiply by 100.</i>
Total percentage of low productive palms standing		<i>Add the percentage of senile, and ageing palms together.</i>
Percentage fallen palms		<i>Divide the number of fallen palms in the table above by the total number of palms, then multiply by 100.</i>
Total percentage of low productive palms		<i>Add the percentage of senile, ageing and fallen palms together.</i>

#### Additional information and notes


### 1e: Key community decisions

Record the key community decisions about the coconut renewal plan below.

Key decision area	Community decision
The preferred replacement period.	
Notes on areas to be protected.	<ul style="list-style-type: none"> <li>Note 1.</li> </ul>
	<ul style="list-style-type: none"> <li>Note 2.</li> </ul>
	<ul style="list-style-type: none"> <li>Note 3.</li> </ul>
	<ul style="list-style-type: none"> <li>Note 4.</li> </ul>
Priority for renewing coconut blocks ( <i>List</i> )	
Members responsible for further action ( <i>List</i> )	

#### Additional information and notes


### 1f: Coconut harvesting and renewal schedule

List the coconut blocks in the order of preferred harvest, their target harvest dates and target site renewal dates.

Coconut block no.	Target harvest date	Target renewal date

## Worksheet 2: Modelling nut and log production impacts

This worksheet provides tables for modelling the impact of coconut estate renewal on coconut and log productions. Begin by writing the chosen replacement period below.

<b>Chosen replacement period</b>	
----------------------------------	--

### 2a: Likely change in nut production

Estimate the likely change in nut production per year in the following table.

- Note the total current nut production for the estate in Worksheet 1c, and include it in the right hand cell of the row on Current est. production
- Write the change factors for nut production for the chosen replacement period for each harvest year in the centre column.
- Calculate the estimated change in nut production by multiplying the change factor for nut production in each period by current nut production.

The value for nut production is for each year.

**Table 11: Likely change in nut production**

Period	Estimated change in nut production <i>Write the likely change for each period below.</i>	Estimated change in nut production <i>Multiply the change in nut production in each period by current nut production.</i>
Current est. production		<i>(From Worksheet 1c)</i>
After initial harvest		
After harvest: Year 5		
After harvest: Year 10		
After harvest: Year 15		
After harvest: Year 20		
After harvest: Year 25		
After harvest: Year 30		
After harvest: Year 35		
After harvest: Year 40		
After harvest: Year 45		
After harvest: Year 50		

### 2b: Likely log production

Estimate the likely log production for each 5-year interval in the following table.

- Note the total number of standing palms for the estate in Worksheet 1c, and include it in the right hand cell of the row on Current est. production
- Write the portion of palms harvested for the chosen replacement period for each harvest year in the centre column.
- Calculate the estimated log availability by multiplying the harvest portion in each period by the total number of standing palms.

The estimated log availability is for each 5-year period.



**Table 12: Likely log availability**

Period	Portion of palms harvested <i>Write the portion of palms harvest for each period below.</i>	Log availability <i>Multiply the portion of palms harvest for each period by the current number of palms.</i>
Total standing palms		
At initial harvest		
At harvest: Year 5		
At harvest: Year 10		
At harvest: Year 15		
At harvest: Year 20		
At harvest: Year 25		
At harvest: Year 30		
At harvest: Year 35		
At harvest: Year 40		
At harvest: Year 45		
At harvest: Year 50		

### Worksheet 3: Block assessment worksheet

This worksheet can be used when assessing any block of coconut palms. First complete the information about the stand, then assess each palm individually. Finally, summarise the result.

<b>Coconut Stand No.</b>	
<b>Assessment date:</b>	
<b>Assessed by:</b>	
<b>Probable Stand Age</b>	
<b>Who established it</b> (if younger than 20 years)	
<b>Stand Species / variety</b>	
<b>Past nut productivity</b>	Note any special effects
<b>Current nut productivity</b>	Average nut/palm/year.
	Total nuts/year.
<b>Areas of significance in the stand.</b>	Reserves, infrastructure, etc.

Other notes on the stand


Describe the palm used to start the block assessment and assessment sequence


#### ***Palm descriptions.***

- A **productive palm** is a growing or mature palm, generally straight, with a crown of fronds and producing more than 20 coconuts every year.
- An **ageing palm** is a mature palm, generally straight, with a crown of fronds and producing between 5 and 20 coconuts every year.
- A **senile palm** is a very mature palm, generally straight, producing about 5 coconuts or less every year.
- A **fallen palm** may be standing but damaged or broken off and without a crown, lying on the ground or completely missing.

Palm No.	Palm condition				Palm No.	Palm condition			
	• Pro ductive	Ageing	Senile	Fallen		• Pro ductive	Ageing	Senile	Fallen
1					35				
2					36				
3					37				
4					38				
5					39				
6					40				
7					41				
8					42				
9					43				
10					44				
11					45				
12					46				
13					47				
14					48				
15					49				
16					50				
17					51				
18					52				
19					53				
20					54				
21					55				
22					56				
23					57				
24					58				
25					59				
26					60				
27					61				
28					62				
29					63				
30					64				
31					65				
32					66				
33					67				
34					68				

Total 1					Total 2				
---------	--	--	--	--	---------	--	--	--	--

### ***Palm assessment summary***

Copy the totals from the bottom of each column to the table below. Add these together to get the total of each type of palm for the stand.

Sheet	Totals	Palm condition			
		Productive	Ageing	Senile	Fallen
Sheet 1	Total 1				
	Total 2				
Sheet 2	Total 1				
	Total 2				
Sheet 3	Total 1				
	Total 2				
Sheet 4	Total 1				
	Total 2				
	Stand Total				

### ***Plantation assessment checklist***

Check the item on the coconut block map against the things listed below. Depending on the size of the block, not all items will be necessary.

<b><i>Plantation items</i></b>	<b><i>Included (✓)</i></b>
<b>Legal boundaries</b>	
<ul style="list-style-type: none"> <li>• The boundary of community land</li> </ul>	
<ul style="list-style-type: none"> <li>• Boundaries around community housing areas.</li> </ul>	
<ul style="list-style-type: none"> <li>• Boundaries between each coconut plantation, or farm block. <ul style="list-style-type: none"> <li>○ Number each block.</li> </ul> </li> </ul>	
<b>Waterways</b>	
<ul style="list-style-type: none"> <li>• Streams, ponds, dams and designated catchments areas</li> </ul>	
<ul style="list-style-type: none"> <li>• Plantation and farm block drains.</li> </ul>	
<b>Water crossing points</b>	
<ul style="list-style-type: none"> <li>• Bridges, and stream and drain crossing points.</li> </ul>	
<b>Photographs</b>	
<ul style="list-style-type: none"> <li>• Photos of the plantation block.</li> </ul>	
<ul style="list-style-type: none"> <li>• Annotation of the photos</li> </ul>	





## Worksheet 5: Map inclusion checklist

Use this worksheet to check the item on the estate map against the things listed below. Depending on the size of the block, not all items will be necessary.

Map items	Included (✓)
<b>Legal boundaries</b>	
<ul style="list-style-type: none"> <li>• The boundary of community land</li> </ul>	
<ul style="list-style-type: none"> <li>• Boundaries around community housing areas</li> </ul>	
<ul style="list-style-type: none"> <li>• Boundaries between each coconut plantation or farm block</li> </ul>	
<ul style="list-style-type: none"> <li>• Number each block.</li> </ul>	
<b>Waterways</b>	
<ul style="list-style-type: none"> <li>• Streams, ponds, dams and designated catchments areas</li> </ul>	
<ul style="list-style-type: none"> <li>• Plantation and farm drains</li> </ul>	
<ul style="list-style-type: none"> <li>• Water crossing points</li> </ul>	
<ul style="list-style-type: none"> <li>• Bridges, and stream and drain crossing points</li> </ul>	
<b>Roads and tracks</b>	
<ul style="list-style-type: none"> <li>• Main and access public roads</li> </ul>	
<ul style="list-style-type: none"> <li>• Private roads and service tracks</li> </ul>	
<ul style="list-style-type: none"> <li>• Footpaths and other community tracks</li> </ul>	
<b>Reserved areas</b>	
<ul style="list-style-type: none"> <li>• Roadside, coastal vegetation and beach reserves</li> </ul>	
<ul style="list-style-type: none"> <li>• Protected forest reserves</li> </ul>	
<b>Services and other infrastructure</b>	
<ul style="list-style-type: none"> <li>• Underground water and sewage lines</li> </ul>	
<ul style="list-style-type: none"> <li>• Any water treatment facilities</li> </ul>	
<ul style="list-style-type: none"> <li>• Overhead services lines such as electricity and telecommunications</li> </ul>	
<ul style="list-style-type: none"> <li>• Other service infrastructure</li> </ul>	
<b>Plantation and other cropping areas</b>	
<ul style="list-style-type: none"> <li>• Fences and access points</li> </ul>	
<b>Buildings and yards</b>	
<ul style="list-style-type: none"> <li>• Buildings, stores or sheds</li> </ul>	
<ul style="list-style-type: none"> <li>• Gardens and landscaping</li> </ul>	
<ul style="list-style-type: none"> <li>• Service yards.</li> </ul>	
<b>Areas with special ground conditions</b>	
<ul style="list-style-type: none"> <li>• Areas that are too steep to farm or drive on</li> </ul>	
<ul style="list-style-type: none"> <li>• Areas that are too wet or boggy to farm</li> </ul>	
<b>Other areas important to the community</b>	
<ul style="list-style-type: none"> <li>• Areas of community, historical or archeological significance</li> </ul>	
<ul style="list-style-type: none"> <li>• Any other features that the community agrees is important</li> </ul>	

## References

Food and Agriculture Organisation of the United Nations (FAO) Office for Asia and Asia Pacific Coconut Community- APCC (2014) Report of the FAO High Level Expert Consultation on Coconut Sector Development in Asia and the Pacific Region.

Forstreuter, W. (2013) Needs for and Status of Capacity for Pacific Coconut Resource Inventory Presentation by Wolf Forstreuter. Secretariat of the Pacific Community October 8th 2013. Suva, Republic of Fiji.

Pacific Agribusiness Research & Development Initiative- PARDI (2011) Coconut Value Chain Review Australian Government. Australian Centre for International Agricultural Research (ACIAR). ACT. Australia.



**Figure 21: Mixed age coconut stand**