

**Practical Manual**

# **PLANTATION CROPS**

HFS 203 3(2+1)

**Dr. Ranjit Pal**  
**Dr. Vinod Kumar**



2020

**College of Horticulture & Forestry**  
**Rani Lakshmi Bai Central Agricultural University**  
**Jhansi-284003, Uttar Pradesh**

**SYLLABUS HFS 203 3(2+1)**

**Practical:** Description and identification of coconut varieties, selection of coconut and areca nut mother palm and seed nut, planting of seed nuts in nursery, layout and planting of coconut, areca nut, oil palm, cashew nut, cocoa gardens, manuring, irrigation; mulching, raising masonry nursery for palm, nursery management in cacao. Description and identification of species and varieties in coffee, harvesting, grading, pulping, fermenting, washing, drying and packing of coffee, seed berry collection, seed extraction, treatment and sowing of coffee, epicotyl, softwood, grafting and top working in cashew, working out the economics and project preparation for coconut, areca nut, oil palm, cashew nut, cacao, etc. Mother plant selection, preparation of cuttings and rooting of tea under specialized structure, training, centering, pruning, tipping and harvesting of tea.

**Name of Student:** .....

**Roll No.** ..... **Batch** .....

**Session** ..... **Semester** .....

**Course Name:** .....

**Course No:** .....

**Credit:** .....

**CERTIFICATE**

This is to certify that Shri/Km ..... ID No ..... has completed the practical course ..... Course No ..... as per the syllabus of B. Sc (Hons) Agriculture/Horticulture/ Forestry ..... semester in the year ..... in the respective lab/field of college.

Date:

Course Teacher



## INDEX

S No.	Exercise	Page No.
1.	To identify plantation crops	
2.	To identify and describe Areca nut varieties	
3.	To identify and describe Coconut varieties	
4.	To identify and describe species and varieties in coffee	
5.	To study propagation method in Coconut	
6.	To study methods of seed nuts sowing in coconut	
7.	To study propagation method in Cashew nut	
8.	To study on top working in decline old cashew nut plants	
9.	To study vegetative propagation methods in cocoa	
10.	To study layout and planting of plantation crops	
11.	To study cashew nut processing techniques	
12.	To study harvesting and processing techniques of areca nut and oil palm	
13.	To study harvesting and processing techniques of cocoa	
14.	To study harvesting and tea processing techniques	
15.	To study harvesting and processing techniques in coffee	
16.	To study training and pruning in tea	
17.	To study tapping of rubber trees	
18.	To study production economics for commercial cultivation of coconut	

## Exercise No. 1

**Objective: To identify plantation crops**

Areca nut	
Scientifical Name	:
Family	:
Chromosomes No	:
Inflorescence	:
Fruit	:
Maturity time	:
Economical value	:

Cashew Nut	
Scientifical Name	:
Family	:
Chromosomes No	:
Inflorescence	:
Fruit	:
Maturity time	:
Economical value	:

Cocoa	
Scientifical Name	:
Family	:
Chromosomes No	:
Inflorescence	:
Fruit	:
Maturity time	:
Economical value	:

Coconut	
Scientifical Name	:
Family	:
Chromosomes No	:
Inflorescence	:
Fruit	:
Maturity time	:
Economical value	:

Coffee	
Scientifical Name	:
Family	:
Chromosomes No	:
Inflorescence	:
Fruit	:
Maturity time	:
Economical value	:

Oil Palm	
Scientifical Name	:
Family	:
Chromosomes No	:
Inflorescence	:
Fruit	:
Maturity time	:
Economical value	:

Tea	
Scientifical Name	:
Family	:
Chromosomes No	:
Inflorescence	:
Fruit	:
Maturity time	:
Economical value	:

Rubber	
Scientifical Name	:
Family	:
Chromosomes No	:
Inflorescence	:
Fruit	:
Maturity time	:
Economical value	:

**Exercise No. 2**

**Objective: To identify and describe Areca nut varieties**

<b>Characteristics</b>	<b>Cultivars / Varieties</b>
High yielding	
Early Bearing	
Highest number of fruits	
Better Nut quality	
Large fruit Size	
Regular bearing	
Semi tall	
Dwarfness	
Uniformity	
Tender nut	

**Mangala:**.....  
.....  
.....  
.....  
.....  
.....

**Sumangala:**.....  
.....  
.....  
.....  
.....  
.....

**Sreemangala:**.....  
.....  
.....  
.....  
.....  
.....

**Mohitnagar:**.....  
.....  
.....  
.....

.....  
.....

**Kahikuchi Tall:** .....

.....  
.....  
.....  
.....  
.....

**Swarnamangala**.....

.....  
.....  
.....  
.....  
.....  
.....

**VILAH-1:** .....

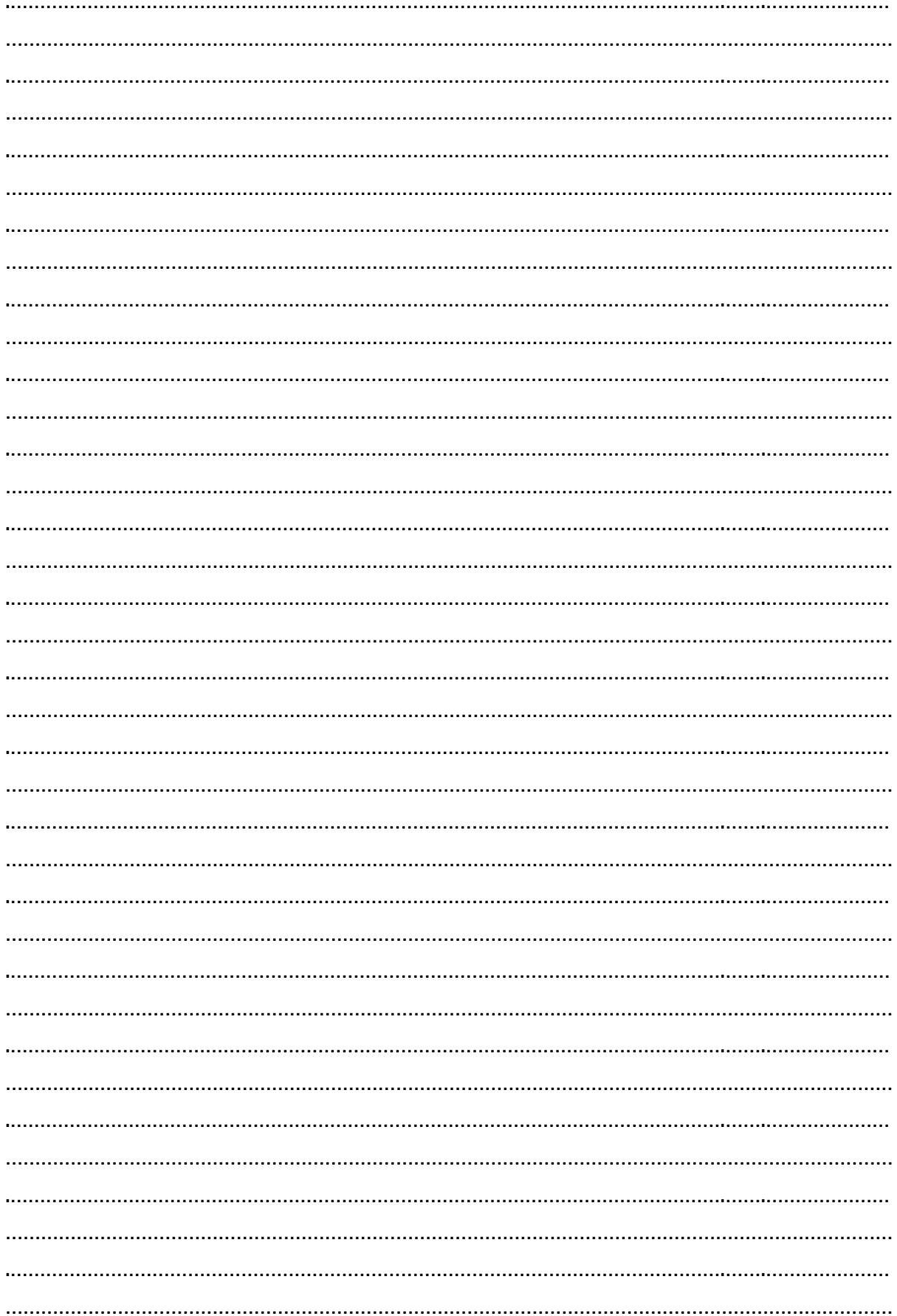
.....  
.....  
.....  
.....  
.....  
.....

**VILAH-2:** .....

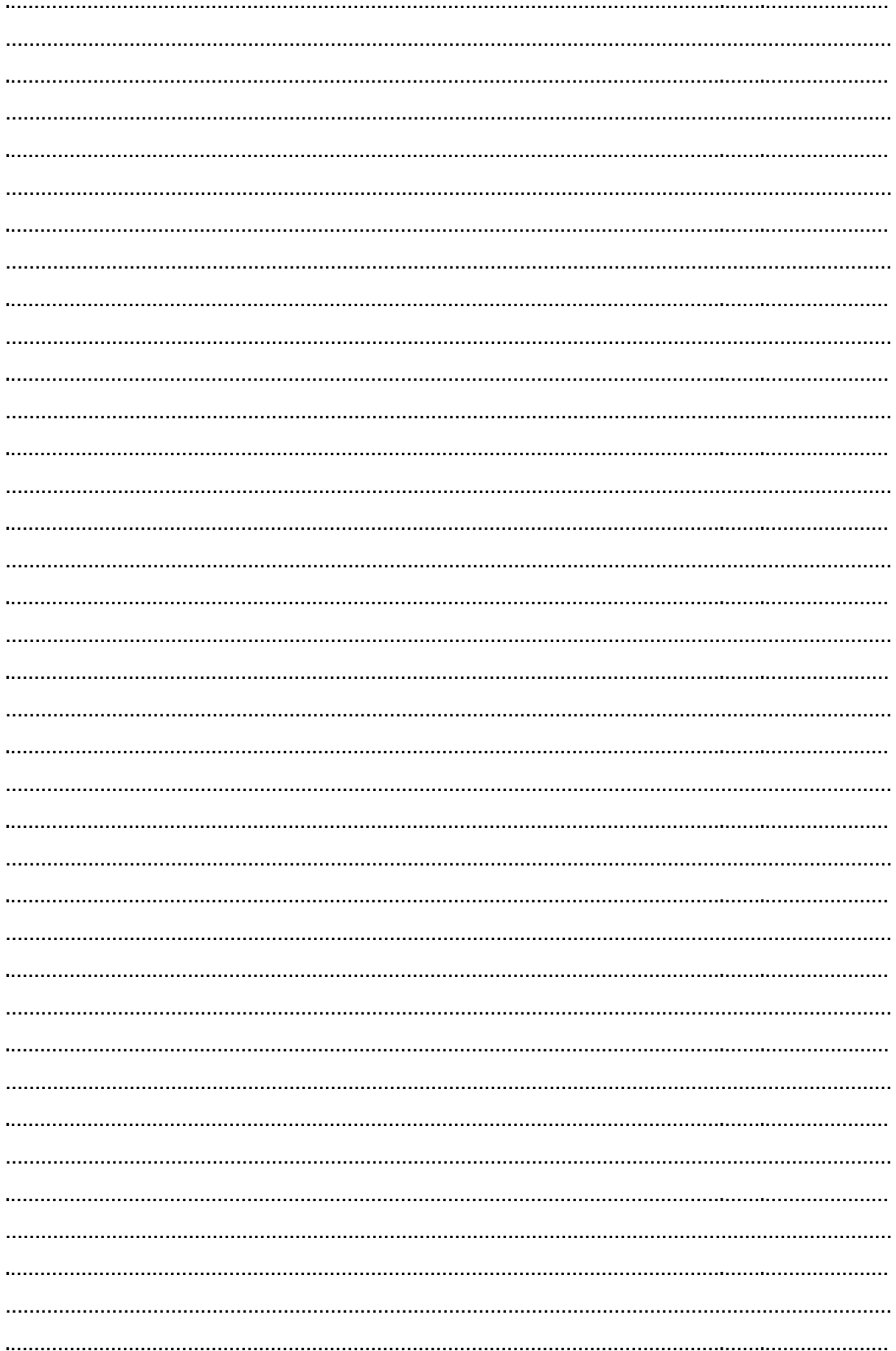
.....  
.....  
.....  
.....  
.....



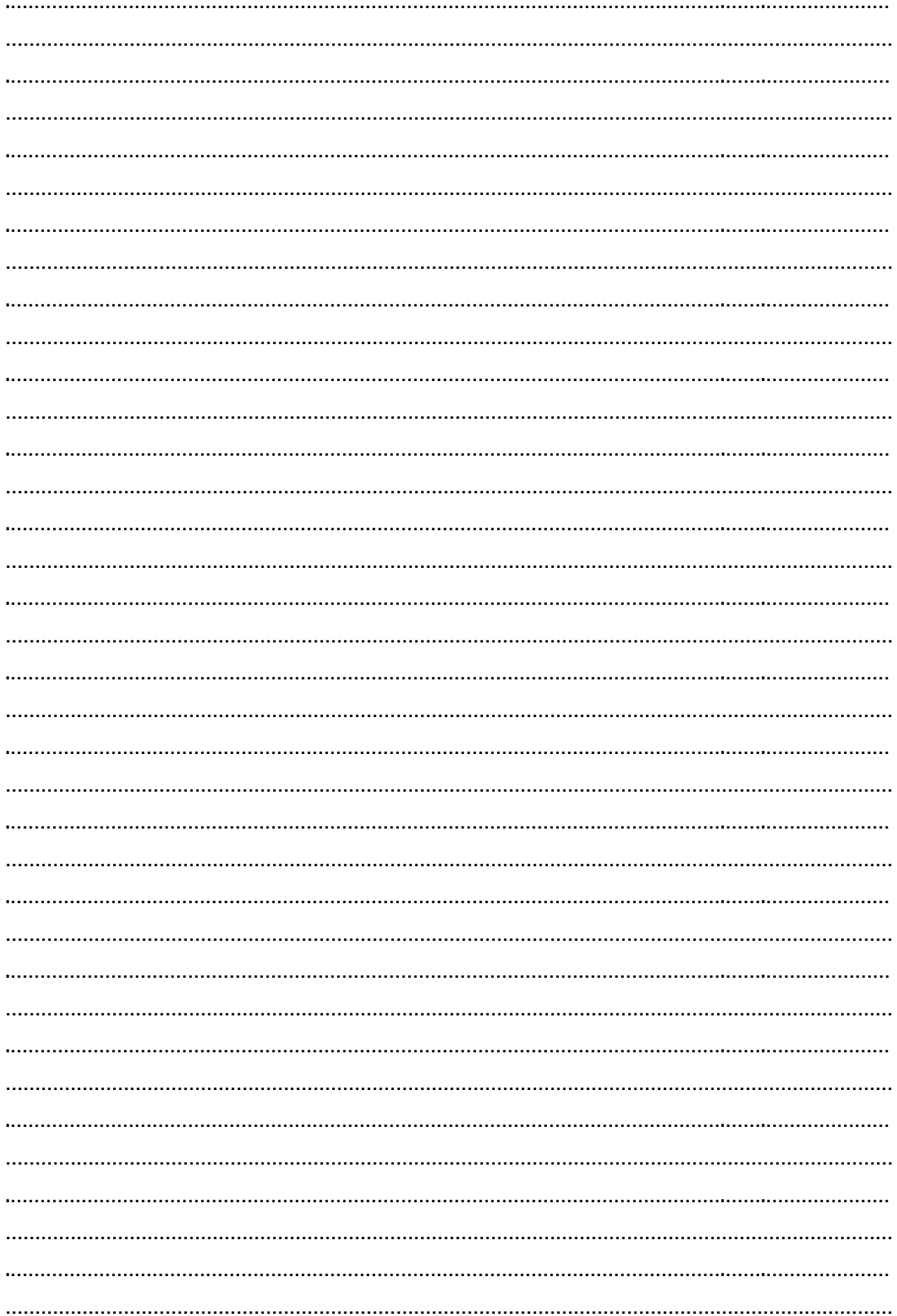












.....  
.....  
.....  
.....

**Objective:** To study propagation method in Coconut

**Materials required:** .....

.....

.....

**Mother palm selection Procedure:** .....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**Seed nut selection procedure:** .....

.....

.....

.....

.....

.....



.....  
.....  
.....

**Nursery site selection:** .....

.....  
.....  
.....  
.....  
.....

**Procedure of seed nut sowing:**

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

**Care and Management of nursery** .....

.....  
.....  
.....  
.....



.....

.....

**Exercise No. 6**

**Objective: To study methods of seed nuts sowing in coconut**

**Materials required:** .....

.....

**Procedure:**.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**Exercise No. 7**

**Objective: To study propagation method in Cashew nut**

**Materials required:** .....

.....  
.....

**Softwood grafting:** .....

.....  
.....

.....  
.....

**Procedure of softwood grafting:**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

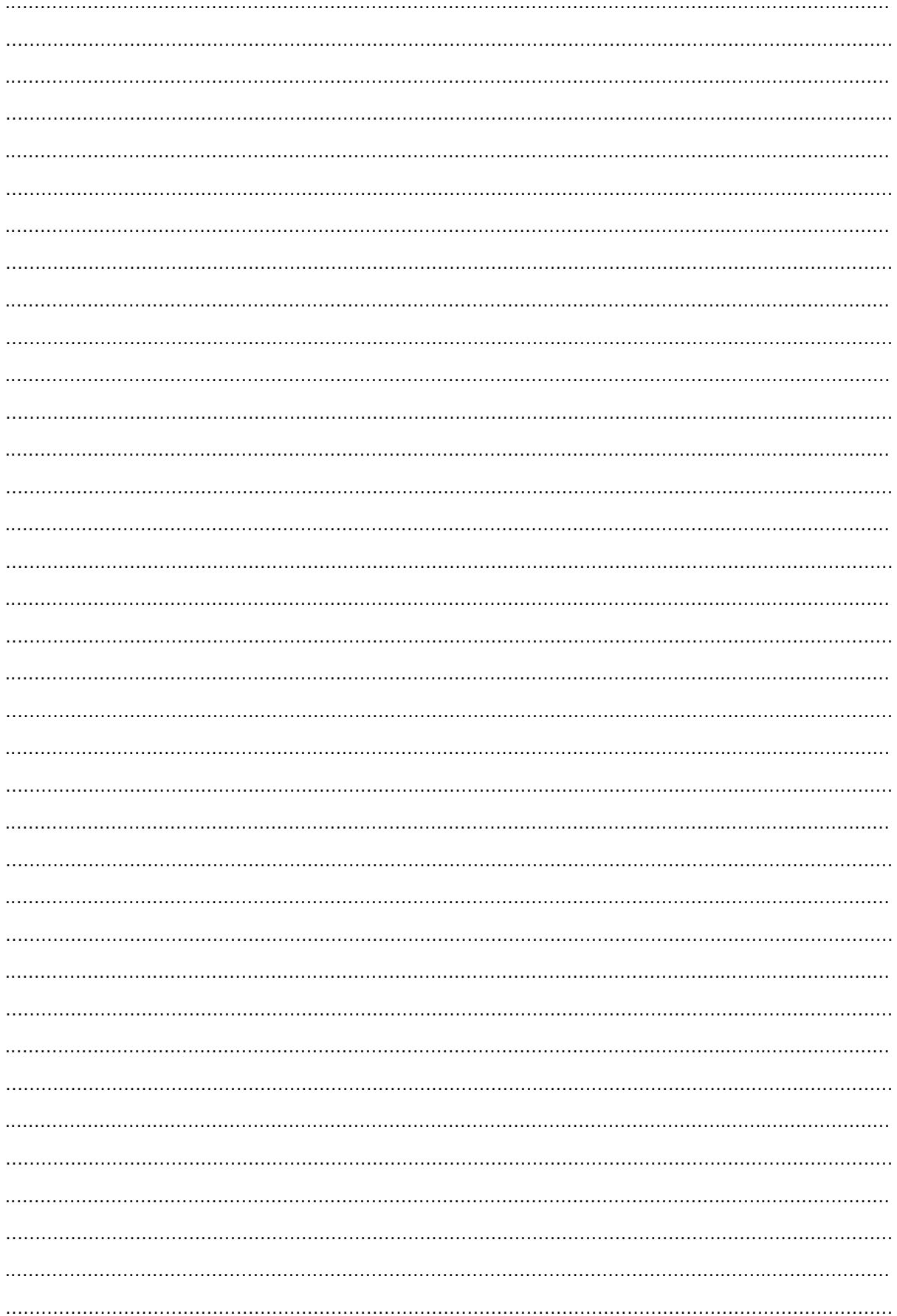
.....

.....

.....

.....

.....



.....

.....

**Exercise No. 8**

**Objective: To study on top working in decline old cashew nut plants**

**Materials required:** .....

.....

**Procedure of rejuvenation:** .....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....





.....  
.....



**Objective:** To study layout and planting of plantation crops

**Materials required:** .....

.....

**Planting system:** .....

.....

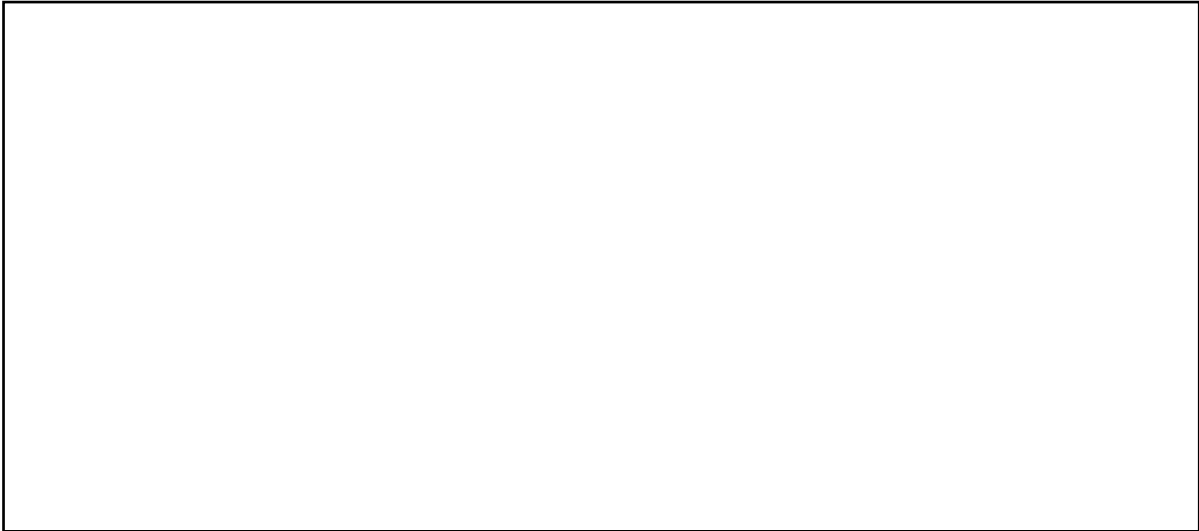
.....

.....

.....

.....

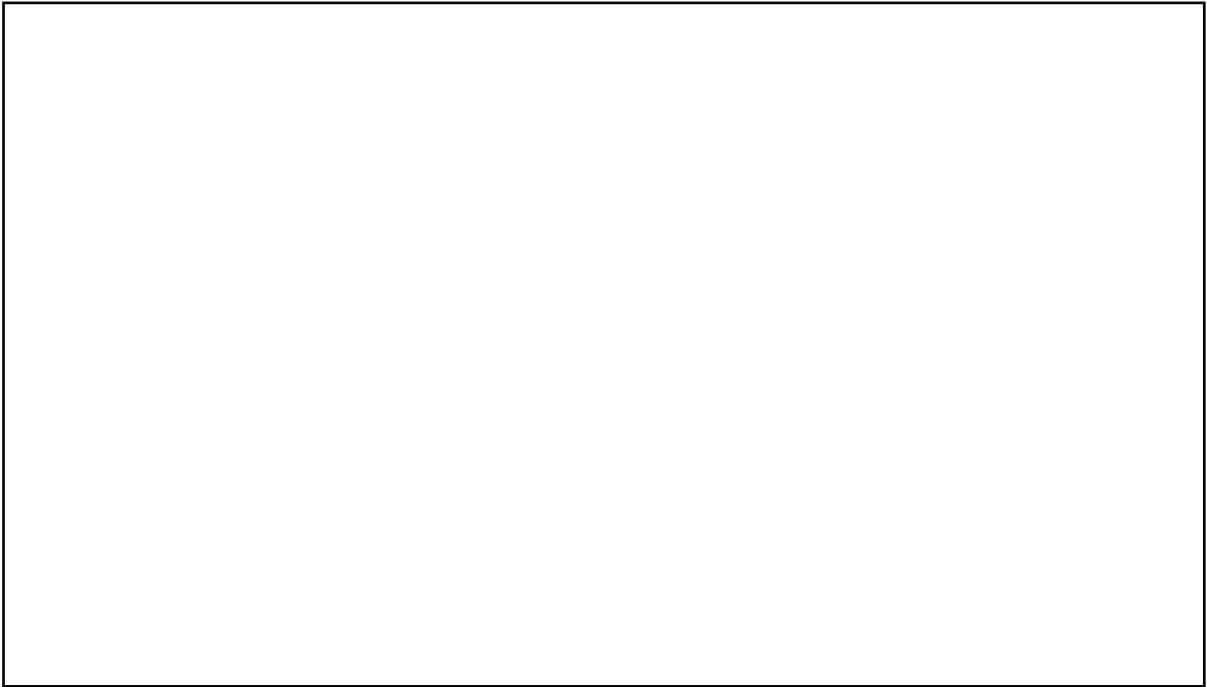
**Square System:**



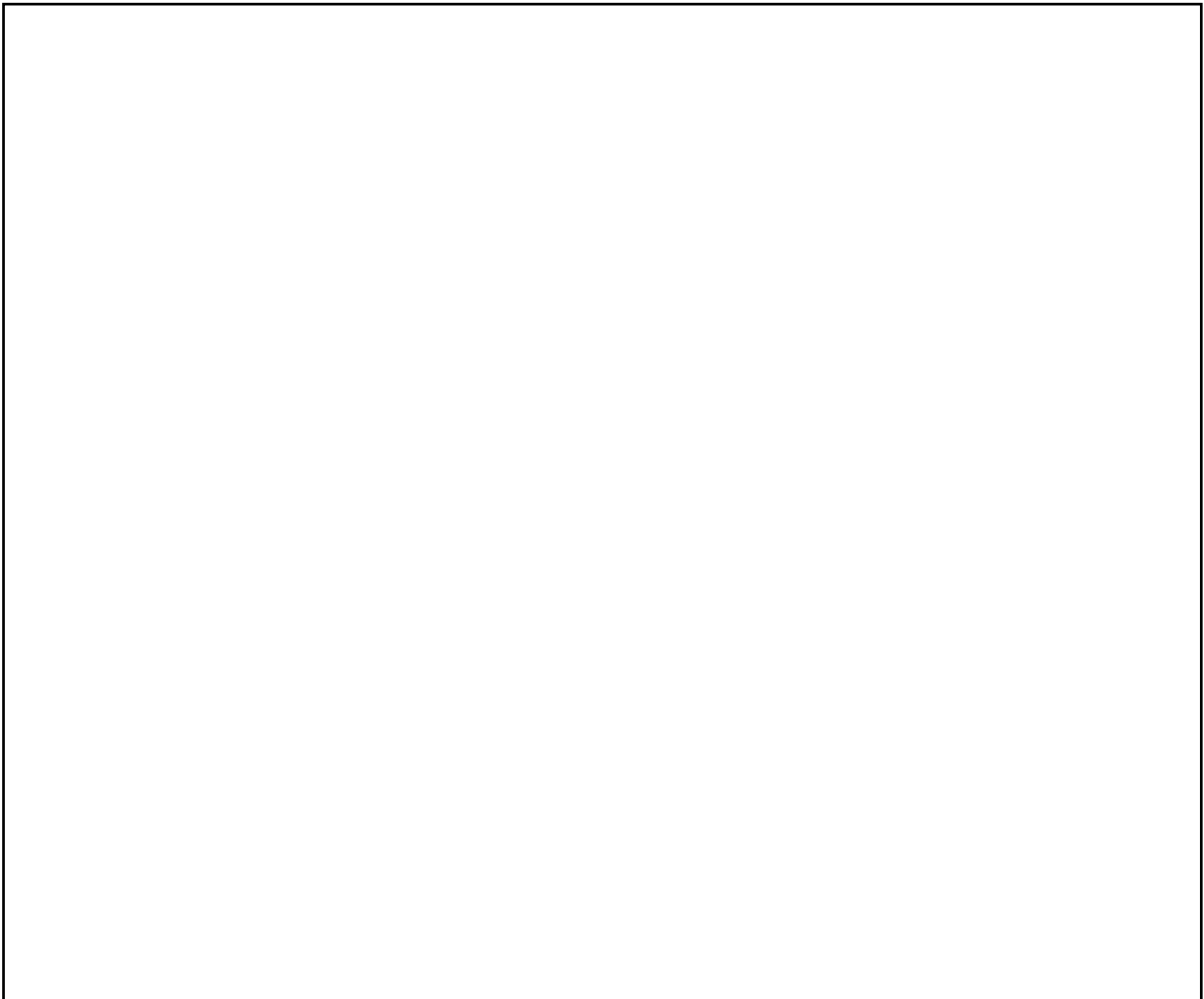
**Triangular System:**



**Single Hedge System:**



**Double Hedge System:**



**Objective: To study cashew nut processing techniques**

**Materials required:** .....  
.....  
.....  
.....

**Harvesting:** .....  
.....  
.....  
.....  
.....  
.....  
.....

**Roasting:** .....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

**Open Pan Method:** .....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

**Drum Roasting Method:** .....  
.....  
.....  
.....  
.....  
.....  
.....











.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**Oil Palm**

**Materials required:** .....

.....

.....

.....

.....

.....

**Harvesting Procedure:**.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

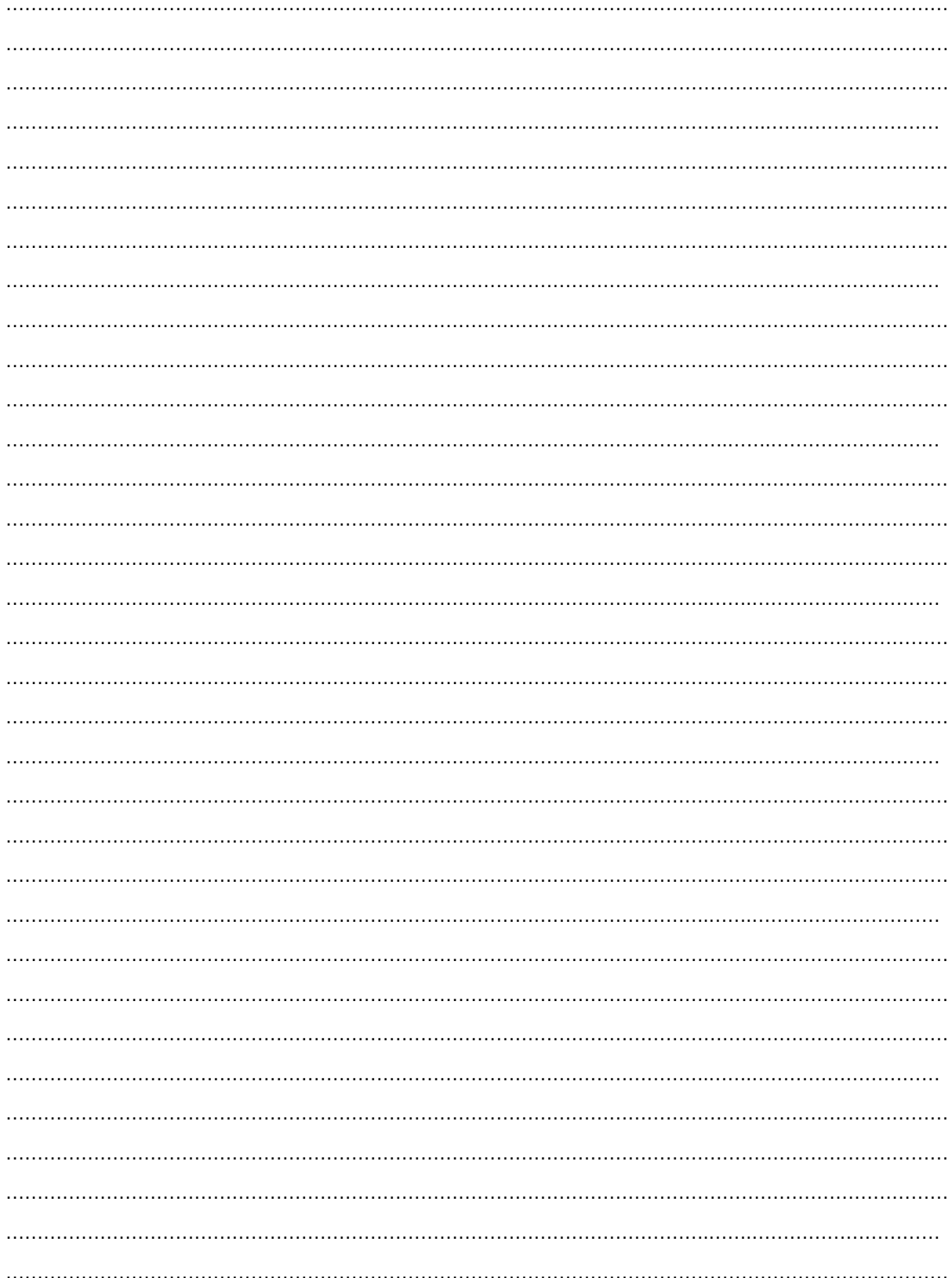
.....

.....

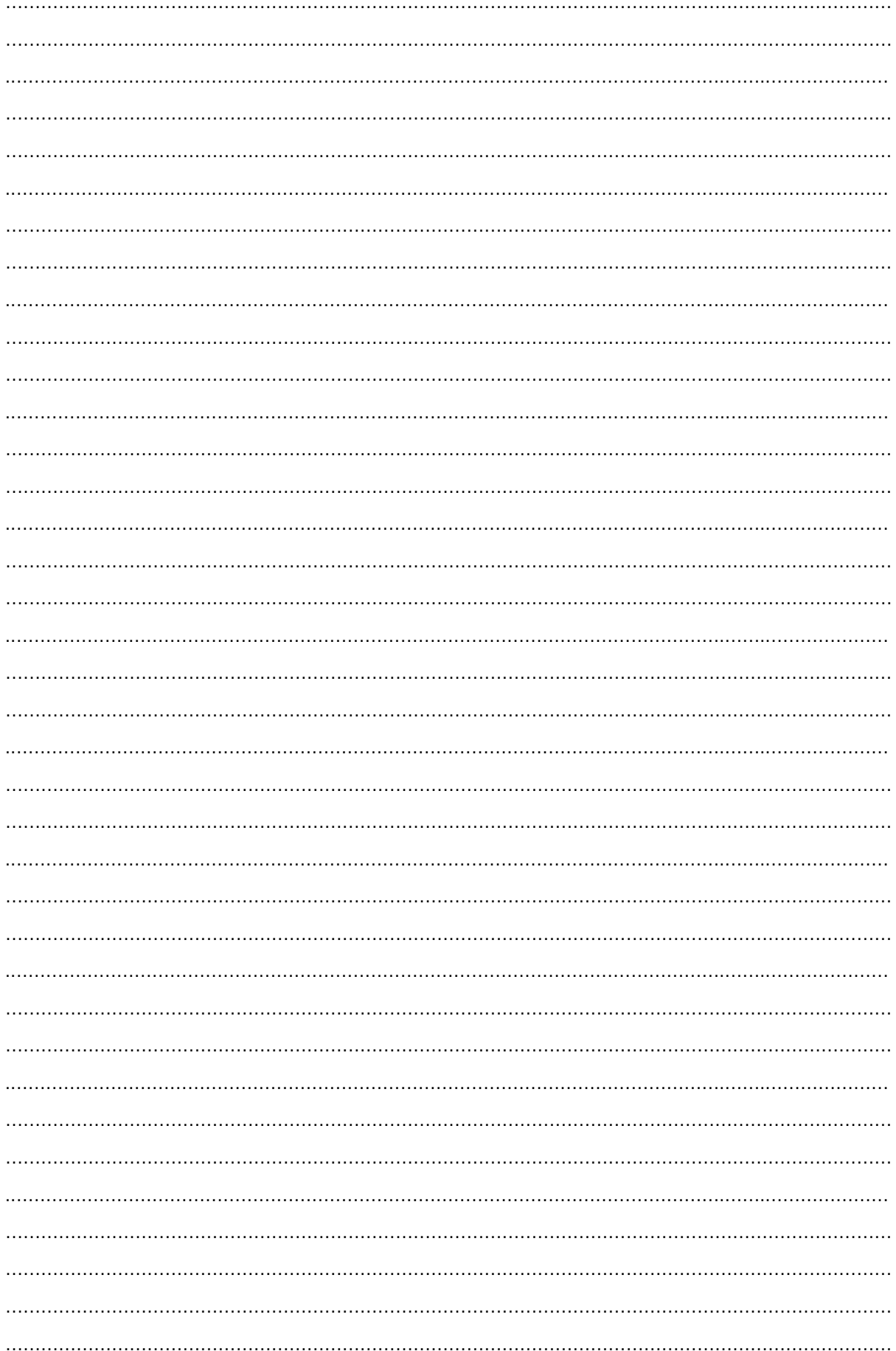
.....

**Processing procedure :**.....

.....

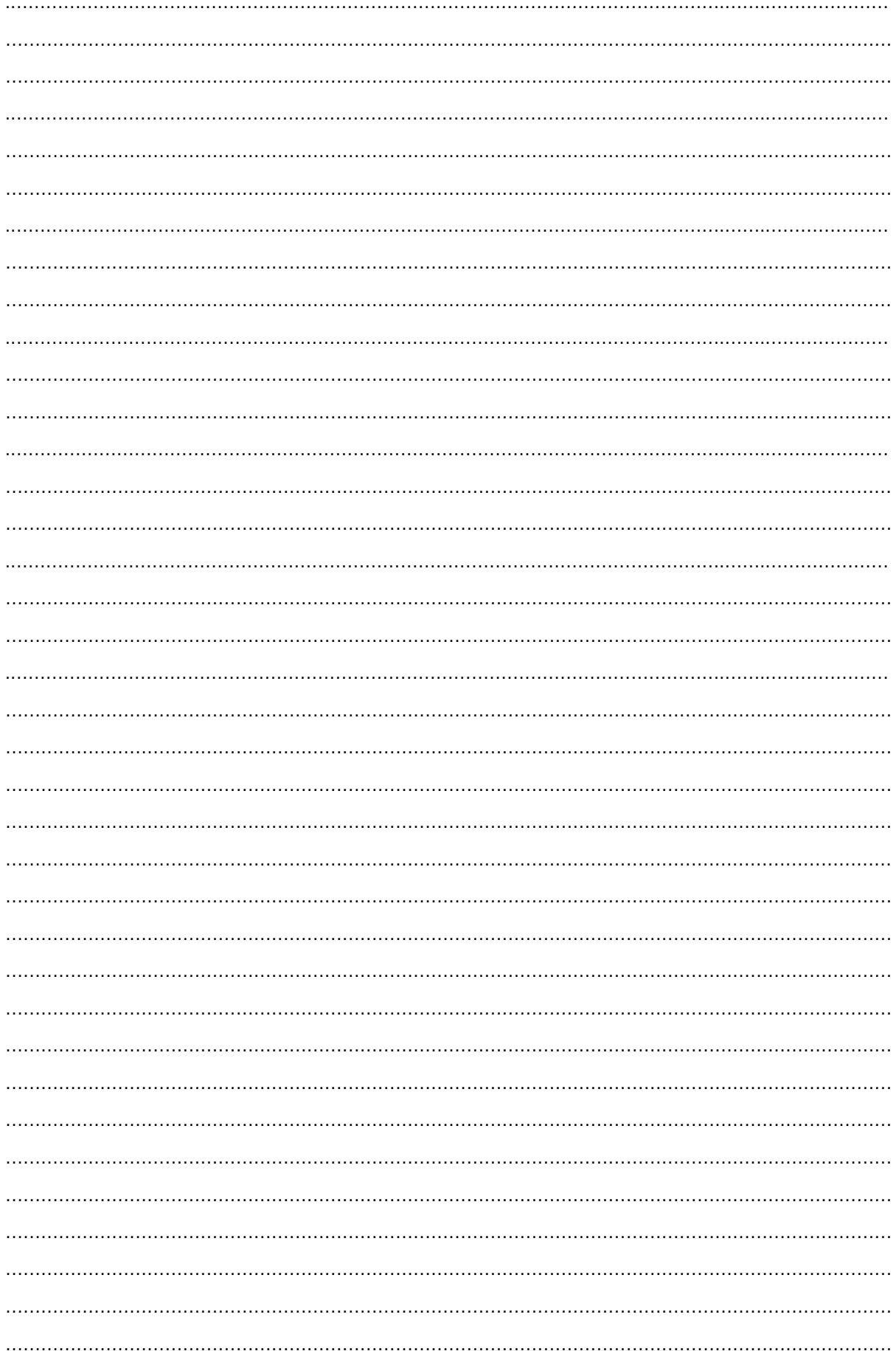










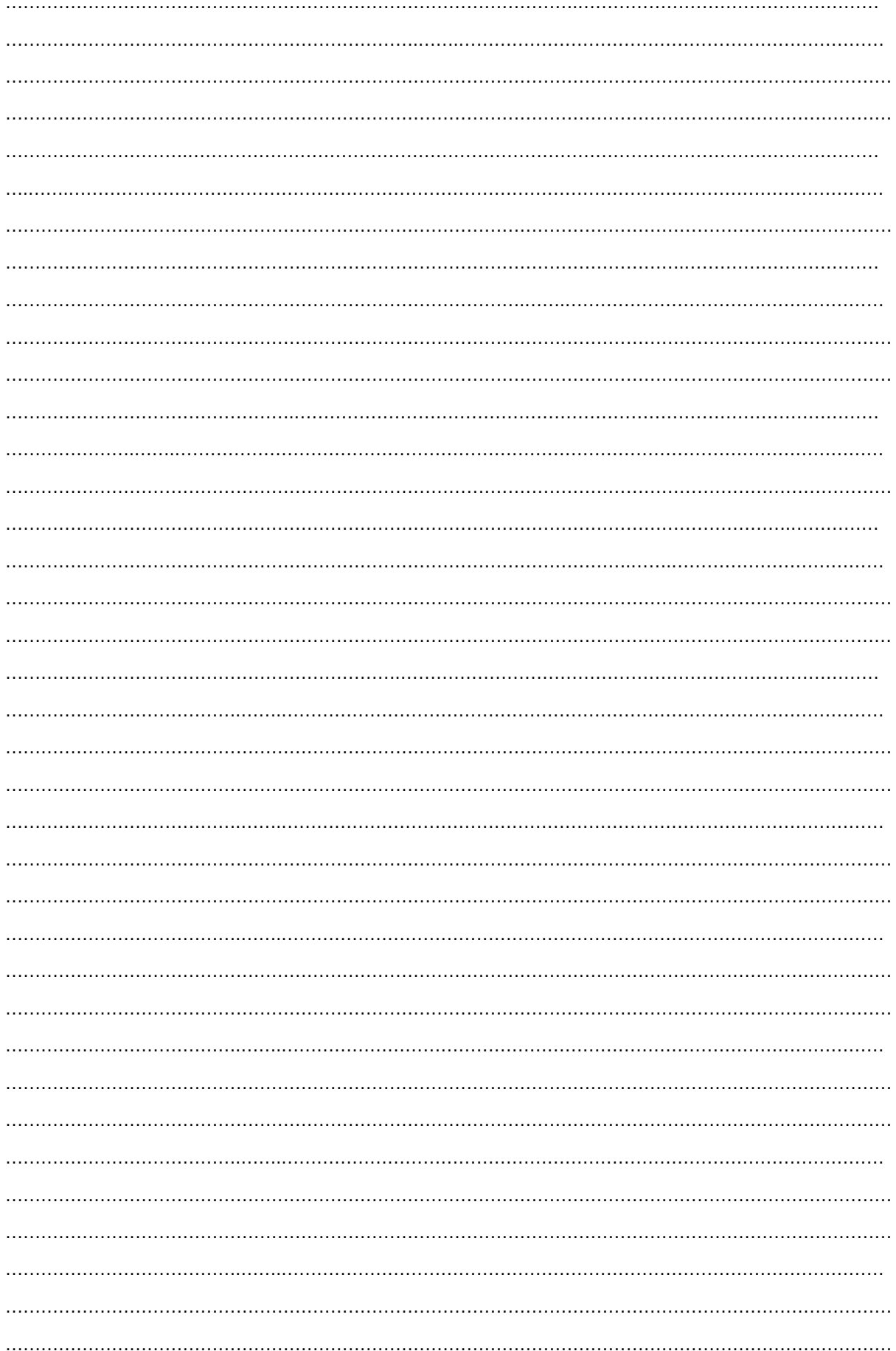




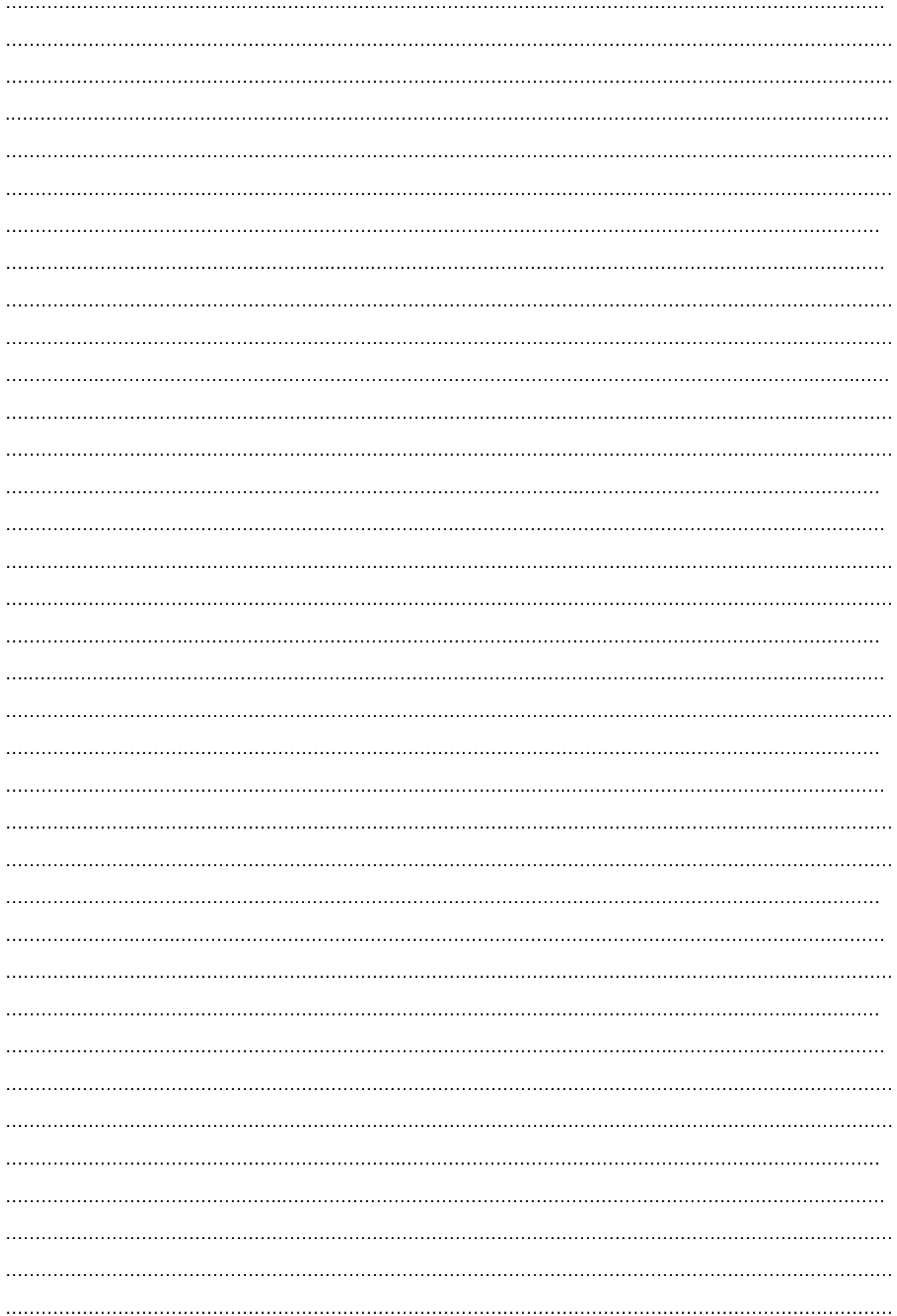












## Exercise No. 18

**Objective: To study production economics for commercial cultivation of coconut**

Items for calculating the cost of cultivation of Coconut for 1 ha. area

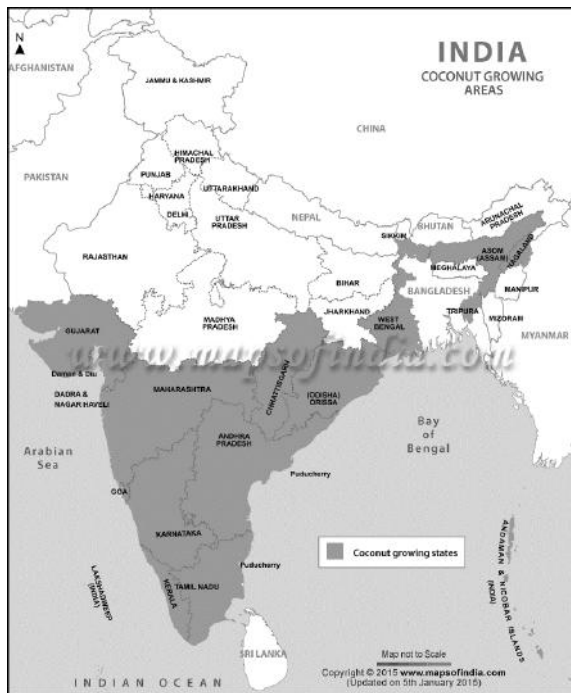
S. No.	Component	Proposed Expenditure
<b>1.</b>	<b>Land purchase and planting preparation</b>	
	Cost of 1 ha. land	
	Soil Leveling	
	Digging	
	Others, if any, please specify	
	Labour charge for transplanting	
	Providing shade to the transplanted seedlings using coconut fronds	
<b>2.</b>	<b>Irrigation cost for first 5 years</b>	
	Tube-well/submersible pump	
	Cost of Pipeline	
	Electricity charges free	
	Others, if any, please specify	
<b>3.</b>	<b>Manures and Fertilizer application for first 5 years</b>	
	I <sup>st</sup> year cost of manures and fertilizers with labour	
	II <sup>nd</sup> year cost of manures and fertilizers with labour	
	III <sup>rd</sup> year cost of manures and fertilizers with labour	
	IV <sup>th</sup> year cost of manures and fertilizers with labour	
	V <sup>th</sup> year cost of manures and fertilizers with labour	
<b>4.</b>	<b>Cost of weeding</b>	
<b>5.</b>	<b>Cost of Insecticides &amp; pesticides</b>	
<b>6.</b>	<b>Infrastructure</b>	
	Store	
	Labour shed & Pump house	
	Farm Equipment	
	Fencing (Live and wire)	
<b>7.</b>	<b>Cost of Harvesting</b>	
<b>Grand Total</b>		
<b>1.</b>	<b>Income details</b>	
	Intercropping with Banana upto 5 years	
	Cost of Banana cultivation	
	Income from Banana cultivation	
	Net profit in five years	
	Income from coconut	
	Income from Intercropping and coconut	
<b>2.</b>	<b>Total expenditure</b>	
	Net income: <b>gross income – expenditure</b>	
	Net income growing one ha. area will be	
<b>3.</b>	<b>Benefit cost ratio: Net income / total cost</b>	

**Conclusion:** .....

.....

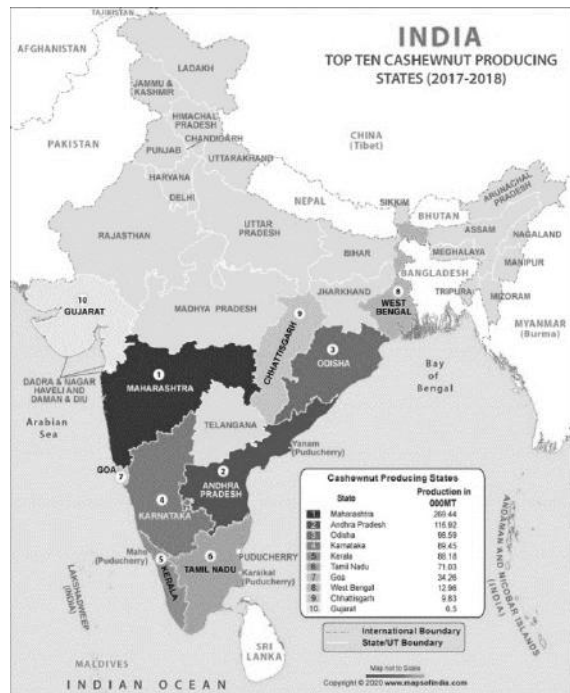
.....

.....



**Coconut growing area**

The major coconut growing states are Kerala, Tamil Nadu, Andaman and Nicobar, Lakshadweep, Goa, Assam, Karnataka, Andhra Pradesh, Maharashtra, Odisha, West Bengal, Tripura, Gujarat and Chhattisgarh.



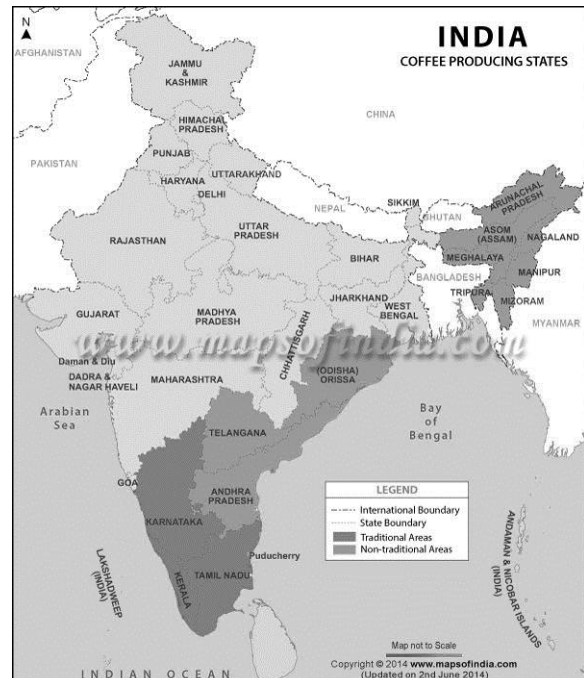
**Cashew nut growing area**

The major cashew nut growing areas are Andhra Pradesh, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Odisha and West Bengal.



**Tea growing area**

The major tea growing areas are Assam, West Bengal, Tamil Nadu, and some part of Kerala, Karnataka, Himachal Pradesh.



**Coffee growing area**

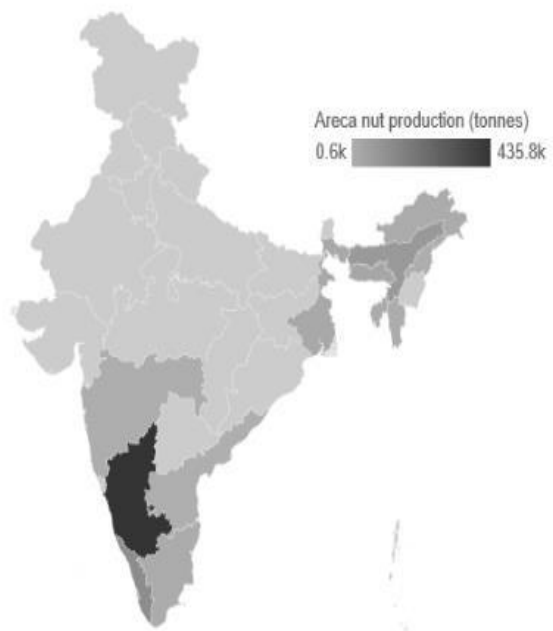
The major coffee growing areas are Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Odisha and North Eastern states.





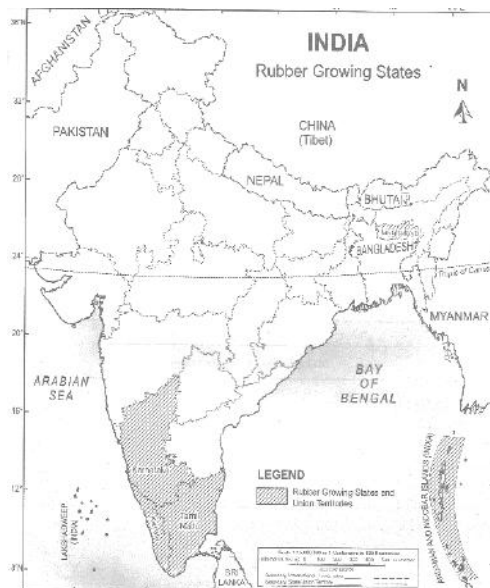
### Cocoa growing area

In India, cocoa is mainly grown in Kerala, Karnataka, Andhra Pradesh and Tamil Nadu.



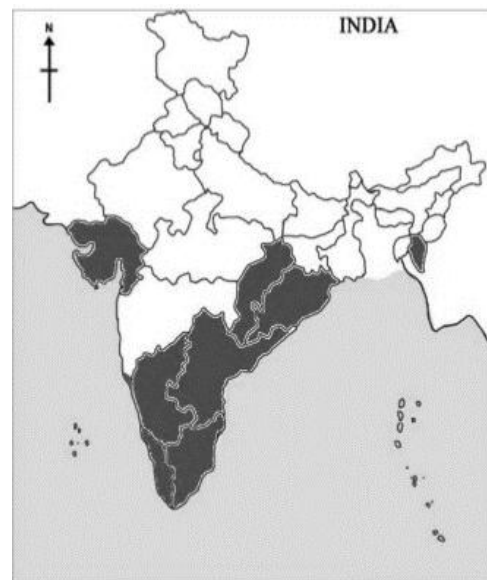
### Areca nut growing area

In India, areca nut is mainly grown in Karnataka, Kerala, Maharashtra, Andhra Pradesh and Tamil Nadu, West Bengal, Assam, Odisha and North Eastern states.



### Rubber growing area

In India, Kerala is the predominant rubber- growing state. Tamil Nadu and Kerala account for 98% of total production. The cultivation has extended to non-traditional areas like Karnataka, Tripura, Meghalaya, Assam.



### Oil palm growing area

The major oil palm producing areas are Andhra Pradesh, Karnataka, Tamil Nadu and Kerala. The cultivation has extended to non traditional areas like Odisha, Chattesgarh, Gujarat, Goa and Tripura.

## COCONUT NURSERY MANAGEMENT TECHNIQUES

**Nursery Area:** Identified nursery area in a well-drained and less water holding capacity plot with coarse texture soil near water source for irrigation. Nursery can be raised in the open space with artificial shade or in the adult coconut garden.

### NURSERY BED PREPARATION



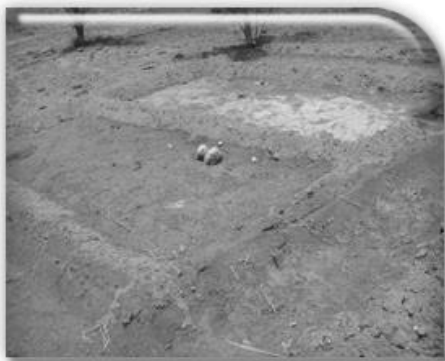
1.5 m Width with Convenient Length



75 cm Space Between Beds



Levelled Beds



Small Length Sized Beds

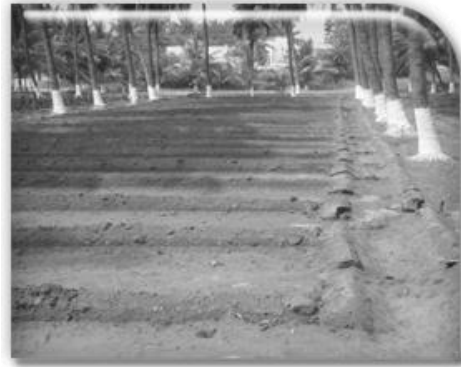


Well Prepared Nursery Beds

### NURSERY STRUCTURE



Nursery Area between Coconut



Raised Nursery Bed



50 % Shaded Nursery



Nursery under Partial Shade in Coconut Plantation

**Seed Nut Planting:** Plant seed nuts in a long and narrow bed at a spacing of 30 x 30 cm either horizontally or vertically in deep trenches with 20-25 cm depth. Five rows of nuts may be planted in each bed accommodating 50 nuts per row.



Prepared Bed for Planting



Nursery Bed



Bed Preparation



Planting Seed Nuts Properly



Placing Seed Nuts Horizontally



Top Portion of Nuts Visible



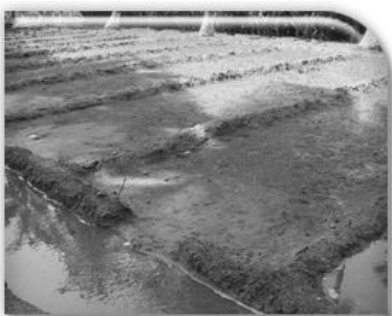
Seedling Growth from Top Portion of Nuts



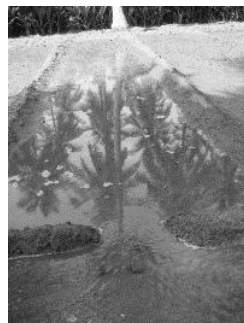
Seedling Growth from Visible Portion of Nuts

### Intercultural Operations in Nursery

- Irrigate the nursery beds once in three days.
- Keep the nursery free of weeds. To manage the weed problem in coconut nursery, growing sun hemp 2 times (each harvested at flowering stage) followed by one hand weeding at 6th month was found to be very effective besides yielding green manure for manuring the adult coconut palms.
- Provide shade to the nursery by raising Sesbania or Leucaena on the sides of beds.
- The seed nuts start germination 6 – 8 weeks after planting and germination continues upto six months. Select seedlings that germinate before 5 months after planting. Remove those nuts which do not germinate 5 months after sowing.
- Regularly survey for pest and diseases.



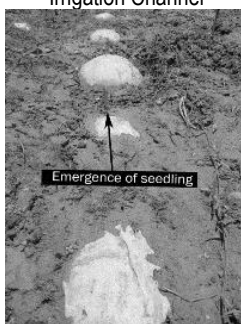
Irrigation Channel



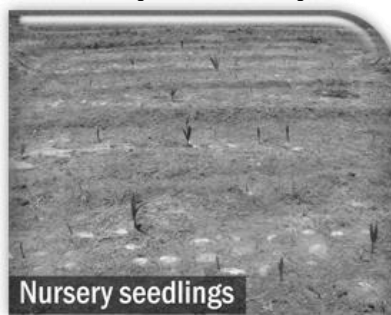
Irrigated after Planting



Irrigated Nursery



Seedling Emergence



Nursery seedlings

Seedling Emergence Field



2 Months Old Seedlings



3 Months Old Seedlings



4 Months Old Seedlings



5 Months Old Seedlings



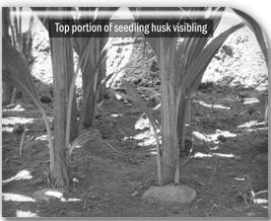
8 Months Old Seedlings



9 Months Old Seedlings



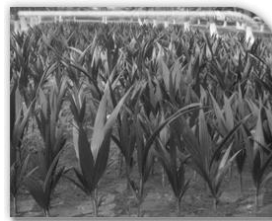
9 Months Old Seedlings



Top Portion of Seedling Husk Visibling



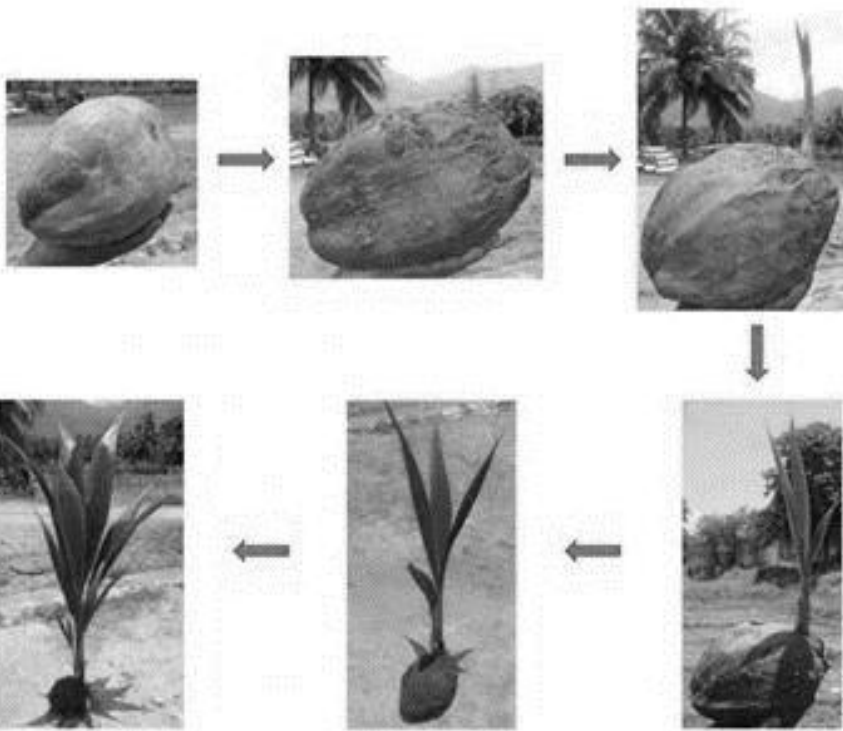
Late Germination



Well Germinated Seedlings



Hand Weeding in Nursery

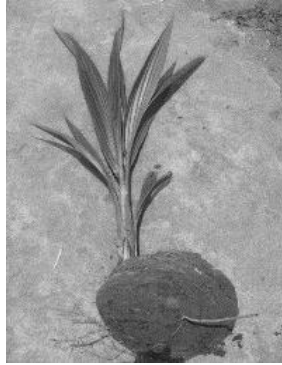


## SEED TO SEEDLING

**Selection of Seedlings:** Select seedlings 9 to 12 months after planting. Seedlings, which have germinated earlier, having good girth at collar and early splitting of leaflets, should be selected for planting.



Healthy Root System



Pest and Disease-Free Seedling

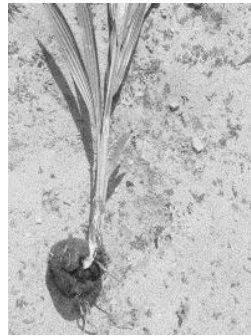


Ideal Well Growth Seedling

**Discarded Seedling:** Do not select the seed nuts which have just germinated. Eliminate the seedlings which are deformed or having stunted growth.



Bud Rot Affected Seedling



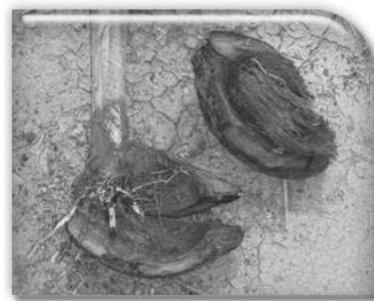
Deformed Seed Nut



Disease Affected Seedling



Stunted Growth Seedling



Stunted Root Growth Seedling

## Seedling Harvesting

- Remove the seedlings from the nursery by lifting with spade. Do not pull out the seedlings by pulling leaves or stem.
- Select quality seedlings with a minimum of 6 leaves and girth of 10 cm at collar.





**Method of patch budding in cacao**



A healthy seedling ready for budding



Preparing rootstock removing bud patch



Bud patch removed from scion shoot



Tying budded portion after inserting the patch



Budding tape removed 21 days after budding












Sprouted bud



### PATCH BUDDING IN CACAO

1. Select the healthy six to twelve months old rootstock.
2. A patch of about 2.5 cm length and 0.5 cm width is removed from the rootstocks.
3. A bud patch of 2.5 cm length and 0.5 cm width from the bud wood is prepared and inserted into the rootstock and tied firmly with polythene tape.
4. After three weeks, if there is bud-take, polythene tape is removed. A vertical cut is made half way through the stem above the bud and is snapped back.
5. The snapped root stock portion is cut back after the bud has grown to a shoot and at least two leaves have hardened.
6. It is then allowed to grow for a further period of three to six months after which they are transplanted. Under normal conditions, success can be around 70-90 per cent.

### METHOD OF SOFT WOOD GRAFTING IN CASHEW NUT

		
Seeds	Root stock	Selection of scion
		
Preparation of root stock	Preparation of scion	Soft wood Grafting
		
Cover the top with 25cm x 4cm 200gauge poly bags	After 15-20 days remove the poly bags	Soft wood Grafting in Cashew nut

### VEGETATIVE PROPAGATION

**Selection of seed nuts:** Collect the nuts during heavy bearing period (Feb-April). Sun dry the nuts for 2-3 days. Select the nuts which sinks in the 10 % salt (NaCl) solution. Sow the nuts as early as possible, because after 6-8 months the germination of seed nut gets reduced. More than one year old seed nut should not be used. Very big and very small seed nut should not be selected. Select only medium sized nuts for sowing (130-150 nuts/kg).

**Production of root stocks:** Soak the seed nuts in water or cow dung slurry for 2 days or 10 % Sodium hydroxide solution for one day to get higher germination percentage. Sow the seeds in poly bags filled with potting mixture (25cm length, 13cm width and 250-gauge thickness). Make 30 to 40 holes in each polythene bag for easy drainage of excess water. Apply 5g of super phosphate per bag along with potting mixture. Fill the poly bags with potting mixture till the margin and put dried leaves or small stones at base for easy drainage of water. Place the seeds at 2.0 to 2.5 cm soil depth and keep vertically in

which the stalk end of the seed nut facing top. Apply water after sowing and daily with rose cane and avoid water stagnation. Seeds germinate with 15 to 20 days after sowing. Staggered sowing at weekly intervals facilitate to make the stocks available continuously for grafting. Provide shade to young root stocks; after greening of leaves keep the stocks under open condition or remove the shade. 40 to 50 days old root stocks are suitable for grafting. During the germination, the cotyledon comes out of the soil and it is tasty, therefore, it will be damaged by birds, monkeys and other animals. So during this period it should be watched carefully. During this period, the root stocks will be affected by root rot and bacterial leaf blight disease therefore to prevent the root rot apply 0.2% Thiram or Mancozeb and spray for later apply 250ppm Streptomycin sulphate for bacterial blight.

**Selection of root stocks:** Good healthy seedlings, without side shoot, growing straight should be selected. Better to use the stocks raised in poly bags. Use the stocks age of 25-30 days for grafting.

**Selection and preparation of scion:** The scion providing mother trees should be grown with good fertilizer application and better management. The shoots from unbar terminal shoots of 3 to 5 month aged should be selected. Select the scion of 10-12cm length, uniform pencil thickness with cream coloured bud. The top 4 to 5 leaves of dark green in fully matured should be selected. 90 days old scion only will be used for grafting purpose which gives better graft uptake. The selected scion sticks should be precured by clipping off leaf blades, leaving petiole. The new shoots of September- October month are not need any precuring of scion but during other season retain the petiole of leaves with scion. Scion can be used for grafting after 7-10 days. The petioles will shed while touching with the fingers. The scion mother trees should not be allowed for flowering therefore during flowering season panicles should be pruned.

**Collection of scions:** Collect the scion from the precured shoots because it will not dry quickly and gives more graft uptake. Collect the scion before the new flush come from the terminal bud. Keep the scion separately on variety wise. After cutting of scion roll with wet cloth and keep in polythene bag and it can be kept for 1-2 days.

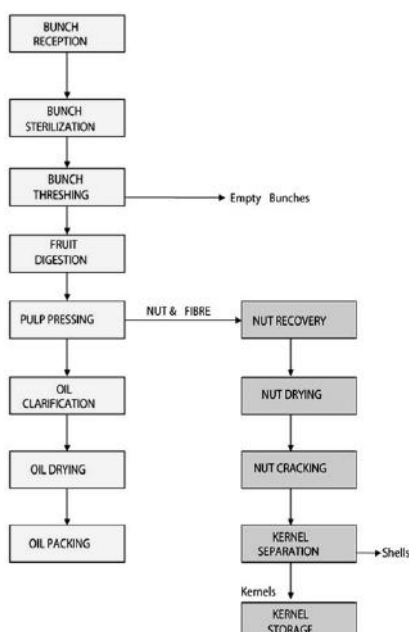
**Preparation of stock for grafting:** In the selected root stock, trim all the leaves except two pairs of basal leaves. Decapitated the stocks at 15cm height from the base. Make a cleavage in the stock from top to 4.5cm in two equal portions.

**Preparation of scion for grafting:** Select the scion of uniform thickness related to root stock. Make the length of the scion to 10cm if lengthier. Prepare a vedge shape of 4.5cm length in proximal end of the scion after removing bark.

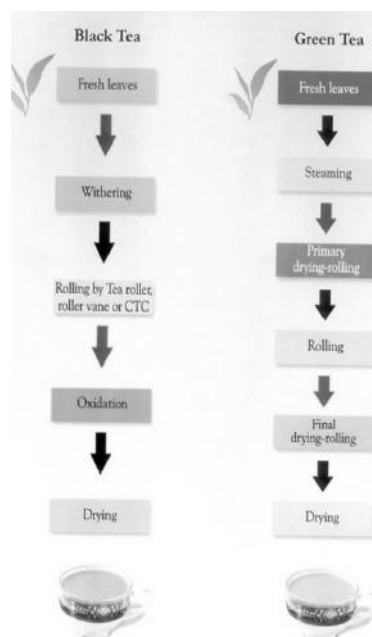
**Grafting:** Keep the vedge shaped scion on the cleft of root stock. Tie the union with polythene sleeves of 200-gauge thickness of 45 cm length and 1.5cm width. After tying of grafted stock, cover the top with 25cm x 4cm 200guage poly bags, it prevents drying of scion. Keep the grafted poly bags immediatly inside the mist chamber for 15-20 days After 15-20 days remove the poly bags placed over the grafts in inverted position. After 20 days remove the grafts from mist chamber and keep it in shade. The grafting success could be seen within 3-4 weeks and scion will be sprouted. The grafts will be ready for planting within 5-6 months.

**Maintenance of grafts:** Apply water to grafts daily with rose can. Prevent the water stagnation during rainy season. Remove the polythene film used for joining the stock and scion after 45 days. Remove the shoots comes out from stocks whenever emerges. 60 days after grafting remove the leaves retained in the root stock. Many of the grafts flower during flowering season. Therefore, remove panicle if grafts flower. Change the place of grafts frequently and keep it in polythene lined floor. During the summer provide shade to the grafts and during rainy season shade not necessary. Frequent spray of pesticide has to be made to prevent the pest and diseases. During planting remove the poly bag without damaging the top root.

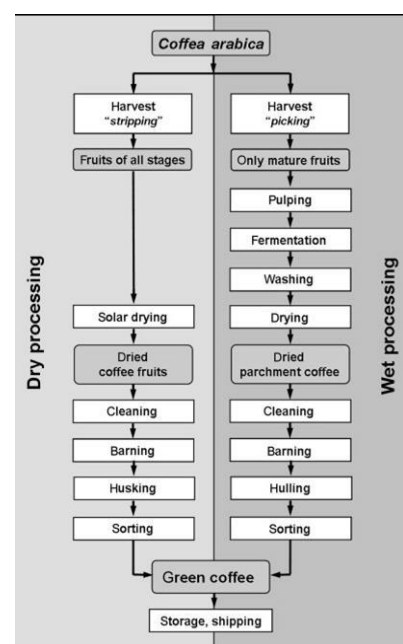
**OIL PALM PROCESSING FLOW CHART**



**TEA PROCESSING FLOW CHART**

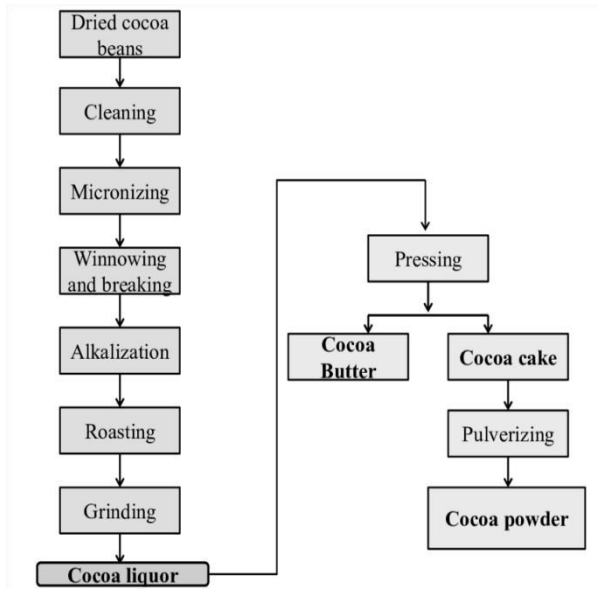


**COFFEE PROCESSING FLOW CHART**

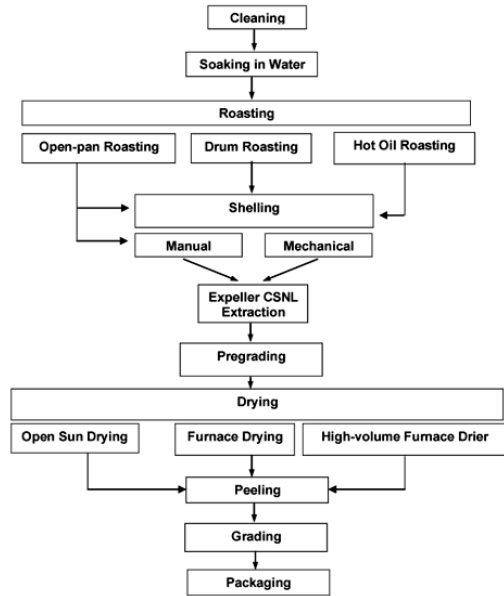




### COCOA PROCESSING FLOW CHART



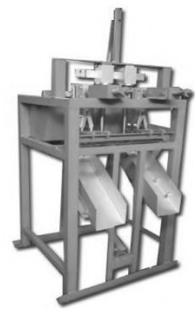
### CASHEW NUT PROCESSING FLOW CHART



Raw cashew nut grading machine



Cashew nut roasting machine



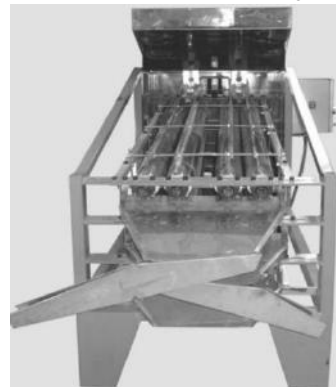
Cashew nut shelling machine



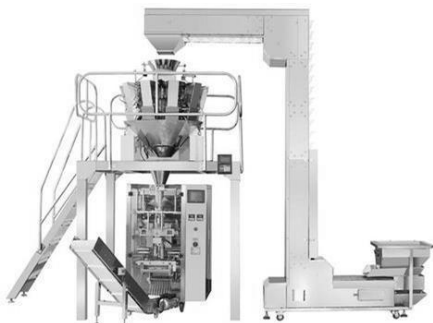
Cashew nut peeling machine



Cashew nut drying machine



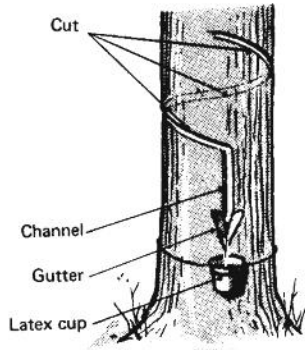
Cashew grading machine



Cashew nut packeting machine



CNSL extraction machine



Rubber tapping



Cocoa Processing unit