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**THE ECONOMICS OF REPLANTING IN RUBBER PLANTATIONS  
PART II : COST OF MATURE UPKEEP**

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**INTRODUCTION**

Replanting of rubber is considered as a long term investment. The cost of production (COP) is a key factor which determines the economic viability of this particular farm activity. For convenience, cost of production can be broadly split into two categories *viz.*: cost of immature upkeep (including the initial investment) and cost of mature upkeep. The part 1 of this paper examined the cost of immature upkeep with special reference to the estate sector. This paper analyses the cost of mature upkeep (including the cost of processing) in the estate sector.

A productive phase of 27 years commencing from the 7<sup>th</sup> year of planting is assumed in the analysis. Input data on labour and material were gathered from a sample of 140 mature fields planted with RRIC 100 series clones. The sample was randomly selected from 15 rubber estates located in Kegalle, Kalutara and Ratnapura on the basis of 5 estates per district.

In this study, the 27-year mature period is sub divided into six age groups *viz.* 7-12, 13-18, 19-24, 25-28, 29-30 and 31-33 to calculate the total cost of mature upkeep. The first 4 groupings are based on the stage of the tapping panel (*i.e.*, A, B, C and D) where tapping would be in progress. A significant variation is observed within the above age groups with respect to average yield, stand per hectare and nature of the agronomic practices such as frequency of weeding and the quantity of fertilizer used. The 5th age group *i.e.*, period of last two years of tapping on D Panel (29th - 30th year), is taken separately due to the fact that fertilization is not being done after the 28<sup>th</sup> year of planting. The last age category *viz.* 30-33 year refers to the period where slaughter tapping is in progress.

**The major activities of mature upkeep**

The major types of activities that take place during the mature period can be broadly sub divided into three categories *viz.* field maintenance, exploitation and processing of latex. The activities that fall into the category of field maintenance include weeding, desilting of drains, terracing, census and numbering of trees, marking of tapping panels and application of fertilizer and pesticides.

## Cost of mature upkeep by different age groups

The estimated average rates of labour and material used for different operations in the mature phase are given in Annex 01. The input prices used for this study are given in Annex 02.

The cost of mature upkeep was compiled using the guidelines given in Annex 01 and Annex 02. The details of the computed costs of mature upkeep for six different age groups are presented in Table 1 to Table 6. The average cost of mature upkeep (per hectare per year) has varied according to age group from Rs 21,470/= (Table 6) to Rs.35,500/= (Table 2). Similarly, the total number of man days required per hectare per year has varied from 200 (Table 6) to 306 (Table 1) whereas the material cost has fluctuated from Rs.1,220/= (Table 6) to Rs 3,740/= (Table 1).

The average cost of mature upkeep (Rs/ha/year) by labour and material according to different age groups is illustrated in Figure 1. The labour has accounted for over 87% of the total cost throughout the mature phase. The share of labour cost has gradually increased from 87% to 93% during the mature period whereas the material cost has declined from 13% to 7% accordingly.

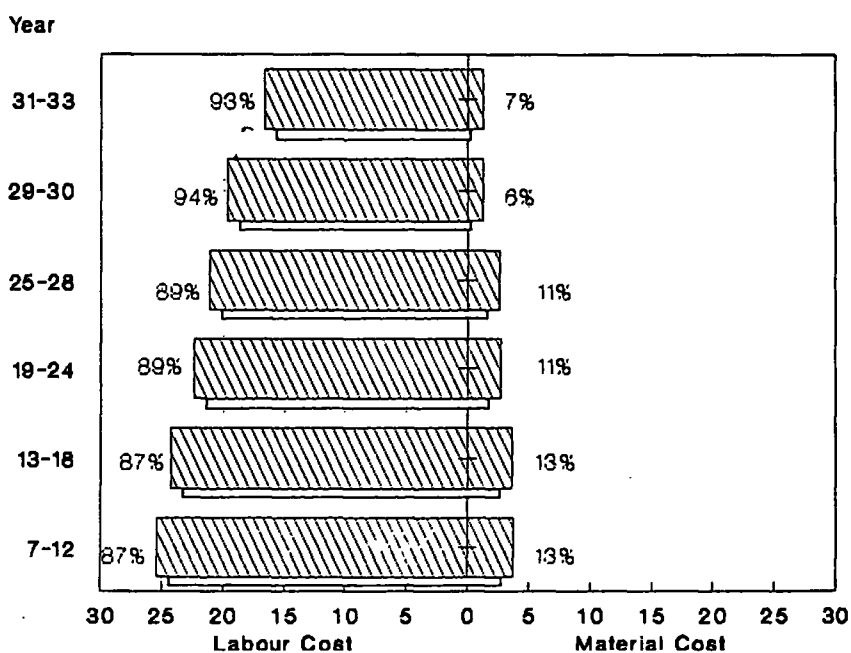


Fig. 1. Average cost of mature upkeep by labour and material according to different age groups (excluding manufacturing cost) Rs'000)

Table 1. Cost of mature upkeep: year 7-12 (while tapped on A-panel) (Rs/ha/yr at 1995 prices)

ACTIVITY	LABOUR USAGE			MATERIAL USAGE					LABOUR + MATERIAL COST <sup>1</sup>	
	No. of	Cost	Percent	Unit	Unit	No. of	Cost <sup>2</sup>	Percent	Rs.	Percent
	Man-days <sup>3</sup>	Rs.			Cost Rs.	Units	Rs.			
Fertilizer U12:14:14	4	332	1.31	kg	5.70	360	2,052	54.80	2,384	7.15
Fertilizer Kieserite				kg	10.00	45	450	12.01	450	1.35
Pest & Disease Control							500	13.35	500	1.5
Census & Numbering of Trees	2	166	0.65	gal	75.00	0.5	38	1.01	204	0.61
Marking of Tapping Panels	3	249	0.98						249	0.75
Tapping	252	20,916	82.4						20,916	62.77
Tapping Utensils				set	150.00	1	150	4.06	150	0.45
Anti Coagulant (Na <sub>2</sub> SO <sub>3</sub> )				kg	36.00	1.5	54	1.44	54	0.16
Manufacturing <sup>4</sup>									4,179	12.54
Desilting of Drains	11	913	3.59						913	2.74
Ferracing	4	332	1.31						332	0.99
Weeding	30	2,490	9.8						2,490	7.47
Tools				set	500.00	1	500	13.35	500	1.50
Total	306	25,398	100.00				3,744	100.00	33,321 <sup>4</sup>	100.00

- 1 Calculated on the basis as given in Annex 01
- 2 @ Rs 5/kg for the average yield for years from 7 to 12
- 3 Including manufacturing cost
- 4 Input prices are given in Annex 02

Assumptions \* Average Yield 835.83 kg/ha  
\* No. of trees 450

Table 2. Cost of mature upkeep : year 13 - 18 [while tapped on B-panel] (Rs/ha/yr at 1995 prices)

ACTIVITY	LABOUR USAGE			MATERIAL USAGE					LABOUR + MATERIAL COST <sup>1</sup>	
	No. of	Cost	Percent	Unit	Unit	No. of	Cost	Percent	Rs	Percent
	Man-days <sup>2</sup>	Rs			Cost Rs	Units	Rs			
Fertilizer 012:14:14	4	132	1.37	kg	5.70	340	1,938	53.55	2,270	6.39
Fertilizer Kieserite				kg	10.00	42.5	425	11.74	500	1.41
Pest & Disease Control							500	13.82	500	1.41
Census & Numbering of Trees	2	196	0.68	gal	75.00	0.5	38	1.05	204	0.57
Marking of Tapping Panels	3	249	1.03						249	0.70
Tapping	238	19,754	81.50						19,754	55.59
Tapping Utensils				set	150.00	1	150	4.14	150	0.42
Anti-Coagulant (Na <sub>2</sub> SO <sub>4</sub> )				kg	36.00	1.9	68	1.88	68	0.19
Manufacturing <sup>2</sup>									7,608	21.41
Desilting of Drains	11	913	3.77						913	2.57
Terracing	4	132	1.37						132	0.93
Weeding	30	2,490	10.28						2,490	7.01
Tools				set	500.00	1	500	13.82	500	1.41
Total	292	24,236	100.00				3,619	100.00	25,518 <sup>3</sup>	100.00

- 1 Calculated on the basis as given in Annex 01
- 2 @ Rs 5/kg for the average yield for years from 13 to 18
- 3 Including manufacturing cost
- 4 Input prices are given in Annex 02

Assumptions \* Average Yield 1521.67 kg/ha  
\* No. of trees 425

Table 3. Cost of mature upkeep: year 19-24 (while tapped on C-panel)(Rs/ha/yr at 1995 prices)

ACTIVITY	LABOUR USAGE			MATERIAL USAGE					LABOUR + MATERIAL COST <sup>3</sup>	
	No of	Cost	Percent	Unit	Unit	No of	Cost	Percent	Rs	Percent
	Mandays <sup>2</sup>	Rs			Cost Rs	Units	Rs			
Fertilizer U12:14:14	4	332	1.48	kg	5.70	220	1,254	46.39	1,586	4.95
Fertilizer Kiesrite				kg	10.00	20	200	7.40	200	0.62
Pest & Disease Control							500	18.50	500	1.56
Census & Numbering of Trees	2	106	0.74	gal	75.00	0.5	38	1.41	204	0.64
Marking of Tapping Panels	3	249	1.11						249	0.78
Tapping	224	18,592	83.09						18,592	58.06
Tapping Utensils				set	150.00	1	150	5.59	150	0.47
Anti Coagulant (Na <sub>2</sub> SO <sub>4</sub> )				kg	36.00	1.7	61	2.27	61	0.19
Manufacturing <sup>4</sup>									6,943	21.7
Desilting of Drains	11	913	4.08						913	2.85
Ferraing	4	332	1.48						332	1.04
Weeding	21.6	1,793	8.01						1,793	5.6
Tools				set	500.00	1	500	18.49	500	1.56
Total	269.6	22,377	100.00				2,703	100.00	33,023 <sup>4</sup>	100.00

- 1 Calculated on the basis as given in Annex 01
- 2 @ Rs 5/kg for the average yield for years from 19 to 24
- 3 Including manufacturing cost
- 4 Input prices are given in Annex 02

- Assumptions
- \* Average Yield 1388.33 kg/ha
  - \* No. of trees 400

Table 4. Cost of mature upkeep: year 25-28 (the 1st 4 years of D-panel) (Rs/ha/yr at 1995 prices)

ACTIVITY	LABOUR USAGE			MATERIAL USAGE					LABOUR + MATERIAL COST <sup>1</sup>	
	No. of	Cost	Percent	Unit	Unit	No. of	Cost <sup>2</sup>	Percent	Rs	Percent
	Man-days <sup>3</sup>	Rs			Cost/ Rs	Units	Rs			
Fertilizer 112-14:14	4	332	1.57	kg	5.70	206	1,174	45.12	1,506	5.19
Fertilizer - Kieserite				kg	10.00	19	190	7.30	190	0.65
Pest & Disease Control							500	19.22	500	1.72
Census & Numbering of Trees	2	166	0.79	gal	75.00	0.5	38	1.46	204	0.70
Marking of Tapping Panels	2	166	0.79						166	0.52
Tapping	210	17,430	82.48						17,430	60.07
Tapping Utensils				set	150.00	1	150	5.76	150	0.52
Anti Coagulant (Na <sub>2</sub> SO <sub>4</sub> )				kg	36.00	1.4	50	1.92	50	0.17
Manufacturing <sup>4</sup>									5,280	18.20
Desilting of Drains	11	913	4.32						913	3.15
Terracing	4	332	1.57						332	1.14
Weeding	21.6	1,793	8.48						1,793	6.18
Tools				set	500.00	1	500	19.22	500	1.72
Total	254.6	21,132	100.00				2,601	100.00	29,014	100.00

- 1 Calculated on the basis as given in Annex 01
- 2 @ Rs 5/kg for the average yield for years from 25 to 30
- 3 Including manufacturing cost
- 4 Input prices are given in Annex 02

Assumptions \* Average yield 1056 kg/ha  
\* No. of trees 375

Table 5. Cost of mature upkeep: year 29-30 [the last 2 years of D-panel] (Rs/ha/yr at 1995 prices)

ACTIVITY	LABOUR USAGE			MATERIAL USAGE					LABOUR + MATERIAL COST <sup>3</sup>	
	No. of	Cost	Percent	Unit	Unit	No. of	Cost <sup>*</sup>	Percent	Rs	Percent
	Mandays <sup>1</sup>	Rs			Cost Rs	Units	Rs			
Fertilizer U12:14:14										
Fertilizer - Kieserite										
Pest & Disease Control							500	40.62	500	1.91
Census & Numbering of Trees	2	166	0.85	gal	75.00	0.5	38	3.09	304	0.78
Marking of Tapping Panels	2	166	0.85						166	0.63
Tapping	196	16,268	82.84						16,268	62.21
Tapping Utensils				set	150.00	1	150	12.19	150	0.57
*Anti Coagulant (Na <sub>2</sub> SO <sub>4</sub> )				kg	36.00	1.2	43	3.49	43	0.16
Manufacturing <sup>2</sup>									5,200	20.19
Desilting of Drains	11	913	4.65						913	3.49
Terracing	4	332	1.69						332	1.27
Weeding	21.6	1,793	9.13						1,793	6.86
Tools				set	500.00	1	500	40.62	500	1.91
Total	236.6	19,628	100.00				1,231	100.00	26,149	100.00

- 1 Calculated on the basis as given in Annex 01
- 2 @ Rs 5/kg for the average yield for years from 25 to 30
- 3 Including manufacturing cost
- 4 Input prices are given in Annex 02

Assumptions \* Average yield 1056 kg/ha  
\* No. of trees 350

Table 6. Cost of mature upkeep: year 31-33 [during slaughter tapping] (Rs/ha/yr at 1994 prices)

ACTIVITY	LABOUR USAGE			MATERIAL USAGE					LABOUR + MATERIAL COST <sup>1</sup>	
	Nr of	Cost	Percent	Unit	Unit	Nr of	Cost <sup>2</sup>	Percent	Rs	Percent
	Mandays <sup>3</sup>	Rs			Cost/ Rs	Units	Rs			
Fertilizer U12 14:14										
Fertilizer Kieserite										
Pest & Disease Control							500	40.98	500	2.33
Census & Numbering of Trees	2	166	1	gal	75.00	0.5	38	3.12	204	0.95
Marking of Tapping Panels										
Tapping	168	13,944	84						13,944	64.95
Tapping Utensils				set	150.00	1	150	12.30	150	0.70
Anti Coagulant (Na <sub>2</sub> SO <sub>4</sub> )				kg	36.00	0.9	32	2.62	32	0.15
Manufacturing <sup>4</sup>									3,650	17.00
Desilting of Drains	11	913	5.5						913	4.25
Ferracing	4	332	2						332	1.55
Weeding	15	1,245	7.5						1,245	5.80
Tools				set	500.00	1	500	40.98	500	2.33
Total	200	16,600	100.00				1,220	100.00	21,470 <sup>3</sup>	100.00

- 1 Calculated on the basis as given in Annex 01
- 2 @ Rs 5/kg for the average yield for years from 31 to 33
- 3 Including manufacturing cost
- 4 Input Prices are given in Annex 02

Assumptions \* Average yield 730 kg/ha  
\* No. of trees 300

The results therefore reveal that upkeep of mature rubber is a labour intensive farming system. Such a farming system may be ideal for smallholders with sufficient family labour especially in situations where the opportunity cost for labour is relatively low. This could have been one of the major reasons for the increase in the share of smallholder extent in all the major natural rubber producing countries. For instance, the share of smallholder rubber extent in the world has increased from 39% in 1960 to 85% in 1994.

The figure 2 shows the cost of mature upkeep by different activity and by age groups. Tapping accounts for nearly 56% to 60% of the total cost at all age levels in the mature phase. The cost of manufacturing is the second most expensive activity accounting for 13% to 21% of the total cost. This is followed by fertilizer application and weeding.

The cost of fertilizer application consists of 5 - 9 percent of the total cost up to the 28<sup>th</sup> year of planting. This clearly suggests the importance of using cheaper substitutes such as rice straw, bush legumes, *etc.* to minimize the cost of inorganic fertilizers.

### Average cost per tree

The average cost per tree (maintenance, exploitation and processing) during the mature phase are given for different age groups in Table 7. The cost per tree in the mature period has ranged between Rs.71.50 - Rs.83.60 per year with an overall average of Rs.78 per year. Hence, each rubber tree would require inputs worth of approximately Rs.2,100/= (78/= x 27 years) during the entire mature phase.

Table 7. Average cost per tree during mature phase by age groups

Age group (years)	Average cost* (Rs/tree/year)
7-12	72.05
13-18	83.62
19-24	80.05
25-28	77.37
29-30	74.71
31-33	71.57

\* which includes maintenance, exploitation and processing costs

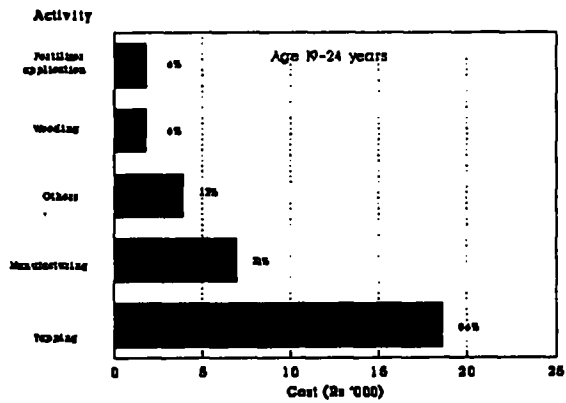
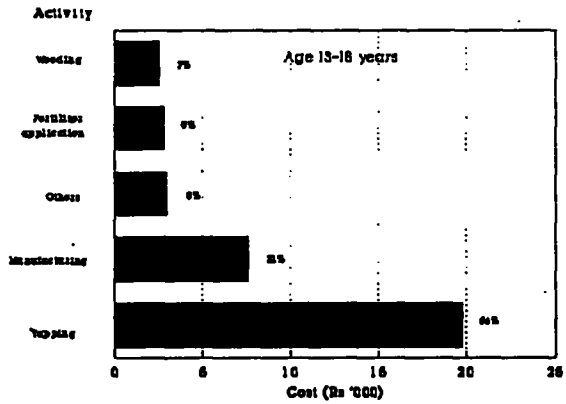
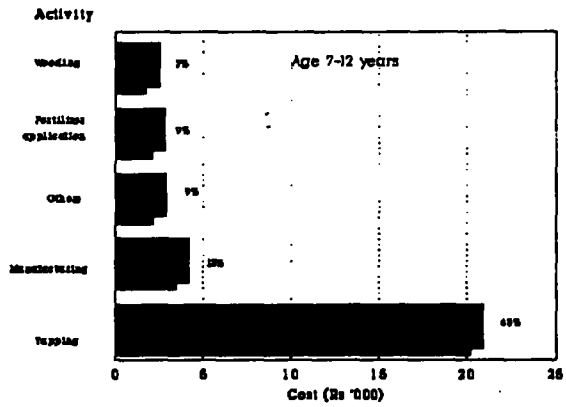


Fig. 2. Cost of mature up keep by activity according to age group (up to year 24)

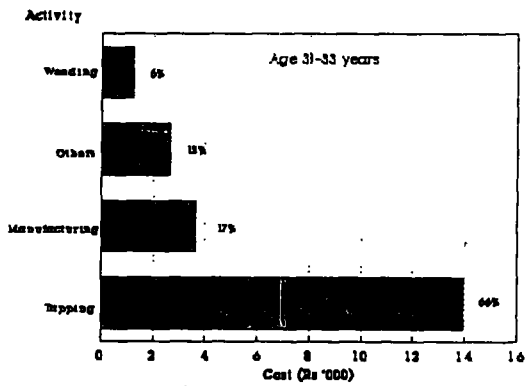
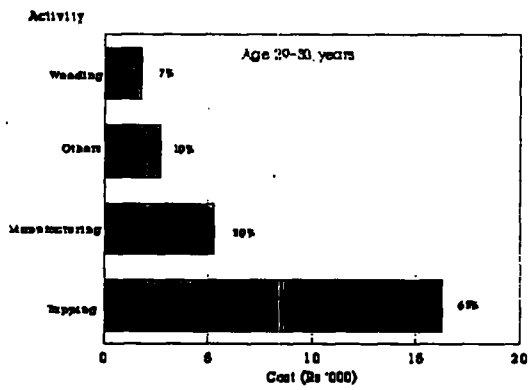
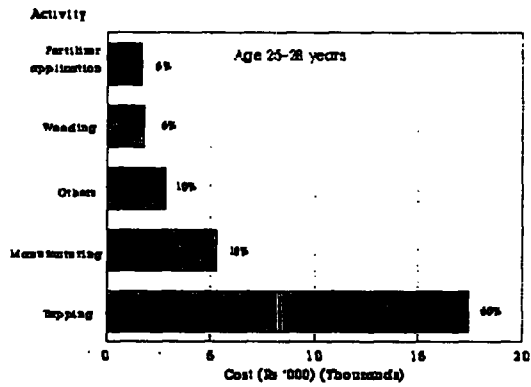


Fig. 3. Cost of mature upkeep by activity according to age group (from year 25 up to year 33)

## Guidelines for Calculation of Cost of Mature Upkeep

Type of operation/input	Remarks
1. Fertilizer Application: A) Material While tapped on virgin bark:(year 7-18)  While tapped on renewed bark, upto 5 years before uprooting: (year 19-28) In the last 5 years before uprooting B) Labour	@ 800g of U12:14:14 mixture/plant/year in one application and 100g of Kieserite/plant/year in one application x No. of plants  @ 550g of U12:14:14 mixture/plant/year in one application and 50g of Kieserite/plant/year in one application x No. of plants  Fertilizers are not being applied  @ 4 labourers per ha per year
2. Pest and Disease Control:	A mixture of Brunolium and Red Powder is applied along with tapping; @ Rs 500/ha/year for chemicals
3. Marking of Tapping Panels:	@ 3 labourers/ha/year from year 7 to 24 and 2 lab/ha/yr from year 25 to 30
4. Tapping:	S/2 d/2 system with 280 tapping days/ha/year assuming a stand of 500 trees/ha and a tapping task of 250 trees/labourer/day
5. Tapping Utensils:	coconut shells (600), spouts (500), tapping knives (2), GI buckets-2.5 gal (2) and small collecting buckets (2)
6. Anti-coagulant (Na <sub>2</sub> SO <sub>4</sub> ):	@ 125g per 100kg of latex
7. Manufacturing:	@ Rs 5 per kg of latex crepe (labour cost + material cost); where an average annual yield for each period (tapping panel) is calculated
8. Weeding:	
While tapped on virgin bark:	@ 2.5 labourers/ha/month
While tapped on renewed bark:	@ 1.8 labourers/ha/month
While slaughter tapping:	@ 1.25 labourers/ha/month
9. Tools:	a set of basic tools used in upkeep of rubber
10. Wage Rate :	Rs 83/= per Manday

## A Summary of Input Prices

Type of input	Unit cost (Rs)
<b>Fertilizers</b>	
- Imported Rock Phosphate (IRP)	4.50/kg
- U 12 : 14 : 14	5.70/kg
- Kieserite	10.00/kg
- Dolomite	00.80/kg
<b>Chemicals for pest and disease control</b>	
- Sulphur	100.00/ha/year
- Mixture of Brunolium and Red powder	500.00/ha/year
<b>Tar</b>	75.00/gallon
<b>Anti - Coagulant (Na<sub>2</sub>SO<sub>4</sub>)</b>	36.00/kg
<b>Tapping utensils</b>	150.00/ha/year
<b>Tools (for mature period)</b>	500.00/ha/year