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SMALLHOLDER COFFEE PRODUCTION IN PAPUA NEW GUINEA – FARMER TRAINING GUIDE

UNIT 3: HARVESTING AND PROCESSING COFFEE

MODULE 1:
COFFEE HARVESTING AND PROCESSING

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COFFEE HARVESTING AND PROCESSING

The Smallholder Coffee Production in Papua New Guinea Training Program

The training program contains modules prepared in partnership with the Australian Centre for International Agricultural Research (ACIAR) and by CARE-International. The structures of the Extension Officer Training Program and the Farmer Training Program are shown in the table below. Some modules also contain references to additional training that learners are encouraged to complete as part of their training.

Extension Officer Training Program

Title	Module reference
Introduction to smallholder coffee production in Papua New Guinea	ACIAR smallholder coffee production in Papua New Guinea Training Package
Extension Principles	
Introduction to the Coffee Extension Officer and Farmer Training Guides	ACIAR Extension Officer Guide Unit 1 Module 1
The extension officer - roles and effectiveness	ACIAR Extension Officer Guide Unit 1 Module 2
Knowing Your Farmers	
Getting to know our coffee smallholders	ACIAR Extension Officer Guide Unit 2 Module 1
What factors affect smallholder coffee production?	ACIAR Extension Officer Guide Unit 2 Module 2
Strongim grup: course facilitator guide	CARE Organisational Strengthening Training

ACIAR Resource

Monograph MN220 Smallholder Coffee Production in Papua New Guinea: a training package for extension officers and farmers. This package contains the modules for both the extension officer training guide and the farmer training guide.

The ACIAR monograph is available online from **www.aciar.gov.au/publication/MN220-PNG-coffee-manual-1**

Hard copies of the ACIAR training package may be available by contacting ACIAR or the Coffee Industry Corporation (CIC).

CARE Resources

Organisational Strengthening Training
CARE Family Money Management Training

The CARE modules are available online from **https://pngcdwstandard.com/resources-for-use-by-cdws-working-with-wards-communities-groups-and-smes**

Hard copies of the CARE modules may be available by contacting the CIC or CARE-International.

Farmer Training Program

Title	Module reference
Becoming a Coffee Farmer	
Knowing your coffee tree	ACIAR Farmer Training Guide Unit 1 Module 1
Coffee nursery development	ACIAR Farmer Training Guide Unit 1 Module 2
Establishing a new coffee garden	ACIAR Farmer Training Guide Unit 1 Module 3
Managing Your Coffee Garden	
Weed control	ACIAR Farmer Training Guide Unit 2 Module 1
Maintenance pruning and rehabilitation	ACIAR Farmer Training Guide Unit 2 Module 2
Shade management	ACIAR Farmer Training Guide Unit 2 Module 3
Drainage	ACIAR Farmer Training Guide Unit 2 Module 4
Pest and disease management	ACIAR Farmer Training Guide Unit 2 Module 5
Coffee berry borer management	ACIAR Farmer Training Guide Unit 2 Module 6
Soil fertility and nutrient maintenance	ACIAR Farmer Training Guide Unit 2 Module 7
Intercropping in your coffee garden	ACIAR Farmer Training Guide Unit 2 Module 8
Harvesting and Processing Coffee	
Coffee harvesting and processing	ACIAR Farmer Training Guide Unit 3 Module 1
Coffee grading systems and pricing	ACIAR Farmer Training Guide Unit 3 Module 2
Establishing a mini wet factory	ACIAR Farmer Training Guide Unit 3 Module 3
Coffee Marketing	
Understanding the domestic coffee market	ACIAR Farmer Training Guide Unit 4 Module 1
Kamapim ol praioriti	CARE Organisational Strengthening Training
Kamapim ol eksen plen	CARE Organisational Strengthening Training
Setim gutpela kastom bilong ronim grup	CARE Organisational Strengthening Training
Wok bilong meneja na memba na lida	CARE Organisational Strengthening Training
Coffee certification	ACIAR Farmer Training Guide Unit 4 Module 2
Fairtrade certification	ACIAR Farmer Training Guide Unit 4 Module 3
Family money management	CARE Family Money Management Training

CONTENTS

MODULE TOPICS

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- Improving livelihoods of smallholder families through increased productivity of coffee-based farming systems in the highlands of Papua New Guinea (ASEM/2008/036)
- Improving livelihoods of smallholder coffee communities in Papua New Guinea (ASEM/2016/100)
- Protecting the coffee industry from Coffee Berry Borer in Papua New Guinea and Australia (HORT/2018/194)

Most of the information provided in this module is from *The Papua New Guinea Coffee Handbook* (2nd edition), Coffee Industry Corporation Ltd, and the findings of ASEM/2008/036 and ASEM/HORT/2018/194.

INTRODUCTION

Aim of Module:

The aim of this module is to provide farmers with information on the best practices to use when harvesting and processing coffee in a coffee berry borer environment so that they obtain high-quality cherry and parchment coffee and receive the best possible prices.

The practices involved in harvesting and processing coffee are just as important as those required for growing it, particularly in a coffee berry borer (CBB) environment. To achieve the best returns for their hard work, farmers should harvest ripe cherry frequently to obtain the best quality. Timely and effective processing is then required to ensure the quality is maintained.

LEARNING OUTCOMES

By the end of this module you will:

- Know the optimum time to harvest coffee cherry
- Know the best way to harvest cherry, and arrange equipment and labour for this activity
- Understand how to process coffee cherry to produce high-quality parchment coffee
- Understand the benefits of using coffee pulp as mulch and as a source of nutrients in food and coffee gardens

LESSON PLAN

The module has three parts:

Sections 1.1 and 1.2	Preparing to harvest and process quality coffee
Sections 1.3 to 1.5	Harvesting, processing, drying and storing coffee
Section 1.6	Effective use of coffee pulp

TIME REQUIRED FOR PREPARATION FOR TRAINING: 1 WEEK

TIME REQUIRED FOR TRAINING: 7 DAYS

LIST OF SYMBOLS:

Information relating to CBB

Farmer notes, brochures & factsheets

Information for farmers that must be taken very seriously

For the Extension Officer

TEACHING AIDS:

- Farmer notes (one copy for each participant plus extra copies)
- The coffee calendar and stickers
- White board, coloured white board markers and white board eraser
- Coffee berries at different stages of maturity from underripe to overripe (Activity 1 and Exercises 1 and 3)
- Parchment coffee from cherries processed at different stages of maturity
- Coffee tree branches containing berries at different stages of development (two or three branches for each group) or coffee berries that can be observed in a coffee garden
- Coffee garden with cherries ready for harvesting
- Harvesting equipment: buckets/bags, holding hook (stick and rope)
- Coffee processing area, including a coffee pulper and fermentation bags
- Basins/buckets and clean water for floating harvested cherry
- Cherries to pulp and place in a fermentation tank (or other suitable receptacle) on Day 1 so that fermentation can be observed on Days 2 and 3
- Bag of recently harvested cherry
- Samples of fresh cherry, parchment coffee covered in mucilage, dried parchment coffee and green bean
- Samples of parchment coffee for classification: high quality (well pulped ripe cherries), regular quality (poorly pulped underripe cherries) and floaters
- Parchment coffee produced by pulping cherry with a stone or a hand pulper
- Parchment coffee produced by processing cherry with a demucilager, if available
- Parchment coffee at different levels of moisture content – farmers who have parchment coffee drying for 1, 3 and 5 days could be asked to bring small quantities for testing
- Moisture Content Dry Basis (MCdb) table (see Section 1.5)
- Fresh coffee pulp
- Composted coffee pulp

PRE-TRAINING ACTIVITIES:

- Confirm number of training participants
- Print sufficient copies of farmer notes (plus some extras)
- Print copies of the Moisture Content Dry Basis (MCdb) table (see Section 1.5)
- Arrange access to a coffee garden that has cherries ready for harvesting
- Arrange access to a coffee wet-processing area
- On Day 1 of training, pulp some cherries and place them in fermentation bags so that fermentation can be observed on Day 2 or 3
- Source all other teaching aids

PRELIMINARY ACTIVITIES

The farmers will complete two exercises prior to undertaking the module topics. These include the coffee calendar (if training hasn't been undertaken within the past 12 months) and the quiz. The purpose of these exercises is for the extension officer to assess the level of knowledge of farmers in the group prior to completing the module.

The coffee calendar

The coffee calendar lists the main events and activities occurring during an annual cycle of coffee production. The first item on the calendar is coffee berry development. All other activities are linked to the stage of development of coffee berries from flowering through to overripe cherry.

Annual coffee production events and activities (stickers)

1. Flowering and cherry development
2. Harvesting coffee
3. Pulping and drying coffee
4. Maintenance – weeding, pruning, mulching, shade management, digging and maintaining drains, and maintaining fences
5. CBB control measures

Using the stickers for each of the annual coffee activities listed above, work with the farmer group to attach them to the appropriate rows of the coffee calendar.

- Begin by attaching the progressive stages of coffee berry development from flowering through to bright red cherry ready for harvest, and overripe cherry.
- Complete the remaining sections linking each activity with the different stages of berry development
- For this module, integrate the activities relating to coffee harvesting and processing of cherry listed below

Harvesting and processing activities

1. If required, organise extra labour for harvesting
2. Identify the best time to harvest
3. Train labourers how to harvest cherry
4. Harvest cherry
5. Sell fresh cherry
6. Screen coffee cherry for defects (i.e. the float test and manual sorting)
7. Process cherry to parchment coffee
8. Store parchment coffee
9. Return fresh coffee pulp to the coffee garden as mulch, or compost coffee pulp
10. Use composted coffee pulp in coffee nursery beds, planting holes, vegetable gardens, etc.

Quiz

- Before beginning the module topics, ask the farmers to complete the quiz at the end of this module
- Repeat the quiz on completion of the module topics

Preventing spread of pests and diseases

- People and equipment can carry pests and diseases
- It is important that training participants do not spread pests and diseases within a coffee garden or to other coffee gardens

1.1 PRODUCING QUALITY COFFEE

Smallholder coffee farmers sell their coffee in the form of either freshly harvested cherry or parchment coffee. The most widely traded form of coffee by smallholders in PNG is parchment coffee. Parchment coffee is the term for dry coffee beans that are still wrapped in their endocarp – the protective layer that surrounds the bean (seed). Processors remove the protective layer to produce green bean which they then on-sell to coffee roasters.

The value of coffee green bean is based on cup quality. Coffee processors want to obtain the best possible price for their green bean and to do this they must process only good quality parchment coffee. The role of coffee buyers is to source coffee parchment that is **good quality and has few defects**. Good quality begins with only perfectly ripe red cherries being harvested.

Smallholder coffee farmers put a great deal of time and effort into producing their coffee crop, so it is important that they receive good returns for their work. The amount a buyer will pay a smallholder for either fresh cherry or parchment coffee is determined by its quality. To produce quality coffee, farmers must ensure that the best practices are adopted from the **start to the finish** of the production process.

Guidelines for producing high-quality coffee

The following are guidelines for producing high-quality coffee. Many of these are covered in detail in other modules in this training package.

Growing coffee

1. Suitable site selection and good site preparation for the coffee garden
2. Correct and timely establishment of shade trees, both temporary and permanent
3. Suitable coffee variety for the local area
4. High quality seed and seedlings
5. Thorough preparation of planting holes and good planting techniques
6. Effective soil and nutrient management and management of weeds, pests and diseases
7. Adoption and timely application of an appropriate pruning system

Harvesting, processing and storage of coffee

8. High-quality harvesting and processing of cherry
9. Clean and secure storage of parchment coffee

Previous training modules cover items 1 to 7, which are the steps involved in growing coffee. The coffee farmer must first establish a coffee garden and carefully maintain the coffee trees to ensure they are healthy and productive and produce good-quality cherry.

The next steps in the production process are harvesting and processing the cherry. These steps are just as important as those involved in growing the coffee. The cherry should be harvested when it is at **peak quality**, that is, when the cherries are **bright red and fully ripe**.

After harvesting, nothing can be done to improve the quality of the cherry or the beans within it.

The quality of the beans can deteriorate if the cherry is not harvested and processed using best practices. If farmers use the harvesting and processing practices recommended in this module the quality of their coffee will improve and they will be rewarded for their hard work with an adequate price. There is good global demand for Papua New Guinea (PNG) coffee, so if enough farmers follow these best practices, PNG coffee will gain a reputation for high quality.

Better quality coffee means better prices.

Coffee green bean grades and parchment coffee standards

Coffee green bean is graded on **cup quality** and further separated according to **bean size**. The number of **defects** is also part of the grading system used to classify coffee. Coffee green bean grades include A, B, Y, Y2 and Y3 (see Appendix 1). The higher grades, particularly A grade, require very controlled, uniform processing. Most smallholders produce parchment coffee capable of yielding Y-grade green bean.

Parchment coffee is assessed as being Class 1, Class 2 or Class 3. These classes are primarily determined by **colour**, but other measurements are also used, such as **moisture content** and **number of defects**. The classes also indicate the grade of green bean the parchment coffee is capable of producing. Classification is done by coffee processors, who purchase parchment coffee from coffee buyers.

Parchment coffee standards and pricing

Standard	Description	Maximum defects (per kg)	K/kg (August 2023)
Class 1	• Clean, sound, pale and even-coloured • Substantially free of visible defects • No off odours • Capable of yielding either A-grade or B-grade green bean	10 per kg	4.28
Class 2	• Clean, sound and pale-coloured • Some visible defects • Capable of yielding Y-grade green bean	70 per kg	3.50
Class 3	• Does not have an excessive number of visible defects • Capable of yielding Y2-grade green bean	150 per kg	not available

Source: PNG Standard 1626:2015. Pricing is based on average prices at the factory door in August 2023. In August 2023, the price received for Y2-grade green bean was around half of that received for Y-grade. For further information on grading and pricing of coffee green bean, see Appendix 1.

Aim for quality

- Better quality = better prices

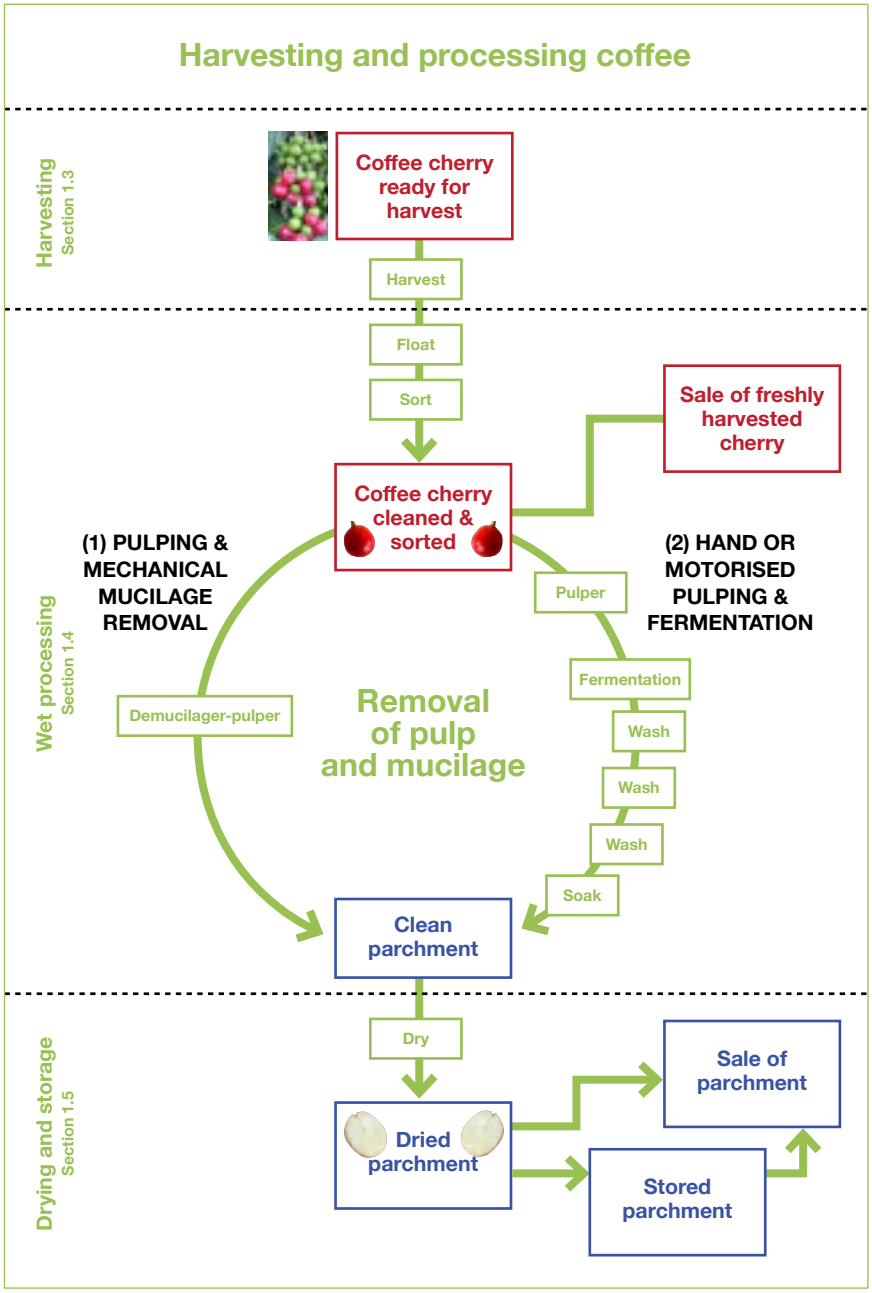
To produce Y-grade green bean, coffee processors require Class 2 parchment coffee. However, because of poor coffee processing techniques, the parchment coffee supplied by many smallholder farmers has a high rate of defects. If the rate is higher than 70 defects per kg, the parchment coffee will be classified as Class 3. This will result in the farmer receiving a considerably lower price for their product.

Parchment coffee standards allow growers of good-quality coffee to demand a higher price for their product. To achieve higher quality, and therefore, higher prices, farmers must:

1. Produce good quality cherry with minimum defects (defects can be caused by nutritional stress, insect damage or foreign matter, such as sticks and stones mixed in with the cherry)
2. Only harvest ripe cherry (any CBB-infested, overripe or raisin cherry should also be harvested and kept separate to ripe cherry to help manage CBB)
3. When processing the cherry to parchment coffee, float, sort, pulp, ferment, wash and dry the coffee correctly, so that the quality of the harvested cherry is maintained
4. Provide well-managed, pest-free storage conditions for parchment coffee

1.2 PREPARING FOR THE HARVEST SEASON

During the coffee harvest season, the ripe cherry is harvested from the coffee trees, processed, then dried ready for sale. It is a very busy period in the coffee calendar, requiring equipment and much harvesting labour.



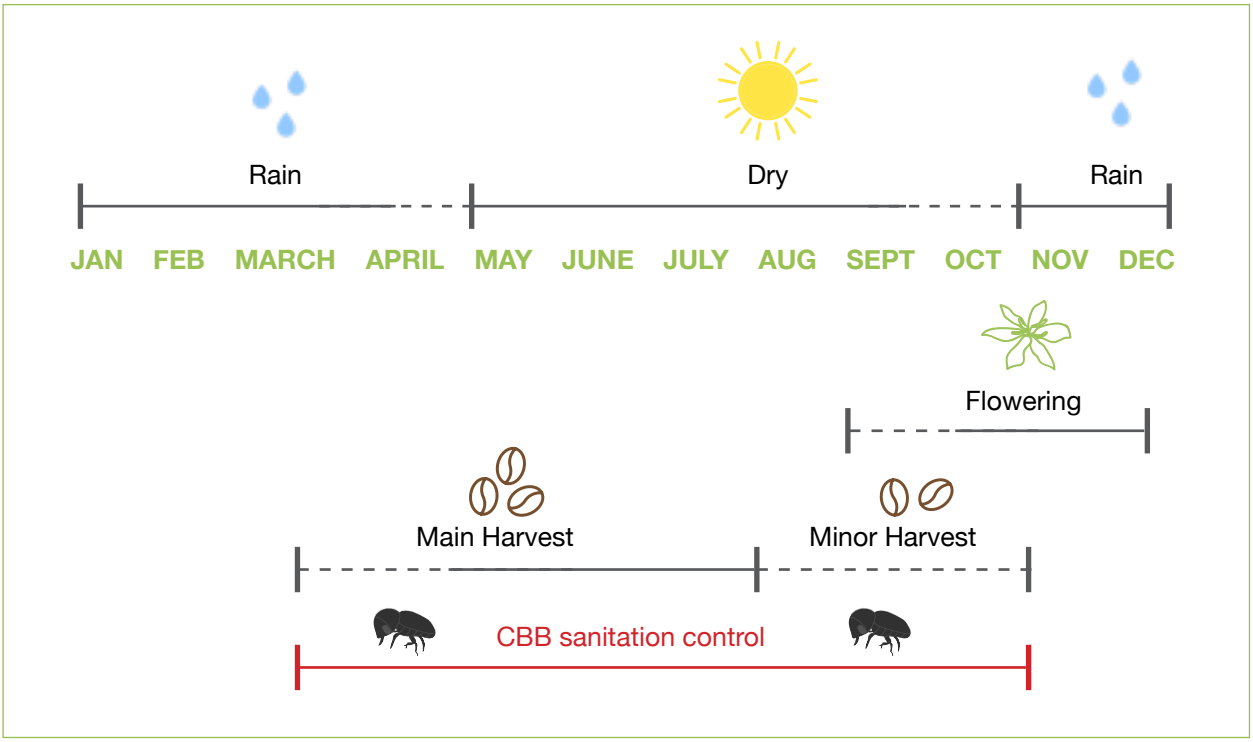
Coffee harvesting and processing steps using (1) a demucilager-pulper combination or (2) a pulper and fermentation

Timing of the harvest

The **timing of the harvest** is very important. It is critical to pick cherry at the right stage of development, because this is when it will be at its highest quality and value.

- Depending on seasonal conditions, coffee berries will take eight to eleven months to develop from flowering through to when the bright red cherries are ready to harvest
- Rain following a dry period will stimulate flowering – in PNG, some flowering can occur from September, with most flowering occurring at the start of the wet season (October to November in the Mt Hagen and Goroka areas)
- The main coffee harvesting period normally runs from May to July, but there is usually enough cherry ripening from March to October for additional harvesting

Coffee Flowering and Harvesting Cycle



Coffee flowering and harvesting cycle

Labour needs

Farmers must plan well before harvesting begins to ensure they have enough labour to both harvest and process their coffee crop.

When planning labour, it is important to remember that **all cherry must be processed on the same day it is harvested** to maintain quality. Effective and efficient harvesting and processing will improve the returns to farmers for their hard work.

Harvesting period

- It is better if harvesting is concentrated within a short time period so that labour is not allocated to this activity over an extended period. For this to occur, the period of flowering needs to be concentrated

- Minimising the flowering period is also an important mechanism in controlling CBB. The key to control the pest is to break its life cycle. An extended flowering period will mean an extended period of cherry production, providing continual habitat for the pest's survival. This means labour is required to continually harvest cherry over a long period to control CBB
- If the harvesting period is long, it will disrupt the allocation of labour to other important household tasks, including coffee garden maintenance, food gardening and other livelihood activities
- Other modules have detailed coffee management practices that can be adopted to shorten the flowering period. These practices include:
  - Establishing suitable permanent shade trees at the appropriate shade level
  - Adopting an effective system of pruning for both the coffee and shade trees

For further information, refer to Farmer Training Guide Unit 2, Module 2 'Maintenance pruning and rehabilitation' and Unit 2, Module 3 'Shade management'

Harvesting frequency

- Once harvesting begins, it is important to **harvest frequently** to minimise infestations of berries by CBB, which will reduce quality and price, and therefore income. Harvesting frequently also reduces the amount of cherry that becomes overripe, decreasing its value
- Coffee trees should be harvested **every two weeks** during the main harvesting period so labour should be available for this to occur. This practice is recommended:
  - To ensure only quality cherry is picked

  - As a control measure against CBB

Quantity to be harvested

- If the coffee trees are yielding well, you may require some additional assistance from family and friends with harvesting to ensure **frequent harvesting** when cherries are at their **best quality**

A smallholder family harvesting their coffee (*Source: Bob Kora*)

Training in good harvesting techniques

- If you are receiving help with harvesting from family or friends, it is important to train them at the beginning of the harvesting period in order to set quality standards for harvesting

Other crops

- Many smallholders also grow food crops for the household and for marketing. Consideration should be given to when these crops are planted so that the peak periods of labour demand for these crops do not clash with the coffee harvesting period

Cherry theft

Farmers may need to put measures in place to ensure the security of their coffee cherry in the field and during transportation.

1.3 HARVESTING COFFEE

When is the best time to harvest coffee cherry?

Coffee cherry does not ripen all at once. Several stages of development will be found on the same tree. It is important to pick **ripe cherry**. This is when the cherry is at peak quality and will attract a **higher price**. Ripe cherry is also heavier.

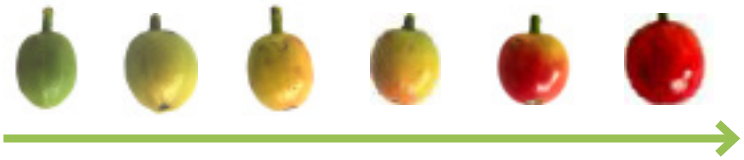
Cherry ripening stages					
Unripe berry	Yellow-green ripening berry	Orange-red ripening berry	Bright red ripe cherry	Dark red overripe cherry	Overripe/ raisin cherry
					

For effective control of CBB, it is recommended that all ripe (red) as well as overripe (purple-black) and raisin cherries are picked from the trees.

Coffee berries at different stages of development (*Source: Bob Kora*)

Ripe cherry

- As cherry matures it turns from green to yellow, then orange-red, and finally glossy red



- Cherry is ripe when it is **evenly red** all over. This is when it is at its highest value

- When cherry is ripe it is easy to pick (this will increase productivity and ensure better quality coffee)
- When cherry is ripe, the beans inside the cherry should pop out easily when squeezed between the thumb and forefinger

- The mucilage, or slimy coating around the beans, tastes sweet
- When pulped, fully ripe cherries produce clean white mucilage-coated parchment coffee
- Coffee at a uniform stage of ripeness will ferment evenly and allow more precise control over fermentation times

Overripe cherry

- As cherry continues to ripen, it turns purple then black and softens

- When overripe cherries are squeezed, the individual beans can be felt inside the fruit because the pulp and mucilage are gone
- Overripe cherries that have been left on the tree and dried are called **raisin** cherries. Raisins are light in weight and will float in water. Most will be removed prior to pulping

Overripe cherries are not suitable for processing because:

- Fermentation is already taking place inside the cherry
- The mucilage will taste rotten and will affect the flavour of the coffee
- The mucilage is dry, making pulping difficult and discolouring the parchment coffee
- The beans break during pulping and damage the machine
- Cup quality will taste sour, meaning the coffee will be defined as low quality and attract a lower price

Harvesting frequently will reduce the number of overripe cherries as well as help control CBB because overripe cherries contain the highest populations of CBB. Any overripe cherries should be picked into a separate bag so they do not devalue the good quality cherry.

Underripe cherry

If coffee cherry is picked before it is ripe, it will not ripen further after harvesting (unlike some other fruits such as banana, mango, tomato and pawpaw). Underripe green, yellow and orange berries should be left on the tree to mature, and picked during a later harvesting round. When ripe, they will be of higher value.

- When picked, unripe cherry often brings the stalk with it
- Underripe cherries will be bitter and contain smaller and lighter beans
- If the cherry is hard and the beans cannot be squeezed out, the cherry is too immature to pulp
- Very immature cherry is lightweight and will float in water. It should be removed prior to pulping
- Some underripe cherry will not float in water and therefore will make it through to the pulping stage of processing. Pulp on underripe cherry is very difficult to remove
- Unripe cherry often has to be removed by hand after processing. This adds to the processing costs, and these extra costs are deducted from the farmer's payment

Undeveloped cherry

If the coffee trees have suffered nutrient stress, the fruit may turn from green to reddish brown. These fruits are usually smaller than normal and probably contain immature, low-quality beans. They generally float in water and are removed prior to pulping.

Harvesting quality cherry

Cherries are at their peak weight, quality and value when bright red. More weight and better quality means more money.

Activity 1: Harvesting cherry

Using a selection of cherries at varying stages of maturity, separate them into four groups:

- Underripe (green)
- Almost ripe (orange-red)
- Ripe (red)
- Overripe/raisin (purple/ brown/black)

This will enable the farmers to clearly see which cherries are at the optimum stage of maturity for picking.

Show participants examples of parchment coffee processed from cherries belonging to each of the four groups above.

Reasons to only pick ripe cherry	
Advantages of picking fully ripe cherries	**Why you should not pick unripe cherries**
Only high-quality cherry is processed into parchment coffee by the farmer	The farmer receives less money for the cherry and labour is wasted in picking it
Farmers earn more money for ripe cherry	There are many 'floaters', which weigh less and reduce the farmer's income
Pulping is easier, quicker and less costly	They cause uneven fermentation, which reduces the quality of parchment coffee
There is less damage to the pulping machine	The beans break during pulping, which greatly reduces the famer's income, and can also damage pulpers
The quantity of floaters and overripe beans is minimised which means less 'cleaning' of the dry parchment coffee is required before sale	Parchment coffee from unripe cherries mixed in with parchment coffee from ripe cherries must be removed by hand by the buyer/processor, meaning farmers are paid less for their parchment coffee
If all coffee farmers were to pick only fully ripe cherry the reputation of PNG coffee would improve	It undermines PNG's reputation on the world coffee market
Coffee farmers' confidence in local and world markets is maintained because they are receiving a higher price for their coffee	Farmers lose confidence in the marketplace because they receive a lower price for their coffee

What is best practice when harvesting coffee cherry?

Following correct harvesting procedures is important for maintaining the quality and value of ripe cherry picked from the coffee trees. These include harvesting strategies to limit potential infestations of CBB.

Picking cherry from the trees

- Always pick cherry with your fingers
- Each cherry should be picked individually. Hold the cherry between your fingers and thumb, and pick with a twisting action to separate the cherry from the stalk
- **Do not strip-pick cherry** off the branches
- Start picking from the top of the tree, close to the main stem. Work your way outwards until you reach the end of the branch, then move down to the next branch. Be sure to check all branches for ripe and overripe cherry
- If the coffee trees are tall, use one hand to place a hooked stick over the branch being harvested and carefully pull the branch down within reach for harvesting with the other hand. If using a holding hook with a rope, both hands can be used simultaneously, each hand picking from either side of each branch
- Only pick **mature red cherries** and **overripe and raisin cherries**. Leave the green, yellow and orange berries on the trees to ripen further
- Remove **overripe cherries** during every harvesting round. Pick overripe cherries into a **separate bag** to save labour in sorting before processing
- When the bags are full, tie them off firmly and place them out of the direct sunlight to prevent uneven fermentation

Harvesting equipment

Holding hooks

Holding hooks can be made from tree branches to pull down tall coffee branches and bring them into reach for picking. The picker holds the branch with one hand and picks cherry with the other.

An alternative is to tie a rope to the end of the tall branch and attach it to a hook on the ground made from a stick. This allows the picker to pick cherry with both hands.

Buckets, baskets or picking bags

Large containers such as buckets or strong bags (e.g., bilums, rice or feed bags) are required for picking coffee cherry.

Extra bags may be needed to collect damaged, unripe, overripe or CBB-infested cherry.

Picking bags or buckets must be **thoroughly cleaned** prior to use. This is particularly important if they have been used in previous harvesting rounds and have contained raisin and/or CBB-infested berries.

NEVER use bags that have contained fertiliser or other chemicals.

Source: Allison, A. G., et al. (1987), In: Coffee Association of Malawi (2015) 'Handbook for Sustainable Coffee Production in Malawi', p. 98.

Picking bags

A picking bag can be made by placing a wire in the top of the bag and two stones in the sides of the top seam (with top seam rolled down on top) to keep it slightly open. It should hold 7–8 kg of cherry when it is full. This works best if it can be fastened with a belt or rope around the waist.

Ladder

If available, a ladder may be used for picking cherries from the high branches on tall coffee varieties. A ladder should only be used on level ground or in a position where stability can be assured.

CBB control

- Old coffee cherries (raisins) are reservoirs of CBB, harbouring several generations at once, so it is important they are removed. These cherries are also likely to fall off the trees and onto the ground during harvesting
- Avoid dropping cherries, because they are a target for CBB infestation
- Tying off bags stops CBB escaping and infesting other cherries

All ripe and overripe cherries must be picked during every harvesting round (*Source: Big Island Coffee Roasters*)

Pick all red ripe cherry and leave only green, yellow and orange berries on the coffee trees to ripen (*Source: Donna Chambers*)

Remove all overripe and raisin cherries from the coffee trees (*Source: Donna Chambers*)

Frequency of harvesting

- Cherries should be picked **every 1 to 2 weeks** during the flush period. With frequent harvesting there will be fewer overripe cherries to harvest in each harvesting round
- Frequent harvesting will **improve the quality** of each harvest. This is particularly important for farmers who want to access the speciality coffee market
- Regular harvesting will prevent CBB populations building up and interrupt the life cycle of the pest, which is the key to good CBB management

Pick every 1 to 2 weeks | Pick only ripe cherries | Leave green, yellow and orange berries on the tree

Efficient harvesting

- Good picking techniques in the field will result in less time sorting prior to processing
- If you have wantoks or hired labour helping with coffee harvesting, carefully monitor the quality of the coffee being picked by each picker. Also check that the coffee tree branches are not being damaged when pickers pull them down to harvest from them
- In a CBB environment, it is important to remove as much red-ripe and overripe/raisin cherry as possible during each harvesting round to prevent build-up of CBB. Check harvesting efficiency to ensure that this control measure is being adopted adequately
- To monitor the efficiency and effectiveness of pickers, assess a sample of five trees after a harvest round is completed:
  - Good and efficient harvesting is indicated by no more than five ripe or overripe cherries left on any one tree
  - Poor and inefficient harvesting is indicated by more than ten ripe or overripe cherries left on any one tree

Remember

Final bean quality cannot be improved once the cherry has been picked.

It is essential that a very high standard of picking is maintained.

Harvesting standard

- The goal is to pick all ripe and overripe/raisin cherries from the trees
- The harvesting standard is measured by the number of ripe and overripe cherries remaining per tree after a harvesting round
- Sample five trees that have just been harvested and count the number of ripe and overripe/raisin cherries left on each tree

Standard	Number of ripe and overripe cherries remaining on tree
Excellent	Less than 5
Good	5 to 10
Bad	More than 10

Assessing the quality of the harvested cherries

It is worthwhile for farmers to take some time to assess the quality of cherry being picked during harvesting as this will be an indicator of two important things:

- Whether the correct cherry is being picked (fully ripe, bright red cherry as well as overripe cherry)
- If there is a problem with the management of the coffee garden

A good test of quality is to work out the percentage of picked cherries that fall into the following categories:

1. Ripe
2. Underripe
3. Overripe
4. Floaters

Underripe cherries, overripe cherries and floaters are of poor quality and will be discarded or processed to produce lower quality parchment coffee. This means less money for the farmer.

Ideally, none of the categories of poor-quality cherry will make up more than 3% of the total harvest. If that is not the case, the farmer may need to take immediate action to improve harvesting efficiency and/or long-term action to improve management of the coffee garden.

Over 3%	Possible cause	Recommended action
Underripe	The pickers are being careless and picking green berries	Closer supervision of harvesters may be required
Overripe	The period between harvests is too long	Identify the cause of the problem and address it
	Harvesters are missing ripe cherry in earlier harvesting rounds	
	Overripe cherries are not being kept separate to ripe cherries	
Floaters	The garden is not being managed correctly. Floaters are usually the result of over-production and a lack of nutrition. This may be because: • the coffee trees have too many uprights • the coffee trees do not have enough shade	Refer to Farmer Training Guide Unit 2, Module 2 'Maintenance pruning and rehabilitation' and Unit 2, Module 3 'Shade management'
	Cherries are infested with CBB	Improve garden sanitation. Harvest frequently and efficiently

Calculating the percentage of each category

- Put at least 100 harvested cherries into a bucket of water
- Scoop out the floaters and place them in a pile
- Scoop out the cherries that sank and sort them into three separate piles based on ripeness
- You will now have four piles of cherries:
  1. Ripe
  2. Underripe
  3. Overripe
  4. Floaters
- Count how many cherries are in each pile
- Add the numbers to work out the total number of cherries in your sample
- Calculate the percentage of cherries in each category using this formula:

$$\frac{\text{No. of cherries in the category}}{\text{Total number of cherries}} \times 100$$

Worked example

Category	Number	Calculation	Percentage
Ripe	106	$\frac{106}{120} \times 100 = 88$	88%
Underripe	8	$\frac{8}{120} \times 100 = 7$	7%
Overripe	4	$\frac{4}{120} \times 100 = 3$	3%
Floaters	2	$\frac{2}{120} \times 100 = 2$	2%
Total	**120**		**100%**

Harvesting hygiene and CBB

- Ensure all harvesting equipment is clean, including bags, baskets and buckets
- CBB can escape from harvested coffee and re-invade the coffee trees, so immediately after filling, close all bags and tie firmly
- Keep harvested cherry away from CBB-free coffee trees
- Destroy all badly CBB-affected, overripe and raisin cherries
- Transport or process the cherries as soon as possible
- Cover loads or stockpiles

After harvesting your cherry

Coffee cherry can be sold as **freshly picked cherry**, or processed and sold as **parchment coffee**. Either way it is important to sell or process it without delay to prevent deterioration in its quality.

Freshly picked cherry

- Processors will pay more for clean, ripe freshly picked cherry that has been harvested that same day. A premium of up to one-third for cherry over parchment coffee has been recorded in the past
- Not having to spend time processing cherry also gives farmers more time for further harvesting, coffee garden maintenance and other livelihood activities

Parchment coffee

- Processing cherry to parchment coffee requires more work and equipment. Cherry quality declines rapidly after harvesting, so cherry must be pulped on the **same day** it is picked
- Farmers in remote areas may be unable to sell their cherry to town processors, so processing it to parchment coffee is their only option
- The majority of farmers, regardless of their location, prefer to process their cherry to parchment coffee. There are two main advantages of producing parchment coffee:
  - It can be stored for up to four months, allowing farmers time to build up the number of bags they have and arrange transport to town buyers
  - While the coffee is being stored, a better price can be negotiated with buyers

Final harvesting round

- In a CBB environment, strip-pick all remaining cherry from the trees during the final harvesting round of the coffee season. Strip-pick the coffee trees by pulling the branches through your hands to remove all cherry, including immature, ripe and overripe cherries
- Leaving cherry on the coffee trees after the final harvest provides habitat for CBB to breed. It is crucial to remove all cherries to break the CBB's breeding cycle, thus preventing it from continuing into the next coffee season
- End of season strip-picking will give farmers more quality cherry at the start of the next season
- The cherry harvested will include slightly underripe and overripe cherries. These can be sorted during processing and sold separately as lower-grade parchment coffee. Other underripe and overripe/raisin cherries should be destroyed to prevent infestation by CBB
- At the end of the coffee season, it is important to prune the coffee trees. Pruning makes future harvesting easier, which is particularly important for CBB control, and also improves quality and yield. *For further information, refer to Farmer Training Guide Unit 2, Module 2 'Maintenance pruning and rehabilitation'*

During the final harvest of the season, pick all green, yellow, orange, red-ripe, overripe and raisin cherry.

LEAVE NOTHING.

Objective:

To identify when coffee cherry is fully ripe and quality is at its peak

You will need:

Ideally it would be best to conduct this exercise in a coffee garden that is currently being harvested. If this is not possible, use coffee tree branches containing berries at different stages of maturity (underripe through to overripe). You need two or three branches for each group

EXERCISE 1

Identifying peak-quality coffee cherry

Practical activity

1. Ask the farmers to divide into small groups
2. Ask the farmers in each group to:
   - Look closely at the berries on the branches and decide which are:
     - fully ripe and top quality
     - underripe
     - overripe
   - Carefully pick the fully ripe cherries
   - Take a handful of the ripe cherries and note the weight
   - Squeeze the ripe cherries to see if the beans pop out easily
   - Taste the cherry. Is it sweet?
3. Now pick the underripe and overripe cherries and place them in separate piles
4. Take a handful and compare the weight to the ripe cherries. How does their weight compare with the ripe cherries?
5. Squeeze the underripe and overripe cherries. Do the beans pop out easily?
6. Taste the underripe and overripe cherries. Do they taste sweet?

Discussion

7. Why is it important to pick only ripe bright red cherry and overripe cherry during a harvesting round and not strip-pick the branches?
8. Why might several rounds of harvesting be required to pick peak-quality cherry?
9. Why should overripe cherry removed during each harvesting round be placed in a separate bag to the good quality cherry?
10. Why is removal of overripe cherry an effective sanitation method for CBB control?

Demonstration

If conducting this exercise in a coffee garden, ask the farmers to harvest some of the trees.

11. Demonstrate how best to pick the cherry
12. Demonstrate how to make and use a hook to carefully pull tall branches down and make them easier to pick from

Objective:

To understand why the coffee trees should be strip-picked during the final harvesting round of the coffee season

EXERCISE 2

Crop sanitation at the end of the coffee season

Discussion

1. Discuss the importance of crop sanitation in general as a tool for pest and disease control
2. Discuss how strip-picking berries at the end of the coffee season will remove habitat for pests and diseases and so reduce the risk of attack. Remind farmers that strip-picking should only be practised during the final harvesting round of the coffee season, not during regular harvesting rounds
3. Emphasise the importance of strip-picking at the end of the coffee season as a strategy for CBB control. CBB populations in old cherries can be very high and if left on the coffee trees the pest will survive until the next coffee season. This will lead to very high CBB numbers, and lots of CBB-damaged cherries, in the first harvests of the next season. A strip-pick at the end of the season will reduce the incidence of pests and diseases, including CBB

1.4 PROCESSING CHERRY

Processing cherry to parchment is a **very important step**. It must be done correctly to ensure the quality of the harvested cherry is carried through to the parchment coffee stage. This will preserve the quality of the coffee and help farmers receive a higher price.

Maintaining quality during processing


"To maintain coffee quality and value, it is important that smallholders carefully follow the best practice recommendations for processing cherry to parchment coffee. PNG is recognised as growing some of the best quality coffee in the world but once it is harvested, quality is lost during every stage of processing." Joeri Kalwij, NGHCE

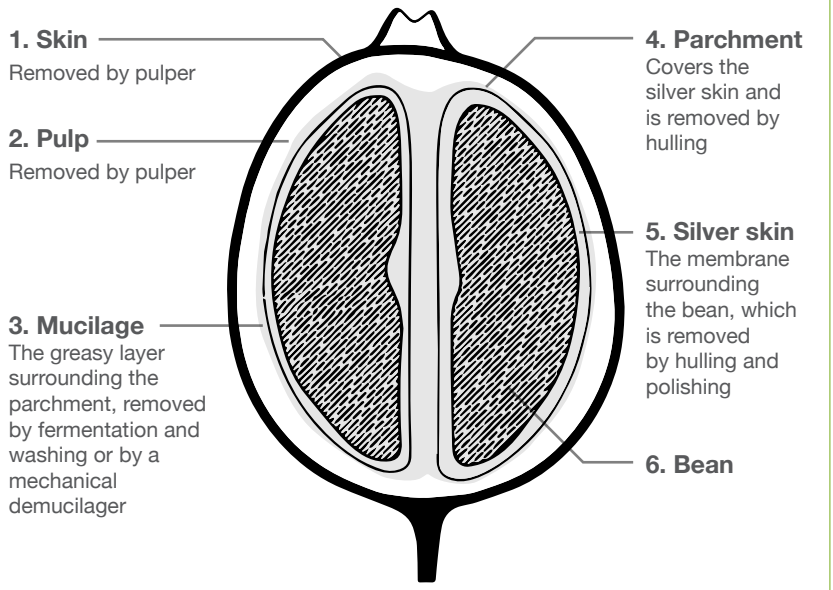
What is involved in processing cherry?

- Coffee production produces green bean that can be sold to roasters
- Complete processing of coffee cherry to green bean includes the removal of the skin, pulp, mucilage, parchment and silver skin, leaving just the green bean
- On-farm, most smallholders undertake the initial stages of processing, referred to as **wet processing**. This involves the removal of the skin, pulp and mucilage to produce parchment coffee
- Smallholders prefer to produce parchment coffee because, if stored properly, it can be kept for up to four months before further processing.
  The parchment protects the silver skin and bean. If the coffee undergoes further processing to green bean, the removal of this protective coating means the bean will begin to deteriorate
- Producing parchment coffee gives farmers more time to transport their crop to market, which is especially important for farmers in remote areas. It also allows them to store their crop while they negotiate a satisfactory price with buyers
- Parchment coffee is sold to mills for further processing to green bean. This involves the removal of the parchment and silver skin (hulling and polishing) and is referred to as **dry processing**

Activity 2: Parts of the coffee cherry

Show examples of the parts of a coffee cherry:

- Skin and pulp – outside layer
- Parchment coffee covered in mucilage
- Dried parchment coffee
- Green bean



Parts of the coffee cherry removed by processing on-farm and at the mill to produce green bean

Coffee at different stages of processing

Stage					
					
Ripe cherry	Bean with skin and pulp attached	Washed parchment coffee	Dried parchment coffee	Dried parchment and green bean exposed	Green bean

Adapted from Sweet Marias

This module will explain the process of wet processing using a hand or motorised pulper.
For more detailed information on the use of a demucilager, refer to Farmer Training Guide Unit 3, Module 3 'Establishing a mini wet factory'.

Wet processing

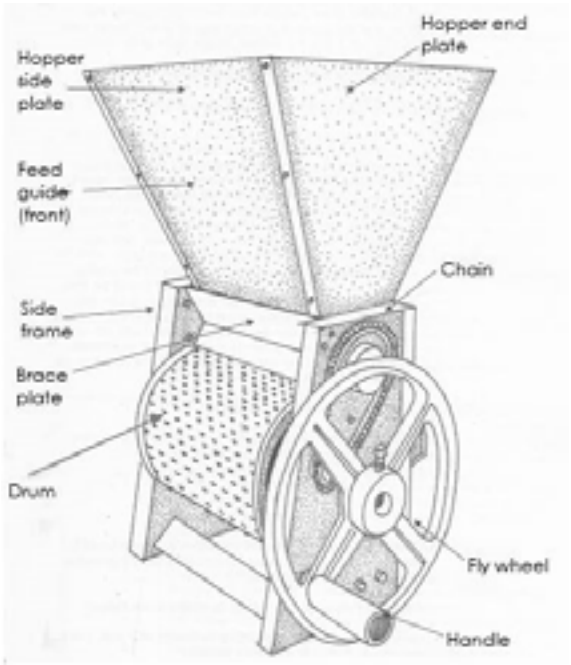
The most common processing method used by coffee farmers to remove the skin, pulp and mucilage from the coffee cherry is wet processing, which uses water.

Wet processing can be undertaken using either of the following types of equipment:

1. Pulper – this may be a hand pulper or a motorised pulper. Some farmers pulp cherry using a stone, but mechanical pulping is the most commonly practised form of wet processing by smallholders
2. Demucilager (ecopulper)

Pulper

- The skin and pulp are removed from the coffee cherry using a hand-pulper or motorised pulper
- The released beans, largely free from the skin and pulp of the cherry, are fermented to remove the mucilage
- The beans are then washed and dried to make parchment coffee



Hand pulper

Note the accumulation of coffee pulp after pulping coffee cherry. The coffee pulp contains valuable nutrients that can be used in coffee and food gardens.

A hand pulper in a citrus orchard
(*Source: Tim Sharp*)

Demucilager-pulper (ecopulper)

- A demucilager-pulper combination is a machine that removes the skin and pulp and also mechanically strips the mucilage from the bean
- A demucilager-pulper combination is more expensive to purchase and set up than a standard hand pulper, particularly for an individual farmer. However, if owned and used by a farmer group, establishment costs can be very economical, producing better quality coffee of a more consistent standard, which attracts a higher price
- After processing using a demucilager, the beans are dried to make parchment coffee using the same drying process as that used when hand-pulping, fermenting and washing

Advantages

- Avoids the need for fermentation (e.g., bag or tank fermentation) and associated equipment
- Wet processing is much faster
- Parchment coffee dries in less time than parchment coffee processed using conventional village methods
- Labour demands in processing are much less
- Water consumption is much lower
- The mucilage removal stage of the process also gets rid of the remaining skins that have passed through the pulper, producing a cleaner parchment coffee
- The demucilager produces more uniform parchment coffee, which will attract a higher price than that produced by fermentation by individual farmers
- The demucilager standardises the quality of coffee from many different farmers belonging to the demucilager group

Coffee demucilager-pulper combination

Wet processing equipment

The processing of coffee cherry must begin **as soon as possible after harvesting** to prevent deterioration in the quality of the coffee beans. Several steps are involved in wet processing of coffee but first, it is important to have all the necessary equipment in place so that processing can begin with ease and be done correctly.

Equipment needed for wet processing

- A good supply of clean water
- Large clean basins
- Scoop
- Pulper (well maintained and in good working order)
- Fermentation tanks or bags
- Cloth to clean the pulper and fermentation tanks or bags
- Raised drying table with a mesh surface or large canvas or plastic sheets if drying on the ground. A raised drying table is preferred
- Coffee bags for bagging the dried parchment coffee

Tips for maintaining quality

A major cause of quality deterioration in coffee is decomposition of the cherry pulp before pulping. This can happen when harvested cherries are not pulped on the day they are harvested. If the mucilage covering the bean begins to decompose (ferment) before pulping, the quality of the bean can be affected in two ways:

- The bean can be mechanically damaged in the pulping process
- The flavour of the bean declines as it becomes acidic

Key principles for processing

- Process the coffee cherry as soon as possible after harvesting to maintain quality. Pulp on the day it is harvested. **NEVER delay processing**
- Keep cherry that is ready for processing in a shaded area
- If pulping is delayed, store the cherry under water to keep it cool and minimise fermentation
- Never mix newly harvested cherries with a previous day's harvest
- Check the processing equipment and sorting areas every day. Keep them thoroughly washed and clean. Any fermented cherry from the previous day will contaminate the newly harvested cherries and result in deterioration of the entire batch
- Careful floating and sorting of the cherry are very important steps in ensuring that quality is maintained

Setting up a pulper

- Do not pulp your cherry in or near a waterway. Set up the pulper at least 30 metres away from any waterways (rivers, creeks, springs) to meet the environmental standards of the main certification organisations. *For further information, refer to Farmer Training Guide Unit 4, Module 2 'Coffee certification'*
- Allow the wastewater to drain onto dry land, preferably a food or coffee garden where nutrients in the wastewater can be taken up by coffee trees or food crops
- If possible, pulp the cherry near the coffee garden so that the cherry does not have to be carried too far. The pulp can be spread around the coffee garden or a nearby food garden (see Section 1.6)

Pulping coffee next to a coffee garden

Processing coffee cherry

Processing coffee cherry involves six steps:

1. Floating
2. Sorting
3. Pulping
4. Fermentation
5. Washing
6. Soaking

Floating

- Pour the harvested cherries into a clean basin containing clean water
- The good, ripe cherries will sink to the bottom while the bad, poor-quality cherries will float
- Floaters are underripe and overripe cherry, raisins or cherry that has been attacked by pests (such as CBB) and diseases
- Scoop out the floating cherries and other floating matter, like sticks and leaves
- All CBB-infested floaters should be treated to kill the pest (see below)

Floating cherries (*Source: Pr. Albert Ukaia*)

Sorting

- Place the good cherries that sunk during floating on clean canvas or plastic sheets, either on the ground or on mesh tables
- Remove all foreign material, such as sticks, stones and leaves that were not removed during floating
- Sort through the cherries and remove any that are immature, overripe or lightly CBB-affected for separate processing

Sorting cherries to remove debris and defects

Pulping

- It is important to clean the pulping machine both inside and out
- After cleaning the machine, rinse it thoroughly with clean water
- Fill the hopper of the pulper with the good cherries and begin pulping
- The pulper will remove the skin and pulp from the cherries

Pulping coffee cherries

- The pulper may have to be adjusted to ensure:
  - The beans are not being nipped
  - No beans are passing out with the skins
  - Only the smallest cherries, plus the unripe ones, pass through the hole
- The skin and pulp can be dried and used as mulch or compost for the coffee garden or food gardens (see Section 1.6)
- If the pulp does not come off, the cherries were not completely ripe. If this is the case, you will need to sort them again later by hand
- Place the beans in a clean basin of water. If there are any floaters, remove them now
- Drain the beans

Fermentation

Fermentation is done to disintegrate the mucilage (the greasy/slimy coating stuck to the parchment layer) from the beans. Fermentation can be done in clean tanks or bags. After fermentation, the broken-down mucilage can be washed off the beans.

If the mucilage is not removed:

- The beans will continue to ferment and will develop a fruity/fermented taste, which reduces their quality
- The beans will be sticky, which prevents effective drying
- Dust and dirt will stick to the wet parchment
- Microbes may grow, increasing acidity and spoiling the quality of the parchment coffee

Fermentation tanks

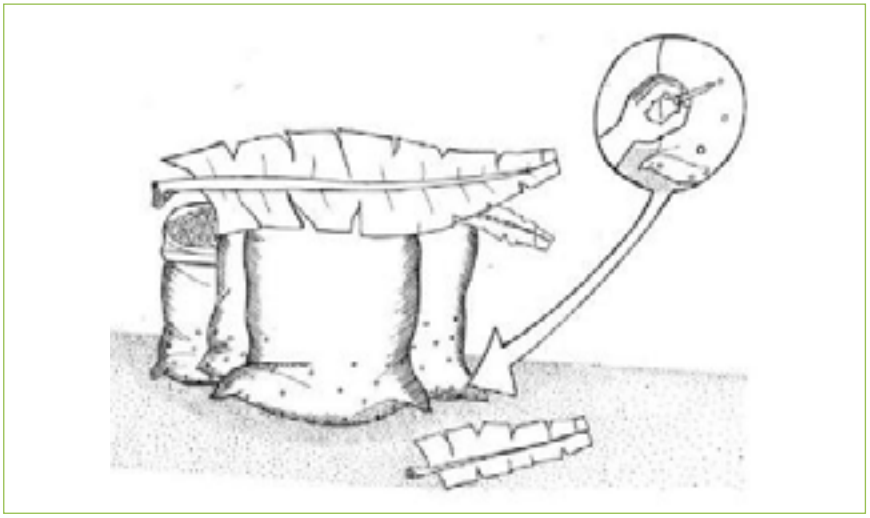
Fermentation can be done in tanks, but **do not use an unpainted steel container**. Wet parchment or fermenting coffee should never be left next to steel for more than a few minutes. As well as discolouring the parchment, the cupped coffee may acquire a metallic taste.

Fermenting coffee beans in a wooden fermentation tank

Fermentation bags

Smallholders often use bags for fermentation. Bags are suitable if they are prepared and used correctly:

- The bags must be strong
- The bags must **not be waterproof**, as this will not allow airflow or drainage, which will spoil the coffee. Holes should be punched in the bags. Nail-size holes are best, but ensure there are enough holes to allow free drainage
- Heap the bags together out of direct sunlight and cover them (e.g., with banana leaves) to maintain as much heat as possible



Fermenting coffee beans in strong bags containing nail-size holes

- Fermentation will take between 1 to 1.5 days depending on:
  - Temperature (faster if warmer)
  - Thickness of the mucilage layer
  - Concentration of the enzymes (the chemicals produced by natural bacteria in the cherry that cause fermentation)
- It is important to continually monitor the fermentation process
- During fermentation, the beans should be **washed** to remove fermented mucilage and dilute the build-up of acids in the bag or tank. If the mucilage is not removed, it will reduce the quality of the coffee by affecting the flavour and discolouring the parchment (as the mucilage breaks down, the water becomes darker)
- **At least once a day** (preferably every 12 hours), stir the beans, then rinse off the mucilage with **clean running water**. Dirty water can give the coffee a "muddy" taste, which will reduce quality

To test whether fermentation is complete, take a handful of fermenting beans and squeeze it out between your hands. If the beans feel gritty or rough, like sand, fermentation is complete. If they feel greasy or slimy, allow fermentation to continue.

Washing

- When fermentation is complete, wash the beans thoroughly, **at least three times**, rubbing gently to remove all traces of dirt and mucilage
- The best way to wash your coffee is in a clean hessian bag or bilum. Water runs through these much more easily than in a plastic bag (e.g., Chemica or Farmset brands). A clean wooden tank or old oil drum can also be used for washing
- Wash the beans until you can see clearly through the water and the beans have lost their slimy texture and have a rough, gritty feel
- Washing should be done at least 30 metres away from any waterways
- Thoroughly wash the fermentation bags or tank after each fermentation round so they are ready for the next batch of coffee from the pulper
- Pour the fermenting liquid and washing water containing mucilage onto coffee or food gardens to add nutrients to the soil

Washing parchment coffee in a tank

Soaking

- After washing is complete, it is preferable to soak the beans in clean water for 16 hours or overnight to completely remove degraded mucilage and further improve quality
- If all canvas or drying beds are in use when a batch of beans is ready for drying, **DO NOT** let the beans continue to ferment. Washed beans can be kept **under water** for up to 48 hours, providing the water is replaced with fresh water after 24 hours. Keeping the beans under water cuts off the air supply and stops fermentation
- The parchment coffee is now ready for drying

Treating very overripe and raisin floaters infested with CBB

Floaters infested with CBB will require further treatment to kill the pest. There are a few simple options available to do this, depending on the quantity of cherry.

Bury

- CBB-infested overripe cherry and raisins can be buried under at least 15 cm of well compacted soil

Burn

- Ensure the fire is hot enough to completely destroy the overripe cherry and raisins

Solarise

- Place the CBB-infested overripe cherry and raisins in sealable buckets, drums or other containers and leave them in direct sunlight
- The outside of the containers must be dark-coloured, black or painted black. The dark colour absorbs more heat from the sun and heats up quickly
- Alternatively, place the CBB-infested crop in sealed, heavy-duty black plastic bags
- Leave the sealed CBB-infested overripe cherry and raisins in direct sunlight for at least two weeks (a useful guide is to reuse the bag at the next harvesting round)

Compost

- Place the CBB-infested overripe cherry and raisins in a pile and cover with a thick plastic sheet
- Secure the edges of the plastic sheet to prevent CBB escaping (round river stones could be placed on the edges of the sheet to pin it to the ground)
- Leave the pile until the cherries and raisins are fully composted. This will be when the pulp is unrecognisable and it will have an earthy texture and smell. Worms may be present and weeds may begin to grow in it

Soapy water

- Soak small amounts of cherry in soapy water for 3–5 days

Objective:

To understand how to prepare cherry for processing to maintain its quality and high value

You will need:

A bag of recently harvested coffee cherry and a basin of clean water for each group

EXERCISE 3

Preparing coffee cherry for processing

Practical activity

Ask the farmers to form into small groups. Ask each group to:

1. Place the cherries into a basin of clean water
2. Scoop out debris, such as twigs and leaves and any cherries that float
3. Describe the differences between the cherries that sank to the bottom of the basin and the floaters. Is there any evidence of CBB damage? What should be done with the floaters?
4. Drain the water from the basin
5. Carefully sort the remaining cherries, separating out any underripe, overripe or CBB-affected cherries, and foreign matter (e.g., rocks or sticks). What is done with the cherries that are separated from the high-quality ripe cherries?
6. Observe the high-quality cherries

Discussion

7. Emphasise to farmers that it is very important to separate the good cherry from the poor-quality cherry. If they are processed together, the whole batch will have to be sold as lower-grade parchment coffee.

Additional practical activity

8. As part of this exercise a quality assessment could be conducted on the harvested cherry after floating (see Section 1.3). Calculate the percentages of underripe, ripe and overripe cherry, and floaters. Discuss what the results mean.

Objective:

To learn how to pulp coffee cherry

You will need:

A coffee pulper and underripe and ripe cherries from Exercise 3

EXERCISE 4

Pulping coffee cherry

Practical activity

Ask the farmers to:

1. Wipe the pulper inside and out, and rinse with clean water
2. Put the good-quality ripe cherries through the pulper
3. Discuss the quality of the pulped cherry. Has all the pulp been removed?
4. Wash the pulper
5. Repeat steps 1 and 2 using the underripe cherries
6. Discuss the quality of the pulped cherry. Has all the pulp been removed?
7. Wash the pulper on completion of the exercise

Objective:

To learn how to identify when coffee beans have been adequately fermented

You will need:

Coffee beans that were placed in a fermentation bag on Day 1 of training

EXERCISE 5

Identifying when fermentation is complete

Practical activity

1. Ask the farmers to test whether fermentation is complete by taking a handful of fermenting parchment coffee and squeezing it between their hands.
2. Discuss how the beans feel. Are they gritty or rough, like sand, or are they greasy or slimy?
3. If they feel gritty, fermentation is complete. If the beans are still greasy or slimy, allow fermentation to continue

1.5 DRYING AND STORING PARCHMENT COFFEE

After pulping and fermentation, parchment coffee contains approximately 55% moisture. The aim of drying is to produce high-quality, clean parchment coffee with a moisture content of about 10–12%. At this level, it is stable and will maintain its quality.

Dry parchment coffee can be sold immediately or stored for up to four months while transport is arranged, or an acceptable price is negotiated with buyers.

Drying will take 4 to 7 days.

Drying methods

Parchment coffee can be dried on a range of surfaces, but it is very important that the drying surface and drying area is clean and protected from animals.

Plastic and canvas sheeting

- The most common method used by smallholders is sun-drying parchment coffee on plastic or canvas sheets laid on the ground
- Plastic is cheaper, but canvas is more durable

Disadvantages

- There is a very high risk of contamination of the parchment coffee with dust, dirt, animal faeces and stones
- It is very labour-intensive to rake and stir the coffee to ensure it is drying evenly
- Plastic sheeting can cause the coffee to sweat, reducing its quality

Drying parchment coffee on plastic sheets (*Source: Susan May Inu*)

Raised beds or tables

- The preferred method is to spread the parchment coffee on raised mesh beds or tables
- The parchment coffee can be dried from above and underneath, and it is aerated more evenly, which is better for preserving quality
- Drying will continue even if the parchment coffee is covered
- Having the parchment coffee elevated keeps it clean while drying
- Raised tables can be made using 4 mm coffee tray mesh with table dimensions 0.8 m high (about waist height) x 0.9 m wide and 30 m long (the length of a roll of coffee tray wire). However, this is a costly option and may be too expensive for smallholders
- A cheaper but effective alternative is to dry the parchment coffee on shade cloth on a raised bamboo mesh bed. Mount the shade cloth on a wooden frame to keep it taut, and place it on a raised bed made of split bamboo

Drying parchment coffee on shade cloth on a split bamboo bed
(*Source: 1 & 3 Pr. Albert Ukaia, 2 Nosare Maika*)

Solar dryer

- A solar dryer is a wooden frame covered by durable greenhouse plastic. To allow air to circulate, the plastic does not go all the way to the ground and openings are left at the front and the back
- A solar dryer protects the parchment coffee from rain and improves the drying process by filtering UV radiation, concentrating heat, reducing the relative humidity of the air and therefore drying the parchment coffee with constant and natural ventilation
- Drying time is reduced to two to three days
- Raised beds made of bamboo and shade cloth (as described above) can be placed inside the solar dryer to spread out the parchment coffee
- Depending on the height of the solar dryer, the drying beds may have one, two or three levels. A space of at least 50 cm between each level is recommended for easy access and to allow air circulation

A simple solar dryer

A larger solar dryer

Best practice when drying coffee

- Spread the wet beans in a thin layer over raised mesh tables or on canvas or plastic sheets on the ground (as described above)
- Sort through the beans, removing any husks and beans that have been broken (nipped) during pulping. The parchment coffee should appear very clean
- Sun-drying (or drying using a solar dryer) improves the visual quality of the parchment coffee, reducing much of the brown discolouration and enhancing the blue-green colour of the coffee bean
- **Be alert for rain and hot weather**
- If it rains, cover the coffee or take it inside
- Removable shade cloth or loose thatch can be used during the hottest part of the day to prevent the parchment coffee being exposed to the hot sun
- Take the coffee inside at night to keep it secure and prevent dampness from dew
- For the first 2 to 3 days, it is important that the parchment coffee is not dried too quickly, as this may cause shrinking and cracking of the bean, reducing its quality
- If parchment coffee remains wet for too long, particularly in the early stages of drying, it can become mouldy, which can create musty smells and taints that reduce its quality
- Parchment coffee should be stirred and turned over by hand or using a rake at least 3 to 4 times every day, so that moisture loss is kept as even as possible (this is particularly important for parchment coffee drying on plastic sheets)
- Parchment coffee must be dried evenly, otherwise fermentation may occur, producing mouldy flavours that reduce its quality
- Hand-pulped parchment coffee that has been fermented in bags can take up to 10 days to dry
- Parchment coffee processed using a demucilager will dry much faster than bag fermented coffee

Turning drying parchment coffee with a rake (*Source: Susan May Inu*)

Skin drying

- After the early stages of drying, the moisture content of the parchment coffee will have decreased to about 42%
- The parchment will appear dry, but the beans inside will still be moist and soft
- Further drying is required to prevent spoilage

Final drying

- During final drying, the beans shrink and become detached from the parchment
- The parchment stays intact, protecting the beans from the air and maintaining their quality
- Dry parchment can be removed easily during hulling
- Once adequately dry, parchment coffee can be stored for up to 4 months in good storage conditions

Dried coffee bean with the parchment intact

Dried coffee bean with some of the parchment removed

Dried coffee bean with all of the parchment removed

Moisture content

- To achieve the **best quality**, it is recommended that parchment coffee be dried to **10–12% moisture**
- Coffee processors will only accept parchment coffee that is adequately dried. If the moisture content is too high, the processor may ask the farmer to take it back and dry the parchment coffee further
- The table below is a guide to moisture content based on bean colour (and texture)

Moisture Content dry basis (MCdb)	
MCdb	**Indicators**
45–40%	• Skin-dry • No water between bean and parchment
40–35%	• White stage • Parchment soft
35–32%	• Opaque stage
32–25%	• Very soft black stage • Bean partially opaque
25–20%	• Soft black • All parts of bean coloured black
20–16%	• Medium black • Bean easily marked by teeth
16–14%	• Hard black • Bean marked by teeth with difficulty
14–12%	• Colour change • Blackness disappears
12–10%	• Fully dry • Translucent jade green colour • Only barely marked by teeth
10–8%	• Over dry • Bean fractures when bitten

Source: CIC (2016) *PNG Coffee Handbook*

Storage of parchment coffee

Parchment coffee that is fully dry (MCdb 10–12%) can be stored for 3 to 4 months. During storage, the beans are at risk of taking up moisture, which will cause them to deteriorate. To maintain quality, they must be stored in the correct conditions.

Storage bags

- Store the coffee beans in clean, odour-free bags
- Consider investing in GrainPro bags, as these will prevent insects, moisture and odours like smoke penetrating the bag and affecting the coffee

Storage area

- Coffee store houses must be dry, well ventilated, clean and secure
- Store good-quality and lower-grade parchment coffee separately
- Keep the beans in a dry, cool and low-light environment
- Raise the bags off the ground, on a wooden platform or pallets, to avoid them absorbing moisture from the ground
- Ensure the bags are not in contact with walls
- Monitor the moisture levels
- Never use a coffee store house as a temporary store for fuel, chemicals, or anything else that may cause the coffee to absorb bad tastes or smells
- Do not allow the coffee to be affected by smoke from cigarettes or fires

Pests and diseases

Parchment coffee is still susceptible to attack by pests and diseases. Insect damage is one of the most serious problems for coffee in storage.

CBB

- CBB can feed on coffee beans for months after harvesting
- CBB-infested beans reduce the overall value of the parchment coffee, as they often turn to charcoal when roasted
- CBB survives very well in parchment coffee if the moisture content is above 13%, so it is important that the coffee is dried to 10–12% and stored in optimum conditions
- The ability of CBB to survive during storage and transportation is the main reason that the pest has been able to spread worldwide

Other pests and diseases

Other insects, rats, mice, birds and mould can also pose a problem for stored parchment coffee. The storage area and bags should be regularly inspected.

Buyers will always remember a farmer who delivers a premium product.

A premium product fetches a premium price.

Objective:

To learn to identify when parchment coffee is at 10–12% moisture content

You will need:

Parchment coffee at differing moisture contents, and copies of the Moisture Content dry basis (MCdb) table

EXERCISE 6

Drying parchment coffee

Practical activity

1. Ask the farmers to use the MCdb table and the bite test to determine the moisture content of the samples of parchment coffee.

Discussion

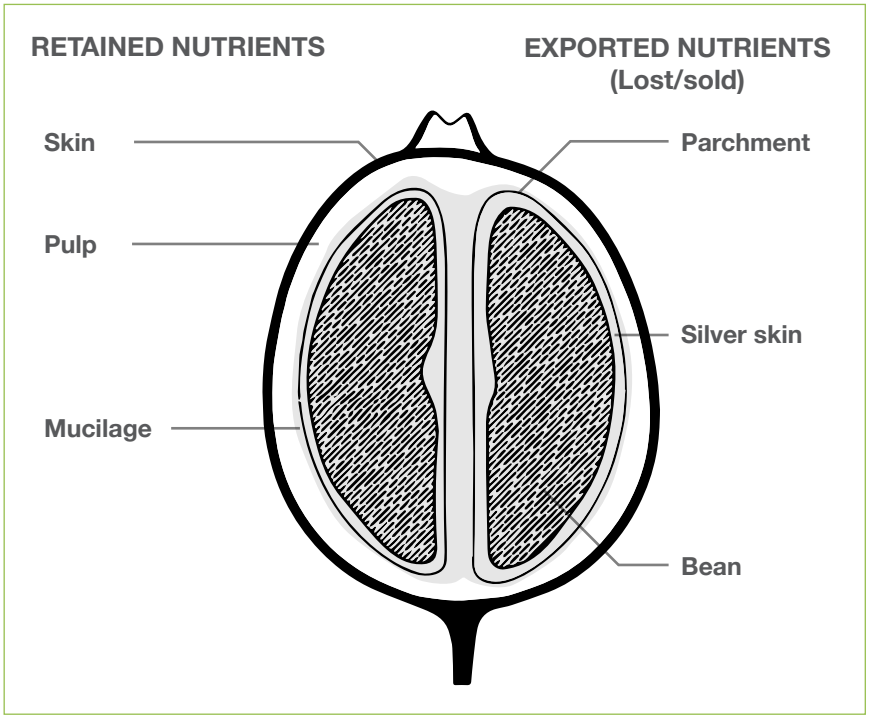
2. Discuss the differences in colour and texture of the samples of parchment coffee that are at various stages of drying
3. Discuss the farmers' experiences with drying coffee. Is it difficult for them to determine when the correct moisture content has been reached?
4. Discuss the importance of the drying process

1.6 WHAT TO DO WITH COFFEE PULP AFTER PROCESSING

When cherry is processed to parchment, farmers are left with a large volume of skin, pulp and mucilage, also known as 'coffee pulp'. This is a **valuable resource** that can be put to good use in the coffee garden or food gardens.

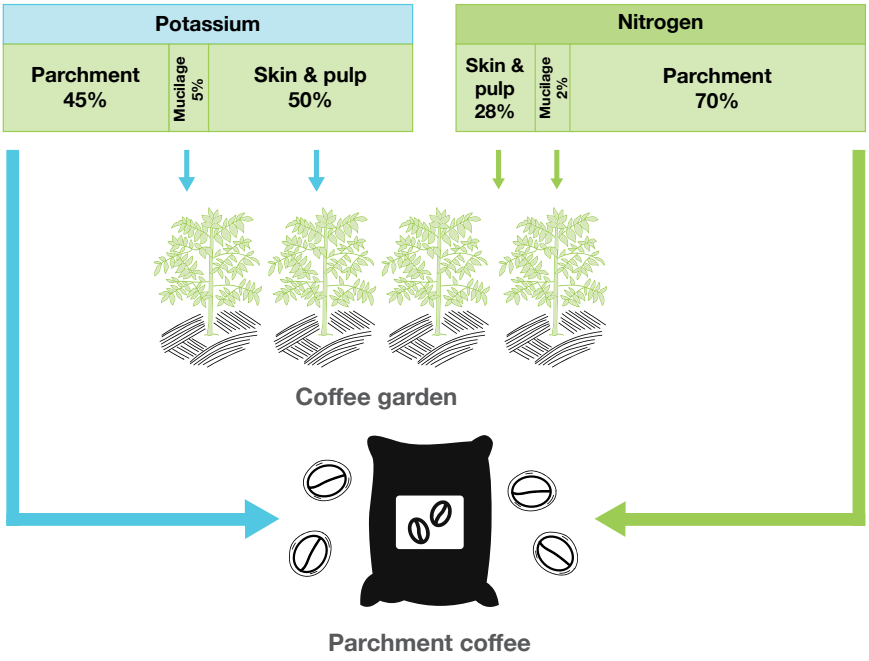
Nutrients in coffee cherry

- During cherry production, coffee trees take up a lot of nutrients from the soil
- When the coffee cherry is harvested, these nutrients are removed from the coffee garden
- After on-farm processing, the parchment coffee containing the bean and silver skin is sold, and their nutrients are permanently lost
- The cherry skin, pulp and mucilage are retained, along with their nutrients



Parts of a coffee cherry retained or exported after on-farm processing

- The approximate proportions by fresh weight of each part of a coffee cherry are:
  - Skin and pulp = 44%
  - Mucilage = 17%
  - Parchment coffee = 39%
- The skin, pulp and mucilage make up about 60% of the fresh weight of the cherry
- Many coffee and food gardens in the PNG highlands are low in essential plant nutrients, especially nitrogen (N), phosphorus (P) and potassium (K)
- The skin, pulp and mucilage of cherry contain:
  - 30% of the total nitrogen
  - 55% of the total potassium
- Effective use of the skin, pulp and mucilage can assist in minimising the loss of nutrients from coffee gardens



Potassium and nitrogen available to recycle in the coffee garden after processing cherry to parchment coffee

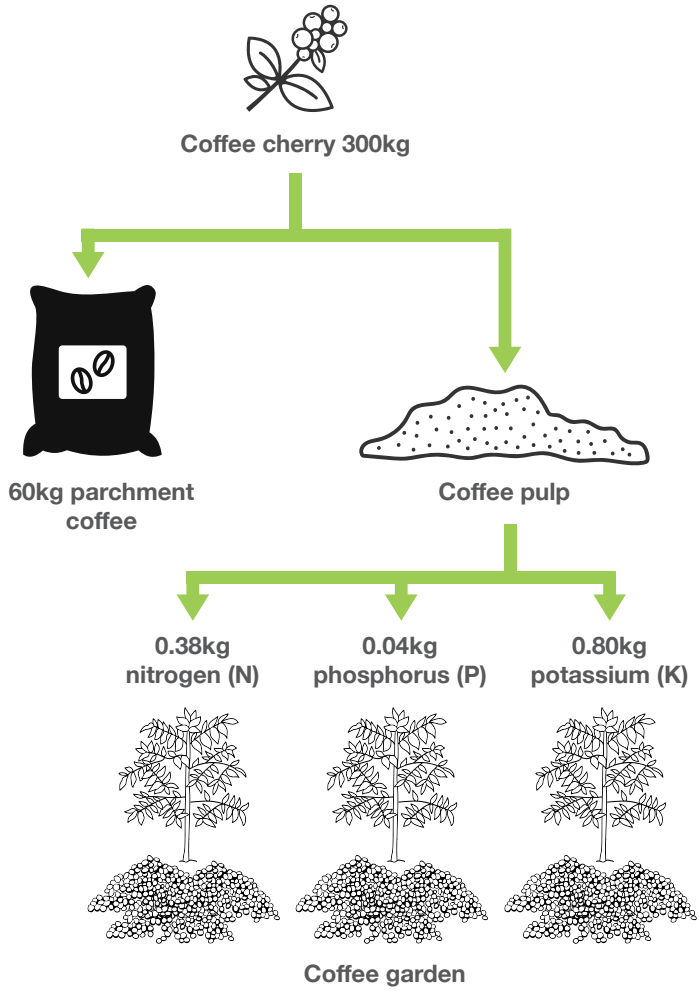
Fertiliser equivalents

If farmers were to purchase fertiliser to replace the nutrients lost in coffee pulp, it would be very costly.

- The diagram below shows the value of the nutrients in the coffee pulp of 300 kg cherry
- These nutrients will be retained by the farmer if the coffee pulp is recycled
- Additional fertiliser inputs are needed to replace the nutrients lost in the bean, silver skin and parchment

Don't waste your coffee pulp – it's worth money!

When you produce a 60 kg bag of parchment coffee, the nutrients contained in the leftover skin and pulp are worth up to K72.



Fertiliser equivalent	Cost (PGK) (Feb 2024)
Individual fertilisers: Urea + TSP + MOP	24.44
Compound fertiliser: NPK (12:12:17)	48.00
Compound fertiliser: NPK (10:25:10)	72.00

(See Appendix 2)

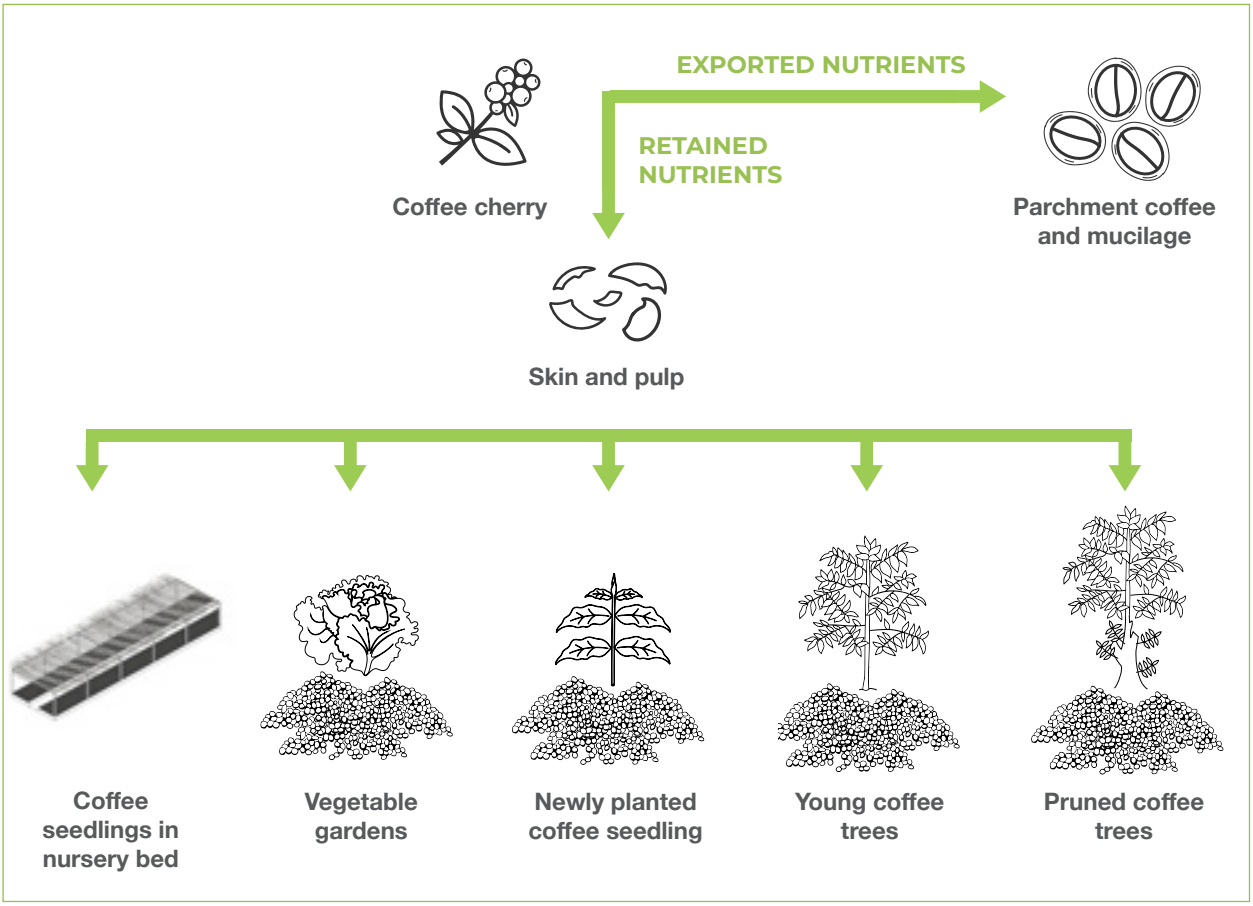
Value of nutrients in the skin and pulp from the production of 60 kg parchment coffee

Using fresh coffee pulp

- Fresh coffee pulp is very high in nutrients, particularly potassium, which is very good for plant growth
- It can be used as mulch in coffee gardens or food gardens soon after pulping
- It can be used in a bare root coffee nursery after the coffee seed has germinated

Mucilage

- If a hand pulper is used, the mucilage will remain attached to the parchment. After fermentation the liquid containing the mucilage can be returned to the coffee garden
- If a demucilager-pulper combination is used, the mucilage will already be mixed into the coffee pulp



Recycling nutrients in fresh coffee pulp

How to use fresh coffee pulp in a garden

- Use it as soon as possible to avoid nutrient losses due to leaching
- Apply it thinly, in just one layer
- Do not put it next to coffee stems
- Done regularly, this will help maintain soil fertility

Coffee pulp used in a food garden (*Source: Mike Webb*)

Coffee pulp spread around a coffee tree (*Source: Mark Thomas*)

Composting coffee pulp

- Fresh coffee pulp can also be used to make compost
- Compost is decomposed organic material. It is very good for improving soil texture and therefore the uptake of water and nutrients. During the composting process, the pulp loses a lot of organic matter, so it is easier to transport than fresh pulp
- Most of the nitrogen and potassium is lost during the composting process, so it is good to add other organic residues, like animal manure, which has a high nitrogen content, to improve the nutrient content of the compost
- During the composting process, the nitrogen and potassium that are lost can be taken up by nearby plants, so think about this when choosing a location for making compost
- When composting, heap the fresh pulp and cover with banana leaves to help retain the heat but still allow some air to escape
- Ensure that valuable nutrients will not be washed away by rain
- Turn and mix the heap every 3 to 4 days

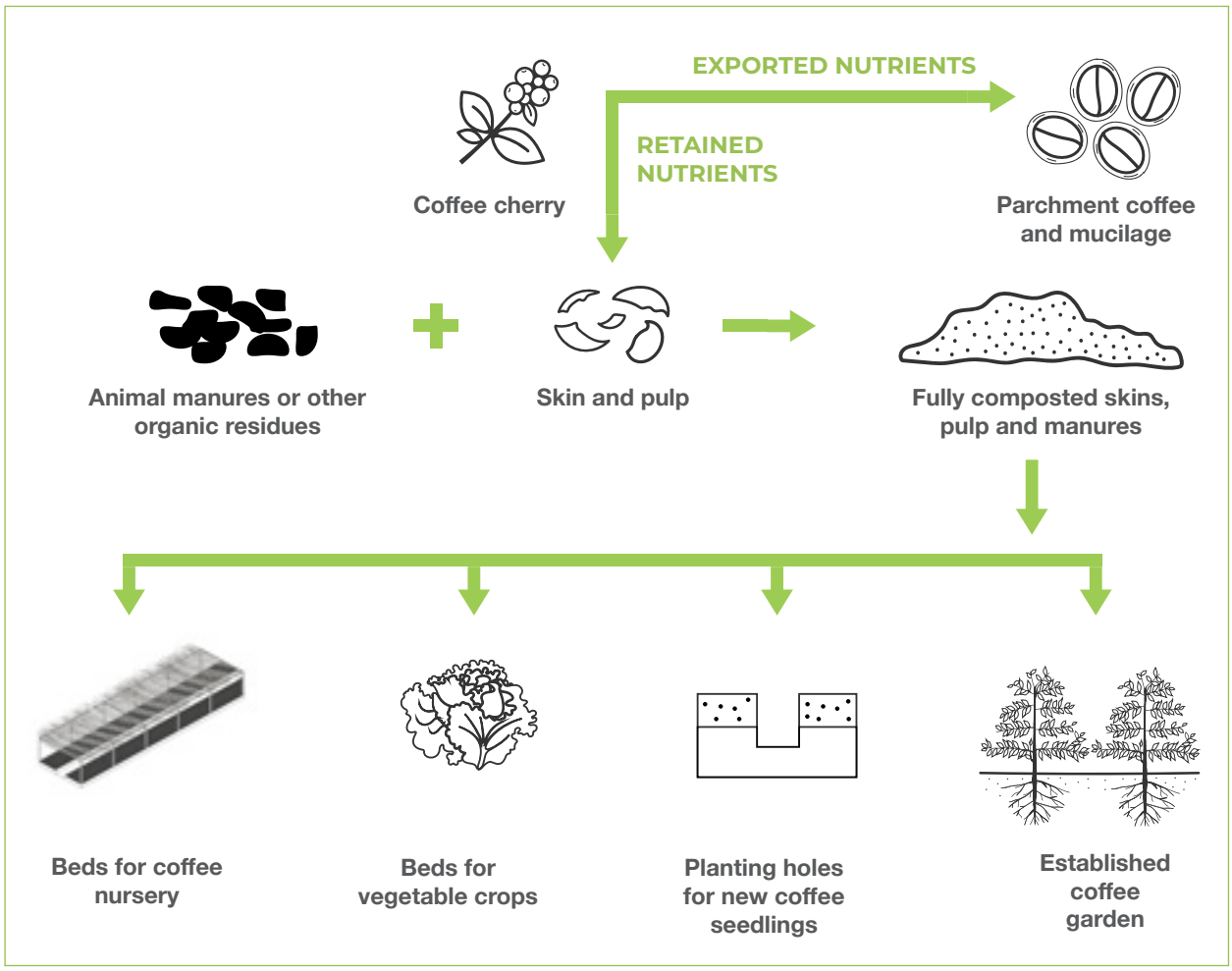
Activity 3: Fresh and composted coffee pulp

Show farmers the fresh and composted coffee pulp.

Point out the differences:

- Fresh pulp is red and wet
- Composted pulp is dry and earthy

- Allow the pulp to decompose until it has a fine, earthy texture. It is ready to use when worm activity is observed or weeds begin to grow in it
- If the above procedures are **followed strictly**, coffee pulp takes 4 to 6 weeks to break down sufficiently to be mixed into soil or used in preparation of soil mix
- If compost is used before it is fully decomposed, it could damage the stems and roots of plants
- Mix compost into the soil mixture to be used in nursery beds, vegetable garden beds or new planting holes for coffee seedlings. Compost can also be used in established coffee gardens
- Note: If prepared nursery beds are close to the pulper, the fresh pulp can be mixed directly with the soil mix in the beds and left to compost for 4-6 weeks. Do not sow seed until the mix is fully composted as it will damage germinating seedlings



Recycling nutrients in coffee pulp–composting

Coffee pulp and CBB

When CBB attacks coffee cherry, it bores through the skin and pulp to get to the bean.

Once the bean has matured, it is very unlikely that there will be any remaining CBB in the pulp. It is therefore safe to use the pulp as mulch in coffee gardens without the risk of spreading the pest.

Applying fresh coffee pulp in coffee gardens will not spread CBB.

Objective:

To understand the importance of recycling the nutrients in coffee pulp

EXERCISE 7

Recycling nutrients in coffee pulp

Discussion

1. Ask the farmers what they usually do with the coffee pulp after processing their cherry
2. Discuss what can be lost if coffee pulp is left at the pulper
3. Talk about what can happen if pulping is done near a waterway (nutrients will be lost and the waterway will be contaminated)
4. Discuss the value of the nutrients lost when coffee pulp is not recycled (revise the section on fertiliser equivalent costs)
5. Discuss the ways that coffee pulp can be used:
   - to replenish lost nutrients in coffee gardens and food gardens
   - to make compost for soil mixes for sowing seed
   - to make compost for new plantings of vegetables or coffee seedlings

1.7 KEY MESSAGES

- The best time to harvest cherry is when it is evenly bright red. Bright red cherry is fully ripe and is at peak weight, quality and value
- Coffee cherry should only be harvested at peak quality, as there is nothing that can be done to improve the quality of a cherry or its beans after harvesting
- When planning labour for harvesting consider:
  - The length of the flush period
  - Harvesting frequency
  - Approximate yield of cherry
  - Processing activities
  - Training of helpers
  - Labour demands, especially on women, for other livelihood activities such as food gardening and marketing
- During regular harvesting rounds, pick fully ripe cherries individually
- Do not strip-pick cherries that are intended for sale or processing
- Harvest every 1 to 2 weeks to ensure that only high-quality cherry is picked, and put any residual overripe cherry into a separate bag. This will increase parchment coffee quality and value, and help to control CBB

- Strip-pick all berries during the **final harvest** of the season to reduce infestation by pests and diseases. This is particularly important for CBB control
- Coffee cherry can be sold fresh at a premium price, if the farmer is located close to a wet mill
- Coffee cherry can be processed and sold as parchment coffee
- Follow best-practice processing methods for pulping, fermentation, washing, drying, and storage to ensure that the parchment coffee is of the highest possible quality, and value
- Using a demucilager to process coffee is expensive to set up, but it is very efficient. For a farmer group, a demucilager can be very economical. It will help the farmers produce more consistent, high-quality coffee that will attract higher prices
- A lot of nutrients are lost from the coffee garden when cherry is harvested. The coffee pulp remaining after on-farm processing is a valuable resource and should be used to replenish some of these lost nutrients

Causes of inconsistent smallholder coffee

- Harvesting immature cherry
- Not pulping all the cherry on the same day it is harvested
- Poorly adjusted pulpers, or use of other pulping methods
- Failure to separate rubbish, floaters, and chipped or broken beans from properly pulped beans
- Fermentation in unclean bags
- Over-fermentation
- Poor washing of beans or washing in unclean or muddy water
- Drying on the ground or in situations leading to contamination or extended drying periods
- Incomplete drying

1.8 QUIZ

Place a '✓' in the correct box.

1. The main role of honest coffee buyers is to:

- A Purchase as much parchment coffee as possible
- B Purchase any parchment coffee as long as it is cheap
- C Source coffee that is of good quality with few defects
- D Source coffee that is heavy by weight

2. For farmers to receive high prices for their coffee they must:

- A Harvest only ripe cherry
- B Process the coffee correctly
- C Provide well-managed, pest-free storage conditions
- D All the above

3. The best time to harvest coffee cherry is when it is:

- A Large, round and beginning to turn red
- B Bright red
- C Purple
- D Starts to fall from the trees

4. During routine harvesting it is best to:

- A Strip all cherries off the branches so further harvesting is not required
- B Pick the cherries that are beginning to turn red as they will ripen later
- C Leave any overripe cherries on the tree
- D Individually pick only the bright red cherries, and pick any overripe cherries into a separate bag

5. During the final harvesting round of the coffee season, it is best to:

- A Strip-pick all berries off the trees
- B Pick the cherries that are beginning to turn red as they will ripen later
- C Leave any overripe cherries on the trees
- D Individually pick only the bright red cherries, and pick any overripe cherries into a separate bag

6. Harvested cherry should be:

- A Pulped on the day it is harvested
- B Pulped 2 days after harvesting to allow fermentation to begin
- C Left in bags to keep the temperature high
- D Pulped next to a waterway

7. During wet processing, any cherry that floats:

- A Is good quality
- B Is poor quality
- C Should be returned to the coffee garden as mulch
- D Can be sold separately as quality fresh cherry

8. Coffee is fermented after pulping:

- A To increase the weight of the beans
- B To remove the mucilage stuck to the parchment
- C To remove the sliver skin
- D To speed up ripening of the beans

9. Fermentation is complete:

- A When the beans have been in the fermentation tank for 4 days
- B When the colour of the water in the fermentation tank is grey
- C When the beans feel gritty or rough
- D When the beans feel greasy or slimy

10. The advantage of using a demucilager-pulper combination instead of a hand or motorised pulper is that:

- A Fermentation is not needed
- B Processing is much faster and requires less labour
- C Drying time is reduced
- D All the above

11. After wet processing, it is important to turn parchment coffee regularly when it is on drying beds:

- A To stop dust settling on it
- B So it dries slowly
- C So it dries quickly
- D So it dries evenly

12. The moisture level of parchment coffee should be:

- A 6–8%
- B 8–10%
- C 10–12%
- D 12–14%

13. When parchment coffee is dried to the recommended moisture level, the bean is:

- A Hard and black
- B Hard and jade green
- C White and very soft
- D Very hard and fractures easily

14. CBB has spread across the world because:

- A It can survive in fallen coffee cherries
- B It can reproduce in large numbers
- C It can survive during storage and transportation of parchment coffee
- D It can fly long distances

15. The main benefit of using coffee pulp on coffee or food gardens is:

- A It contains valuable nutrients
- B It stops the spread of CBB
- C To preserve moisture in the soil
- D To stop weed growth

16. If kept away from the stems, fresh coffee pulp can be used on:

- A Newly germinated coffee and vegetable seedlings
- B Newly transplanted coffee seedlings
- C Mature coffee trees
- D All the above

True or false

	True	False
a. When wet processing coffee cherry, it is best not to sort the cherry prior to pulping as it requires too much labour.	☐	☐
b. Coffee trees should only be strip-picked during the final harvesting round.	☐	☐
c. Using a demucilager reduces the demand on labour and eliminates the need for fermentation.	☐	☐
d. Fermentation tanks or bags should be well sealed so that they do not allow any airflow or drainage.	☐	☐
e. For effective control of CBB, no more than 20 ripe, overripe or raisin cherries should remain on each coffee tree after strip-picking at the end of the coffee season.	☐	☐
f. If processing of newly harvested cherry is delayed, it can be stored under water.	☐	☐

Answers to quiz questions

Multiple choice

1. The main role of honest coffee buyers is to:

   Answer = C. Source coffee that is of good quality with few defects

   Section 1.1: Processers will receive a good price for their green bean if it produces high cup quality. This can only be accomplished if they process high-quality parchment coffee. Therefore, it is in the buyers' interest to purchase good-quality parchment coffee.

2. For farmers to receive high prices for their coffee they must:

   Answer = D. All the above

   Section 1.1: Farmers must ensure that the best practices in all aspects of coffee production are adopted from the start to the finish of the production process.

3. The best time to harvest coffee cherry is when it is:

   Answer = B. Bright red

   Section 1.3: When cherry is uniformly bright red all over, it is at its highest quality and value.

4. During routine harvesting it is best to:

   Answer = D. Individually pick only the bright red cherries, and pick any overripe cherries into a separate bag

   Section 1.3: Pick mature red cherries, and overripe cherry and raisins individually with a twisting action. Pick the overripe cherries into a separate bag to save labour in sorting before processing.

5. During the final harvesting round of the coffee season, it is best to:

   Answer = A. Strip-pick all berries off the trees

   Section 1.3: In a CBB environment, during the final harvesting round of the coffee season, strip-pick all remaining berries from the trees. Leaving berries on the coffee trees or on the ground after the final harvest provides habitat for CBB, allowing it to breed and carry over to the next coffee season.

6. Harvested cherry should be:

   Answer = A. Pulped on the day it is harvested

   Section 1.4: Pulping of coffee cherry must begin as soon as possible – no more than 12 hours after harvesting – to prevent deterioration in the quality of the coffee beans.

7. During wet processing, any cherry that floats:

   Answer = B. Is poor quality

   Section 1.4: Cherries that float may be very immature, have come from trees suffering from nutrient stress, be overripe and have already begun to deteriorate, or be impacted by pests or diseases.

8. Coffee is fermented after pulping:

   Answer = B. To remove the mucilage stuck to the parchment

   Section 1.4: If the mucilage is not removed, the beans will have a fruity or fermented taste, reducing its quality. The beans will also be sticky, which allows dust and dirt to stick to the parchment, preventing effective drying. Microbes may grow, increasing acidity and spoiling the bean.

9. Fermentation is complete:

   Answer = C. When the beans feel gritty or rough

   Section 1.4: When the beans are squeezed in your hands, if they feel gritty or rough, like sand, fermentation is complete. If they feel greasy or slimy, mucilage is still present and further fermentation is required.

10. The advantage of using a demucilager-pulper combination over a standard coffee pulper is that:

    Answer = D. All the above

    Section 1.4: Using a demucilager-pulper combination removes the need for the fermentation stage. Processing is faster and requires less labour, and drying time is reduced. A demucilager also results in more uniform green bean, which attracts a higher price.

11. After wet processing, it is important to turn parchment coffee regularly when it is on drying beds:

    Answer = D. So it dries evenly

    Section 1.5: If parchment coffee dries too quickly, it may cause shrinking and cracking of the beans. If it dries too slowly, it may become mouldy, creating musty smells and taints. These outcomes will reduce the quality and value of the parchment coffee.

12. The moisture level of parchment coffee should be:

    Answer = C. 10–12%

    Section 1.5: The moisture content of parchment coffee must be reduced to 10–12% to prevent spoilage. This also allows farmers to store it for 3 to 4 months before selling. When drying to 10–12%, although revenue based on weight is reduced, revenue is gained due to the improvement in quality. Drying to below 13% also kills CBB.

13. When parchment coffee is dried to the recommended **moisture level, the bean is:**

    Answer = B. Hard and jade green

    Section 1.5: When the parchment coffee is fully dry, it is translucent jade green in colour and is barely marked by teeth biting it.

14. CBB has spread across the world because:

    Answer = C. It can survive during storage and transportation of parchment coffee

    Section 1.5: CBB survives well in parchment coffee if the moisture content is above 13%. This allows the pest to survive during storage and international transportation, meaning it can infest coffee gardens in other countries.

15. The main benefit of using coffee pulp on coffee or food gardens is:

    Answer = A. It contains valuable nutrients

    Section 1.6: Coffee pulp contains valuable nutrients, particularly potassium, which is very important for plant growth. Although some fertiliser may be required to replace the nutrients lost in the beans, by using coffee pulp in coffee gardens, farmers do not have to buy lots of costly fertilisers to replace the nutrients lost in the pulp.

16. If kept away from the stems, fresh coffee pulp can be used on:

Answer = D. All the above

Section 1.6: Fresh coffee pulp can be used on newly germinated and young coffee and vegetable seedlings, and mature and pruned coffee trees.

True or false

a. When wet processing coffee cherry, it is best not to sort the cherry prior to pulping as it requires too much labour.
Answer = FALSE

b. Coffee trees should only be strip-picked during the final harvesting round.
Answer = TRUE

c. Using a demucilager reduces the demand on labour and eliminates the need for fermentation.
Answer = TRUE

d. Fermentation tanks or bags should be well sealed so that they do not allow any airflow or drainage.
Answer = FALSE

e. For effective control of CBB, no more than 20 ripe, overripe or raisin cherries should remain on each coffee tree after strip-picking at the end of the coffee season.
Answer = FALSE

f. If processing of newly harvested cherry is delayed, it can be stored under water.
Answer = TRUE

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APPENDICES

Appendix 1: PNG Arabica coffee green bean specifications and value

Coffee beans are graded on **cup quality** and the average number of defects per kilogram.

Arabica coffee green bean grades and value			
Grade	**Cup quality**	**Maximum defects**	**Value (K/kg) (August 2023)**
A	• Full, reasonably balanced, uniform, clean • Well pronounced body and acidity • Rich and distinct fragrance and aroma	10 per kg	13.80
B	• Regular, uniform clean • Medium-to-high acidity and pronounced body • Rich fragrance and aroma	30 per kg	7.86
Y	• May lack some uniformity • Good acidity and body • Some fruit or wine character • Good fragrance and aroma	70 per kg	7.55
Y2	• Irregular profile • Fair acidity and body • No foul or foreign flavour	150 per kg	4.00
Y3	• No foul or foreign flavour • No foreign matter • Fit for human consumption	30% defects by weight (exc. good, nipped beans)	3.00

Value is based on prices paid for coffee beans delivered in-store (DIS), Lae, August 2023.

In August 2023, the price received for Y2-grade green bean was around half of that received for Y-grade.

Appendix 2: Value of nutrients found in coffee pulp

Cost of nitrogen, phosphorus and potassium in fertiliser									
Type of fertiliser	Nutrient content (%)			Bag size (kg)	Cost		Cost of nutrient (K/kg)		
	N	P	K		K/ bag	K/kg	N	P	K
Urea	46			5	49.50	9.90	21.52		
TSP		18		25	245.00	9.80		54.44	
MOP			50	5	44.00	8.80			17.60
NPK (12:12:17)	12	5	14	5	42.00	8.40	70.00	168.00	60.00
NPK (10:25:10)	10	11	10	5	45.00	9.00	90.00	81.82	90.00

Notes: TSP = Triple superphosphate; MOP = Muriate of potash; NPK = weight ratio of N, P_2O_5 and K_2O
All fertiliser prices provided by Farmset Ltd (February 2024)

Appendix 3: Useful facts and figures

The following table provides some useful facts and figures to show farmers the **potential production** from their coffee gardens.

Facts	Figures
Yield of a good coffee garden on good soil with no fertiliser	1500–1875 kg of parchment coffee/ha
Yield of a good coffee garden on average soil with no fertiliser	1250–1500 kg of parchment coffee/ha
Yield of a good coffee garden on poor soil	1000 kg of parchment coffee/ha
Average yield of a rehabilitated coffee garden in PNG	1375 kg of parchment coffee/ha
Average yield of a non-rehabilitated coffee garden in PNG	937.5 kg of parchment coffee/ha
Number of bunches of cherry on a good bearing lateral	6
Number of cherries on a good bunch (1000–1700 masl)	10
Number of cherries on a good bunch (1700–1850 masl)	6
Number of cherries on a good lateral (1,000–1,700 masl)	60
Average number of beans in 1 kg of parchment coffee	3500
Average number of cherries in 1 kg of cherries	500
Weight of cherries needed to produce 1 kg of green bean	6.25 kg
Number of cherries to make 1 kg of green bean (500 x 6.25)	3125
Weight of cherries to make 1 kg of parchment coffee	5 kg
Weight of parchment coffee to make 1 kg of green bean	1.25 kg
Number of cherries in 1 kg of parchment coffee (500 x 5)	2500
Recovery rate of green bean from dry parchment coffee	75–82%
Average number of leaves on mature, well-maintained tree	6000
Weight of dry parchment coffee in a well-packed feed bag	40 kg
Weight of dry parchment coffee in a well-packed copra bag	50 kg
Weight of 1 export bag of green bean	60 kg
Time to pulp one 60 kg bag of cherry using a demucilager-pulper combination	12 minutes
Time to pulp one 60 kg bag of cherry using a hand pulper	30 minutes
Time to pulp one 60 kg bag of cherry using a stone	At least one day

Note: masl = metres above sea level
Information compiled from *CIC Coffee Handbook* (2016) and other sources

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