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FINANCIAL IMPLICATIONS OF DIFFERENT POST-PRUNE CULTIVATION PRACTICES

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Profitability of five post-prune cultivation practices was analysed. Data gathered from an experiment at St. James Estate Hali-ela (Uva) and the different practices were tested against a control on the effect of the soil physical properties and the yield of mature tea. The practices were (T_2) growing Guatemala grass (*Tripsacum laxum*), (T_3) growing Weeping Love grass (*Eragrostis curvula*), (T_4) forking at the end of the pruning cycle (every row), (T_5) forking at the middle of the cycle and end of the cycle (every other row), (T_6) burying of prunings and (T_1) control (no soil reconditioning). The Net Incremental Benefit (NIB) of each treatment over the control was calculated; thereafter the Net Present Value for each treatment over a pruning cycle (4 years) was arrived at. Results show that the highest NIB is from T_3 (growing Weeping Love grass) and NPV Rs.136,831 per hectare per cycle at 22.5% discount rate. All the other treatments have shown positive NPVs (T_2=Rs.71,687, T_4=Rs.91,257, T_5=Rs.83,991 and T_6=Rs.18,014 per hectare for the cycle at the same discount rate).

INTRODUCTION

Improved soil physical properties are associated with better crop response. Years of unchecked cultivation of tea has degraded the soils in several tea growing areas in Sri Lanka. Forking was a practice recommended to improve soil physical properties. However, it has been observed that under up country conditions, forking has not helped to increase tea yields (Manipura, 1973). There is now a need to identify alternate soil cultivation practices to improve the soil physical properties and thereby increase the yield.

Cultivation practices are usually undertaken soon after pruning the mature tea fields because of the ease of operations during this time; hence the term as post-prune cultivation practices.

The beneficial effects of 5 alternative post-prune cultivation practices that could be adopted by the tea plantations were evaluated by Amarasekera, et al (1997). However, before recommending any of them, its profitability must be made known to tea growers. Although the beneficial effects from improving soil physical properties cannot always be calculated in monetary terms, it could be assumed to be reflected in terms of improved yields. To that extent, the magnitude of improved yield is the most frequently used criterion to select among the alternative measures. This analysis uses yield levels as the representative indicator of the beneficial effect. The different post-prune cultivation practices tested were as follows:

T_1	-	Control
T_2	-	Growing *Guatemala grass* (*Tripsacum laxum*) by cutting and incorporating into the soil.
T_3	-	Growing Weeping Love grass (*Eragrostis curvula*) by cutting and incorporating into the soil.
T_4	-	Forking at the end of the pruning cycle (every row)
T_5	-	Forking at the mid of the pruning cycle and end of the pruning cycle (every other row).
T_6	-	Burial of prunings in small drains in the inter-row space

OBJECTIVE

The main objective of this analysis was to identify the most profitable post-prune cultivation practice. This warrants a financial analysis of the alternative methods from the growers' perspective because yield improvements alone cannot explain the relative profitability as there may be costs associated with increased yields. Tea prices (NSA) and yield levels must also be considered to derive the break-even price and yields.

METHODOLOGY

In the analysis, incremental costs and incremental benefit of the treatments over the control are calculated. Any cost incurred or any benefits realised by the treatments over and above the control is crucial in this exercise. Increment is referred to as the increment in cost, benefit or yield over the control (where no post prune cultivation method is practiced). It is easier to compare the difference in cost or profits from a standard (relative terms) rather than calculating the entire cost or profits itself (absolute terms). A Cost-Benefit Analysis is undertaken after having identified the incremental costs and incremental benefits for each year of a pruning cycle and expressed in terms of Net Present Value (NPV) of each treatment. Net present value is the summation of the differences between discounted cost and discounted benefit over a given period of time.

$$\text{Net Present Value} = \{B_t - C_t\}/\{1+r\}^t$$

B_t	=	Incremental benefit at year t
C_t	=	Incremental cost at year t
r	=	Discount rate (22.5% commercial interest rate)
t	=	Time period (years)

Tea yield and tea prices are considered to test the robustness of results obtained. Break-even yield increment, i.e. the yield increment required to cover the incremental cost over the control is calculated for each treatment. The impact of price variations on profitability of the treatments is investigated in the sensitivity analysis. Finally, break-even price is calculated for each treatment. This is the price or Net Sale Average at which the incremental cost is covered at the incremental yield resulting from the treatments.

DATA

An experiment conducted at St. James Estate in the mid-country Intermediate Zone (Uva) constitutes the source of data (Amarasekera, et al 1997). Five treatments each replicated four times in blocks were laid out in September 1987 and harvesting commenced in March 1988. Yield figures were recorded till August 1992 and in Table 1. Incremental yields of the treatments appear in Table 2.

RESULTS AND DISCUSSION

Tables 3 to 7 show the Net Present Value (NPV) of the financial returns from different post-prune cultivation practices. Net Present Value of all the treatments are positive, indicating that all the tested post-prune cultivation practices are capable of generating net benefits to the grower. Hence, it is profitable to adopt any of the tested practices. However, growing *Eragrostis* in between tea rows (T_3) gives the highest net incremental benefit and hence the highest Net Present Value. This is 33 per cent higher than that of the next best alternative practice (end cycle forking). The lowest net incremental benefit is observed from the burying of prunings (T_6). Therefore, growing *Eragrostis* in between tea and lopping back to tea the field is the most profitable option among the tested post-prune cultivation practices. The cost of adopting the selected post-prune practices is given in Tables 3 to 7. As will be seen, the highest cost is also incurred in respect of growing *Eragrostis*. However, the higher yield increment (36 per cent higher than the next highest increment) adequately compensates the extra cost.

Table 8 shows the break-even yield levels, i.e. levels of yield to compensate the incremental cost of the treatments. Such yield levels are calculated at different Net Sale Averages, namely Rs. 60, 65, 70, 75 and 80 per kg of made tea. Since these break-even yield levels are calculated on a yearly basis, the annual gain in yield required to compensate the yearly incremental cost of the treatments can be derived. Table 8 shows that with increasing Net Sale Average, the yield increment required to compensate the incremental cost of a given treatment declines. However, the incremental yield required to compensate the incremental cost by adopting the cultivation practices is in the region of 421 kg of made tea per hectare per year, being the average for all the treatments. This indicates that an yield increment at an average of 421 kg of made tea per hectare per year is adequate to cover the additional cost incurred by any given post-prune cultivation practice. It is relevant to note here that the observed average yield increment by the post-prune cultivation practices is in the region of 825 kg per hectare per year. The break-even Net Sale Average calculated in Table 9 shows that the robustness of the treatments for possible price fluctuation is substantial. The price at which the Net Present Value (at 22.5 per cent discount rate) of a treatment becomes zero is the break-even Net Sale Average for that particular treatment. Table 9 shows that even at NSA of Rs. 35 per kg, growing *Eragrostis* in between tea bushes and lopping back to the field is a financially viable option. It provides sufficient additional yield to break-even the incremental cost incurred. This is not to suggest that a tea field can earn profits at the NSA of Rs. 35, but it merely implies that the additional benefit from the post-prune cultivation practice is cost effective even at the NSA of Rs. 35. Table 9 also provides break-even NSAs for the other treatments. The highest break-even NSA is observed for T_6, burial of prunings because of the loss in yield in the second year of the cycle (Table 2). Therefore, the total incremental yield for that option for the cycle has reduced up to 1139 kg per hectare per year, i.e. five folds less than that of growing *Eragrostis*. The analysis indicates the relative profitability to the grower in the event of ameliorating soil physical properties by either biological or mechanical means. The recommended standard practice of forking to loosen the compacted soil is also shown to be a profitable option. However, it is sub-optimal among the other post-prune practices. Some of the important soil physical properties influenced by the treatment were also measured in the experiment (organic C content of the soils, water retention parameters, etc.) but their cause and effect relationship with yield are yet to be established. Therefore, none of these factors were included in the analysis.

ASSUMPTION AND LIMITATIONS OF THE STUDY

A following assumptions were made in the analysis:

1. Labour cost is assumed to be Rs. 80 per day.
2. Plucking cost is assumed to have a negative linear relationship with the yield.

The incremental plucking cost is calculated using the following linear equation:

$$Y = 23.732 - 0.00001524X$$

Y = Plucking cost (Rs.) per kg made tea

X = Yield per hectare in kg made tea

(It must be acknowledged that the complex relationship between plucking cost and the yield cannot be fully explained by this model).

3. Factory variable cost associated with the incremental yields is assumed to be Rs. 9.20 per kg made tea (any scale effect in manufacturing operation in factory, there fore, is omitted).

4. All the other costs of agricultural operations associated with the incremental yield are deliberately excluded because such costs on proportional basis are minimal.

5. The beneficial effect of the post-prune cultivation practices may even extend beyond a pruning cycle (4 years). For ease of the study and due to the lack of infor mation, such effects are not brought into the incremental cost-benefit analysis.

6. Agronomic superiority of the tested post-prune cultivation practices would vary with the relevant field conditions. The suitability of each post-prune cultiva tion practice considering slope, soil, rainfall factors and macro climatic conditions need to be investigated. Therefore, generalisation of the results must be done with caution.

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TABLE 1 - Yields of the tested post-prune cultivation practices (kg ha^{-1})

Treatments	Year 1	Year 2	Year 3	Year 4
T1 Contro	13199	4305	3264	3581
T2 Growing *Guatemala* grass	3540	4887	4651	4543
T3 Growing *Eragrostis* grass	4770	5405	5013	4568
T4 End cycle forking	4284	4980	4422	4109
T5 Mid & end cycle forking	4302	4721	4416	4144
T6 Burying of prunings	3484	4176	3678	4150
L.S.D. (P=0.05)	769	628	662	650

Table 2 - Incremental Yields (kg ha^{-1}) (Treatment-Control) of the post-prune cultivation practices

Treatments	Year 1	Year 2	Year 3	Year 4	Total
Mid & end cycle forking	1103	416	1152	563	3234
Growing Guatemala grass	341	582	1387	962	3272
End cycle forking	1085	675	1158	528	3446
Burying of prunings	285	-129	414	569	1139
Growing *Eragrostis* grass	1571	1100	1749	987	5407

Assumptions relevant for Table 3 to 7

1. Labour cost is assumed to be Rs. 80 per day.
2. Incremental yield is the difference between the control and treatment yield.
3. Plucking cost variation is calculated using the up country model.
4. Manufacturing cost is assumed to be Rs. 9.20/ kg of made tea.
5. Discount rate used is 22.5% (commercial interest rate).
6. NSA of Rs. 75 per kg is assumed for the cost benefit analysis.

TABLE 3 - Returns from growing *Guatemala* grass in between tea rows (Rs. ha^{-1} year^{-1}) (T2)

Item	Year 1	Year 2	Year 3	Year 4
Incremental costs				
Labour days (for maintenance)	10	10		
Labour days (for lopping grass)	30			
Manure (U 709) cost (8 Rs/ kg)	2480	2480		
Labour cost	3200	800		
Tool cost	500			
Incre: yield (kg made tea)	341	582	1387	962
Incre: plucking cost	7875	13440	32031	22216
Incre: manufacturing cost	3137	5354	12760	8850
Total incremental cost	17192	22075	44791	31066
Incremental benefit				
Gains from incre: yield				
Total incremental benefit	25575	43650	104025	72150
Net incre: benefits	25575	43650	104025	72150
	8383	21575	59234	41084
NPV(at 22.5% Discount Rate)	71687			

TABLE 4 - Returns from growing *Eragrostis grass* in between tea rows (Rs. ha^{-1} year^{-1}) (T3)

Item	Year 1	Year 2	Year 3	Year 4
Incremental costs				
Labour days (establishment)	50			
Labour days (lopping grass)	45	45		
Labour cost	7600	3600		
Tool cost	500			
Incre: yield (kg made tea)	1571	1100	1749	987
Incre: plucking cost	36088	25268	40176	22672
Incre: manufacturing cost	14453	10120	16091	9080
Total incremental cost	58641	38988	56267	31753
Incremental benefit				
Gains from incre: yield	117825	82500	131175	74025
Total incremental benefit	117825	82500	131175	74025
Net incremental gains	59184	43512	74908	42272
NPV (at 22.5% Discount Rate)	136831			

TABLE 5 - Returns from end cycle forking (Rs. ha^{-1} $year^{-1}$) (T4)

Item	Year 1	Year 2	Year 3	Year 4
Incremental costs				
Labour days	30			
Labour cost	2400			
Tool cost	1000			
Incre: yield (kg made tea)	1085	675	1158	528
Incre: plucking cost	25017	15563	26700	12174
Incre: manufacturing cost	9982	6210	10654	4858
Total incremental cost	38399	21773	37354	17032
Incremental benefit				
Gains from incre: yield	81375	50625	86850	39600
Total incremental benefit	81375	50625	86850	39600
Net incre: benefit	42976	28852	49496	225688
NPV (at 22. 5% Discount Rate)	91257			

TABLE 6 - Returns from mid and end cycle forking (Rs. ha^{-1} $year^{-1}$) (T5)

Item	Year 1	Year 2	Year 3	Year 4
Incremental costs				
Labour days	30			30
Labour cost	2400			2400
Tool cost	1000			1000
Incre: yield (kg made tea)	1103	416	1152	563
Incre: plucking cost	25454	9600	26585	12992
Incre: manufacturing cost	10148	3827	10598	5180
Total incremental cost	35602	16827	37183	21572
Incremental benefit				
Gains from incre: Yield	82725	31200	86400	42225
Total incremental benefit	82275	31200	86400	42225
Net incre: benefit	47123	14373	49217	20653
NPV (at 22. 5% Discount Rate)	83991			

TABLE 7 - Returns from burial of prunings (Rs. ha^{-1} year^{-1}) (T6)

Item	Year 1	Year 2	Year 3	Year 4
Incremental costs				
Labour days	120			
Labour cost	9600			
Tool cost	1000			
Incre: yield (kg made tea)	285	-129	414	569
Incre: plucking cost	6585	-2980	9565	13146
Incre: manufacturing cost	2622	-1187	3809	5235
Total incremental cost	19807	-4167	13374	18381
Incremental benefits				
Gains from incre: yield	21375	-9675	31050	42675
Total incremental benefit	21375	-9675	31050	42675
Net incre: benefit	1568	-5508	17676	24294
NPV (at 22.5% Discount Rate)	18014			

TABLE 8 - Incremental yield required to cover the total incremental cost at varying Net Sale Averages

Treatments	Total incremental cost (Rs. ha^{-1})	Break even yield (kg ha^{-1})				
		Net Sale Average at				
		Rs. 60	Rs. 65	Rs. 70	Rs. 75	Rs. 80
Guatemala grass in inter raws (T2)						
Year 1	17,192	287	264	246	229	215
Year 2	22,075	368	340	315	294	276
Year 3	44,791	747	689	640	597	560
Year 4	31,066	518	478	444	414	388
Eragrostis grass in inter raws (T3)						
Year 1	58,641	977	902	838	782	733
Year 2	38,988	650	600	557	520	487
Year 3	56,267	938	866	804	750	703
Year 4	31,753	529	489	454	423	397
End cycle forking (T4)						
Year 1	38;399	640	591	549	512	480
Year 2	21,773	363	335	311	290	272
Year 3	37,354	623	575	534	498	467
Year 4	170,232	284	262	243	227	213
Mid and end cycle forking (T5)						
Year 1	35,602	593	548	509	475	445
Year 2	16,827	280	259	240	224	210
Year 3	37,183	620	572	531	496	465
Year 4	21,572	360	332	308	288	270
Burying of pruning (T6)						
Year 1	19,807	330	305	283	264	248
Year 2	-4,167	-69	-64	-60	-56	-52
Year 3	13,374	223	206	191	178	167
Year 4	28,072	468	432	401	374	6351

TABLE 9 - Brake-even Net Sale Averages for Post-pruned Cultivation Practices (Observed yield increment is used)

Treatment	Observed yield increment per pruning cycle (kg made tea ha^{-1} $year^{-1}$)	Break-even NSA (Rs. kg^{-1})
T2 Guatemala grass inter raws	3272	35.2
T3 Eragrostis grass inter raws	5407	34.3
T4 end cycle forking	3446	33.2
T5 Mid & end cycle forking	3234	34.4
T6 Burial of prunings	1139	40.0