Good Agricultural Practices to Sustain Coconut Development

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- Good Agricultural/Manufacturing Practices are a set of principles, regulations and technical recommendations applicable to production, processing and food transport, addressing human health care, environment protection and improvement of worker conditions and their families. (FAO)

Global emphasis on Farming

2014-Family Farming

- Small scale farming linked to World food security
- Feeding the world and caring the earth
- Preserves traditional food products

2015-Soil

- Non-renewable resource
- Healthy soil for health life
- Where food begins

2016-Pulses

- ✓Nutritional benefit of Pulses as part of Sustainable food production
- ✓Utilize pulse-based proteins
- ✓Food security nutrition and Innovation

2020-Plant Health

- ✓Promote healthy Ecosystem for sustainable development
- ✓Plant health to solve hunger, poverty and threat to environment
- ✓Phytosanitary standards for International trade of plant and plant products

Why GAP is important for coconut

- Sustainable Development Goal
- Lot of degradation of natural resources over the period of time.
- Perennial – long life 60 to 80 years
- Safeguarding environment
- Reducing occupational hazard
- One Health Approach (includes plant, animal, environment and human health)

GAP in coconut

I Pedigree
(Location specific)

II Production

III Protect

IV Process

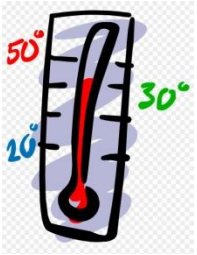
My presentation includes

- Ideal site selection
- Production of planting materials
- Planting and after care
- Water management
- Nutrient management
- Soil and moisture conservation
- Cropping /farming system
- Pest and disease management
- Harvesting
- Processing

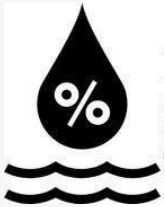
Ideal site selection

→ 130-230cm

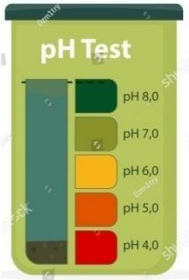
→ 210 bright sunshine h/month



→ 27 °C +/- 5 °

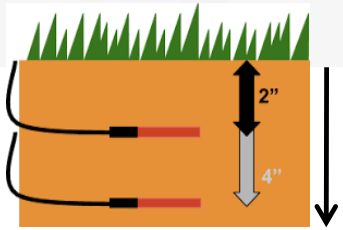


→ >60 % RH



→ 6 to 7.5 pH

600 m MSL



1.5m to 2m depth

well drained soil

Suitable Varieties ….

Wider adaptable varieties that are also tolerant to abiotic/biotic stress

Tall varieties preferable under water deficit condition

Cold tolerant varieties in low temperature zones

Varieties delivering high biomass potential and harvest index

Hybrids responsive for high inputs and resources

Location specific varieties that tolerate pest and disease incidences

Varieties amenable for product diversification requirement

Selection of good seedlings

One year old seedling

Possess 5 - 6 leaves

Early splitting of leaves

Higher collar girth

short petiole

Profuse roots

Polybag seedlings fortified with bioinoculants for early establishment and precocious bearing

LAND PREPARATION AND PLANTING

If the land is uneven and full of shrubs, the shrubs have to be cleared and land should be leveled before digging pits

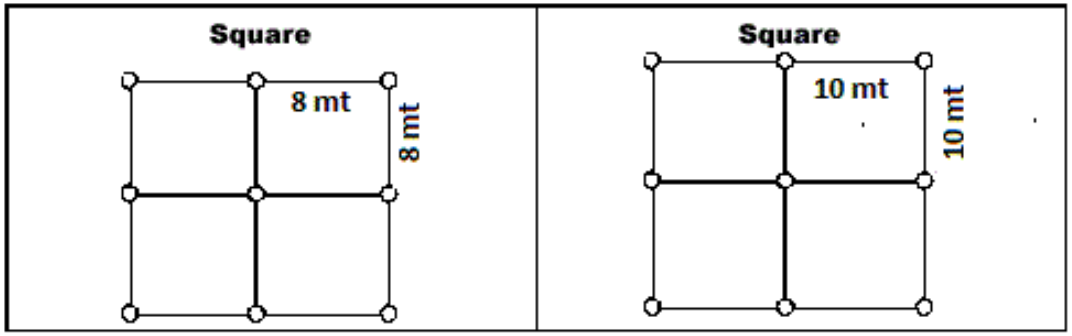
Sunlight and Geometry Viable intercrops for holistic system

Spacing

-> Square system is ideal- 8.0m and above

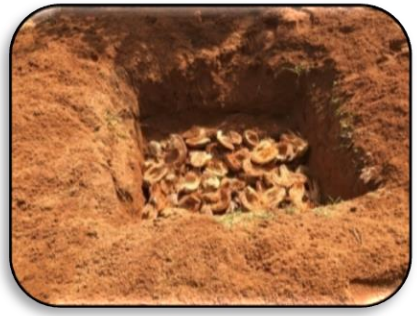
-> Wider spacing 10 x 10 m if perennial intercrops taken up simultaneously like multistreyed cropping/HDMSCS

-> Cyclone prone areas wider spacing is recommended.



PIT SIZE AND PLANTING

Pit size	-> Normal soil	– 1m3
	-> Sandy soil	– 0.6m3
	-> Laterite	– 1.2m3



Pit making and
Layering of coconut husk

Filling with top soil
Incorporation of organic manure

Baby pit for planting seedling

Water logging area

Mound method

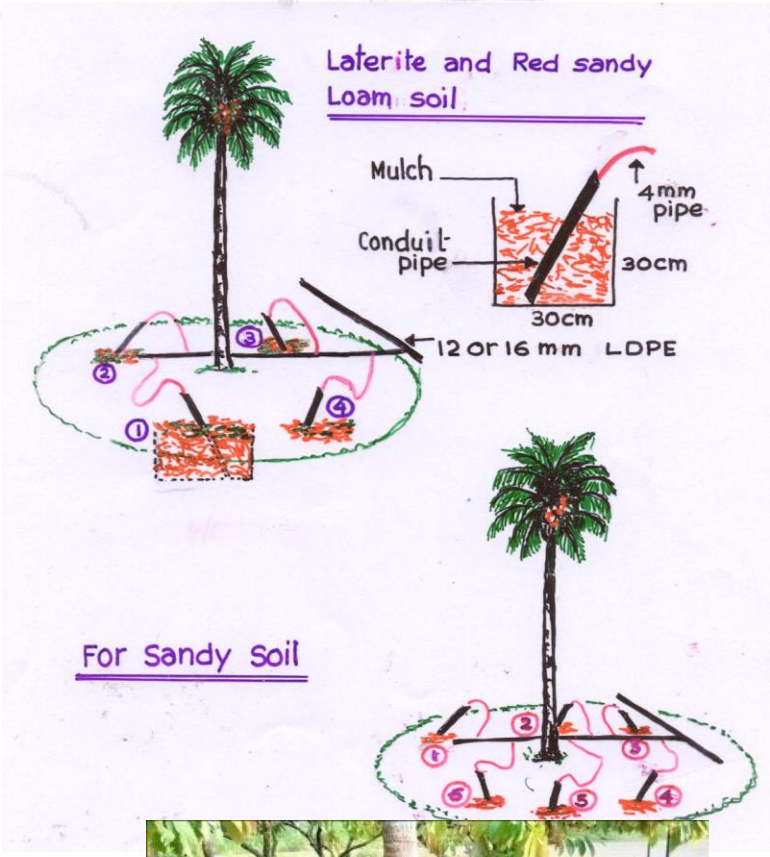
Shading seedling to avoid sun scorching

WATER MANAGEMENT

Flood irrigation is not recommended
Basin irrigation through hose
Sprinkler irrigation for specific cropping system
DRIP IRRIGATION – Ideal method

Why Drip is the ideal irrigation method?

-> Directly on to the root zone
-> Delivered at crop-need based
-> Water saving by 33 %
-> Fertilizer economy and increase in yield
Weed control
-> About 90% efficient delivery & utilization
-> Make non-suited regions productive



Drip irrigation with 4 dripping points

Mulching in the basin after laying drip system

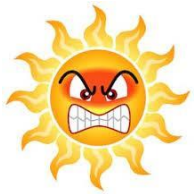
INTER CULTIVATION

- Minimum tillage-Ploughing twice in a year –summer and post monsoon- at least 60 cm from trunk
- To control weeds aeration, conserve soil moisture
- Slash weeding and zero tillage approach

NUTRIENT MANAGEMENT

Points to be considered

- Analyze the soil and leaf once in three years and provide nutrients accordingly
- Integrated nutrient Management
- Liming in acid soil and gypsum in alkaline soil for buffering *p*H
- Always apply well decomposed organic manures (C:N =<12:1).
- Avoid rainy days/ insufficient soil moisture during application of nutrients .
- In drip irrigated gardens adopt fertigation
- Organic manure once in a year
- Need based phosphorus
- Chemical fertilizer application – from 2 to 3 splits (rainfed)
- Irrigated- 4 splits- fertigation 7 to 10 splits in a year



RAINFED COCONUT GARDEN
FIRST DOSE SHOULD BE APPLIED IMMEDIATELY AFTER THE RECEIPT OF MONSOON

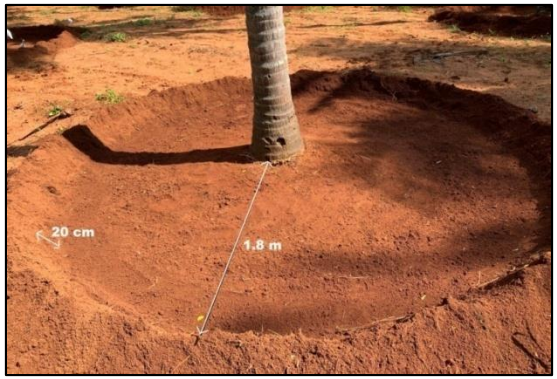
Application of Lime/
Dolomite - Acidic
Gypsum – Alkaline
@1 kg/palm

Mix with soil

Apply chemical fertilizer

Cover with soil

Second dose of manuring under rainfed condition



Opening of basin

Dolomite application

Glyricidia application @ 30-50kg + 5kg neem cake and fortified with trichoderma

Apply chemical fertilizer

After 10 days apply biofertilizer and cover the soil

- In Irrigated conditions –

  -> Organic manure application along with 25% of the soil test based recommended chemical fertilizer towards the end of monsoon if basin irrigation is adopted.

  -> Remaining 75% of chemical fertilizer applied in three equal quantity in 3 months interval

- Fertigation at least monthly interval (7 to 10 months in a year) avoiding rainy days

Type of organic manure

- Green manure
- Green leaf manure
- FYM
- Bio gas slurry
- Vermicompost
- Goat manure
- Poultry manure
- Coir pith manure
- Dosage – 30 to 50 kg/palm/year

FYM OR POULTRY MANURE OR GOAT MANURE SHALL ALSO BE APPLIED

BASIN MANAGEMENT & GREEN MANURING

Leguminous crops

-> Easiest and most economical method – augment soil organic matter.
-> 100 g of legume seeds(cowpea/ sunhump/ daincha/ pureria/ calapagonium/ mimosa) immidiatly after the receipt of monsoon rain.
-> Towards the fag end of monsoon incorporate by biomass and apply chemical fertilizer and cover with soil.

ADVANTAGE

-> Prevention of soil erosion

-> Smothering of weeds

-> Organic matter addition - maintain soil structure

-> Improves soil aeration

-> Protects from excessive heat of sun

-> Soil fertility conservation – arrest leaching loss

-> Atmospheric N fixation – Leguminous crops

Cowpea

Sun hemp

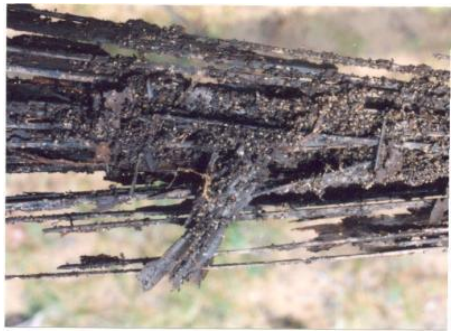
Horse gram *Macrotyloma uniflorum*

RECYCLING OF BIOMASS IN COCONUT GARDEN THROUGH VERMICOMPOSTING

Coconut leaf + cow dung (10:1)

Eudrilus sp.

40- 50% moisture



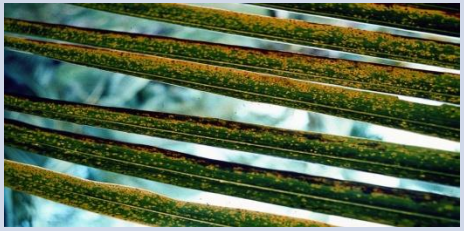
Coconut leaf vermicompost

Modern large scale vermicomposting units at CPCRI

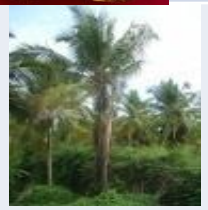
From 1 ha - 5 to 8 tonnes of leaves
Insitu compost in the basin/ in the interspace /vermi composting tanks

- 1.8 % N, 0.21% P, 0.16% K
- Rich in humic acid, plant beneficial microorganisms and growth promoting substances
- Vermicomposting tank should be covered with nylon net to protect from rhinocerous beetle attack

DIAGNOSIS AND CORRECTION OF SPECIFIC NUTRIENT PROBLEMS

Nutrient	Deficiency symptoms	
Potassium	older functional Leaves-yellowing of the leaflets with orange tinge, followed by necrosis. Severe case scorched appearance – decrease in nut production	
Nitrogen	uniform light green discoloration / yellowing (uniform chlorosis) of the oldest leaves.	
Magnesium	**Oldest leaves -broad chlorotic (yellow) bands along the margins with the central portion of the leaves remaining distinctly green.**	
Copper	Coppery bluish leaf- Rolling of terminal leaves due to loss of turgor	

DIAGNOSIS AND CORRECTION OF SPECIFIC NUTRIENT PROBLEMS

Nutrient	Deficiency symptoms	
Boron	failure of the leaves to split, crown choke disorder, leaves have a serrated zigzag appearance, poor nut setting, increase in button shedding and immature nut fall. The inflorescence and nuts become necrotic leading to barren nuts.	  
Zinc	formation of small leaves –leaf size is reduced to 50%. button shedding- saline soils	 

SOIL AND MOISTURE CONSERVATION

MULCHING

COVER CROPS

Cowpea

(*Vigna unguiculata*)

11 ton biomass

45 kg N, 47 kg K2 O

Sunn hemp (Crotalria juncea)

12 ton biomass
53 kg N 49 kg N

Daincha (Sesbania sp)

13 ton biomass

57 kg N

51 kg K

Mimosa

-> Protects soil from beating effect of rain
-> Helps in percolation of rain water
-> Helps in preventing soil and nutrient loss

Half moon bund with pineapple border

-> Flat basin with a slight inward slope towards upstream is made by excavating soil from the upstream side and filling the excavated soil at the down stream

-> A bund of 30 cm height and with suitable width with excavated soil made at downstream end

-> Two layers of pineapple plans planted with a spacing of 20 cm x 20 cm on the bund

-> Collects runoff in the basin

Runoff = 0.32 % (8.75%)*
Soil loss = 0.305 t/ha (6.76 t/ha)
Water conserved = 30 m^3/year
Increase in coconut yield was 37 %
* Values in parenthesis are of control (Mathew *et al.*,2018)

Contour trench filled with coconut husk

-> Trenches- 50 cm width x 50 cm depth with convenient length between two rows of coconut

-> Coconut husk with bottom layer facing up and top two layers facing down

-> A bund of 30 cm height and with suitable width with excavated soil made at downstream end

-> Collects surface runoff and allows to percolate

-> Reinforce the bund with pineapple

Runoff = 0.11 % (8.75%)*
Soil loss = 0.075 t/ha (6.76 t/ha)
Water conserved = 27 m3/year
Coconut yield increase was 29 %
* Values in parenthesis are of control(Mathew et al.,2018)

Coastal sandy soil management through husk/coir pith burial and raising intercrops



Husk burial



Coir pith burial

INTERCROPPING IN COCONUT – WHY?

✖ Monocropping leads to
- Poor natural resource use
- Small holdings and low income
- Limited factor productivity

☑ Coconut
- A natural companion for cropping system/farming system

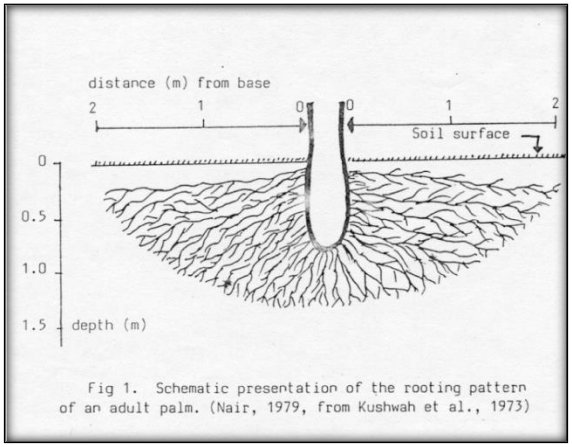
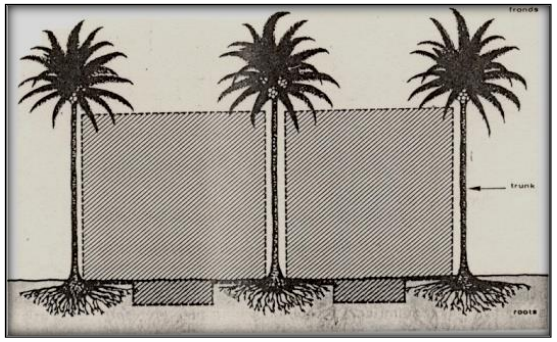


Fig 1. Schematic presentation of the rooting pattern of an adult palm. (Nair, 1979, from Kushwah et al., 1973)

Horizontal – 1.8m
Vertical – 30 to 60 cm

- The unbranched trunk, Venetian structure and orientation of leaves
- 77.7% land area is not effectively utilized
- The intensity at ground level was always higher than 6,700 lux at all parts of the year
- Coconut canopy receives on an average only about 50% of the incident solar radiation.



Coconut based Cropping System

- **Cereals:** Rice, maize
- **Pulses and oil seeds:** Groundnut, horse gram, cowpea, sun flower
- **Fruits** - banana, papaya, pineapple, lime/lemon, orange, noni, mango, sapota
- **Vegetables** -cowpea, coccinia, bhendi, chillies, cucurbits
- **Tuber crops** - colocassia, cassava, yams, sweet potato
- **Spices & condiments** - pepper, clove, nutmeg, cinnamon, ginger, turmeric
- **Beverage crop:** Cocoa
- **Floriculture:** Orchids, anthuriums, heliconia, jasmine, marigold, gomphrena
- **Medicinal & aromatic plants** - Vetiver, Kacholam, Arrowroot, Chittadalodakam, Aloevera, Thippali, Neelayamari, Sathavari, Orila, Patchouli, Moovila, Karimkurinji, Nagadanthi

COCONUT BASED CROPPING SYSTEM

Coconut + Cocoa mixed cropping system

-> Increase in O.M content of soil through cocoa leaves shedding & prunnings

-> Amount of O.M added to soil (oven dry wt.)

SH 818 kg/ha/year

DH 1985 kg/ha/year

-> Nutrient conc. N-2.84%, P-0.26%, K-1.73%

50 kg N, 11 kg P_2O_5, 35 kg K_2O/ha/year

-> Intense activity of beneficial microbes : N fixing bacteria- *Beijerinckia* ,P Solubiliser- 21 isolates of bacteria, a*ctinomycetes* and fungi identified (*Pseudomonas* sp. And *Aspergillus niger*)

-> Evaporation is 30% of that from the open area

-> Variation in mean monthly temperature is low

High Density Multi Species Cropping System

-> Better yield

-> Less input cost

-> Improved soil health & fertility

-> Less pest & disease damage

-> Moisture conservation

-> Weed suppression

-> Year round income

Two or more mutually beneficial plants to increase biodiversity of a cropping system

Coconut based integrated farming system

- Supplementing the entire requirement of phosphorus and > than 70 % requirement of Nitrogen and potassium and the system is sustainable
- Improve the microbial load
- Better soil nutrient status in the system
- Higher net income ($9587) over monocropping ($1400)
- Higher employment generation (900 man days per year) over monocropping (140 mandays)

PLANT PROTECTION IN COCONUT

> Follow safety measures while spraying

> The agro-chemicals you use must be admitted, that is, they must be registered in your country –

> Expired agro-chemicals or in bad state should not be used (verify due date)

> Children, pregnant women and old age people must not be near the area where agro-chemicals are applied

> Once the application is over, the worker should have a shower and wash the protection elements

> Compact area approach for plant protection measures-community action for effective pest and disease management

Pest Management in Coconut

Safety standards and hygienic practices should be observed

Pests	Management
Coconut rhinoceros beetle	Regular hooking out of beetle Prophylactic leaf axil filling with neem cake plus sand or naphthalene balls -Nylon fish net wrapping of spear leaf Incorporation of *Metarhizium majus* and *Clerodendroan infortunatum* in to breeding zone -Release of nudivirosed beetle @ 12 per ha
Red palm weevil	Regular monitoring, sustained surveillance and destruction of crown toppled palms -Cutting fronds at least 1.2 m from trunk Spot application of imidacloprid 0.02% Community trapping of weevils using pheromone lures
Coconut eriophyid mite	Spraying neem oil-garlic (2%) or palm oil-sulphur (0.5%) Spraying of *Hirsutella thompsonii* (20 g/litre) thrice Balanced application of nutrients
Black headed caterpillar	Removal and destruction of severely affected fronds -Release of parasitoids (*Goniozus nephantidis* & *Bracon brevicornis*) 100 per palm
Rugose spiralling whitefly	Pesticide holiday, conservation biological control of *Encarsia guadeloupae* and sooty mould scavenger beetle, *Leiochrinus nilgirianus* –Yellow sticky trap-Ecological engineering with intercrops

Netting around spindle

M. majus infected

***Goniozus nephantidis* parasitising black headed caterpillar**

Parasitism by *Encarsia guadeloupae*

Scavenging by *Leiochrinus nilgirianus*

Disease Management in Coconut

Diseases	Management
Root (wilt) disease – Phytoplasma disease	Diagnosis and removal of advanced diseased plams Raising resistant varieties and tolerant hybrid (Kalpa sankara) Nutritional management
Leaf rot disease	Phytosanitation and removal of diseased spear leaf Crown pouring of Talc-based preparation of Pseudomonas fluorescens and Bacillus subtilis @ 50 g / 500 ml water Application of hexaconazole (Contaf 5 EC) 2 ml / 300 ml water per palm
Basal stem rot	Complete destruction of infected palms at advanced stage Avoid flood irrigation Apply 50 kg bio-suppressive compost containing 500 g Trichoderma harzianum and 5 kg neem cake Root drenching with BM 1% @ 40 litres
Bud rot	Destroy all affected tissues in crown Spot application of 1% BM Placement of Trichoderma coir pith cake on the innermost leaf axils
Stem bleeding	Avoid flood irrigation Apply 50 kg bio-suppressive compost containing 500 g Trichoderma harzianum and 5 kg neem cake

Root (wilt) disease palm

Leaf rot affected palm

Trichoderma coir pith cake

HARVESTING

- Regular harvesting is must
- Harvesting should be done at 45-60 days interval
- Manual or mechanically harvesting can be done with proper safety measures.

POST HARVEST PROCESSING AND VALUE ADDITION

- **Coconut- a small holder's crop, farmers experience resource constraints**
- **Facilitate FPOs- - community approach for production and marketing of value added products to enhance income**

Mature coconut based products

VCO

Coconut chips

Milk powder

Frozen coconut delicacy

Milk powder

Instant coconut chutney

By-product utilization: Coconut Milk Residue

CMR based products

Extrudates

Biscuits

Rusk

Pasta

Fried snack

Inflorescence sap based products

Kapa nutri bar

Kalparasa®

Neera Honey

Coconut jaggery

Kalpa sweets

Coconut sugar

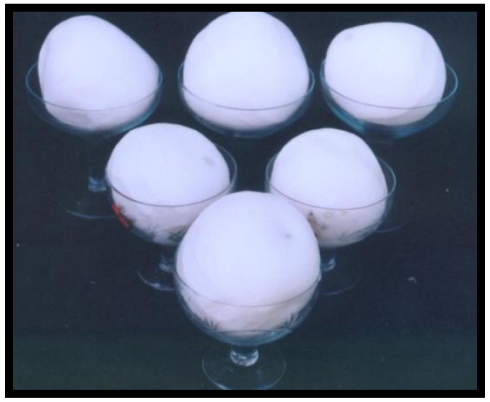
Kalpa Drinking chocolate

Kalpa bean to bite chocolates

VCO VALUE ADDITION

Tender coconut based products

Trimmed tendernuts



Snowball tendernuts

Carbonated tender coconut water

Adoption of a holistic approach by employing Good Agricultural Practices would enable to sustain the coconut productivity

THANK YOU