Jl. Rubb. Res. Inst. Sri Lanka, (1995), 76, 72-89

ECONOMICS OF INTERPLANTING RUBBER WITH TEA IN THE LOW COUNTRY WET ZONE

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(Accepted 10 July 1995)

ABSTRACT

This study examines the economic viability of interplanting Rubber with Tea in the low country wet zone, where cultivation of both these crops is agronomically feasible. In the analysis, apart from Net Present Value (NPV), other measurements of project worth have also been used to determine the return on investment.

Economic lifespan of a 25-years is considered for discounted cash flow analysis. The results reveal the profitability of this integrated farm activity, which generates a NPV of nearly Rs 162,000 at 15% discount rate. The B/C Ratio, Net-Benefit Investment Ratio and IRR are 1.24, 3.73 and 31% respectively. The Pay Back Period of 5 years also emphasizes the economic feasibility of the investment. Sensitivity Analysis on certain parameters have been done to ascertain the economic viability. The conclusion is that commencement of interplanting Rubber with Tea in the low country wet zone, atleast on a limited scale is economically desirable.

INTRODUCTION

Recent studies on interplanting Rubber with Tea have indicated that in agroclimatic regions where conditions are conducive for the cultivation of both Rubber and Tea, establishment of these two crops as an Interplanting activity is agronomically feasible (Yogaratnam and Iqbal, 1994).

The prime objectives of this new concept of interplanting of Rubber with Tea are as follows:

To utilize the inter-row space in Rubber plantations to generate an early income from Tea during the long unproductive period of 5-6 year of Rubber.

- To generate an income during wet days of the productive period when harvesting (tapping) may not be possible from Rubber and thereby to provide a steady stream of income for the grower.

To increase the productivity of land.

To convert uneconomic land into better use *ie* economically viable.

To generate or reduce employment (depending on the type of previous crop *ie* rubber or tea, where the latter consumes relatively more labour than the integrated activity) which would enable estates to utilize the available labour resources more efficiently and effectively.

AGRONOMIC FEASIBILITY

After uprooting the old Rubber, both Rubber (clone RRIC–121) and Tea (clone TRI–2025) were planted without going through the conventional process of soil rehabilitation as recommended for Tea[1], as the land is agronomically suitable for planting of Tea. Rubber was planted at a wider spacing of 12m x 2.4m [40' x 8']. Seven rows of Tea were planted in between two rows of Rubber with a spacing of 1.2m x 0.6m [4' x 2'] by allowing a distance of 2.4m [8'] between a row of Rubber and the nearest row of Tea. This particular spacing accommodates 341 rubber trees (75% of a mono crop stand) and 9,375 tea bushes (70% of a mono crop stand) per hectare (Iqbal,1993).

The Tea yield was achieved after 18 months of planting. The yield curves of Rubber and Tea (under monocropping and interplanting) are shown in Figure 01 and Figure 02 respectively (ADB,1993; RRISL,1995; Yogaratnam and Iqbal,1995). The economic assessment described in this study is based to a largely on the field experiment described by Yogaratnam and Iqbal (1995) and also from Sivaram and Herath (1995).

[1]The conventional process of soil rehabilitation for tea is to establish a soil reconditioning grass for a period of 1–2 years, where tea is to be established.

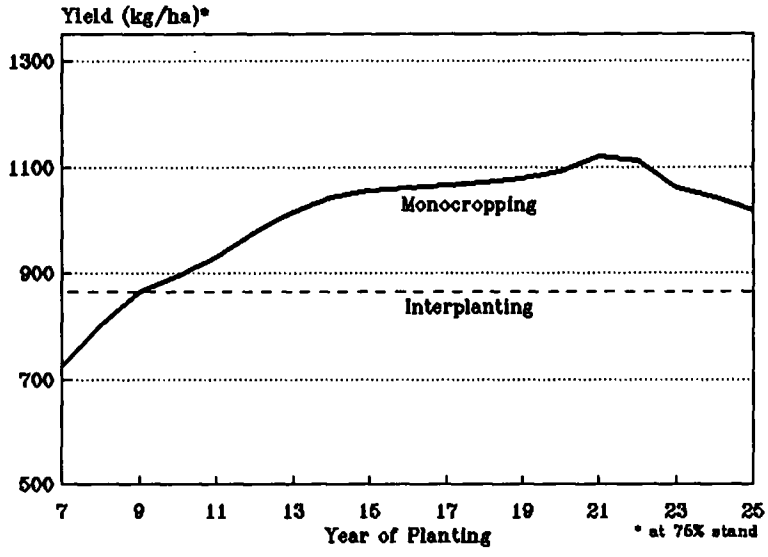

Fig. 1. Rubber yield: Monocropping vs interplanting

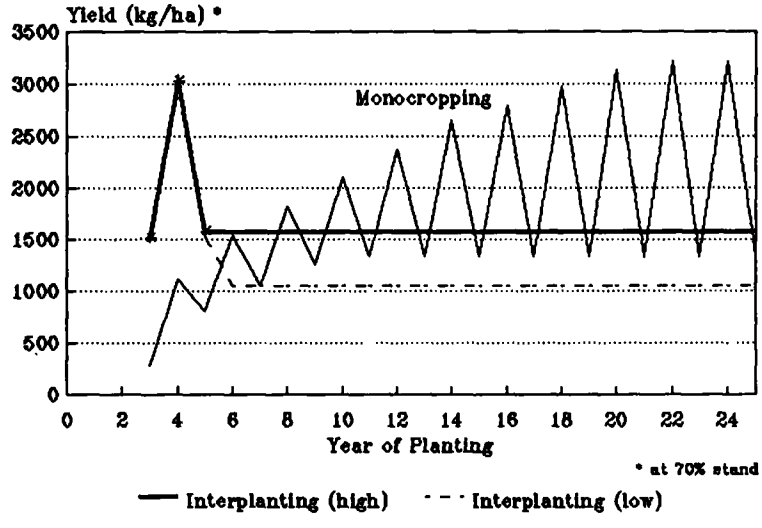

Fig. 2. Average yield of tea under monocropping and interplanting with rubber

METHODOLOGY

In the financial analysis several measurements of project worthiness *viz* Net Present Value (NPV), Benefit–Cost Ratio, Net Benefit–Investment Ratio, Internal Rate of Return (IRR) and Pay Back Period have been used as the criteria to determine the return on investment. The methodology involves the calculation of incremental cost and incremental gain of the integrated activity. A discount rate of 15% (the rate at which the Government of Sri Lanka has made available debentures to private management companies for capital expenditure), an all inclusive wage rate of Rs 83/= per man day (the present wage rate applicable to the estate sector) and cost of materials as per the rate in 1994 are used in this analysis.

RESULTS AND DISCUSSION

Cost of Immature Upkeep

A summary of the total cost of immature upkeep (from year 1 to 6) is given in Annex–01. The general charges and the cost of plucking and manufacturing of tea incurred from year 3 to 6 are not included in Annex–01 (the latter expenses are shown in Table–01). The total cost of immature upkeep accounts to about Rs 224,000 per hectare. The share of labour cost and material cost is 55% and 45% respectively excluding the cost of plucking and manufacture of Tea. The respective share of labour increased from 55% to 80% with the inclusion of the plucking cost incurred from year 3 to 6 (Figure 03). Tea accounts for 83% of labour cost and 76% of material cost whereas the comparative percentages for Rubber are 6% and 18% respectively and the balance 11% of labour and 6% of material cost are jointly utilized by both Tea and Rubber.

The distribution of the cost of labour and material in terms of activity is shown in Figure 04. The most labour consuming activities are plucking (69%) and weeding (8%). The cost of fertilizer for Tea (43%) appears to be the most expensive item among the materials followed by planting materials of Tea (28%), fertilizer for Rubber (9%) and planting material for Rubber (7%).The distribution of the total cost of immature upkeep by crop and by activity is shown in Figure 05. Tea accounts for 85% of the total cost, Rubber only 7% and the balance 8% is for both Tea and Rubber. The cost of plucking appears to be the most expensive operation (48%) followed by manufacture of Tea (14%) and cost of fertilizer for Tea (9%).

Cost of immature upkeep [year 1–6] for interplanting rubber (75% stand) with tea (70% stand)
(Rs/ha – at 1994 prices)

ACTIVITY	LABOUR USAGE									MATERIAL USAGE										LABOUR + MATERIAL COST	
	Number of Mandays							TOTAL COST		UNIT		Number of Units							TOTAL COST				
	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	TOTAL	Rs	%	UNIT	COST (Rs)	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	TOTAL	Rs	%	Rs	%
RUBBER																							
Uprooting & Cleaning	186						186	12434	12.49									0	0	0.00	12434	6.90
Holing	34						34	2272	2.28									0	0	0.00	2272	1.26
Filling Holes	5						5	334	0.34									0	0	0.00	334	0.19
Planting	22						22	1469	1.48	plant	20	341						341	6820	6.80	8289	3.86
Cover Establishment	5						5	334	0.34	kg	90	4						4	360	0.36	694	0.35
Cover Fertilizer(IRP)	6						6	401	0.40	kg	4.50	75						75	338	0.34	739	0.37
Fertilizer-Kieserite							0	0	0.00	kg	10	26						26	260	0.26	260	0.12
Fertilizer-U 12:14:14	10						10	668	0.67	kg	5.70	94	188	273	273	375	375	1578	8994	8.97	9662	4.39
Fertilizer-Dolomite		1	1	1	1	1	5	334	0.34	kg	.80		51	68	85	34	34	272	218	0.22	551	0.28
Supply Vacancies	3	3					6	401	0.40	plant	20	34	17					51	1020	1.02	1421	0.68
Shoot Cutting		1					1	67	0.07									0	0	0.00	67	0.04

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ACTIVITY	LABOUR USAGE									MATERIAL USAGE										LABOUR + MATERIAL COST	
	Number of Mandays							TOTAL COST		UNIT	UNIT COST (Rs)	Number of Units							TOTAL COST			
	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	TOTAL	Rs	%			YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	TOTAL	Rs	%	Rs	%
A																						
ıde Planting	22						22	1826	1.48	pole	.50	540						540	270	0.27	2096	0.94
rking & Leveling	75						75	6225	5.04									0	0	0.00	6225	2.78
ling	105						105	8715	7.05									0	0	0.00	8715	3.89
ling Holes	23						23	1909	1.54									0	0	0.00	1909	0.85
nting	88						88	7304	5.91	plant	3	9375						9375	28125	28.06	35429	15.83
ıching	70	70					140	11620	9.40									0	0	0.00	11620	5.19
ıde Lopping & O.M.	15	15	15	15	15	15	90	7470	6.04									0	0	0.00	7470	3.34
tilizer (U-195)	15	21					36	2988	2.42	kg	7.50	815	1087					1902	14265	14.23	17253	7.71
tilizer (U-599)			17	17	17	17	68	5644	4.57	kg	7.60				960	960	960	3840	29184	29.12	34828	15.56
pply Vacancies		13	13				26	2158	1.75	plant	3		940	470				1410	4230	4.22	6388	2.85
ntering	7	7	8				22	1826	1.48									0	0	0.00	1826	0.82

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CTIVITY	LABOUR USAGE									MATERIAL USAGE										LABOUR + MATERIAL COST	
	Number of Mandays							TOTAL COST		UNIT		Number of Units							TOTAL COST		
	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	TOTAL	Rs	%	UNIT	COST (Rs)	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	TOTAL	Rs	%	Rs	%
RUBBER																						
t Pegging	40						40	1320	2.69									0	0	0.00	1320	1.48
t Silt Pits	38						38	3154	2.55									0	0	0.00	3154	1.41
g	15	3	3	3	3	3	30	2490	2.01									0	0	0.00	2490	1.11
	93	63	50	67	64	56	393	32619	26.39									0	0	0.00	32619	14.57
Disease Control		2	5	2	2	2	13	1079	0.87	kg	0	100	100	100	100	100	100	600	180	0.15	1259	0.55
									0.00	tools	1000	1	1	1	1	1	1	6	6000	5.99	6000	2.68
MANDAYS	877	199	112	105	102	94	1489															
COST (Annual)	72791	16517	9296	8715	8466	7802	123587	123587				44525	13450	11341	9945	10485	10485		100234	100.00	223821	
LABOUR + MAT. COST (Annual)												117316	29967	20637	18660	18951	18287		223821			
TOTAL																					223821	100.00

E : RRISL 1995

BS

- Cost involved in converting Rubber into Rubber + Tea Interplantation
- Rubber spacing : 12m x 2.4m (341 trees/ha – 75% stand), Tea spacing : 1.2m x 0.6m (9375 tea bushes/ha – 70% stand)
- Wage Rate : Rs 83 per man day
- Rubber Fertilizer : Kieserite @ 75 g/plant in 1st year (together with U-12:14:14 mixture)
  U-12:14:14 @ 1125 g/plant/yr upto 4th year and @ 800 g/plant/yr in 5th, 6th years
  Dolomite @ 150 g/plant in 2nd year, 200 g/plant/yr in 3rd & 4th year & 250 g/plant/yr in 5th & 6th years
- Rubber : Filling of vacancies : 10% in the 1st year & 5% in the 2nd year
- Tea : Filling of vacancies : 10% in the 1st year & 5% in the 2nd year
- Tea : Shade : Medium shade for 70% tea area *ie* 90 shade trees
- Tea Fertilizers : U-195 @ 1165 kg/ha in 1st year and 1553 kg/ha in 2nd year (in 100% stand)
  U-599 @ 1372 kg/ha/yr from 3rd year till pruning
- Tea : Cost of plucking and manufacturing from year 3–6 not included (See Table-1)
- General Charges : Not included

Table 1. *Financial Analysis of interplanting rubber (75% stand) with tea (70% stand) (Rs/ha – at 1994 Prices)*

Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 25[a]
Cost									
Capital cost[b]	117,316	29,967	20,637	18,660	18,951	18,287			
Maintenance cost[c]			72,480	145,488	75,744	75,600	111,309		111,309
Total cost (at 0% D.R.)	117,316	29,967	93,117	164,148	94,695	93,887	111,309		111,309
Total discounted cost (at 15% D.R.)	102,065	22,655	61,271	93,893	47,063	40,559	41,852		3,339
Returns									
Tea yield(kg) – (actuals upto 5th year)			1,510	3,031	1,578	1,575	1,575		1,575
Total revenue from tea (@ Rs 70/kg)	0	0	105,700	212,170	110,460	110,250	110,250		110,250
Rubber yield (kg)							865		865
Revenue from rubber yield (@ Rs 75/kg)	0	0	0	0	0	0	64,875		64,875
Revenue from old rubber trees[d]	75,000								
Total revenue from rubber + tea (at 0% D.R.)	75,000	0	105,700	212,170	110,460	110,250	175,125		175,125
Total discounted revenue (at 15% D.R.)	65,250	0	69,551	121,361	54,899	47,628	65,847		5,254
Accumulated cost (at 0% D.R.)	117,316	147,283	240,400	404,548	499,243	593,130	704,439		2,708,001
Accumulated cost (at 15% D.R.)	102,065	124,720	185,991	279,884	326,947	367,506	409,358		665,703
Accumulated returns (at 0% D.R.)	75,000	75,000	180,700	392,870	503,330	613,580	788,705		3,940,955
Accumulated returns (at 15% D.R.)	65,250	65,250	134,801	256,162	311,060	358,688	424,535		827,848
Total net returns (at 0% D.R.)	(42,316)	(29,967)	12,583	48,022	15,765	16,363	63,816		63,816
Total net returns (at 15% D.R.)	(36,815)	(22,655)	8,280	27,469	7,835	7,069	23,995		1,914

Measures of project worth	
NPV (at 15% discount rate)	162,145
Benefit Cost Ratio	1.24
Net Benefit – Investment Ratio	1.73
I.R.R.	31.3%
Pay Back Period	5 Yrs

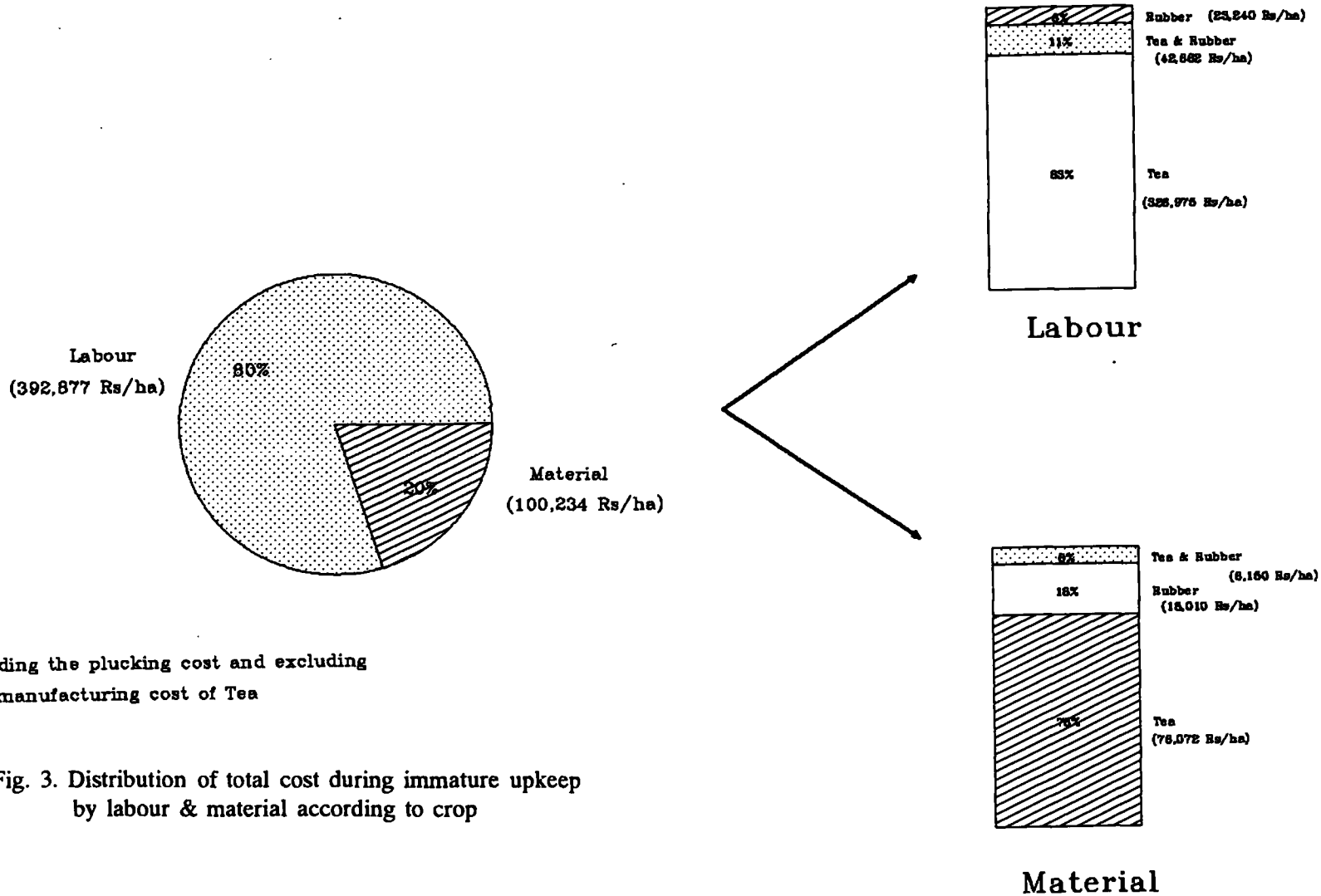
FOOTNOTES:

a. Analysis is based on a 25 year economic life span

b. As per Annex 1

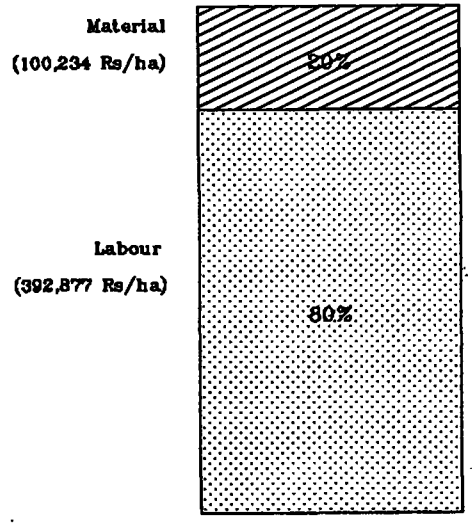
c. As per Annex 2 + The Cost of Plucking & Manufacturing of Tea @ Rs 35 per kg from year 3 to 6

d. Revenue from selling old rubber trees @ Rs 250 per tree x 300 trees/ha



* Including the plucking cost and excluding the manufacturing cost of Tea

Fig. 3. Distribution of total cost during immature upkeep by labour & material according to crop



* Including the plucking cost and excluding the manufacturing cost of Tea

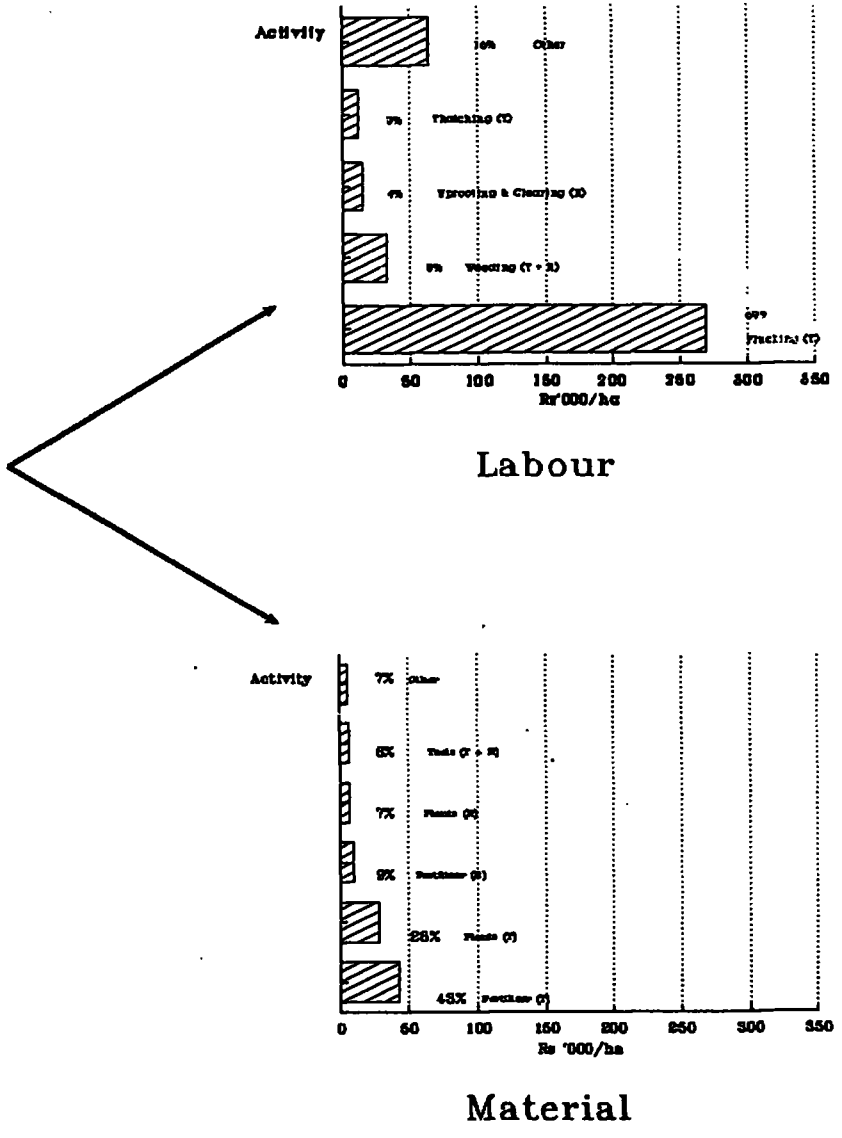
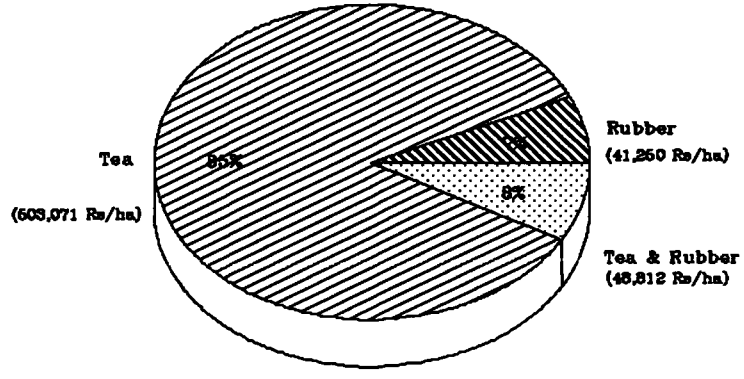
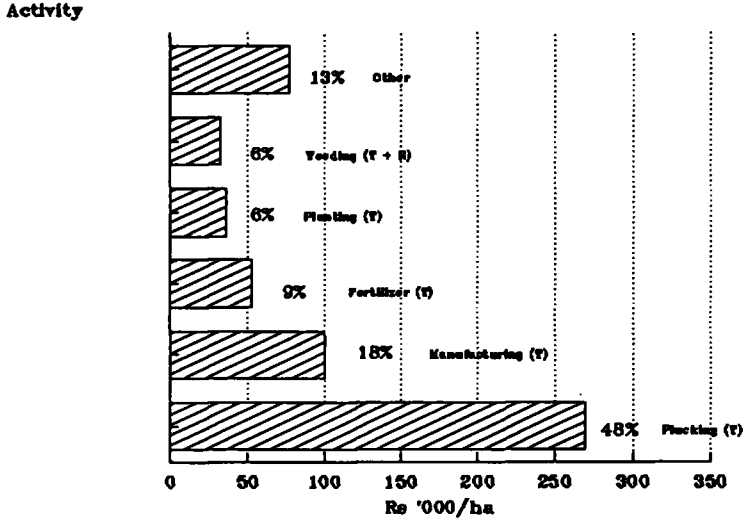


Fig. 4. Distribution of total cost during immature upkeep by labour & material according to activity



* Including the plucking & manufacturing cost of Tea.



Crop Activity

Fig. 5. Total cost of immature upkeep by crop & by activity

The Figure 06 illustrates the cost of immature upkeep by year of planting. The initial investment in year one accounts for 24% of the total cost of immature upkeep. The high cost of immature upkeep shown from year 3 onwards is largely due to the cost involved in plucking and manufacturing of Tea.

Cost of Mature Upkeep

The approximate annual cost of mature upkeep per hectare is given in Annex–02. Most of these data on mature upkeep are derived from several estates which are already engaged in this particular interplanting activity since 1985. However, some approximations have been made in preparing the cost of mature upkeep as certain data have not been maintained, separately for both Rubber and Tea during this integrated farm activity. The cost of plucking is taken at Rs 35/= per kg of made tea whereas cost of manufacture for Tea and Rubber is taken as Rs 13/= and Rs 5/= per kg respectively (ADB,1993). The cost of mature upkeep is approximately Rs. 111,000 per hectare per year of which the cost of labour consists of over 70%.

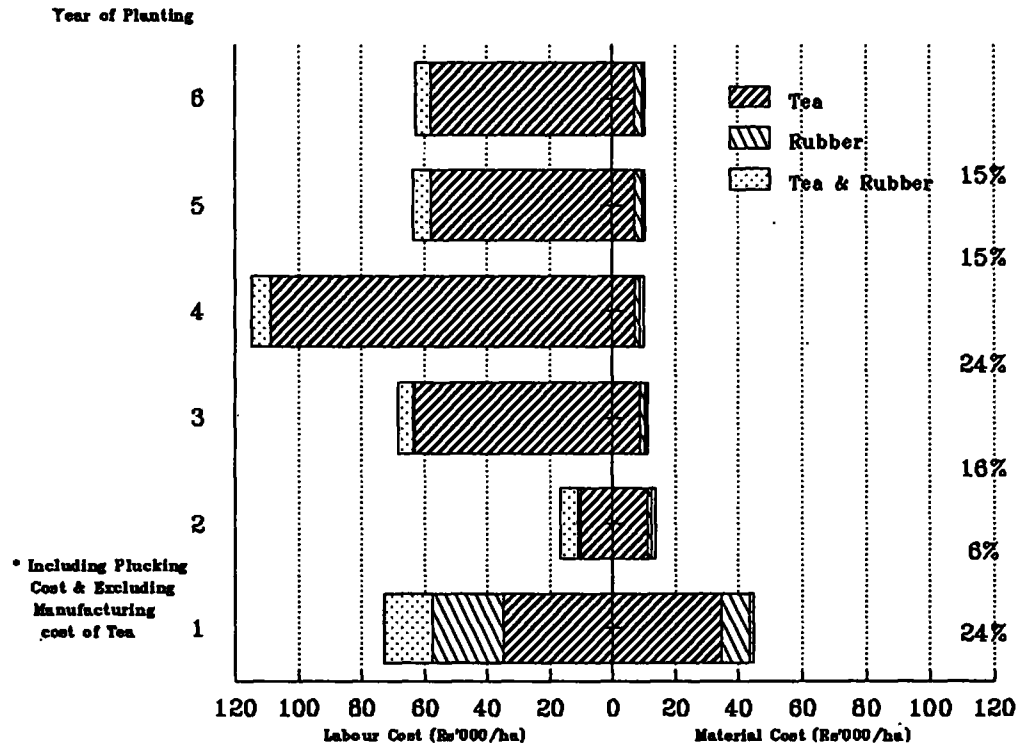


Fig. 6. Distribution of total cost during immature upkeep by labour & material according to crop

Average cost of mature upkeep for interplanting rubber (75% stand) with tea (70% stand) (Rs/ha/Yr – at 1994 prices)

ACTIVITY	LABOUR USAGE		MATERIAL USAGE				LABOUR + MATERIAL USAGE	
	Mandays	Cost	Unit	Unit Cost	No. of Units	Cost	Cost	Percent
RUBBER								
FERTILIZER – U 12:14:14	3	249	kg	5.70	230	1,311	1,560	1.40
– Kieserite			kg	10	26	260	260	0.23
CENSUS	2	166					166	0.15
MARKING (Tapping Panels)	2	166					166	0.15
TAPPING	150	12,450					12,450	11.19
TAPPING UTENSILS			Set	1,50	0.75	1,125	1,125	1.01
ANTICOAGULANT (Na_2SO_4)			kg	36	1.50	54	54	0.05
PEST & DISEASE CONTROL	2	166	Mix	460	0.75	345	511	0.46
MANUFACTURING COST (@ Rs 5/kg)							4,325	3.89
TEA								
SHADE MANAGEMENT	7	581					581	0.52
PRUNING	8	664					664	0.60
BUSH SANITATION	4	332					332	0.30
FERTILIZER – Dolomite	6	498	kg	0.80	200	160	658	0.60
– U 709	11	913	kg	6.70	645	4,322	5,235	4.70
BLISTER BLIGHT CONTROL	7	581	mix	212	1.4	297	878	0.79
PLUCKING COST (@ Rs 35/kg)	664	55125					55,125	49.53
MANUFACTURING COST (@ Rs 13/kg)							20,475	18.40
TEA : RUBBER								
DESILTING OF DRAINS	11	913					913	0.82
TERRACING	4	332					332	0.30
WEEDING – HAND	25	2,075					2,075	1.86
– CHEMICAL (General)	10	830	liter	207	4	828	1,658	1.49
– CHEMICAL (Round Up)	2	166	liter	1,700	0.5	850	1,016	0.91
TOOLS			Set	750	1	750	750	0.67
TOTAL	918	77,207	–	–	–	10,301	111,209	100.0

The cost of mature upkeep by labour and material according to crop is shown in Figure 07 where the labour component consists of 88%. In terms of both labour and material the respective share of Tea is 77% and 46% respectively, which is much higher when compared with Rubber. The Figure 08 presents the distribution pattern of total labour and material by activity. The cost of plucking of Tea and the cost of fertilizer for Tea appear to be the most costly activities in terms of labour and material respectively.

The distribution of the total cost of mature upkeep by crop and by activity are shown in Figure 09. In terms of crop; Tea accounts for 75% whereas in terms of activity; plucking cost accounts for nearly half the cost of mature upkeep.

Financial Analysis

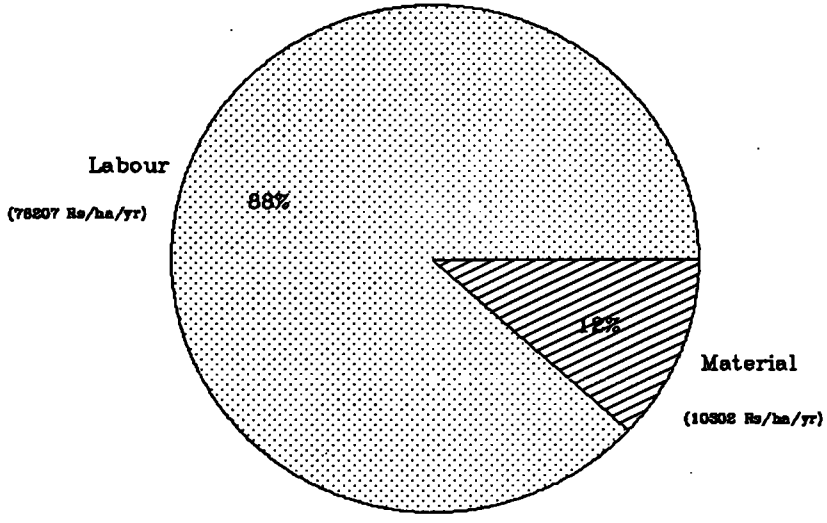
Economic lifespan of a 25–year period is considered for the financial analysis. The cost and revenue streams of this interplanting activity are given in Table 01. The actual Tea yields are used from year 3 to 6 (Yogaratnam and Iqbal, 1995; RRISL, 1995) and from the 7th year onwards with an average yield of 1575 kg (2220 kg/ha at 100% stand) is assumed. A constant yield of 865 kg (1150 kg/ha at 100% stand) is assumed for Rubber from 7th year onwards (RRISL,1995).

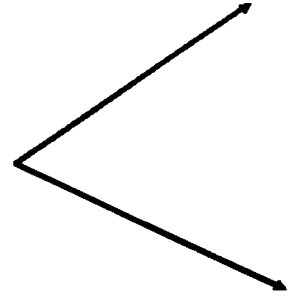
The NSA for Tea and Rubber is taken as Rs 70 and Rs 75 per kg respectively under the standard scenario which also assumes a revenue of Rs 75,000 from selling of old rubber trees in the 1st year of planting (@ Rs 250 per tree into 300 trees/ha).

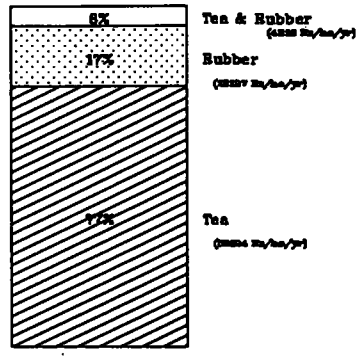
At the end of a 25–year cycle the project will generate a NPV of Rs 162,145 with a B/C Ratio of 1.24 and a Pay Back Period of 5 years. The Net Benefit–Investment Ratio is approximately 3.73 and IRR is around 31%.

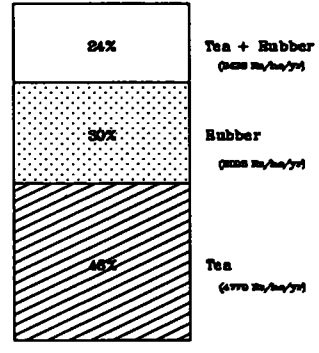
Sensitivity Analysis

A Sensitivity Analysis was performed by changing the values of certain parameters. Firstly, by projecting a fairly low annual yield of 1050 kg for Tea from the 4th year onwards, taking into consideration that the Tea yields are likely to decline due to excessive shade provided by rubber trees. Secondly, by lowering the NSA of Rubber from Rs 75 to Rs 55 per kg. A further analysis was made assuming the revenue from selling of old Rubber trees will be available only at the end of the 25th year (instead of the 1st year). The results of the Sensitivity Analysis are presented in Table– 02 where it has compared the measures of Project Worth under eight different scenarios. NPV has been positive under all such situations. The IRR has been over 30% except for the last scenario. The Pay Back Period ranged from 5 to 7 years.



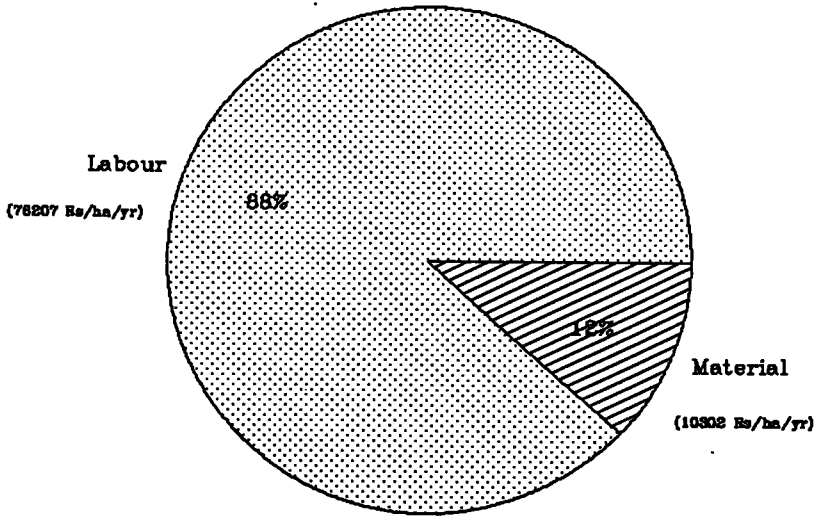


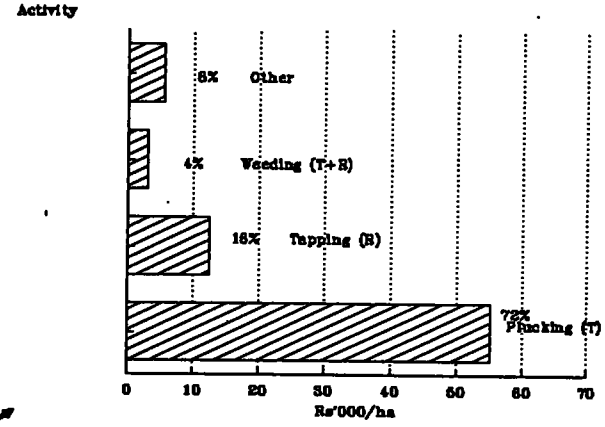




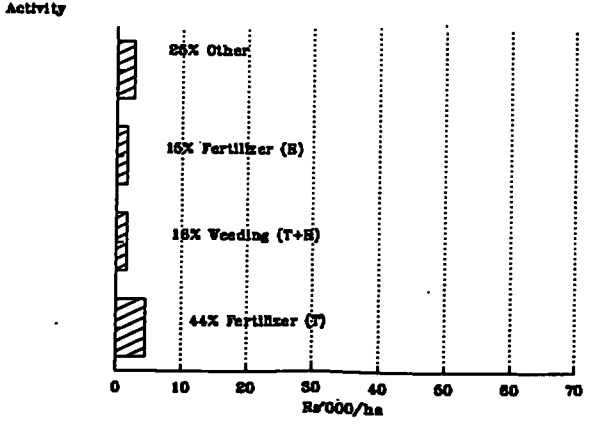
• Excluding the manufacturing cost of Tea.

Fig. 7. Annual cost of mature upkeep by labour & material according to crop



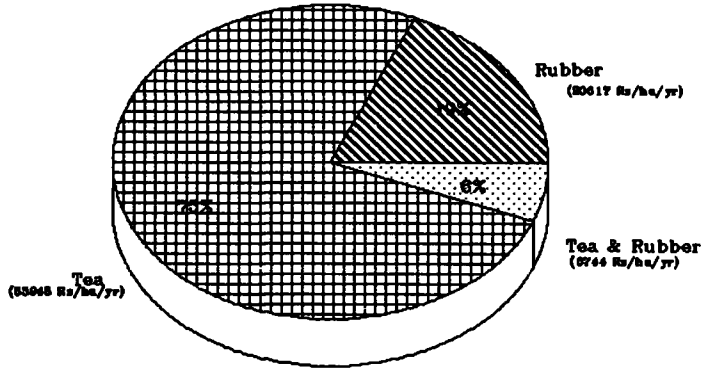


Labour

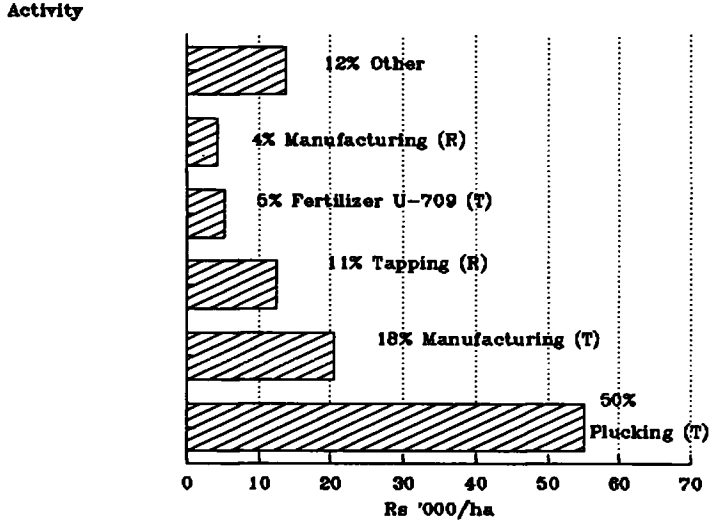


* Excluding the manufacturing cost of Tea.

Fig. 8. Annual cost of mature upkeep by labour & material according to activity



By Crop



By Activity

Fig. 9. Annual cost of mature upkeep by crop and activity

Table 2. *Sensitivity analysis of interplanting rubber with tea*

Scenario			Measurement of project worth				
NSA OF rubber (Rs/kg)	The year of selling of old rubber trees	Tea yield (kg/ha) (Year 4–25)	NPV (at 15%) (Rs)	B/C RATIO	Net benefit – investment ratio	IRR	Pay back period (Yrs)
Rs 75	Year 1	1575	162,145	1.24	3.73	31.2%	5
Rs 75	Year 25	1575	99,145	1.15	1.79	25.2%	7
Rs 55	Year 1	1575	115,799	1.17	2.95	30.5%	5
Rs 55	Year 25	1575	52,799	1.08	1.42	22.5%	7
Rs 75	Year 1	1050	126,213	1.21	3.12	30.5%	5
Rs 75	Year 25	1050	63,213	1.11	1.51	23.1%	8
Rs 55	Year 1	1050	79,867	1.14	2.34	29.1%	5
Rs 55	Year 25	1050	16,867	1.03	1.14	18.2%	8

LIMITATIONS AND CONCLUSIONS

The measurements employed in this study to analyse the feasibility of interplanting Rubber with Tea is from the point of view of individual entrepreneurs. Hence, it does not take into consideration the impact of external factors (indirect benefit and cost) that would effect the society and environment such as employment generation, income distribution, land degradation, foreign exchange gains etc,.

This study clearly demonstrates the profitable return from the interplanting of Rubber with Tea. Nevertheless, it would be premature to arrive at a firm decision with regard to the future investment on this particular joint venture, largely due to the absence of long-term data on technical compatibility of this dual activity. Yet, initial results and its economics are fairly attractive to start this programme of interplanting Rubber with Tea, atleast on a limited scale in the low country wet zone. More experiments are required to study the effects on the yield of Tea with double rows of Rubber with triangular spacing of 2.4m x 2.4m (8'x 8') and of spacing of 18m (60') or 21m (70') within inter-rows for planting Tea which would provide a stand of 80% and 70% respectively for Rubber. These systems would be expected to minimize to a certain extent the adverse effects of shade on Tea.

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(Received 27 June 1995)