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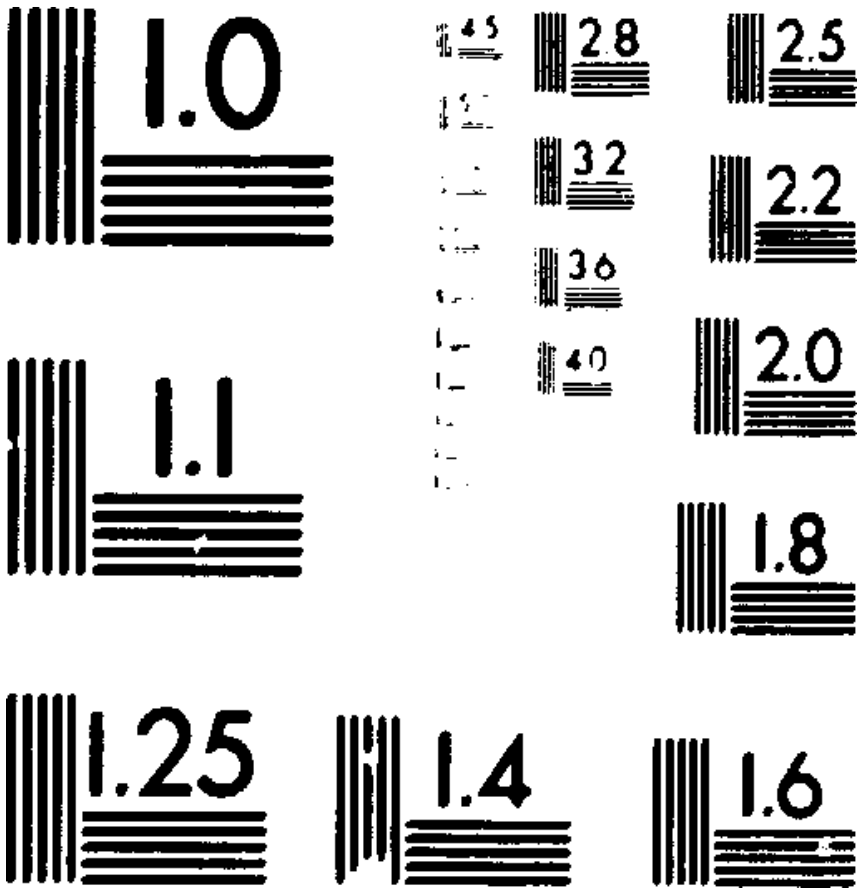

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RESEARCH AND DEVELOPMENT FOR THE UTILIZATION OF RUBBERWOOD AND COCONUT WOOD

DP/SRL/79/053

SRI LANKA

Technical report: Coconut wood sawmilling and sawdoctoring*

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 K. Bergseng, Expert in Sawdoctoring

United Nations Industrial Development Organization
Vienna

cf. 14006

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(a) Equipment

Bandsaw maintenance section

Vollmer Cana S bandsaw grinder (feed left to right).

Vollmer EMS dual side grinder (feed right to left).

Vollmer VWM bandsaw rolling bench.

Vollmer GF 104 stellite tipping machine complete with attachments for circular saws.

ASPAC bandsaw welding clamp.

Bandsaw welding equipment.

Panel torch, welding tips, forging hammer (supplied by consultants).

ASPAC swaging clamp.

Bandsaw shears.

Vollmer manual swage for bandsaws up to 17 guage.

ASPAC bandsaw back guage with dial indicator.

Armstrong No. 5500 shaper (supplied by consultants).

Old equipment:

Robinson bandsaw rolling bench.

Robinson bandsaw grinder.

Robinson bandsaw brazing clamp.

Robinson bandsaw brazing scarf grinder.

Auxiliary equipment:

Birmingham wire guage, straight edges.

Tension guages, etc., for band and circulaw saws were supplied by consultants.

Circular saw section

Loroch JLM 36" automatic grinder.

Robinson manual gulleting machined (totally worn out).

Circular saw hammering bench with saw trolley, made to consultants' design.

Carbide saw section

Loroch tool and cutter grinder.

Loroch electric brazing unit for tipping tungsten saws.

(b) Comments

All the equipment purchased by UNIDO's Chief Technical Adviser, Mr. C. R. Francis, for the sawshop at Borwood Sawmill in Kandane was installed and operational, except for the Vollmer EMS bandsaw side grinder which was waiting for the saw-feed geared motor to be fitted. This unit was ordered through Vollmer, Singapore, in August 1983. With the help of the CTA, telex messages were sent to Vollmer enquiring why its delivery was delayed? Owing to this delay, some holdup was caused in getting on with the stellite tipping and side grinding of the bandsaws for the coconut trials. However, the unit was airfreighted to Colombo and fitted to the machine as soon as it arrived.

Other problems experienced during the sawdoctor's stay were with the grinding head motor on the Cana S bandsaw grinder, which was continually cutting out during the grinding operation because of overheating. The cause proved to be badly worn bearings in the motor, and with new bearings fitted no more problems were experienced.

There were also some problems with leaking guages on gas cylinders used for bandsaw welding resulting in an uneven flame when welding, making it impossible to complete a saw weld with the correct oxy-acetylene gas pressure and consequently poor welds. A new pressure guage was purchased and fitted.

Swaging and shaping bandsaws. A Vollmer manual swage was used for this work and proved adequate for the job. However, 17 guage saws were in the upper limit for the size of swage and will give some problems in the future. No spare parts were purchased with the swage, such as anvils eccentric dies and clamp screws. It is well-known that indentations will occur in both the anvil and die after a period of time. This will result in poor and uneven swaging, causing an excess build-up of steel on one side of the sawtooth which will cause the saw to run and dive when used in the mill. Both the swaging anvil and the eccentric die must be maintained in top condition; that is, if the eccentric die is shifted to a new position, the anvil must also have a new surface.

Worn clamping dies will allow the swage to move during the swaging operation which will produce poor and often uneven and broken saw kerfs. Spare parts, as already mentioned, must be on hand in this area if good work is expected.

Shaper. The sawdoctor was surprised that no shaper had been purchased for the sawshop. The reason given was that all saws were to be stellite tipped. Stellite tipping is a very slow and costly process, and should only be used when cutting coconutpalms. There is no reason for stellite tipping saws which are to be used for sawing soft rubberwood. In the past they have only swaged and sharpened the tooth. Naturally the result of this was disastrous, with the saw scoring the timber badly as none of the tooth points had the same kerf width. Secondly, the tooth point had no strength and often broke. Thirdly, it is damaging to the saw steel to swage the teeth after every run, and it is obvious that the saw would not last more than one or two hours at the most before it had to be taken back into the sawshop. The sawdoctor had a manual shaper air freighted out from New Zealand (on loan from the Timber Industry Training Centre). Thus it was possible to swage and shape the teeth to a proper even kerf width and build up the metal on the side of the tooth giving strength to the cutting point. The result of this was that the saw produced a smooth even sawn surface and lasted up to 10 - 12 hours between changes and 3 - 4 sharpenings between swaging. This cut down the workload around the saw grinder and allowed the sawshop staff to concentrate their work on the tensioning and levelling of the bandsaws which is the most important part of the bandsaw maintenance programme.

Circular saw section. Borwood Ltd. have two manually operated tabletop log breaking down benches using circular saws. These two benches are doing the primary breaking down of the logs while the 54 inch diameter Robinson bandsaw does all the secondary cutting.

Normal maintenance of the circular saws was almost non-existent. The machinery used to maintain the circular log breaking down saws was a manually operated Robinson pull down grinder and this machine was so

worn in the moveable parts that it was impossible to produce a good tooth profile. This machine should be either completely reconditioned or replaced; for example, with a new Armstrong No. 54 costing about $US 3,000. The CTA had bought a Loroch LM.36 automatic circular saw grinder. Unfortunately the grinder was too small to accommodate the larger diameter saws so was only used to sharpen circular saws up to 36 inch diameter.

Carbide saw section. The Loroch tool and cutter grinder was a very useful machine and did a good job on the hard metal saws and various cutters and cutterheads used in the remanufacturing section.

The electric brazing unit for joining carbide tips to the sawplate was not used during the sawdoctor's stay. This type of unit, with electric resistance current, has not proved successful as the copper plate must be kept scrupulously clean; and it is a very slow machine to use. Another fault with this machine is the cracking of the carbide due to the different cooling rates between the carbide and the saw steel. There was no silver solder or flux available at Borwood to braze the teeth onto the sawplate. The maximum diameter saw which could be brazed with the machine was 26 inch so it would be useless in the servicing of saws used for sawing coconut palms.

2. SAWMILL

(a) Sawmilling

As mentioned before, the sawmill operates two circular saw log breaking down units feeding a 1,300 mm band resaw which is the real workhorse in the milling operation. The sawdoctor found it sad to see a machine of that quality so mistreated. For a resaw to produce good sawn timber it must be kept in good working condition. A bandsaw blade is manufactured from high quality alloy steel and will take some abuse; however, it will start cracking and give problems if the machine upon which the saws are used is not kept in good condition. There is nothing more frustrating for a sawdoctor than to see his saws misused on the machine.

The sawdoctor considered that the sawmilling supervisory staff at Borwood did not have the knowledge required to perform good maintenance of the machine. Such common things as setting and maintaining guides, wheel scrapers, lubrication pads and a sawdust removal system were not on the daily check sheet. The sawdoctor formed the opinion that the saw straining mechanism was not functioning as it should, and suspected that the points on the straining struts were worn so that the straining mechanism was slow to respond when required. He also thought that the bandwheels needed regrinding as they were badly worn on the front face. This meant that the saw, when strained, did not have full support on the cutting edge, which, in the long run, would cause the saw to dive in the cut and in the worst instances crack, giving the sawdoctor extra work. All these points were covered in the training programme. Although a bandwheel grinder could have been borrowed from the Timber Corporation Training School in Colombo, the climate between the two organizations was such that it was not feasible.

Other things which the sawdoctor found difficult to understand were the high surface speed of the bandsaws (9,000 ft/min) and the small tooth spacing on the saws used at Borwood. When the saw was cutting it produced a fine dust, rather than course sawdust. This dust was inclined to pack around the bandwheels and saw causing extra cleaning work for the sawshop. This was discussed with the mill's General Manager and Engineer, Mr. Dassanayake. It was the sawdoctor's view that the surface speed of the machine should be slowed down to 7,500 - 8,000 ft/min and the tooth spacing increased to 1 3/4 inch. This should eliminate the fine sawdust packing around the saw. Other advantages are less time taken in swaging, shaping and grinding the saw. High surface speed can create vibration which often causes failures in the bearings and the saw itself.

(b) Log supply

It was noticed during the sawdoctor's stay that there was a shortage of log supply. He was told that this was a seasonal problem. However, he had a distinct feeling that there existed the beginning of competition between the sawmillers for rubber tree logs. This would be natural, as the supply of other species is dwindling at a high rate.

(c) Training of saw maintenance staff

The following staff were selected for the sawshop:

Mr. W. Thilak GALAGAMMNDALI	Senior overseer (speaks good English)
Mr. V. A. RODRIGO	Sawdoctor trainee
Mr. Duglas de SERAM	Sawdoctor trainee
Mr. R. DAYARATHNA	Circular saws

Only one man, Mr. Dayarathna, had worked in the sawshop and mostly on gulleting circular saws. Mr. Galagammndali spoke very good English but the others had very little knowledge of the English language. There was not one saw in operational condition when the sawdoctor arrived. Most of them were in extremely bad condition, with up to 20 large cracks. Therefore it was decided to start with 3 new bandsaws, as they had to have production saws.

Instruction was given in the following saw maintenance areas:

Bandsaws
- Levelling and tensioning
- Swaging and shaping
- Operation of the bandsaw sharpener
- Grinding bandsaws
- Welding, butt welding and crack welding
- Fitting and running in new saws
- Correct setting of bandsaw guides and scrapers
- Understanding the importance of good straining system
- Calculation of saw speed, feed speed and tooth bite
- Tooth profiles
- Theory as requires

Circular saws
- Levelling and tensioning
- Automatic grinding procedures
- Gulleting saws
- Setting and filing
- Understanding the various tooth shapes for various woods
- Changing of teeth in the inserted tooth saw

General
- Stellite tipping of bandsaws and circular saws
- Top and face grinding bandsaws

- Side grinding bandsaws
- Top and face grinding circular saws using the automatic circular saw grinder
- Side grinding was done with a hand held disc grinder and finished on the tool and cutter grinder

The sawdoctor concentrated on giving instruction in the maintenance of bandsaws as he felt that was the main requirement. He stated that he had never visited any sawmill around the world having so many damaged saws due to lack of knowledge of general saw maintenance procedures. He concentrated the training on the senior overseer, who had a good command of English, as he would then be able to transfer the knowledge to the other three staff selected.

During the sawdoctor's stay a stage was reached where not only were the production saws maintained but also 6 bandsaws that had been damaged in earlier operation were brought back into production. The sawdoctor concentrated on the maintenance of circular saws during the last two weeks of his stay.

Stellite tipping was carried out on two bandsaws and one used circulaw saw for use in the log breaking down unit. The sawdoctor wanted to stellite tip a large diameter circular saw but this proved to be impossible as the circular saw grinder did not have the adjustment required to get the correct tooth angles for stellite, nor was the side grinding equipment needed available to carry out the accurate work required on large diameter saws.

The sawshop staff gained an appreciable knowledge of saw maintenance and could carry out most of the work to the sawdoctor's satisfaction. They should now, between them, be able to maintain the saws for the sawmill production. It is important that they receive further training, both on the job and outside, if they are to become a competent saw maintenance team. With this in mind the sawdoctor suggested to the Borwood management they should seek bilateral aid scholarships for at least two of their sawdoctoring and one of their sawmilling staff, through the New Zealand High Commission in Singapore for more specialized training courses in New Zealand.

It was the sawdoctor's considered opinion that, apart from one or two of the senior staff, there was a complete lack of managerial and operational skill available at present for the efficient and economical operation of the sawmilling and remanufacturing plants at Kandane.

(d) Coconut palm sawing trials

Trial sawing of coconut palms was carried out on two occasions during the sawdoctor's stay. One stellite tipped and one inserted tooth circular saw were used, with carbide bits on the breaking down unit. Two bandsaws were prepared with stellite for the secondary sawing operation.

The inserted tooth circular saws purchased by UNIDO and air freighted to Colombo from New Zealand included 100 extra teeth with brazed-on carbide. This saw proved to be the best choice so fas as breaking down the logs was concerned.

Specification
- Diameter 42 inches
- Thickness 8/9 guage
- Number of teeth 36
- Kerf 1/4 inch
- Bore, to suit saw spindle diameter

Inserted tungsten carbide tipped tooth
for circular saw

If sawing of coconut palm logs is going to be carried out at Borwood's present sawmill, using existing machinery, it was the saw-doctor's belief that the above type of saw would be the most suitable. It is also the most simple type of saw to maintain as only face grinding of the teeth is required. When carbide is worn out the teeth can be re-seated and new carbide brazed on, or spare teeth can be purchased and fitted. Spare shanks should also be kept on hand as the sawdust from the coconut palms is very abrasive and will wear the bottom of the gullet. This makes it easy for the sawdust to spill between the body of the log and the saw causing friction and heating of the blade resulting in general loss of tension in the saw.

Although some work was done on fitting a log clamping down system to the tabletop log breaking down unit by the CTA, it was never tried during the sawdoctor's stay.

If the sawing of coconut palm logs is to be carried out at Borwoods as a full time operation, it was the sawdoctor's opinion that two choices existed:

(i) To fit a dogging system to the existing table top bench;

(ii) To replace one of the table top benches with a two-knee dogging carriage with manual or electric sizing unit. It

It is too dangerous at present to saw logs with no log holding down system, no saw guiding system and no riving knife at the back of the saw. The back end of the saw, in the worst instance, could pick up the log and throw it back in the direction of the operator and result in a serious accident.

(e) Band sawing coconut palms

The 54 inch band resaw was used for the secondary sawing operation. As the tooth spacing on the saws used at Borwoods was 1 1/2 inch it was decided to stellite tip every second tooth; this proved to be satisfactory and no real problem was experienced with the sawing. When the saw maintenance staff gain confidence and experience with the stellite tipping

of the teeth, the sawdoctor felt sure they would have no problems in this area. The Chief Engineer, Mr. Dassanayake, was very interested and helpful in getting the stellite tipping under way.

Bandsaw specification		
	- Width	7 inches
	- Guage	17
	- Tooth spacing	3 inches
	- Kerf	1/8 inch
	- Tension circle	38
	- Hook angle	30^{o}
	- Tooth angle	44^{o}
	- Clearance angle	16^{o}
	- Tooth shape	Round back
	- Gullet depth	1/2 inch

3. RECOMMENDATIONS

(i) Borwoods should establish a comprehensive training programme for sawshop, sawmill and remanufacturing staff.

(ii) They should, if possible, try to make use of the sawdoctor/sawmilling training facilities available at the State Timber Corporation Sawmill in Colombo, which was established by the FAO for that purpose. The equipment used at that training centre is very similar to that supplied by UNIDO to Borwoods.

(iii) The sawshop roof should be lifted, proper windows fitted, the walls relined and decent electric lights installed. The present shop is most unpleasant to work in through lack of air circulation, and it is almost impossible to work on the saws on a rainy day as the shop gets so dark. The best solution might be to relocate and rebuild the sawshop altogether.

(iv) A new circular saw gulleting machine should be purchased immediately to replace the useless Robinson grinder. An Armstrong 54 or 54C or equivalent should be installed. (Cost $NZ 5,000, estimated.)

(v) New rollers should be fitted to the Robinson bandsaw stretcher roller, as this rolling bench could be used for on-the-job training of the sawshop staff.

(vi) A jig for brazing carbide tips on to both small and large diameter saws should be obtained from either New Zealand or the U.S.A.

(vii) If large-scale coconut sawmilling is to take place at Kandane, further expenditure for suitable machinery would be necessary.

(viii) It is suggested Borwoods purchase an Armstrong No. 70 heavy duty sidegrinder. This machine has the capacity of sidegrinding saws up to 48 inch diameter. This machine would have a dual prupose - it could be used for sidegrinding of carbide tipped saws as well as the stellite tipped circular saws. If this machine should prove to be too costly, there is a lighter constructed version available from the Armstrong Company, the Armstrong No. 64/48 with a capacity of grinding up to 48 inch diameter saws.

(ix) A new shaper for the bandsaws must be purchased as soon as possible as the one on loan from New Zealand must be returned. Once again an Armstrong 5500B is suggested for saws to a thickness of 18 - 16 guage with tooth stop 18 - 13 guage, to be supplied with carbide tipped shaper dies and clamp screws, plus a spare set of shaper dies, clamp screws and tooth stops.

(x) If large-scale porduction of coconut palm wood is to be produced, it is suggested that a survey of the coconut palm plantations available for timber utilization be undertaken by a consultant organization prior to designing a suitable sawmill layout and ordering equipment. The sawdoctor thought most of the production could be used on the home market as there seems to be a shortage of logs available for the sawmiller.

(xi) It should be clearly understood by the Borwood management when they change from rubberwood to coconut wood, it is not only the sawmill that requires hard metal teeth but the same will apply to the cutting equipment used in the remanufacturing section. It may be necessary to purchase cutters with replaceable carbide inserts.

(vii) When new equipment is purchased, Borwoods should try to buy from only a few manufacturers since so many different makes of machines were purchased in the past for the remanufacturing section that it is almost impossible to obtain spare parts for many of them.

ANNEX

JOB DESCRIPTION
DP/SRL/79/053/11-03/31.7.A

Post title Saw Doctor

Duration Three months

Date required March 1982

Duty station Colombo and Kandane

Purpose of project To assist the Government to upgrade secondary wood processing industries and alleviate wood raw material shortages by developing the use of coconut wood and rubber wood for structures and furniture.

Duties The expert will work with the Team Leader and with counterpart personnel of Borwood Ltd. to establish good saw doctoring and cutting tool maintenance procedures in the complex and for the benefit of the industry. More specifically, the expert will be expected to:

1. Inspect the equipment for saw doctoring ordered as part of the project by Borwood Ltd. and supervise its proper installation;

2. Develop suitable cutting tool configurations (sawing and planing particularly) for coconut and rubber wood and prepare guidelines for machining practices for these two species;

3. Review the nature and content of saw doctor training courses proposed for the Ceylon Plywood Corporation and assess their suitability for training staff of Borwood Ltd. either at the CPC site or at Kandane; recommend modifications or new material as appropriate;

4. Assist in the adaptation of existing machines and equipment for woodworking and saw doctoring - preferably to be carried out in the country and within the duration of the mission.

The expert will also be expected to prepare a final report, setting out the findings of the mission and recommendations to the Government on further action which might be taken.

Qualifications Wood Technologist or Engineer with considerable experience in the machining of a wide range of tropical wood species and in the maintenance of saw blades and cutting tools.

Language English

Background Information

Rubberwood has been researched and developed in the country since 1965 by the Forest Department Laboratories. The work was at that time taken up by the then National Small Industries Corporation which established a research/commercial operation. The Industrial Development Board took over operation in 1972 by organising Borwood Ltd. with the assistance of the Faculty of Engineering, Peradeniya, Colombo Campus. The current target is 60,000 cubic feet of sawn timber per year at a market price of Rs100 per cubic foot. Borwood estimates an annual yield of some 600,000 cubic meters of which only a small part (2,000 cubic meters by Borwood, 5-10,000 by Ceylon Plywood Corporation) is used industrially.

Coconut wood abounds and some 1.2 million stems are felled annually at about 60 years of age. Lack of adequate saw blades and saw doctoring equipment has hampered sawing trials at the Forest Department Laboratories but experience from elsewhere is expected to be used. It is hoped that this project will help rural areas to use more coconut wood in construction.

A solar dryer, with a capacity of 80 cubic feet, has been provided by US AID and installed on the project site since February 1981. A metrological station also exists for data gathering. The data generated by this unit should be used to design and guide initial operation of a larger, commercial kiln of about 10 cubic meters capacity.

The project site is approximately 50 km South-East of Colombo and an adequate range of buildings exists for offices, rubber-wood drying, sawmilling, saw doctoring, timber treatment, moulding and sanding. A pneumatic sawdust collection system has recently been installed. Electricity, water supply, telephone and good roads exist at the site.

Borwood Ltd. currently employs 150 regular employees comprising 15 technical personnel, 10 administrative and about 50 skilled and semi-skilled factory workers, and 25 unskilled workers. About 50 casual rostered unskilled workers are employed when required.

A listing of equipment and tools employed in the factory purchased in 1972 for a total cost of Rps 500,000 is given hereunder:

- 1 Dust-collecting system electrically operating complete with cyclone;
- 3 Circular saws, with electric motors installed on wooden benches complete with rollers;
- 1 Band saw, 52" electrically operated complete;
- 1 Complete set of sawing equipment for converting log to plank;
- 1 Saw doctoring equipment, basic timber treatment unit;
- Woodworking tools consisting of electric drills, planers, moulders and mortizer.

A building which will house the new factory and facilities for the manufacture of glued laminated wood trusses and other structural members and the new sawmilling operations (primarily for coconut trunks) will be constructed in the government-owned land which Borwood Ltd. has been using since 1972 for this factory. Design and construction will be undertaken by the counterpart staff. This building will be financed by Borwood Ltd. from available internally generated funds and is expected to be completed by April 1982, to enable installation of equipment upon arrival by the first quarter of 1982.