OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

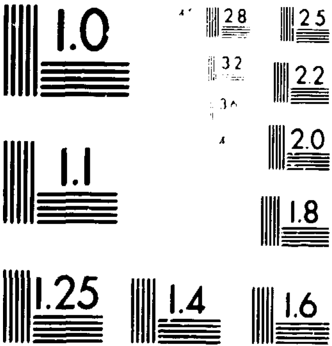
FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

RESTRICTED

14006

DP/ID/SER.A/ 528
6 August 1984
English

RESEARCH AND DEVELOPMENT FOR THE UTILIZATION OF
RUBBERWOOD AND COCONUT WOOD

DP/SRL/79/053

SRI LANKA.

Technical report: Sawing Small Coconut Logs*

Prepared for the Government of Sri Lanka
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of C. R. Francis, Timber Engineer
and K. Bergseng, Expert in Sawdoctoring

United Nations Industrial Development Organization
Vienna

*This report has been reproduced without formal editing.

V.84-89015

CONTENTS

COCONUT SAWMILLING

1. INTRODUCTION

Sri Lanka contains a large area of overmature coconut plantations. These palms are overdue for felling and replanting in modern high yielding hybrid strains. Estimates of the annual area to be replanted vary depending on their source but are in the range of 6,000 to 10,000 acres per year.

This activity will result in the availability of a very large volume of coconut logs which represent a valuable timber resource. Coconut is a traditional material for the manufacture of rafters as a cottage industry. Recently interest has been expressed in its use as panelling and furniture timber.

There is a large amount of information available on the properties and uses of coconut. This is contained largely in the proceedings of the two seminars on coconut wood held in Tonga in October 1976 and in Manila and Zamboanga in October 1979. This report does not pursue these questions. It rather recommends sawing techniques recently proved in Sri Lanka, and also in use in several Pacific islands, and recommends their combination with modern small log sawing practices.

A cursory investment analysis reveals the possibility of a very profitable sawmilling industry.

2. SAW TYPES FOR COCONUT WOOD

Coconut is extremely abrasive and only two types of material are sufficiently hard to be used for saw teeth when working this material. These are tungsten carbide and stellite. Tungsten carbide is considerably harder than stellite and lasts four to six times as long in the same environment. Table 1 is a comparison between the two materials. High skill levels are required for maintaining both materials. There is considerably more work involved in maintaining stellite tipped saws, since it does not last nearly as long as carbide. Approximately, for every sharpening given to a TCT saw, a stellite tipped saw will be sharpened five times and retipped and side ground once. It is the opinion of both the Chief Technical Adviser and the sawdoctor expert that tungsten carbide is the preferable material for economic and technical reasons. However, while coconut continues to be sawn with band saws, stellite must continue to be used.

The most convenient type of saw for initial slabbing cuts is the inserted tooth circular saw (see Figures 1 and 2). In a slabbing cut, kerf thickness has no bearing on recovery so heavy plates can be used for stability. The teeth can be removed and replaced with a sharp set without removing the saw from the machine, an operation which takes about 30 seconds per tooth. Thus the teeth in a 36" twin saw machine can be replaced within a lunch break if required.

For resawing, a fine kerf is required to maintain recovery. This can be achieved by either band saws or guided thin plate (3.2 mm kerf) circular saws.* Modern developments in saw guides have resulted in edger kerfs being reduced nearly to those of bandmill kerfs. Further, the superior precision of a guided circular sawn surface compared with a bandsawn surface results in the required overcut for a final size being less with the circular saw, so that recoveries are identical.

Circular saw maintainence is simpler and less demanding than bandsaw maintenance. Also the cost of the maintenance equipment is much less. They are therefore preferred to bandsaws where:

Depth of cut is limited to their diameter capability.

Only slabbing cuts are taken with simple guided saws.

Resawing cuts are less than 8" and so are within the capability of fully guided thin kerf saws.

Bandsaws are used where:

Deep cutting capacity is required.

Boarding is undertaken on a log carriage.

In coconut sawing all the first set of criteria are met in the type of sawmill recommended and none of the second; therefore bandsaws are not recommended for this use.

---

*The maintenance of the white metal saw guides requires particular skill and may make this equipment inappropriate!

Figure 1. Inserted tooth saw 42" diameter

Figure 2. Tungsten carbide tipped inserted teeth and keepers 8-9 gauge, style B

Table 1. Comparison of tungsten carbide and stellite

Tungsten carbide	Stellite
Extremely hard.	Very hard.
Sharpened only by diamond wheel.	Sharpened with carborundum wheel.
Brittle.	Tough.
Applied by brazing pellet into saw or inserted shank - toolroom job.	Applied by melting drop onto prepared saw tip - routine saw shop job.
Very long life before replacement required.	Withstands only 4 to 6 sharpenings.
Circular saws only.	Circular and band saws.
Machine for sharpening: Precision universal grinder.	Machines for sharpening: Stellite tooth former; Side equalizing grinder; Gullet grinder.

3. COCONUT SAWMILL DESIGN

Coconut falls into the "small log" category of sawmilling. Apart from its absolute requirement for hard teeth and its prospensity to sweep, sawing coconut presents no particular problems. In its favour, from a sawmiller's point of view, are its complete freedom from knots and the predictable density variation from bark to core. This results in grade being determined solely by the position of the board in the log.

Grading requirements frequently determine the preferred timber dimension; thus structural type grades are cut in scantling sizes and appearance grades in board or moulding stock sizes. In the case of coconut structural quality wood is only obtainable from the outside of the log. Appearance is partly a matter of taste. In turn this may be influenced by advertising. It is recommended that only the interior of coconut should be promoted for panelling or furniture use, and that a sharp price distinction should be drawn between scantlings and boards. This should allow a fixed sawing pattern to be followed.

A very standard type of small log sawmill consists of a twin-saw log edger feeding to a circular gang edger. This is almost universal in stud mills sawing peeler cores in the U.S.A., and hundreds of such mills are found around the world from Scandinavia to the South Pacific. Machines for this type of mill are widely available from numerous manufacturers in Canada, the U.S.A. and Sweden.

A typical gang edger is shown in Figure 3. This is a standard type of small edger of which numerous brands are available. It is capable of absorbing high horsepowers and can have feed speeds of several hundred feet per minute. Sawing accuracy is good and thin kerf saws can be used with mist lubricated guides.

The diameters of Sri Lanka coconut are very uniform above the butt swell. A very few large diameter palms have been observed. These were all of low stature and enquiries in two areas elicited the information that these were recently planted modern hybrids. No tall large diameter palms were seen. All tall palms were 7" to 9" d.b.h.

This uniformity of diameter permits the use of a fixed sawing pattern and obviates the need for setworks. Setworks are a source of inaccuracy accidents and maintenance problems. They are also expensive.

A sawing pattern as shown in Figure 4 is recommended. This can be produced by a twin log edger spaced 6" clear followed by passing the cant through a fixed-saw gang edger set as shown. The side flitches are edged on one side or other of the machine depending on the minimum face of the flitch.

A suitable mill layout capable of handling logs up to 20 ft long is shown in Figure 5. Besides the two machines described above, this mill contains a two-saw crossover docking system. This is also a standard equipment item available from numerous manufacturers. Although end docking is not standard practice in Sri Lanka, inclusion of a docking system is recommended in order to:

- Upgrade the appearance of the timber. Standard length timber is presently only available in imported timbers, e.g., Kempas.

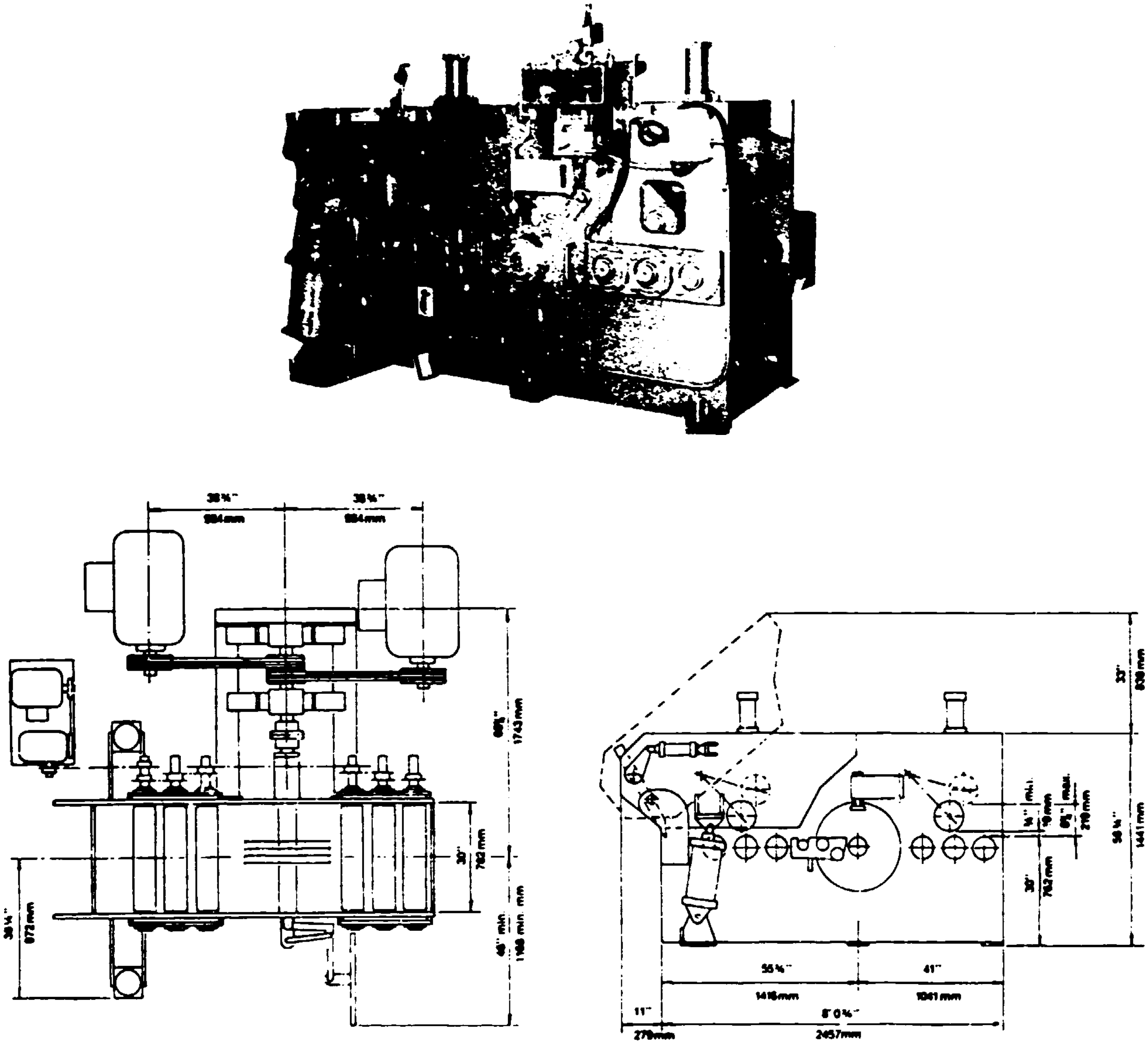


Figure 3. 30" x 8" gang edger.

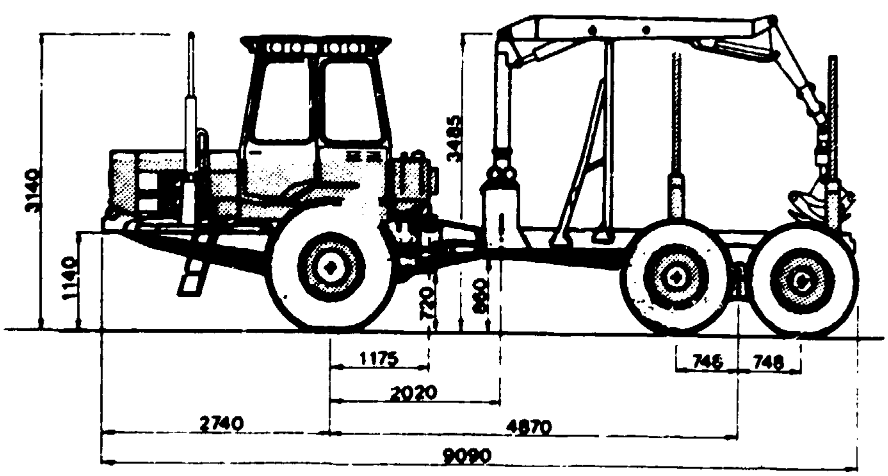
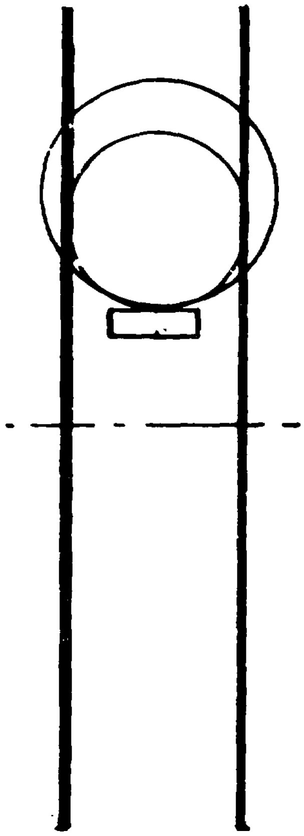


Figure 6. Self-loading logging truck.

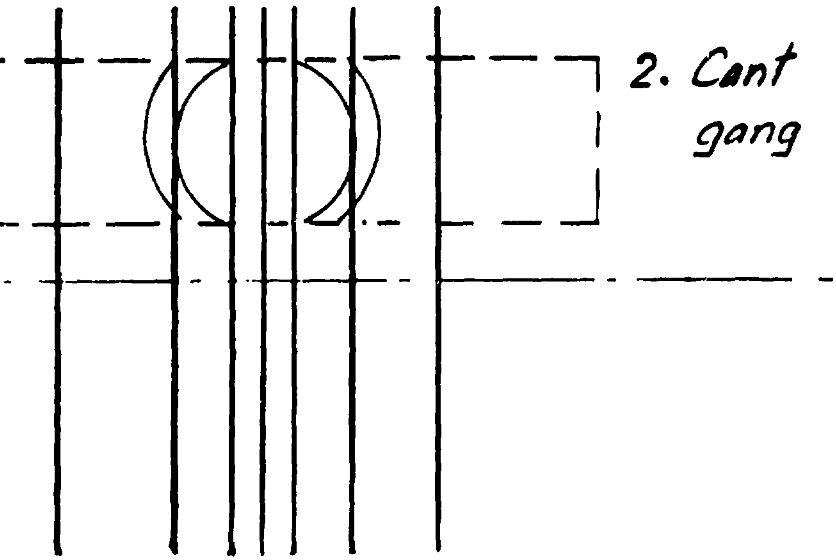


1. Log through 6"
log edge-

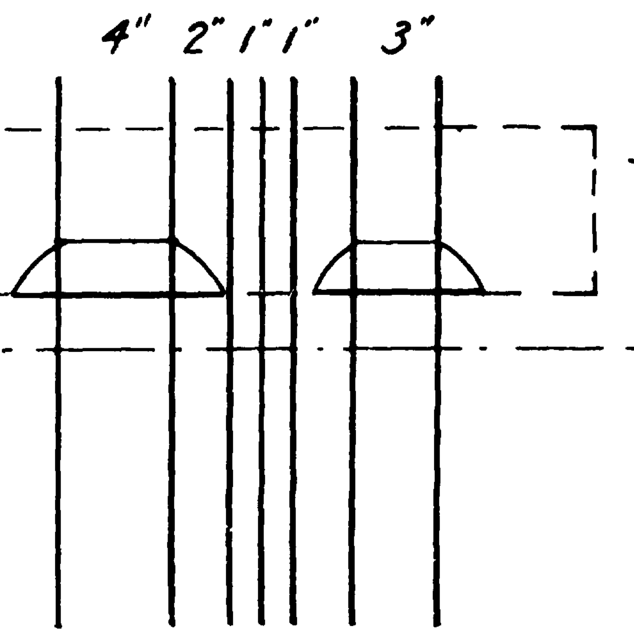
COCONUT SAWMILL

SAWING SEQUENCE

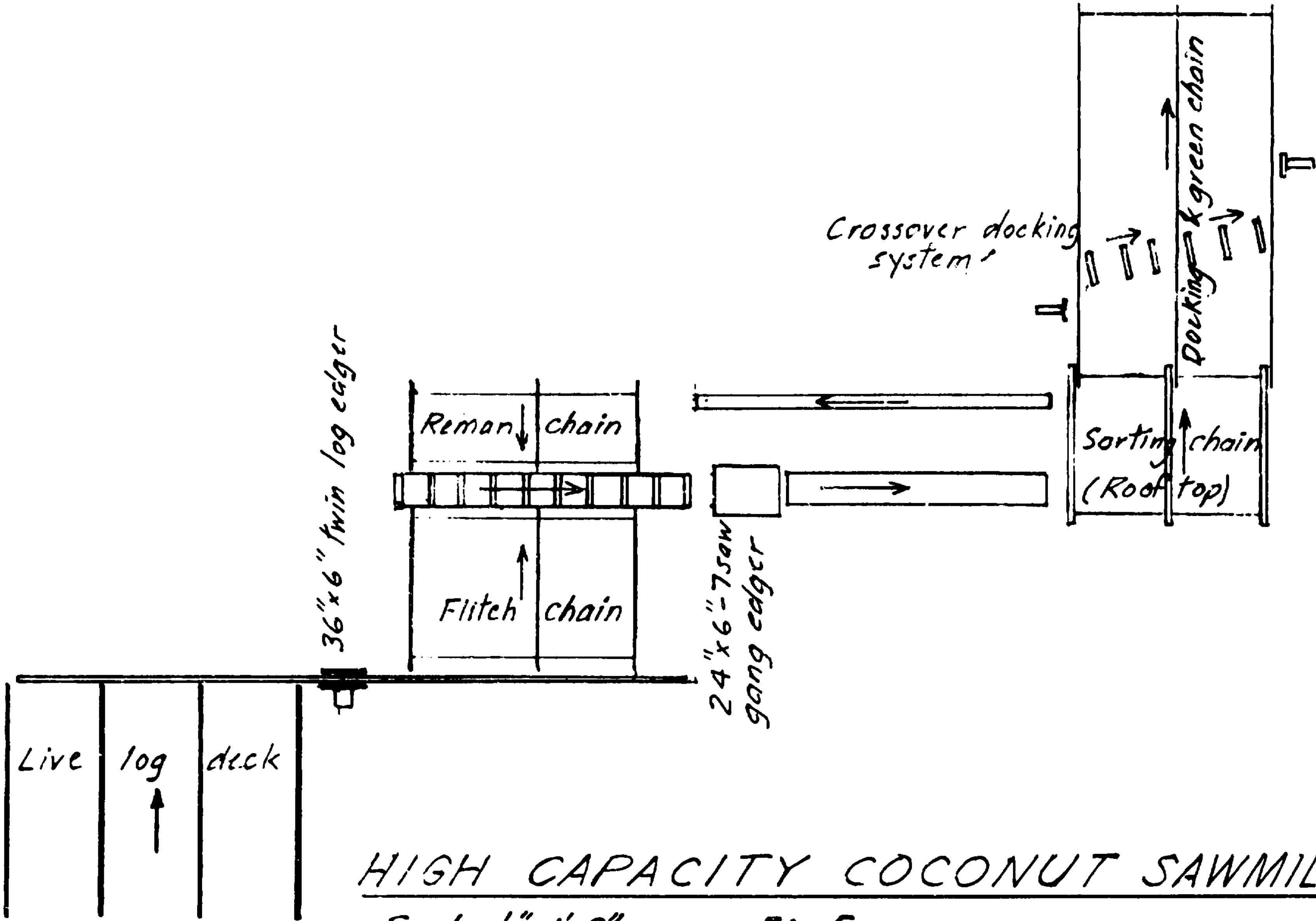
Fig. 4



2. Cant through gang edger



3. Side flitches reworked through gang edger



HIGH CAPACITY COCONUT SAWMILL

Scale $\frac{1}{8}$" = 1'-0"   Fig. 5

- Eliminate sloven ends.
- Eliminate end wane formed when sawing excessively swept or incorrectly bucked logs.

4. SAWMILL CAPACITY

The sawing capacity of this mill may be obtained as follows:

Assumptions

Log edger feed speed 40 f.p.m.

Gang edger feed speeds 90/180 f.p.m.

Millable length per stem 30 f.

50 % of stems yield 3 logs

50 % of stems yield 2 logs

Effective cutting time 360 minutes per 8 hour day

Log loading time 15 seconds

Then:

Average log length $= \left(\frac{30}{3} + \frac{30}{2}\right) \frac{1}{2} = 12.5$ f.

Time through log edger $= \frac{12.5}{40} \times 60$ seconds $= 18.75$ seconds

Plus loading time = 15 seconds per log = 33.75, say 34 seconds

No. of logs per day $= \frac{360 \times 60}{34} = 635$

No. of stems per day $= 635 \times \frac{12.5}{30} = 265$

Sawing time for cant through gang edger $= \frac{12.5}{90} \times 60$ seconds $= 8.33$ seconds

Sawing time for flitch $= \frac{12.5}{180} \times 60$ seconds $= 4.17$ seconds

Total sawing time $= 635 \times 8.33 + 2(635 \times 4.17)$ seconds

$= 10{,}583$ seconds $= 176$ minutes

Time for loading $= 360 - 176 = 184$ minutes

No. of cants and flitches $= 635 \times 3 = 1{,}905$

Loading time per piece $= \frac{184 \times 60}{1{,}905} = 5.8$ seconds - O.K. for two side loading

Note: If this loading time is considered too short, it may be increased by increasing the horsepower of the edger, but at the expense of more capital and electricity charges.

Outputs

/ ıal capacity for 140 day year

No. of stems per year = 240 x 263 = 63,600 stems

Assume 100 stems per acre

Annual area required = $\frac{63,600}{100}$ = 636 acres

Timber volume

Assume from each average log	2/6" x 1" x 12' =	12 f.b.m.
	1/4" x 2" x 10' =	6.67 f.b.m.
	1/3" x 2" x 10' =	5 f.b.m.
		23.67 f.b.m.

Total volume = 63,600 x $\frac{30}{12.5}$ x 23.67 f.b.m. = 3.61 million f.b.m.
301,000 cubic feet

Recovery

Assume average log diameter = 7.5"

True log volume = $\frac{7.5^2}{4} \times \frac{\pi}{144} \times 12.5 \times 12$ f.b.m. = 46.1 f.b.m.

Conversion = $\frac{23.67}{46.1} \times 100 = 51.3\ \%$

5. COCONUT SAWMILL INVESTMENT ANALYSIS

A sawmill of the layout and capacity shown in Figure 5 and described in the report is analysed. The following assumptions are made:

- No log shortages.
- All scantlings and boards can be sold.
- Boards are planed on four sides; however price variation from scantling has not been assumed.

It should be noted that in a mill of this capacity mechanical handling of logs and sawn timber will be essential. Two crane equipped (i.e., self-loading) log trucks are assumed adequate if the mill is located in the coconut triangle since haul distances will be short. A suitable type of vehicle is shown in Figure 6 (see p.6).

Considerable variations to capital investment are possible without greatly affecting the profitability.

The estimates are believed to be reasonable, but prices should be checked by inviting quotations for major items.

Fixed capital costs - all figures US$

Live log deck	12,000		
Log edger	16,000		
Feed chain	10,000		
Flitch chain	8,000		
Roll case	8,000		
24" x 6" gang edger	60,000		
24" belt	6,000		
Sorting chain	9,000		
Return belt	5,000		
Remanufacturing chain	7,000		
Docker	8,000		
Green chain	12,000		
Sapstain bath	6,000		
Building 6,000 square feet	30,000		
Grinder	10,000		
Saw equipment	5,000		
Workshop equipment	12,000		
Planer	40,000		
Roll case	10,000		
Sorting chain	12,000		
Knife grinder	7,000		
	293,000	say	300,000

Vehicles

2 self loading logging trucks	80,000
2 fork lift trucks	60,000
2 jeeps	20,000
	160,000
Plus fixed capital	300,000
Total capital	460,000

For annual financial charges, assume an overall rate of 40 per cent to cover:

- Loan costs
- Capital repayment
- Insurance
- Depreciation

This is a rather rough manner in which to determine this item, but until detailed investigations are made of financial sources and depreciation rates, it should be sufficient to determine an approixmate break even selling price.

Financial costs = 40 % of 460,000 = 184,000 p.a.

Convert at Rs. 25 per US$ 1 = Rs. 4,600,000 p.a.

<u>Labour</u>

Drivers	4)	Sawmill
Skiddies	2)	
Log sawyer	1)	
Slabbies	2)	
Edgermen	2)	
Edgings	1)	
Sorter	1)	
Dockers	2)	
Pullers	6)	
Machinist	1)	Planing mill
Pullers	3)	
Sawdoctors	2)	Skilled tradesmen
Knifeman	1)	
Fitter	1)	
Electrician	1)	
Mill foreman	1)	Supervisory, Administration
Storemen	2)	
Clerks	6)	
Manager	1)	
	40 @ Rs. 1,500 p.m.	= Rs. 60,000

Charge labour at average rate Rs. 1,500 p.m. - includes overheads.

40 @ Rs. 1,500	Rs. 60,000 p.m.	
Electricity - estimate	80,000 p.m.	
Fuel - estimate	34,000 p.m.	
Total	174,000 p.m.	= 2,088,000 p.a.

Spare parts and maintenance:

Assume 4 % of capital

4 % of $ 460,000 = $ 18,400 = Rs. 460,000

Log purchases:

63,600 stems @ Rs. 70 = Rs. 4,452,000

Total purchases	Rs.	2,088,000
		460,000
		4,452,000
		7,000,000 p.a.

Working capital

3 months' interest	1,750,000
Interest 25 %	437,500
Financial costs b/f	4,600,000
Purchases b/f	7,000,000
	12,037,500 p.a.

Break even price:

Annual volume	3,610,000 f.b.m.
Break even price	12,037,500 / 3,610,000 = Rs. 3/33 per f.b.m.

Note that this figure is ex mill.

It is believed that even taking transport costs into account, the present retail prices of timber in Colombo and other centres are such that considerably higher ex mill prices are possible. An indication of profits and payback periods is given in Table 2.

Table 2. Effect of price on profit and payback period

Ex mill price Rs.	Gross profit Rs. million	Payback period
4	2.42	4.75 years
5	6.03	1.9 years
6	9.64	1.2 years
7	13.25	10 months

No account of tax has been included, but this investment study should indicate the potential. A full study taking into account income tax, business turnover tax, and the availability of equity and loan capital appears warranted.

An indication of market may be made by assuming that all scantling will go into roof rafter for low cost houses. A 24' x 16' house (384 square feet would have 14 pairs of 10' rafters of say 4" x 2"). Timber volume = 187 f.b.m. The scantling volume produced is $\frac{11.67}{23.67}$ x 3.61 million f.b.m. = 1,557,972 f.b.m.

Number of houses roofed = 8,331. This is considerably lower than the widely publicised targets.

A thorough market analysis appears warranted.

7