

ECONOMICS OF FUELWOOD PLANTATIONS

01. Tea is the largest wood consuming industry in the country, the annual consumption being in the region of 657,000 tonnes. Following the shift from furnace oil, tea factories are now overwhelmingly dependent on firewood for drying and allied operations.

02. Presently, the cost of fuel in the COP of tea ranges widely between Rs 1.90 to Rs 3.50 per kg of made tea, being of a greater order in the high and medium elevations than in the low country. In most cases, fuelwood is obtained from outside purchases and with the cost of supplies and transportation having escalated over the years, there has been a corresponding increase in the expenditure on this account to factories both in the estate and bought leaf sectors. Table I illustrates this trend:

TABLE 1-Trends in firewood prices
(Rs/cu metre)

Year	<u>Elevation</u>	
	High/Medium	Low
1980	82	50
1985	196	126
1990	234	198
1994	497	412

On the average annual increase of 11 per cent observed over the last decade, it is estimated that the price of fuelwood payable by estates in the high/mid country by the turn of the century could be in the region of Rs 850 per cubic metre.

03. Cost considerations apart, the availability of bought fuel wood is itself at stake. The Forest Department has stopped the practice of reforesting State lands adjoining tea areas which were available supplies to the industry. Further, rubber tree fellings for fuel purposes are bound to shrink in the years to come with much of them going into value-addition in the form of building material and furniture. It is, therefore, imperative that estates should achieve self-sufficiency by establishing in-house fuel clearings, particularly in the high and medium elevations.

04. Besides serving to maintain factory throughput, the development of fuel clearings will help to provide workers with their domestic firewood requirements, no doubt on the explicit understanding that they will not be permitted to remove tea prunings from the field. This assumes particular significance in the light of TRI studies on post-prune cultivation practices demonstrating the higher yields and better financial returns from the burial of prunings. From a longer-term perspective, it may be mentioned that fuelwood plantations could bring in a supplementary income to estates from the sale of timber to pulp mills. For meeting the primary factory needs, the rule of thumb is that an estate yielding about 1500 kg per hectare of made tea will require to diversify 12-15 per cent of its area into fuel clearings. It could be planted on degraded slopy areas unsuitable for tea cultivation such as some C category fields. Where individual estates do not have the land for this purpose, the operation could be done as part of an

integrated group or company activity but it is important that the harvesting and transportation involved do not unduly add to the cost.

05. In the selection of wood species, the Forest Department suggests various criteria such as the growth rate for increased biomass production, coppicing ability after harvesting, pollarding ability, ability to suppress weed competition, adaptability to a wide range of sites and soils, copious seed production and easy natural regeneration, denser wood to sustain burning for a longer period, easy handling and non-thorny bark etc. By and large, the choice in the higher and medium elevations has been for *Eucalyptus grandis* which, on a 10-year cycle, is expected to yield about 425 cubic metres per hectare.

06. In regard to the extent of land that may have to be set aside for a self-sustaining wood energy system, the TRI has, at the meetings of the Experiments and Extension Forum, suggested certain related formulae for this purpose, and these are reproduced below along with examples for easy reference.

The general formula relating to the fuelwood requirements for tea manufacture is:

$$A_f = \frac{8PF}{(Ms) * 10^4} \quad * \text{ At where}$$

- A_f = Area under fuel wood (ha)
 P = Tea yield (kg made tea/ha)
 F = Specific fuel wood consumption in tea processing, taken at 20% M.C. for fuel wood (kg/kgMT)
 M = Mean Average Growth Increment (MAI) of species selected for firewood (m^3 /ha/year)
 s = specific gravity of fuelwood species, and
 A_t = Area under tea (ha)

Example

Area under tea = 400 hectares
 Yield = 1500 kg made tea/ha
 MAI (say, *Eucalyptus grandis*) = 42.5 m^3 /ha/an
 on a 10-year rotation

Therefore, at specific fuel wood consumption of 2 kg/kgMT,

$$A_f = 0.113 A_t$$

or 11.3 per cent of the tea area

If specific fuel wood consumption is lower at 1.5 kg/kgMT,

$$A_f = 0.085 A_t$$

or 8.5 per cent of the tea area.

The formula can be extended to cater to the domestic needs of workers and their families as well, in which case it becomes:

$$Af = \frac{8(PF + 770p)}{(Ms) * 10^4} * At$$

where p = population density of household (persons per ha)

Taking the per capita fuel wood consumption in the estate sector at 770 kg/year and assuming a population density of 4 persons per hectare, the area that may possibly be planted under fuel clearings for both processing estate leaf (at 2 kg/kgMT) and meeting the requirements of workers could be arrived at as follows:

$$Af = 0.229 At$$

or 22.9 per cent of the tea area.

Clearly, this may seem unrealistic as the priority for the use of grown fuelwood should be for manufacture and only thereafter as domestic fuel. Another variation is to cover the specific cases of bought leaf factories which cater to the production of small holders from nearby villages. Accordingly, the formula will be as follows:

$$Af = \frac{8KF}{(Ms) * 10^4}$$

where K = production of bought leaf (kgMT/year)

Example

Where a bought leaf factory produces 750,000 kgmt/year at a fuelwood consumption rate of 2 kg/kgmt, the area required under *Eucalyptus grandis* (with MAI of 42.5 m³/ha/year) to maintain a sustainable supply of fuelwood is about 56 hectares.

07. The financial viability of diversifying into *Eucalyptus* plantations may now be examined. Based on feedback from the Forest Department, Table 2 details the cost of planting and maintenance over a 10-year period before harvesting. This works out at current costs to Rs 60,328 per hectare or a cumulative of Rs 36 per plant. It is to be noted that the cost will be minimal in the subsequent cycle(s) if three harvests - the original and two coppices - could be obtained from each planting. In respect of harvesting and transportation to the factory, the cost is placed at Rs 150 per cubic metre but could be lower if, in keeping with the practice adopted in some estates, the underemployed men workers are encouraged to harvest the produce on a task of or around 1 cubic metre per man day.

On the revenue side, the returns are worked out during the 10th year at the current price of Rs 500 per cubic metre on a yield of 425 cubic metre per hectare. Table 3 summarises the position.

TABLE 2 Fuelwood plantations in uneconomical/abandoned tea areas (Rs per hectare at 1994 prices)

Operation	Mondays					Total Mandays	Mandays Cost	Unit	Unit Cost	Material					Total Cost	
	Yr 1	Yr 2	Yr 3	-	Yr 10					Yr 1	Yr 2	Yr 3	-	Yr 10		
Survey										1000					1000	1000
Land Clearing	65			-		65	5395									5395
Lining and Pegging	10			-		10	830									830
Holing	15			-		15	1245									1245
Planting Eucalyptus	18			-		18	1494	Plant	3	1666					4998	6492
Termite Control	8			-		8	664	kg	475	16.8					7980	8644
Weeding (slashing)	59	59		-		177	14691									14691
Fertiliser	6	6		-		12	996	kg	8.5	60	90				1275	2271
Fire Protection	3	5		-		48	3984									3984
Resupplying		4		-		4	332	Plant	3		168				504	836
Watcher	18	18		-		180	14940									14640
Total Mandays	202	92		-		537									15757	
Annual Cost	16766	7936		-			44571			14468	1269					60328
Grand Total																

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Per plant cost (Rs)	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10
Labour and material cost (Rs/ha)	31254	8905	6806	1909	1909	1909	1909	1909	1909	1909
Per plant cost (Rs/plant)	19	5	4	1	1	1	1	1	1	1
Labour and material cumulative cost (Rs/ha)	31254	40159	46965	48874	50783	52692	54601	56510	58419	60328
Cumulative per plant Total Cost (Rs/Plant)	19	24	28	29	30	31	33	34	35	36

Assumptions

1. Suscon Fore application for termite control
2. NPK (12:9:6) for fertiliser application and cost calculated at Rs 425 per 50 kg bag
3. 10% resupplying in 2nd year
4. Labour days annually at 5 on fire protection and 18 on watchman to remain constant from 4th to 10th year
5. No material cost required from 3rd year onwards
6. Harvesting of fuelwood in 10th year

TABLE 3-Returns from fuelwood plantations

Item (Rs/ha)	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
Capital cost	31254	8905	6806	1909	1909	1909	1909	1909	1909	1909
Harvesting										63750
Gross Returns										121250
Net Returns	-31254	-8905	-6806	-1909	-1909	-1909	-1909	-1909	-1909	146841
NPV (15% D.R.)	83885									

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Assumptions

1. Harvesting cost (felling and transportation) taken at Rs 150 per cu metre
2. Fuelwood price taken at Rs 500 per cu metre
3. Planting to harvesting on 10 year rotation

As will be seen, the activity generates a healthy Net Present Value of Rs 83,885.

08. For the estate, the value that will accrue from developing its own fuelwood coupes may also be seen in relation to the projected cost of outside purchases. This benefit will accrue by way of savings in COP and has been estimated in Table 4 for the year 2005 by which time the planting now initiated will be ready for harvest. The calculation proceeds on the basis that the expenses on planting and maintenance, at current costs, will rise annually by a real interest rate of 6 per cent, being the difference between the interest rate of 16 per cent on capital expenditure and the estimated inflation rate of 10 per cent.

To this has to be added the compounded harvesting cost which, being of a variable nature, is expected to increase annually at the inflation rate of 10 per cent. Accordingly, the cost of the grown fuelwood element in the COP by the year 2005 at an estimated yield of 425 cubic metre per hectare could work out to about Rs 2.46 per kg MT. In the calculations, 1 cubic metre of *Eucalyptus grandis* is taken at 355 kgs and also that 1.5 kg of fuelwood is required to manufacture 1 kg of made tea. Alongside, it has been observed that fuelwood prices have risen over the last decade by about 11 per cent per annum, being far more pronounced in recent years. Even if this lower rate is assumed for estimating future trends, the price of bought fuel wood by 2005 could be conservatively put at Rs 1420 per cubic metre and, to that extent, the

TABLE 4 Relative Savings from Bought fuelwood vis-a-vis Grown fuelwood in year 2005

Item	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Capital Cost (Rs/ha)	31254	8905	6806	1909	1909	1909	1909	1909	1909	1909	Total
Compounded Capital cost (Rs/ha)	55971	15044	10847	2870	2707	2554	2410	2273	2144	2023	98943
Compounded harvesting cost (Rs/ha)											148551
Total Compounded cost (Rs/ha)											247394
Unit cost of grown fuel wood (Rs/cu metre)in 2005											582
Projected cost of fuel wood (Rs/cu meter)in 2005											1420
Grown fuel wood element in C.O.P. in 2005 (Rs/kg made tea)											2.46
Bought fuelwood element in C.O.P.in 2005 (Rs/kg of made tea)											6.00
Saving in C.O.P. in 2005 (Rs/kg made tea)											3.54

1. Capital cost as per 1994
2. Compounded capital calculated at real interest rate of 6%
3. Harvest in 2005 estimated at 425 cu metre per ha
4. Compounded harvesting cost calculated at Rs 150 per cu metre rising annually at 10%
5. One cu metre of Eucalyptus grandis taken to be 355 kg
6. Price of outside purchase estimated to increase at 11% per annum
7. 1.5 kg of fuelwood assumed to dry 1 kg of made tea

cost of the bought fuelwood element in the COP could be in the region of Rs 6 kg MT. The difference - Rs 3.54 per kg MT - could be the long-term saving in cost to the management by growing fuelwood on the estate. In other words, the difference between the value of grown and bought fuelwood at the projected price of Rs 1420 per cubic metre will work out to as much as Rs 356,000 per hectare.

09. It must be pointed out that the establishment of in-house clearings is merely one of the components in the changed situation. Apart from improved utilisation (use of split firewood instead of log feeding, reduced moisture content through better drying and use of furnace flue gases, etc), the proposed diversification has to be dovetailed into a gasifier system which reportedly operates at a much higher level of efficiency, thereby reducing the extent of land that has to be brought under fuel clearings. A combination of these efforts will not only bring down fuel costs steeply but is also a national priority.

10. Considerable cost savings are, therefore, possible if tea estates are encouraged to grow their own fuelwood as an on-going and integrated plantation operation. Being a sustainable activity, this will go a long way in meeting both the factory requirements and the domestic fuel of the workforce. The former, however, is the priority although the latter objective, if and when it were to be realised, should be in-built into a firm understanding that prunings are left in the field for conserving, recycling and improving the organic content of the soil.