

PULP & PAPER MAKING

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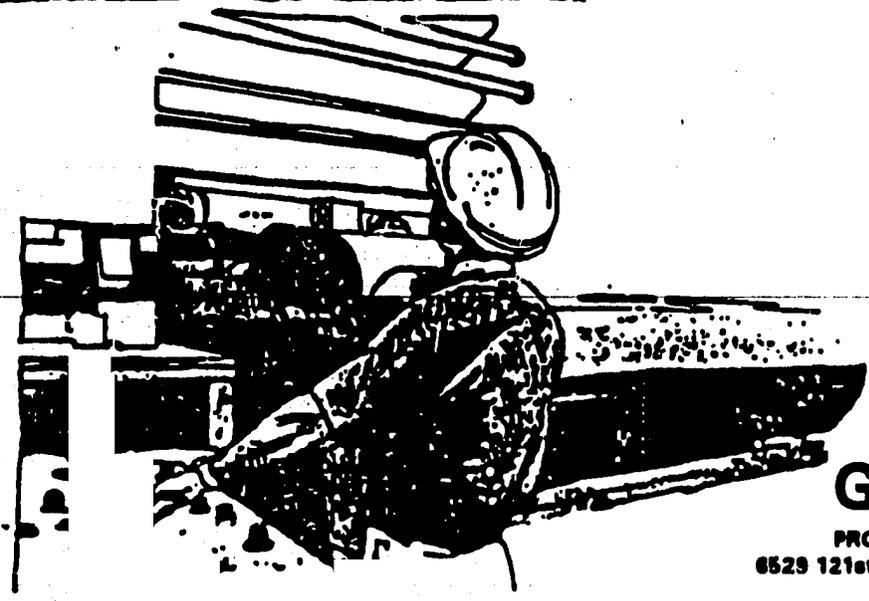
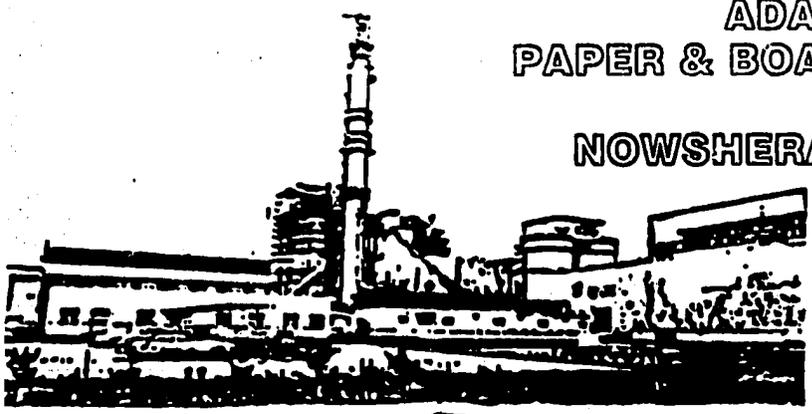
TREE FARM GROWN

EUCALYPTUS CAMALDULENSIS

AT

**ADAMJEE
PAPER & BOARD MILLS LTD.**

NOWSHERA, PAKISTAN



G. WIRE CO.

**PROCESS & CONTROL TECHNOLOGY
6529 121st P1 S.E., BELLEVUE, WASHINGTON 9800**

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EUCALYPTUS CAMALDULENSIS

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NOWSHERA, PAKISTAN

prepared for

THE FORESTRY PLANNING AND DEVELOPMENT PROJECT
U.S.A.I.D. - GOVERNMENT OF PAKISTAN

BY

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**PULP AND PAPER MAKING
FROM PAKISTANI TREE FARM GROWN EUCALYPTUS CANALDULENSIS
at ADANJEE PAPER & BOARD MILLS, LTD., NOWSHERA, PAKISTAN**

CONTENTS

<u>SUBJECT</u>	<u>PAGE</u>
TABLES, FIGURES, EXHIBITS & APPENDICES LISTING	1
EXECUTIVE SUMMARY	1
GENERAL INTRODUCTION	4
GENERAL BACKGROUND	4
Part 1. WOOD PROCUREMENT & PROCESSING	6
Part 2. LABORATORY PULPING EXPERIMENTS	12
Part 3. MILL PULP & PAPER MAKING TRIAL	14
Part 4. FARMERS FIELD DAY	20
SUMMARY AND CONCLUSIONS	23

<u>APPENDICES</u>	29
A1. WOOD PROCUREMENT & PROCESSING	30
A2. LABORATORY PULPING	31
A3. MILL TRIAL	32
A4. FARMERS FIELD DAY	33
A5. TERMS OF REFERENCE	34

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TABLES

TABLE	PAGE
ES1: SUMMARY DATA	3
1.1: ADANJEE TRIAL WOOD PULP DATA AND COSTS	10
1.2: EUCALYPTUS CAMALDULENSIS PULP WOOD DATA	10
2.1: PILOT SCALE PULPING DATA	12
2.2: PILOT PULP EVALUATION DATA	12
3.1: E. CAMALDULENSIS PULP MANUFACTURE TRIAL CONDITIONS	17
3.2: EUCALYPTUS CAMALDULENSIS PULP TEST DATA	17
3.3: EUCALYPTUS CAMALDULENSIS PAPER MAKING DATA	17

FIGURES

FIGURE	PAGE
1.1: MAP SHOWING TREE FARM - ADANJEE RELATIONSHIP	9
1.2: ADANJEE PAPER & BOARD LTD. MILL PLAN	9
1.3: WOOD PREPARATION PROCESS STEPS	9
3.1: PULP & PAPER MILL PLAN	16
3.2: PULP AND PAPER MAKING TRIAL PROCESS FLOW	16

EXHIBITS

SUBJECT	PAGE
1.1: WOOD PREPARATION PHOTOGRAPHS	11
3.1: PULP MANUFACTURE PHOTOGRAPHS	18
3.2: PAPER MAKING PHOTOGRAPHS	19
4.1: FARMERS FIELD DAY AGENDA	21
4.2: FARMERS FIELD PHOTOGRAPHS	22
A1. REFERENCES	25
A2. KEY PERSONS	26
A3. GLOSSARY	27

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EXECUTIVE SUMMARY

There has been a great deal of work by the GOP/USAID FP&DP team; GOP, provincial and district forestry personnel; and the involved tree farmers to get Eucalyptus camaldulensis (E.c.) plantations underway. There is need to market this wood to some extent, to compensate the tree farmers and encourage increased planting. Pulp manufacture may be the best market for E.c.; it requires young wood.

Sustainable yield of 3-6 year farmer wood is approaching a level wherein commercial production of wood pulp for paper may be supported. There is need for this commodity, which currently must be imported. E.c. use for pulp would provide a steady, stable market for this young wood, i.e., a relatively short term crop. However, there has been no pulpwood commerce in Pakistan, nor is there infra-structure, nor experience in the enterprise of wood delivery and preparation for pulp production.

A previous study proposed developing and encouraging utilization of wood, particularly the E.c., for a portion of the fiber requirement of the existing pulp and paper mills within their existing process. This would enable development of supply/utilization on a small scale, in effect, boot strapping the pulp wood enterprise, evolving the necessary procedures and relationships. When sufficient pulpwood delivery capability is achieved, a full scale pulp mill will become viable.

The activity herein reported is the first pulp wood commerce in Pakistan. It is a milestone, with the purchase and utilization of some of the wood for pulp, by Adamjee. There have been a number of conferences and meetings; but another milestone is reached through an industry hosted user/supplier meeting. These are important accomplishments to the establishment of supply/demand for Eucalyptus camaldulensis and other farmer wood. This will facilitate increased afforestation in Pakistan as well as upgraded paper products and reduced dependence upon imported wood pulp.

The objectives of the project(s) have been accomplished, in that all aspects had success and represent significant accomplishment. Specifically:

1. Agreements and sales contracts were reached between buyer and seller. Business relationship has commenced.
2. Farmer Eucalyptus camaldulensis pulpwood was harvested, loaded onto trucks and transported to the Adamjee mill.
3. The mill received, scaled, de-barked and chipped the wood; the farmer-supplier has been paid.

4. Laboratory tests found suitable if not optimum pulping conditions; higher pulp yield and strength characteristics are desired. More extensive laboratory evaluation is recommended.
5. Eucalyptus camaldulensis wood was pulped, bleached and made into paper by a conventional process and methods in the existing mill. The product was commercially acceptable for the grade made, meeting or exceeding all specifications. However, the same comments as 4. above apply.
6. The Farmers Field Day was held and deemed successful. It enabled farmers and foresters to observe the mill handling and utilization of wood per the above. It provided opportunity for user/supplier to get better acquainted, share thoughts, concerns and ideas, and human relations basis for continuing.

Much was learned; but much remains to be learned. Also, extents of perceived success are conditional.

For example, there needs be work on:

- a. More efficient wood and chip handling.
- b. Loading trucks to full capacity.
- c. Establishment of a pulpwood tariff classification with improved inter-province taxes and transport costs.
- d. Wood bark removal requirement and methods.
- e. Pulping conditions for better quality; and pulping conditions suitable for all mills.

All the above are important. Items a. to d. above can and will be evolved as pulpwood utilization proceeds. However, accomplishing this would be speeded by assistance with material handling methods; also basic data is needed on the wood. This work may be appropriate to PFI and the Forestry Departments.

Item e. above requires some research and laboratory work. The objective would be to find conditions for pulping of E.c. amenable to most of the existing Pakistani mills. Reasons and methods are advanced in the text and in Appendix 2.1.

Congratulations are in order to all involved and participating in the work reported herein: Adamjee Paper & Board Co., owners, management and workers; the farmers, foresters, and FP&DP teams who have fostered and implemented the private sector afforestation program; the Inspector General Forests, GOP as Program Director of the overall afforestation activity and the U.S.A.I.D. for its support and sponsorship.

This is not the end; but it is a very good beginning.

TABLE ES1: SUMMARY DATA

TABLE ES1.1: ADAMJEE TRIAL PULPWOOD DATA AND COSTS SUMMARY

DESCRIPTION	PLAN	ACTUAL			FUTURE
		LOW	HIGH	AVERAGE	
Load Wt., mound	250	123	250	171	250
Cost, Rs/mound					
Farmer Net*		22.50	22.50	22.50	22.50
Farmer Price	25.00	25.00	25.00	25.00	25.00
Cost @ Mill	28.20	30.30	34.75	32.37	28.34
Roundwood/ODT Pulp				8.054	5.335
Rs./ODT Pulp		6,427	7,324	6,844	3,397

TABLE ES1.2: E.c. PULP PRODUCTION SUMMARY DATA

PROPERTY	Unbleached	Bleached
Ka. No. (T214), ml	15.5	15.5
Beating Time, min.	12	11
Drainage Time, sec.	15	15
Bulk, cc/g	1.75	1.50
Burst Factor	27	26
Tear Factor	25	34
Tensile, m	4300	4300
Folds, DF#	17	10
Brightness, %GE	na	77

TABLE ES1.3: PAPER PRODUCTION SUMMARY DATA

QUALITY TESTS:	WEIGHT	BURST	TEAR	TENSILE	FOLD	BRIGHT.
UNITS:	G/M ²	FACTOR	FACTOR	meters	D-FLD	%GE
TEST PAPER*:	58.5	12.7	43.6/47.4	4220/2320	8.5	72.5
NORMAL PRODUCT:	59	11	47.4/50-8	4590/2820	10.6	70.5
SPECIFICATION:	58	12				76

TABLE ES1.4: FARMER FIELD DAY SUMMARY DATA

Attendance: (approximate)

Farmers	35
Provincial Forestry Personnel	25
Pakistan Forestry Institute	6
GOP Forestry Personnel	6
Adamjee Paper & Board Ltd.	10
FP&DP/USAID Personnel	8
TOTAL	90

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GENERAL INTRODUCTION

Pakistan has serious deficiency of timber, and substantial need for all the classic ecological and commercial reasons, including pulp and paper production. The purpose of the Forestry Planning and Development Project (FP&DP), in part, is addressing this through private sector tree farming, particularly, Eucalyptus camaldulensis (E.c.). Plantation establishment is underway. Markets for grower compensation now need to be developed.

Young E.c. wood fiber can produce a very satisfactory paper pulp. Representative statistics on Pakistan paper commerce (1988-1989) follow (1, 2). Figures are metric tons; pulp stock includes both virgin and secondary fiber.

PAPER PRODUCTS, TONS/YR		IMPORTS, TONS/YR			IMPORT VALUE	
CONSUMPTION	PRODUCTION	PAPER	PULP	STOCK TOTAL	mmRs	mm\$
492,000	230,000	262,000	58,000	320,000	3,042	152

A previous study for this project (1) estimated sustained yield of plantation stands could support about 200 TPD chemical pulp production in 1995 and 300 TPD by 2005, in the entire country. The stands are located in good position for the existing industry. However, no pulpwood commerce exists today, nor facilities nor experience for its harvest, assembly, delivery and processing to pulp chips. This, in itself, is a considerable undertaking.

That study, therefore, recommended that the existing Pakistani pulp and paper industry set about to utilize a small portion of this wood for its pulp making (neutral sulfite and soda process). This, to establish and gain experience in procurement, transportation, handling, processing, etc., and related trade. The E.c. wood pulp should have substantially better characteristics than the indigenous straw/kahi etc. pulp, approaching imported kraft pulp, and thus enable better quality paper production and displacement of imported pulp. The compensation and stable market for farmers would encourage increased planting. At such time as the sustainable wood yield and supply infrastructure is sufficiently in place, a full scale pulp mill will become viable.

GENERAL BACKGROUND

Adamjee Paper and Board Ltd. produces about 100 TPD of paper and paperboard products on two machines. It produces about 25 TPD of bleached pulp from wheat straw, Kahi, bagasse and cotton wastes; the balance of its furnish is purchased secondary and imported virgin fiber. Its pulp production is limited by fiber availability, and it is aggressively seeking additional supplies. This includes its own experimental plantations of both annual and tree crops, and seeking out of other fiber raw materials.

Adamjee therefore has enthusiastically responded to the prospect of tree farm wood fiber supply, and set about this trial to purchase tree farm E.c., produce pulp and paper from it and to host a farmer's field day for mutual acquaintance/education.

Adamjee employs the "neutral" sulfite (NS) pulping process (as do most other bleached pulp producers in Pakistan). This process has been applied successfully to a wide range of fiber sources for a wide range of pulp qualities and over a wide range of conditions. However, process conditions need be very specific, depending upon fiber source (type/species) and pulp quality. When the fiber source is wood, mechanical defibration (refining) is often required (NSSC), and bleach chemical required is higher than with other chemistries. But pulp quality can be very good.

The kraft* and soda* process are commonly employed with hardwoods (E.c., poplar, etc.). They render full chemical (i.e. fully defibrated), bleachable pulp. Kraft is most desirable; strength characteristics with soda are not very good, bulk and opacity are. All of these chemical processes normally require chemical and energy recovery processes to be economically and ecologically acceptable. This requires a large and expensive complex. Conventional recovery operations are not viable for small mills such as Adamjee and most others in Pakistan.

Adamjee also employs the soda process on occasion. They operate a chlor-alkali plant on site, providing their own soda (NaOH) supply and influencing chemistry options and economics. Due to the better prospect for full chemical pulp, their prior experience and unique position, the mill determined to employ the soda process. Sulfide is not available, precluding kraft processing.

OBJECTIVES:

The activity reported herein had several objectives and parts:

1. Wood procurement, delivery and preparation trial
2. Pilot scale pulping trials
3. Mill pulp and paper making trials
4. Farmers field day

This report is organized hereafter according to the above. There were to have been two additional parts:

5. Meetings with other paper industry officials, following up on the earlier report (1) and questions about it.
6. A pulp and paper industry meeting at PFI:
 - a. review the earlier report (1),
 - b. review the findings of this trial, and
 - c. present a pulp and paper technology seminar.

These were postponed due to the mid-east crisis.

*See Exhibit 2, Glossary for definitions.

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PART 1. WOOD PURCHASE, DELIVERY AND PREPARATION:

1.1 INTRODUCTION: The mill arranged for purchase and delivery of E.c. roundwood to the mill site. This was debarked, chipped, and transported to the pulp mill area to subsequently be charged to the digesters, pulped, bleached and made into paper. This was the first time for any such wood utilization in Pakistan.

1.2 OBJECTIVE: test wood procurement and preparation procedures.

1. to enter into agreements for purchase.
2. to harvest, yard and transport.
3. to receiving and handling.
4. to prepare wood for pulping, i.e. debarking and chipping.

1.3 PROCEDURES: See Figure 1.1-1.3, Tables 1.1-1.4

Wood Procurement and Receipt: See Table 1.1 and Appendix 1.

The FP&DP sponsored marketing workshops for farmers in the Attock district, Punjab, with pulp industry representatives and district foresters in attendance as well. During the workshops farmers were encouraged to sell some trees to cooperate with the pulping trial. Potential buyers and sellers were given room to negotiate, and several agreements were arranged.

Adamjee contracted to purchase wood from five farmers from plantings 50 km to 140 km from their Nowshera, NWFP plant site. About 34.13 tons were received. Farmers were identified and contact was arranged and assisted by the FP&DP - District Forester team. The primary contracting and commercial official for the mill was Rahat-ullah Khattak, Commercial Manager. The purchase price was Rs.25/maund (Rs.1,000/ton) fob the farm. The roundwood ranged 5cm to 20cm (2" to 8") diameter by 2m to 4m (6' to 12') length, most sticks being longer length. It was transported to the mill in motor trucks. Upon arrival the loads were weighed and receipted, then dumped at the debarking-chipping site.

Adamjee also had several tons of 4 to 6 year old E.c. from its own plantation adjacent the mill site. This was already chipped. It had been planned to keep this separate in order for the trial to be totally farmer wood. However, the debarking/chipping of farmer wood was insufficient at pulping time for the intended volume, so about 14 tons of this was used.

Wood Preparation: The roundwood bark was manually peeled, employing 3 to 5 laborers at a time. This was very slow, perhaps 30 min. per stick. (See discussion). Chipping was with a KMW horizontal feed chipper with about 1m chipping disk and 15cm throat. Over diameter stems were split with a band saw. All wood handling was manual. Chips were blown to a screen separating overs (about 5cm) and unders (about 25mm). The accepts were collected in approximately 1m x 1m x 1.5m stevedore bags for temporary storage. When needed for digester charging, the bags were loaded onto motor trucks and transported to the mill fiber-charge area.

1.4 DISCUSSION: (Tab. 1.1-1.2, Fig. 1.1-1.3, Ex. 1 and App. 1)

The purchasing of wood, transporting it to the mill, and processing to chips is perhaps the most important aspect of this trial. This is the first known purchase of roundwood for pulp in Pakistan. Adamjee has purchased Poplar residuals and used some of their own test-plantation wood. However, there is no background or experience in pulp roundwood commerce by farmer or pulp mill, nor is there much cost/price experience.

Price: This was Rs.25/maund fob truck, i.e. cut and loaded, and succeeded in bringing forth some sales. Pricing volumetrically so that moisture content is not an issue should be considered. In the final analysis, the stumpage value will be value at the mill, less all costs to get it there. European and American stumpage prices equate to Rs. 50-100/maund (Rs.22/\$).

Harvest, Yarding and Size: The delivered stems were less than 28" circ. (i.e. less than 9" dia.), mostly tree length but under 14'. Weight/stem was 45kg - 64, average 57kg. The methods of harvest, yarding and truck loading were not observed by this consultant. The hearsay report is that it was awkward and inefficient. But as methods are improved, the cost should be substantially reduced. Harvest and yarding cost was reported at Rs.2.5/maund.

Transport: This was by motor truck at a cost per load. The first load was Rs. 900 for 180 maunds, whereas Adamjee expected Rs. 600/250 maunds. Thereafter, Adamjee set a maximum it would pay at Rs.700/load. It had been expected that truck loads would be 250 maunds or larger (10,000 kg). The largest load was that size, but the others ranged 125-180 maund, average 171 maund causing substantially higher transport cost than expected. This cost can be reduced by continued education of farmer/loader to load to full truck capacity, and by sharper dealing with haulers.

Taxes and Duties: Under the GOP Forestry Act, taxes are assessed on inter-provincial transport of wood. Thus, the loads were subject to inspection and collection of duty. The Punjab export duty rate for timber (over 27"-28" circumference), is Rs.3.5/cf, whereas for fuel it is Rs. 120/load, about Rs. 0.5/mound. The NWFP import duty rate for timber is Rs.5/cf, whereas for fuel it is Rs. 25/load, about Rs. 0.1/mound.*

There is no pulpwood import/export tax classification. Lacking classification, most loads were taxed as timber, even though it was of circumference below the timber minimum. Evidently, the tree-length loads were cause of confusion re. regulations, causing rule interpretation as timber, and a high tax rate.

The matter of customs, duties and taxes needs to be investigated. This might be acceptance as fuel, or a pulpwood category established, with more appropriate rates, if this commerce is to be encouraged. A scaling bureau should be considered.

* Per Adamjee Paper & Board, Exhibit 1.1, page 2 (Jan. 1991)

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Receiving, Debarking and Chipping: The wood was received and scaled at the mill, then dumped proximate the chipper. Labor cost for this and transport to the digesters was Rs.70/ green ton.

Bark Removal: The wood was manually debarked. This was done by peeling the stringy bark on young wood, an easy task. The bark on older wood is thicker and stronger, requiring more effort. The unit labor was 20-40 minutes per stem. Weight loss was estimated at 15% of whole wood.

Pakistan has an abundance of manual labor, work is needed and hourly/daily cost is low. With the small volume of wood being handled this may be the best way to debark. We doubt if mechanical debarking can be justified until the wood utilization becomes routine, and at much higher volume than is anticipated in the near future. It is the cost per ton of pulp which is important and that will provide future mechanization justification.

None the less, more efficient methods of manual debarking need to be learned and taught to the laborers. Persons experienced with this should be brought forth to assist with methodology. Also, it is not uncommon to chip and pulp young, small diameter Eucalyptus and tropical hardwoods without debarking. This needs investigation, as it would substantially reduce the need for bark removal.

Chipping: The chips produced were not very good quality. They were not classified for evaluation, but were obviously substantially bruised, and a large portion of excessively small size, under 3/8". Upon comment about this, the chipper knives were sharpened, but by that time chipping was done. See Exhibit 1.1c.

The importance of chip quality is not understood by mill personnel. This is an appropriate subject for a seminar, including presentation of comparative pulping results data.

Chip Screening: The chipper-screen arrangement was awkward for accept chip collection. Also, the chip feed under-shot the screen reducing effective screen area. This can be easily remedied by extending the chip feed.

Chip Handling: The manner of handling chips in bags and trucking perhaps was expedient for the trial work. But it caused an excess labor consumption and, more important, was very slow. Digester filling required about three hours. A bit of design work would speed this up and preserve chip quality. Digester filling should be possible in 20-30 minutes. Chipping adjacent the digesters, blowing to chip screens and an accepts discharge hopper, would enable gravity feed of chips directly to the digester or digester feed conveyer; this would greatly reduce digester charge time. Screen overs could gravity feed for re-chipping.

Chip Yield: Chipping losses of over 16% plus moisture loss over 8% were reported. This is inordinately high. Significant moisture loss is not expected, and chipping/handling losses of 1% to 2% are typical, depending on whether fines are used.

FIGURE 1.1: MAP SHOWING TREE FARM - ADANJEE RELATIONSHIP



FIGURE 1.2: ADANJEE PAPER & BOARD LTD. MILL PLAN

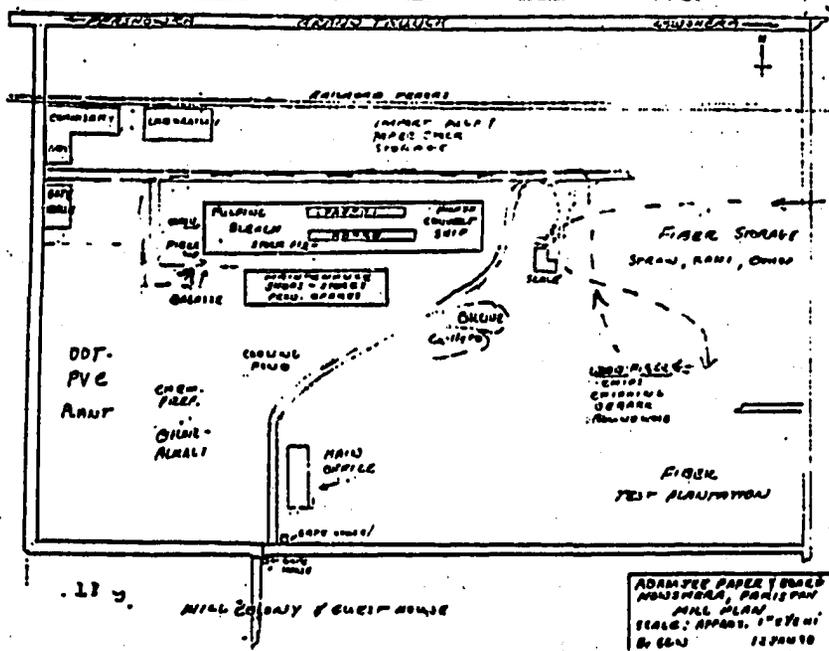


FIGURE 1.3: WOOD PREPARATION PROCESS STEPS

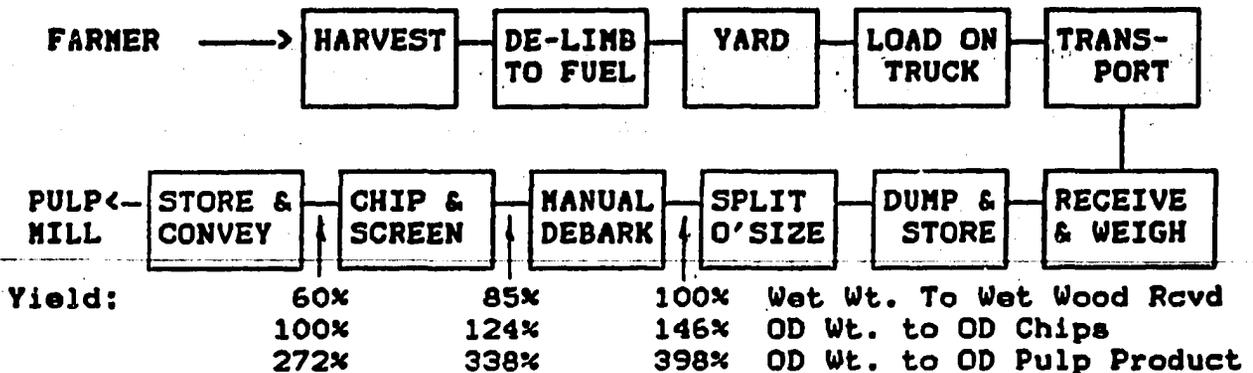


TABLE 1.1: ADAMJEE TRIAL WOOD PULP DATA AND COSTS

DESCRIPTION	Adamjee Purchased	FARMER SELLER					TOTAL	AVERAGE	GMC Expect	GMC Expect
		1 Burhan	2 Dhakrai	3 Pindi Gabb	4 Magro	5 Pindi Gabb				
Origin Locale										
Date		09-Nov-90	06-Dec-90	06-Dec-90	12-Dec-90	15-Dec-90				
Load Wt., mds	250	183	125	135	160	250	853	170.6	250	
Load Wt., kg	10,000	7,320	5,000	5,400	6,400	10,000	34,120	6,824	10,000	
No. Trees		115	110		134		359		120	
Kg/tree		63.7	45.5		47.8			57.0		
TOTAL COSTS, Rs.:										
Farmer Net *		4,118	2,813	3,038	3,660	3,625	19,193	3,839	5,000	
FDB Cost *		458	313	338	400	625	2,133	427	625	
Price FOB Mill	6,250	4,575	3,125	3,375	4,060	6,250	21,325	4,265	5,625	
Haul	600	900	700	700	700	700	3,700	740	700	
Export tax	100	360	150	250	300	350	1,410	282	400	
Import Tax	100	325	0	0	275	275	1,075	215	inc.	
Cost @ Mill	7,050	6,360	3,975	4,325	5,275	7,575	27,510	5,502	6,725	
COSTS, Rs./Round:										
Farmer Net *		22.50	22.50	22.50	22.50	22.50	22.50	20.00	22.50	
FDB Cost *		2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	
Price FOB Farm	25	25.00	25.00	25.00	25.00	25.00	25.00	22.50	25.00	
Haul	2.40	4.92	5.60	5.19	4.38	2.80	4.58	2.80	2.80	
Export tax	0.40	1.97	1.30	1.85	1.88	1.40	1.66	1.60	0.40	
Import Tax	0.40	2.87	0.00	0.00	1.72	1.10	1.14	0.00	0.14	
Cost @ Mill	28.20	34.75	31.80	32.04	32.97	30.30	32.37	26.90	28.34	
COSTS, Rs./Tons:										
Roundwood Blvd.	705	869	795	801	824	758	809	673	709	
Debark & chip	70	70	70	70	70	70	70	70	70	
Bark credit	30	30	30	30	30	30	30	30	30	
Net cost	41	41	41	41	41	41	41	41	41	
Green Chips	746	909	836	841	865	798	850	713	749	
WOOD PROCESS COSTS										
Debark/R ¹ wood							85.00%	85.00%	85.00%	
Pulp Chip/R ¹ wood							80.26%	90.00%	98.00%	
Moisture							47.94%	50.00%	50.00%	
OD Pulp/Net OD Wd							37.36%	42.00%	45.00%	
R ¹ wood/OD Pulp							8.05%	6.225	5.335	
TOTAL WOOD, Rs./OD Pulp	7,324	6,729	6,777	6,964	6,427		6,844	4,438	3,397	

Ref.: YMA1418/L1051701

TABLE 1.2: ADAMJEE PAPER & BOARD TRIAL WOOD PULP DATA

	METRIC TONS		PERCENT OF WHOLE ROUNDWOOD-			GMC	MET WT. TO	OD WT. TO	MET WT. TO	OD WT. TO	MET WT. TO	OD WT. TO
	FARMER PURCHASE	ADAMJEE PLANTATION	TOTAL	FARMER PURCHASE	ADAMJEE PLANTATION							
WHOLE ROUNDWOOD	29,380	14,318	43,698	100.00%	100.00%	100.00%	100.00%	100.00%	146.06%	397.55%	835.20%	
BARK	3,407	2,178	5,585	15.00%	15.00%	15.00%	15.00%	15.00%	21.31%	59.64%	150.27%	
DEMANDED R ¹ WOOD	24,973	12,340	37,313	85.00%	85.00%	85.00%	85.00%	85.00%	124.75%	337.92%	709.91%	
CHIPPING LOSS												
a. fines, etc.	0.929	2,330	7,259	16.78%	16.05%	16.54%	2.00%	16.54%	24.15%	65.74%	134.11%	
b. moisture	2,270	1,230	3,500	7.93%	8.82%	8.11%		8.11%	0.00%	0.00%	67.74%	
Total	7,199	3,560	10,759	24.50%	24.93%	24.65%	2.00%	24.65%	24.15%	65.74%	201.85%	
GREEN CHIPS	17,774	8,720	26,494	60.50%	60.06%	60.35%	83.00%	60.35%	100.00%	272.18%	504.06%	
OD PULP	3,648	1,608	5,256	12.42%	11.08%	11.97%	16.81%	11.97%	36.74%	100.00%	100.00%	
R ¹ WOOD/OD PULP	8.05%	9.08%	8.35%									

Ref.: YMA1418/L1051701

TABLE 1.3: EUCALYPTUS CAMALDULENSIS PULP WOOD DATA
Adamjee Paper & Board Ltd., January 1991

Source: Attock Dist. Punjab, 50-135 km of Nowshera, NWFP
 Age: 3-6 years
 Size: 5cm-20cm (2"-8") diameter x 2m - 4m (6'-12') long
 Transport: motor truck
 Basic Den.: 705 kg/m³, 44 lb./cf; 2 cf/round (dry)
 Moisture: Fresh wood chips: 44%-49%; 46% average;
 5- day old wood chips: 33%
 Chip Bulk: 400 kg/m³ @ 46% moisture; 215 kg/m³ OD
 Kahi Bulk: 125 kg/m³ OD (for comparison)



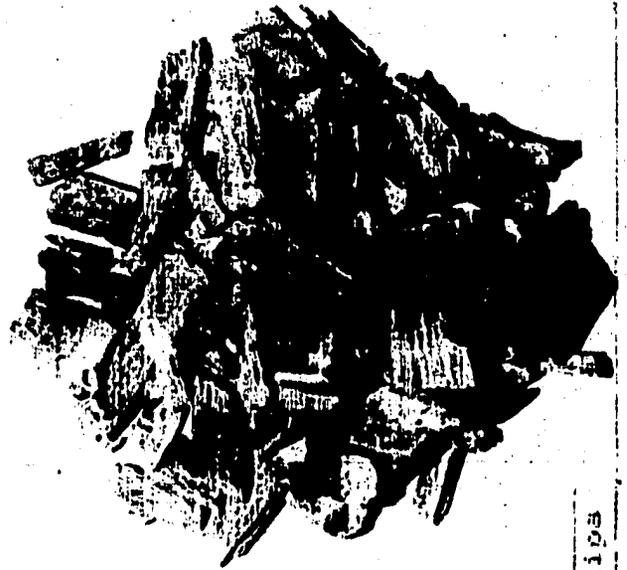
a. Debarking



b. Chipper



c. Pushing chips into chip blower to digester



c. Chips

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TABLE 2.1: PILOT SCALE PULPING DATA

NO.	CHEMICAL/OD WOOD				L:W: TEMPERATURE & TIME			% YIELD		Ka. No. T-236	
	NaOH	Na2SO3	SULFUR	Eq. Na2O	Eq. S	MAX	MIN TO	MIN AT	ACCPY		REJ
1.	23			17.8		4.5:170	90	210	40.0	2.4	36
2.	25			19.4		4.5:170	90	210	42.2	4.1	36
3.	18	+7		17.5	+3.6	4.5:170	90	210			
4.	25		+2	19.4	+2.0	4.5:170	90	240			
COMPARATIVE DATA											
II	23			17.8		6.0:170	60	240	45.3	9.5	24
Pa*	25			19.4		6.0:160	80	90	45.3	6.9	49
Pb*	25			19.4		6.0:170	90	120	47.0	1.5	21
KG*	15			11.6		6.0:160	80	90	52.0	1.1	21
BG*	15			11.6		6.0:160	80	90	51.1	0.2	15
LI*	10			7.8		6.0:160	60	90	62.2	UNS	23

* Reference 5

II = Ioil Ioil; P = Poplar; KG = Kahi grass; BG = Berruzi grass; LI = Licker-in (cotton)

TABLE 2.2: PILOT PULP EVALUATION DATA

PHYSICAL PROPERTIES OF e.C PULP INTERPOLATED @ 45 SR

RAW MATERIAL	UNITS	e. CANALDULENSIS		POPLAR	KAH1	WHEAT	COTTON	
		COOK 1	COOK 2	RESID.	GRASS	BAGASSE	STRAW	WASTE
NaOH/OD WOOD	%	23	25	25	5	3.5	5	10.5
Na2SO3/OD WOOD	%				12	14	13	
KA. NO.	ml	34.0	25.9	25.0	18.4	21.0	20.3	
BRIGHT., 10% OCL-	%	66	73	80	76	77	76	72
BL. YIELD	%	38	40	44	36	36.6	38	59.3
BEATING TIME (1)	Min.	33	38	42	27	22	25	11
DRAINAGE TIME	Sec.	12	12	13	34	11	24	19
BULK	cc/g	1.88	1.62	1.28	1.72	1.78	1.58	2.00
BURST FACTOR		42	38	42	30	12.6	33	25
TEAR FACTOR		59	51	45	43	30	47	230
BREAK. LNPTH	■	6587	5460	7200	4700	3100	6500	4600
FOLD ENDUR.	D-FOLDS	244	103	27	20	2	70	170

BEST AVAILABLE DOCUMENT

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2.4 DISCUSSION: A Kappa No. of 18-26 is usually in line for bleachable hardwood pulp. If there is much difference between screened and un-screened yield it indicates a high amount of insufficiently de-lignified wood and probable high shive (dirty) pulp, bleaching difficulty and process inefficiency. The lower the Ka No., the lower the pulp strength.

Trial 1 pulp is somewhat high Ka. No. and Trial 2 is good. The yield data is converse of expectation for the cook conditions and Ka. Nos. It is noted that Ipil Ipil, a softer wood, pulped by the same laboratory and conditions similar to Trial 1, produced Ka. No. and yield at very desirable levels (and as expectable from E.c.). It is noted that 25% NaOH is equivalent to 20% EA as Na₂O, a typical bleached hardwood soda pulping condition.

Trial 3 was to simulate a highly alkaline-sulfite cook, which can approach kraft pulp qualities. Upon completion of the cook, the mass was still not pulp, typical of un-defibrated semi-chemical processing. No further evaluation was made nor data obtained.

Trial 4 was to simulate a 25% alkalinity kraft cook using NaOH and elemental sulfur. Upon completion of the cook, the chip mass was black, non-defibrated and there was no sulfide odor. No further evaluation was made nor data obtained.

Beater test and other evaluation data are in Table 2.2 and Exhibit 2. The pulp quality was as good or better than that from other available raw materials. Viscosity tests were not run; they should be for quick cellulose quality evaluation.

These experiments were on the spur of the moment. Other than the soda pulps (trials 1 and 2) conditions were constrained by chemicals and apparatus availability. Pulp evaluation was likewise restricted.

Other laboratory pulping data is included as a matter of interest, without comment. This was produced other laboratories, with different test apparatus and standards.

2.5 CONCLUSIONS: The pulp from tests 1 and 2 was deemed generally satisfactory for papermaking, but lower in quality and yield than hoped for. The conditions of Test 2 were set as the start condition for the mill trial cooks, i.e. 25% NaOH and 4- hr. at 170°C.

In general, this work corroborates our previous and continuing recommendations: designed experimental work of this type needs to be done under more satisfactory and controlled conditions. This will enable development and assessment of pulping conditions most suitable for use of *E. camaldulensis* by Pakistani industry.

The facilities, pilot digester, methods and most particularly the personnel engaged in this work were generally satisfactory. However the facility is very limited, particularly for analytical work. Also, certain chemicals were unavailable. Personnel were generally competent and certainly enthusiastically cooperative.

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PART 3. MILL EUCALYPTUS CAMALDULENSIS PULP AND PAPER MAKING TRIAL

3.1 INTRODUCTION: Adamjee Paper & Board Ltd. scheduled trial, mill scale production of bleached E.c. pulp and a standard grade of printing/writing paper for 8-9 January, 1991. The plan was for 3 to 4 batch cooks of soda pulp and bleaching to 76% to 80% GEB. This pulp was to be mixed 50% with the previously produced standard pulp, and run on the fourdrinier paper machine.

3.2 OBJECTIVE: to test and evaluate

1. Pulp production methods and quality
2. Papermaking runability, suitability, and characteristics.

3.3 PROCEDURE: (See Tables 3.1 - 3.3 and Figures 3.1 and 3.2.).

Pulping: Three cooks were made in one of the 36 m³ rotary cylindrical digesters. The supply was augmented with Adamjee test-plantation E.c. chips. The chips were transported to the fiber area and dumped onto the ground. They were then manually fed to the intake of the straw/kahi blower and charged to the selected digester. Charge time was about 3-hr./digester.

Pulping was by the soda process. The first two cooks were selected based upon pilot trials (see Part 2). Cook No. 3 was a dual modification: (1) to increase the Kappa No. from the first two; (2), to increase strength. This turned out unpulped when the cook was done, so it was extended 2 hours with 5% additional alkali. This pulp had high screenings and Kappa No. but still bleached OK to 76% GE brightness.

All pulp was washed, screened and bleached in accordance with normal mill practice. Processing was without any extraordinary events such as excessive screenings, shives, foam, washer difficulties, etc. The resulting pulp was of satisfactory strength, brightness, cleanliness and other characteristics.

PAPER MAKING:

Paper making conditions and quality are shown in Table 3.3. The paper made was a standard writing grade. The furnish was 50% trial E.c. pulp, 50% Licker-in (cotton waste) and the normal additives for the grade. The furnish change was from standard furnish for the grade, without prior wash-up or shut-down. The change-over caused an immediate wet-end break and appeared due to light weight. However, upon adjustments, paper went through the machine satisfactorily. Within about ten minutes it was on the reel at specification. About ten tons of paper were made, running at normal speed for the grade/weight. The paper made was deemed of satisfactory quality, i.e. weight, brightness, caliper and strength were at or exceeded specification. Burst (Mullin) tests were 110% to 130% specification.

3.4 DATA: See Tables 3.1 TO 3.3 and Figures 3.1 and 3.2.

3.5 DISCUSSION:

This mill trial was planned and run such that paper was being made from the test pulp concurrently with the Farmers Field Day (see Part 4). This was an ambitious undertaking; the farmers would not know the difference, and it put unnecessary strain and risk upon mill management and personnel. However, the fact that this pulp came across the paper machine in the presence of key FP&DP personnel was good education for them and impressive.

Pulping: Generally the trial went well, and usable pulp was made, not the least of accomplishments. Charging of the digesters with chips was very lengthy, about 3-hours/digester. This should be readily reduced to about 20-30 minutes with better chip unloading and blower feed arrangement.

The mill chose to use the soda process for this trial. They routinely use it for Licker-in (cotton waste) and have used it for other wood pulping trials. It was a safe choice, and in this situation, not a bad one. That the trial went without incident producing a usable pulp is testimony to that.

However, one cannot expect to yield pulp with good strength from the soda process. Poor strength would be exacerbated by the low Ka. No. of 15 obtained. Since the primary reason for Pakistani paper mills to make and use wood pulp is to achieve higher strength, this needs to be a primary processing focus. The Adamjee soda pulp processing conditions need to be refined to yield higher yet still bleachable Ka. No., i.e. around 25. Use of anthraquinone should be considered to enhance strength at an acceptable bleachable Ka. No.

Bleaching conditions were exceptionally harsh for 15 Ka. No. pulp; 7.9 % Cl₂ in the C-stage yielding a CEKa.No. of 6.9. Normally about 3% Cl₂ should be required for this Ka.No. The overall Cl₂ application at 13.4% is extremely high for the pulp also, and brightness of 77 rather low. This high Cl₂ application would also be expected to greatly reduce pulp strength.

It also is a possibility that mill Ka.No. procedure and/or chemical flow measurements are off, which might nullify the above comments. If further work is to be done, this should be checked.

However, arrival at more advantageous process conditions and control would be facilitated by running routine CEKa.No. (Micro-Kappa) and pulp CuEn viscosity tests. The point is, there is room for much improvement for commercial practice. This was pointed out, and copies of procedures given to the Chief Chemist.

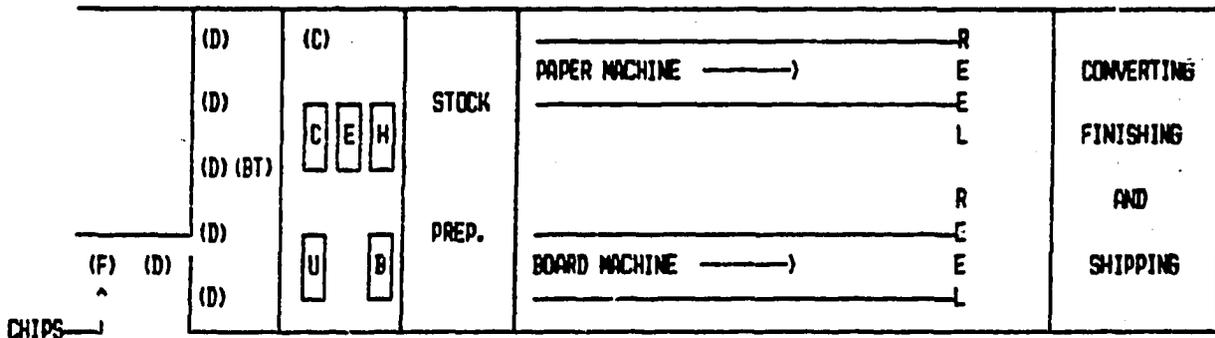
This mill's use of the soda process is somewhat unique; but they produce caustic soda. This is not the case for most Pakistani mills, which are geared for pulping straw with neutral sulfite. Also, stronger pulp is more likely from sulfite processing, but processing may require additional equipment.

Papermaking, (See Table 3.3): The pulp produced made satisfactory paper of a grade routinely produced by the mill. It ran reasonably well, with no exceptional problems or incidences. That is a fine accomplishment and requires no further comment.

3.6 CONCLUSION: Let there be no mistaking, the mill did an excellent job, and the conditions were reasonable and worked. That is always a good accomplishment for a first trial. All the foregoing comments are appropriate subject for laboratory pilot plant initial investigation, preliminary to commercial scale trial.

Continued production and use of E.c. pulp will enable improvement of methods, with resulting improved quality and economics.

**FIGURE 3.1: PULP & PAPER MILL PLAN
ADANJEE PAPER & BOARD LTD.
Nowshera, NWFP, Pakistan**



LEGEND: F=FIBER BLOWER; D=DIGESTER; BT=BLOW TANK; U=UNBLEACHED WASHER
C=C-STAGE; E=EXTRACTION STAGE; H=HYPO STAGE; B=BLEACHED PULP DECKER

**FIGURE 3.2: PULP AND PAPER MAKING TRIAL PROCESS FLOW
ADANJEE PAPER & BOARD LTD.**

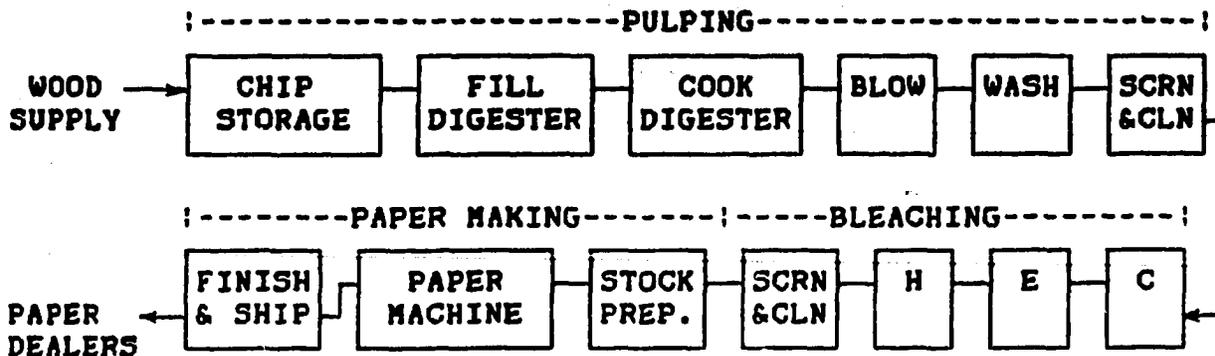


TABLE 3.1: E. CAMALDULENSIS PULP MANUFACTURE TRIAL CONDITIONS
Adanjee Paper & Board Ltd., January 8-9, 1991

COOK	PULPING							BLEACHING						
	NaOH	%Na ₂ SO ₃	%Na ₂ O	%S	L:W	MAX °C	MIN TO	MIN @	KAPPA	%Cl ₂	%NaOH	%Cl ₂	DEK	%BRT
1	26		20		3.8	170	60	240	15.5	7.9	2.0	5.5	6.3	77.0
2	26		20		3.8	170	60	240	15.5	7.9	2.0	5.5	6.3	77.0
3	20+5	5	18+4	1.27	3.8	170	60	360	39					

Other conditions were: liquor:wood = 3.8; 1 hr. to and 4 hr. at maximum temperature of 170 °C;
Cook 3 had 5% NaOH added after 4-hours, then cooked 2 more hours at 170°C. Bleached yield was 38%

TABLE 3.2: EUCALYPTUS CAMALDULENSIS PULP AND PAPER TEST DATA
Adanjee Paper & Board Ltd., January 1991

PROPERTY	PULP 045°SR Freeness					WRITING PAPER** -:		
	Unbl. E.c.	Bl. E.c.	Ipil Ipil	Puget *	Poplar	E.C. Kraft	E.c. TEST	NORMAL
Ka. No. (T214), ml	15.5	15.5	24.0	*15				
Beating Time, min.	12	11	35					
Drainage Time, sec.	15	15	14					
Bulk, cc/g	1.75	1.50	1.45	1.27			1.42	1.40
Burst Factor	27	26	47	54			12.7	11.
Tear Factor	25	34	54	69			43.6/47.6	47.4/50.8
Tensile, m	4300	4300	7400	8600			4220/2320	4590/2820
Folds, DF#	17	10	200				8.5	10.6
Brightness, %E	na	77	84	89			72.5	70.5

* Georgia Pacific, Bellingham Puget S. **See Table 3.3, below.

TABLE 3.3: EUCALYPTUS CAMALDULENSIS PAPER MAKING DATA
ADAMJEE PAPER & BOARD LTD., NOWSHERA, PAKISTAN

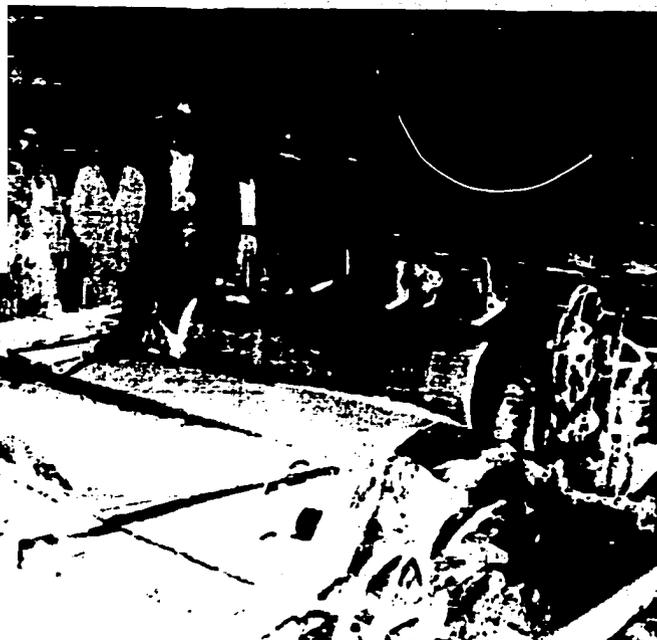
PAPER MACHINE: No. 1, 2.15 m trim fourdrinier

		E.C. TEST	NORMAL
GRADE:	58 g/m ³ writing	58.5	59.0
FURNISH:	E. camaldulensis soda pulp	50x	
	Licker-in (cotton) soda pulp	50x	45x
	Grass		30x
	Clippings		15x
	Broke		10x
	Ash	8x	9.5x

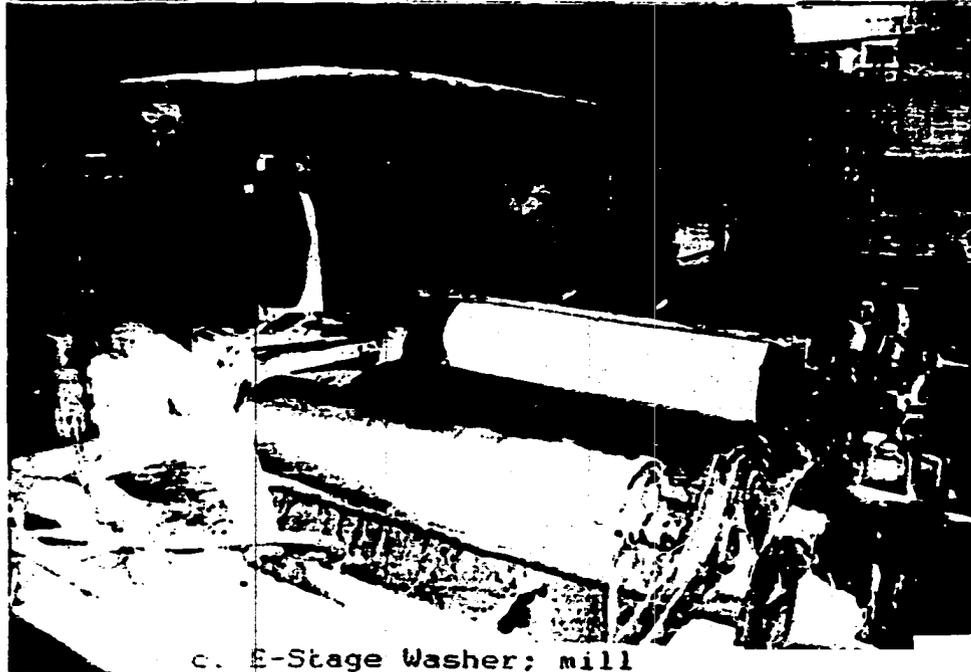
- All data are average s for the run;
- all E.c. paper tests were within specification. Burst (Mullin) tests were 110% to 130% specification.



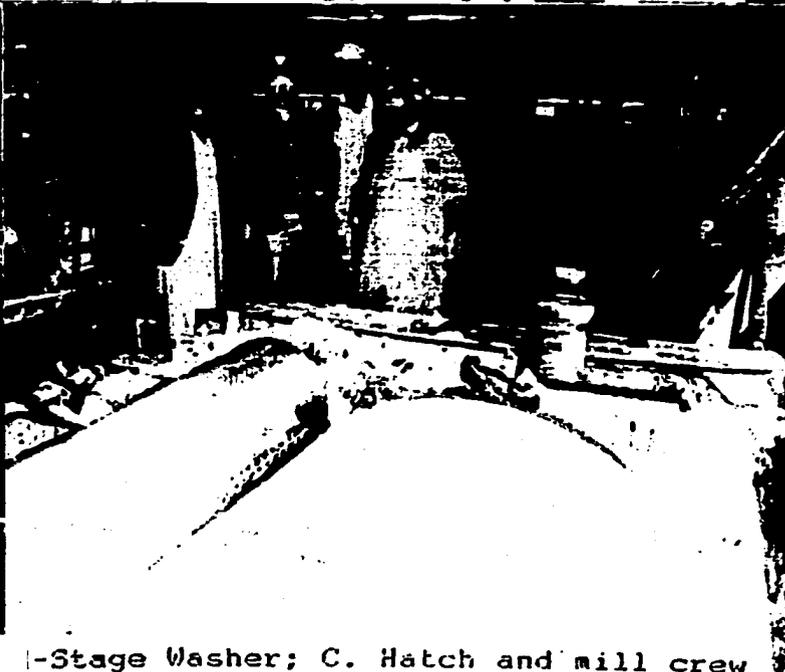
a. Brown stock washer; G. Wire and mill crew



b. C-Stage washer; C. Hatch and mill crew



c. E-Stage Washer; mill



d. D-Stage Washer; C. Hatch and mill crew

PART 4. FARMERS FIELD DAY:

4.1 PURPOSE: To

1. enable tree farmers to see how wood is used, pulp and paper made, and thus better understand the needs of the wood user.
2. bring Seller and buyer together and foster understanding.

4.2 INTRODUCTION: Exhibit 4.1 is the agenda. This was an event to bring tree farmers to the mill and industrial environment, and enable them to see how the wood is used. Also, it was hoped to facilitate establishment of a "partners in business" attitude and encourage increased tree planting, harvesting, and sales. It was the culmination of several events leading to the sale/purchase of wood and the other activities, subject of this report.

4.3 BACKGROUND: There are many needs of both supplier and user of pulpwood, which if satisfied can ameliorate problems for each, and enhance utilizability, final product quality and costs. This, in turn will enable more wood to be used, and increase its value to both user and seller. They are mutually inter-dependent partners in this, depending upon each other for success.

An important vehicle to accomplishing the goals of all parties in this regard, is for each to know the other's circumstances and needs, and hopefully establish a "partners in business" attitude. There have been previous conferences, meetings and field trips to the farm. This field day, hosted by Adamjee, was to let farmer and forester see first hand, what the mill was like, how wood and other fibers were handled and used, and to become acquainted with the facilities, processes and operations. Invitations and farmer transportation was arranged by the FP&DP.

4.3 DISCUSSION: Attendance of 65 was expected; about 90 were present. The agenda went according to schedule with no problems. The technical presentation by Mr. Rafiq and mill tour was well received. E.c. pulp and paper were being made and could be seen.

There was lively discussion at the Guest House. The farmers are concerned about prices; the mill about achieving adequate wood supply at acceptable cost per ton pulp. It announced intent to purchase wood on a daily basis as soon as the subject trial was analyzed. The need for cooperative endeavors towards more favorable classification and taxation of pulpwood, transport rates and greater efficiency in harvest and handling was also discussed.

CONCLUSIONS: This was a good program, and well received. The mill learned a good deal about how to put on such an event. The farmers and foresters gained some familiarity with their market. Similar functions, should continue to be held. Perhaps, also there can be a set discussion agenda, addressing to mutual problems with which they can help one-another; e.g, wood size based pricing, truck load size, transport cost reduction, duties and taxes, field bark removal and appropriate pricing, etc.

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EXHIBIT 4.1: FARMERS FIELD DAY AGENDA
Adamjee Paper & Board Ltd., Nowshera
9, January 1991

- 1000 - 1030: Arrive, assemble in mill conference room; tea.
- 1030 - 1100: Welcome & Introductions
Mr. M. Raffiudin, General Manager, Adamjee
Mr. A.H. Adamjee, Managing Director, Adamjee
- 1100 - 1200: Presentation on Pulp & Paper Technology
Mr. M. Rafiq, Chief Chemist, Adamjee
- 1200 - 1300: Mill Tour,
-wood Yard
-wood preparation; chipping demonstration
-pulping, digesters, bleaching
-papermaking,
-paper converting, finishing, shipping
- 1300 - 1400: Assembly at Guest House Garden
Introductions
Award presentation, G. Naughton, FP&DP
to Mssrs. Adamjee and Raffiudin.
Comments, observations and discussion
- 1400 - 1500: Buffet lunch
- Adjourn

Attendance: (approximate)

Farmers	35
Provincial Forestry Personnel	25
Pakistan Forestry Institute	6
GOP Forestry Personnel	6
Adamjee Paper & Board Ltd.	10
<u>FP&DP/USAID Personnel</u>	<u>8</u>
TOTAL	90

22



a. In the will conference room; G. Naughton & farmers

b. In the will conference room; Tahir & foresters



c. Welcome by Mr. Adamjee at Guest house; Messrs Wiro, Monsoor, Raffiudin, Hatcher & Naughton



d. Pobar & Nosshera kabab cooks

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SUMMARY AND CONCLUSIONS:

There has been a great deal of work by the GOP/USAID FP&DP team; GOP, provincial and district forestry personnel; and the involved tree farmers to get E.c. plantations underway. There is need to market this wood to some extent, to compensate the tree farmers and encourage increased planting. Pulp manufacture may be the best market for E.c.; it requires young wood.

Sustainable yield of 3-6 year farmer wood is approaching a level wherein commercial production of wood pulp for paper may be supported. There is need for this commodity, which currently must be imported. E.c. use for pulp would provide a steady, stable market for this young wood, i.e., a relatively short term crop. However, there has been no pulpwood commerce in Pakistan, nor is there infra-structure, or experience in the enterprise of wood delivery or preparation for pulp production.

A previous study proposed developing and encouraging utilization of wood, particularly the E.c., for a portion of the fiber requirement of the existing pulp and paper mills within their existing process. This would enable development of supply/utilization on a small scale, in effect, boot strapping the pulp wood enterprise, evolving the necessary procedures and relationships. When sufficient pulpwood delivery capability is achieved, a full scale pulp mill will become viable.

The activity herein reported is the first pulp wood commerce in Pakistan. It is a milestone, with the purchase and utilization of some of the wood for pulp, by Adamjee. There have been a number of conferences and meetings; but another milestone is reached through an industry hosted user/supplier meeting. These are important accomplishments to the establishment of supply/demand for Eucalyptus camaldulensis and other farmer wood. This will facilitate increased aforestation in Pakistan as well as upgraded paper products and reduced dependence upon imported wood pulp.

The objectives of the project(s) have been accomplished, in that all aspects had success and represent significant accomplishment. specifically:

1. Agreements and sales contracts were reached between buyer and seller. Business relationship has commenced.
2. Farmer Eucalyptus camaldulensis pulpwood was harvested, loaded onto trucks and transported to the Adamjee mill.
3. The mill received, scaled, de-barked and chipped the wood; the farmer-supplier has been paid.
4. Laboratory tests found suitable if not optimum pulping conditions; higher pulp yield and strength characteristics are desired if not necessary. More extensive laboratory evaluation is recommended.

5. Eucalyptus camaldulensis wood was pulped, bleached and made into paper by a conventional process and methods in the existing mill. The product was commercially acceptable for the grade made, meeting or exceeding all specifications. However the same comments as 4. above apply.
6. The Farmers Field Day was held and deemed successful. It enabled farmers and foresters to observe the mill handling and utilization of wood per the above. It provided opportunity for user/supplier to get better acquainted, share thoughts, concerns and ideas, and human relations basis for continuing.

Much was learned; but much remains to be learned. Also, extents of perceived success are conditional.

For example, there needs be work on:

- a. More efficient wood and chip handling.
- b. Loading trucks to full capacity.
- c. Establishment of a pulpwood tariff classification with improved inter-province taxes and transport costs.
- d. Wood bark removal requirement and methods.
- e. Pulping conditions for better quality; and pulping conditions suitable for all mills.

All the above are important. Items a. to d. above can and will be evolved as pulpwood utilization proceeds. However, accomplishing this would be speeded by assistance with material handling methods; also basic data is needed on the wood. This work may be appropriate to PFI and the Forestry Departments.

Item e. above requires some research and laboratory work. The objective would be to find conditions for pulping of E.c. amenable to most of the existing Pakistani mills. Reasons and methods are advanced in the text and in Appendix 2.1.

Congratulations are in order to all involved and participating in the work reported herein: Adamjee Paper & Board Co., owners; management and workers; the farmers, foresters, and FP&DP teams who have fostered and implemented the private sector afforestation program; the Inspector General Forests, GOP as general manager of the overall afforestation program and the U.S.A.I.D. for its support and sponsorship.

This is not the end; but it is a very good beginning.

G.WIRE CO.

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15. Raffiudin, M. & Rafiq, M., "Wood Pulp & Paper Making Trials, January 1991": Adamjee Paper and Board Mills Ltd, Nowshera, NWFP, Pakistan, 20 pages (14 May, 1991).

EXHIBIT A2: KEY PERSONS

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WOOD SUPPLYING FARMERS

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Master M. Akhtar, Hagro, Attock, Punjab
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EXHIBIT / 3: GLOSSARY

Acid Sulfite Pulping: see sulfite pulping process

Alkaline Sulfite Pulping Process: see sulfite pulping process

BEATER TEST: A procedure for refining (beating) pulp, forming paper-like sheets, and testing for physical properties, i.e. tensile, tear, fold, burst, density/bulk, etc. (TAPPI T200)

Bisulfite Pulping: see sulfite pulping process

CEKa.No.; CE Kappa No.: The Kappa No. of pulp following chlorination and extraction; a measure of work done, and pulp degradation by chlorination. Micro Kappa No. (TAPPI UM 246); See Kappa No.

E.c.: Eucalyptus camaldulensis, primary FP&DP project private sector tree farming species.

FP&DP Forestry Planning & Development Project, Winrock International/U.S.A.I.D.-Government of Pakistan.

Ka.No., Kappa No.: The test procedure for determination of extent of pulping and bleach chemical required; determines residual lignin in pulp; the amount of $KMnO_4$ consumed under standard conditions (TAPPI 236). Note: K. No. or P. No. (TAPPI 214) is a simpler variant of this procedure, but does not correlate well with residual lignin content nor is it as reproducible.

Kraft Pulping Process: The process employing sodium hydroxide (NaOH) with sodium sulfide (Na_2S), typically 15%-20% caustic of which 25% is sulfidity, both expressed as Na_2O . The most widespread pulping process in the world, but requiring extensive chemicals and energy recovery processing. Kraft pulp mills need be over 250 TPD capacity, costing over \$250. million; more often they are over 600 TPD and cost \$650-1,000 million.

Monosulfite Pulping Process: see sulfite pulping process

Mound: 40 kg; a common unit of weight in Pakistan.

NS: neutral sulfite, referring to the pulping process; see Sulfite pulping processes.

NSSC: neutral sulfite semi-chemical pulping; the NS process wherein additional mechanical action, i.e. refining, is required to defibrate the cooked chips. See sulfite process.

Soda Pulping Process: A pulping process employing caustic soda as soda ash (Na_2CO_3) or NaOH; in affect a kraft process with no sulfidity. As a rule, the process is limited to hardwoods, softwood pulps being of very poor quality. The hardwood pulps are of substantially lower strength than their kraft counterparts, but often have desirable bulking and opacity characteristics.

Sulfite Pulping Processes: Pulping based upon lignin sulfonation with an SO₂ containing solution. It can function over a wide range of pH, but conditions for specific fiber and product types tend to be very specific. Reaction rate is higher with lower pH, with both beneficial and adverse consequence. Selection of the process specifics is a function of wood (fiber) raw material, product to be made, production rate, other plant circumstances, effluent/emissions requirements and both capital and operating costs. Sulfite is more difficult to recover than kraft/soda.

The sulfite process types are broadly classified as follows:

Acid Sulfite, pH<3: employs a solution of free H₂SO₃ and bisulfite which may be Na⁺, NH₄⁺(NH₃), MgO (Mg⁺²), or Ca⁺². The acid conditions are extremely corrosive and require resistant materials. Acid sulfite is used with softwoods and hardwoods and renders full chemical (mechanical defibration not required) pulp relatively bright, easy to bleach but weaker and denser than kraft pulp. Products include newsprint (unbleached), fine papers, tissue and dissolving pulps for rayon and chemicals.

Bisulfite, pH 3-5: employs a solution of nearly equal free and combined SO₂ and substantially HSO₃ most often the base is Na⁺ or Mg⁺² (Magnefite), but NH₃ is possible; Ca⁺² is insoluble except under acid-sulfite conditions, and so not usable. Products are generally similar to those of acid sulfite, possibly with higher strength and bulk characteristics.

Neutral Sulfite (NS, NSSC), pH 7-9: the solution is Na₂SO₃ buffered with soda ash, the base chemical being Na⁺. NH₃ and potassium could be used but this is not known in commercial practice. NS wood pulps usually require mechanical action (refining) to defibrate and thus are semi-chemical (NSSC). It is most often used to produce corrugating medium stock. During the 1930s-1960s a number of mills produced bleached pulps, especially from hardwoods, which were satisfactory for fine and printing papers and board. Environmental requirements forced chemicals recovery, favoring the kraft process.

Monosulfite, pH 9-11: The chemistry is essentially the same as neutral sulfite above, but buffered at higher pH, with soda ash (Na₂CO₃) or caustic soda (NaOH). This is believed most often used with vegetable fiber such as straw, bagasse, reeds, etc. It is the common process by Pakistani mills. Wood processing usually renders a semi-chemical pulp, darker and more difficult to bleach than the acid or neutral sulfite versions.

Alkaline Sulfite, pH<11: The pulping chemistry is essentially soda process, with addition of 10%-20% SO₂. The claim is pulp properties more akin to kraft, but without the obnoxious kraft process odors. We do not know of any commercial practice.

Viscosity, Pulp: A rapid test procedure for estimation the relative strength of semi-bleached and bleached pulp; the viscosity of the pulp dispersed in cupriethylene diamine (TAPPI T254).

APPENDICES

APPENDIX 1. WOOD PROCUREMENT & PROCESSING

- 1.1 1990 Success Story - FP&DP, Pakistan (Ref. 9)
- 1.2 Eucalyptus Wood Purchase (Ref. 10)
- 1.3 Procurement of Eucalyptus Wood from M. Arif (Ref. 11)
- 1.4 Trip Report, Farmers Field Day (Ref. 12)
- 1.5 Eucalyptus Pulp Wood Taxes and Tariffs (Ref. 13)
- 1.6 Procedure for Pulp [Wood] Sales Negotiations (Ref. 14)
- 1.7 Adamjee Wood Procurement and Processing Data

APPENDIX 2. LABORATORY PULPING

- 2.1 Adamjee Data
- 2.2 Proposed Work

APPENDIX 3. MILL TRIAL

- 3.1 Adamjee Data
- 3.2 Preliminary (Exit) Report
- 3.3 Data Request

APPENDIX 4. FARMERS FIELD DAY DATA

APPENDIX 5. TERMS OF REFERENCE

APPENDIX 1.

WOOD PROCUREMENT & PROCESSING

- 1.1 1990 Success Story - FP&DP, Pakistan (Ref. 9)
- 1.2 Eucalyptus Wood Purchase (Ref. 10)
- 1.3 Procurement of Eucalyptus Wood form M. Arif (Ref. 11)
- 1.4 Trip Report, Farmers Field Day (Ref. 12)
- 1.5 Eucalyptus Pulp Wood Taxes and Tariffs (Ref. 13)
- 1.6 Procedure for Pulp [Wood] Sales Negotiations (Ref. 14)
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APPENDIX 1.1: 1990 Success Story, FP&DP, Pakistan (Ref. 9)

FPD Project Success Story, 1990

Although an active market for wood exists in Pakistan, most of the farmers in the project lack the basic knowledge and experience for dealing in this wood market. An additional level of uncertainty exists because eucalyptus, the tree most commonly planted by farmers in the FPDP, is an introduced species which is neither well known to the growers nor the potential market purchasers.

In the spring of 1990 a nation-wide conference was held at Lahore to bring farmers, industrialists, and foresters together to discuss the opportunities for expansion of the private market for forest products from farmlands. This conference, the Wood Producer's - User's Seminar, brought 190 people from all three interest groups together under one roof for 3 days of discussions and deliberations. The principal result was an understanding of the role of each of the three parts in liaison with each other, to make this privatization effort work. Farmers have the capability and interest to produce the wood, with the technical advice of professional foresters, and the sponsorship of industries to establish and maintain a market demand for the products.

Within a few months following the conference, a special tour of tree farm plantations was arranged for a group of the industrialists who had expressed an interest in using eucalyptus wood. As a result of that tour, the Adamjee Paper and Board Mill of Nowshera expressed an interest in conducting a test run of eucalyptus wood for manufacture of paper at their plant. It was determined that they would need 40-50 tons of wood - about 5 truckloads. In order to provide the greatest opportunity for farmer participation, it was further agreed that the company would enter into 5 separate transactions with farmers, taking only one load from each.

During the fall, a series of 8 field workshops were held for farmers to discuss the marketing process, the value of their trees, the market specifications as to size and condition of the wood, and the purpose of the paper making test run. These workshops, conducted at the farmer's plantations, were attended by 290 farmers.

Development of the forestry private sector in Pakistan has taken long strides forward during 1990 as a result of specially targeted efforts by the Winrock technical assistance team on the Forestry Planning and Development Project.

Trees planted on farms since 1986 have grown rapidly and, in order to motivate more farmers to plant trees, it was determined that it was time for the early planters to begin to do some thinning and harvesting to generate some cash flow. Earlier attempts to get farmers to thin their plantations had met with farmer resistance because they were more interested in selling their tree crops for cash than in merely cutting them for fuelwood. After all, they argued, "fuelwood is always

APPENDIX 1.1: 1990 Success Story, FP&DP, Pakistan (Ref.9)

produced from the tops and limbs when trees are cut for any purpose -- but what we need is cash income from the land where these trees have been growing".

The people from the Adamjee Company made their purchasing transactions with 5 of the farmers on the spot during these meetings. Some of the farmers were not interested in selling their trees for the prices offered, while others wanted to sell more than one load. Altogether, the company purchased and took delivery of 40 tons of eucalyptus and the 5 farmers received a total of Rs.23,000.00 (about \$1,100.00).

After all the wood had been stockpiled, Adamjee company hosted a field day at its mill to show the paper making process. During this field day there were lively discussions between farmers, industrialists, and foresters about the various problems that each group faces in making the production and marketing system work. The over-all spirit of these discussions was of optimism and cooperation for the future. The farmers were keenly interested in watching their trees being chipped, ground, digested, mixed and rolled out on the paper-making machine.

Just as in the production of other crops, market forces drive farmers' interest. This initial step forward has created income for farmers, and other farmers are coming forward, already motivated to plant trees.

G. WIRE CO.

APPENDIX 1.2: Eucalyptus Wood Purchase (Ref. 10)

Phones: (05231) 2751
(05231) 2752



Cable: "ADAMJEEES"

Adamjee Paper & Board Mills Limited

SHAHRAH-E-PAKISTAN, NOWSHERA N.W.F.P. PAKISTAN.

REF. NO. FBM-^{0968/}0968/5192

DATE: 27-12-1990,

Mr. Gary G. Naughton,
Field Demo, Forester,
Winreck International,
Forestry Planning & Development Project,
58-Margalla Road,
F-7/2, Islamabad,

Sub: Eucalyptus Wood.

Dear Sir,

Reference your letter of December, 24, 1990 the
desired information is talinted below :-

S.No.	Date	Name of Supplier	Load Weight (Maund of 40 Kg)	Distt:Attock Export Tax	NWFP Forest Import Tax.
1.	9-11-90	Haji Malik Arif	183	Rs. 360	Rs. 525
2.	6-12-90	Samandar Khan,	125	Rs. 150	NIL
3.	6-12-90	Mohd. Abdul Latif	135	Rs. 250	NIL
4.	12-12-90	Master Mohd. Akhtar	160	Rs. 300	Rs. 275
5.	15-12-90	Liaqat Ali Khan	250	Rs. 350	Rs. 275

Mr. Samandar Khan and Mr. Mohammad Abdul Lateef have
either not claimed reimbursement of the NWFP Forest Department
Import Tax or their cargo passed the Forest check post during
the night time when the staff may have been resting and,
therefore, the tax was avoided.

As desired photo copies of documents relating to
consignments of Sr. Nos 2 to 5 are attached herewith.

RUK/Niaz.

Yours faithfully,

Rahatullah Khattak,
Commercial Manager.

BEST AVAILABLE DOCUMENT

APPENDIX 1.3: Procurement of Eucalyptus Wood from Malik Arif (Ref. 11)

Phones: (05231) 2751
(05231) 2752



Cable : "ADAMJEE'S"

Adamjee Paper & Board Mills Limited

SHAHRAH-E-PAKISTAN. NOWSHERA N.W.F.P. PAKISTAN.

REF. NO. PBH-0068/

3727

DATE: 11-11-1990

Mr. Gary Naughton,
Field Demonstration Forester,
Forestry Planning & Development Project,
58, Kheyban-2-Iqbal,
F-7/2,
ISLAMABAD

Sub: Procurement of Eucalyptus Wood from
Malik Arif's Plantation at Burhan

Dear Sir,

Reference telephonic discussions the undersigned had with you in the evening of 10-11-1990 regarding the excessive transportation and related incidentals incurred on the procurement of wood from Malik Arif's Plantation at Burhan. As desired, I am enclosing herewith copies of the following documents:

- i) District Export Tax Receipt
No.10632 dated 9-11-1990 for Rs.360/-
- ii) Forest Department Govt of NWFP
Receipt No.80 dt.9-11-90 for Rs.525/-
- iii) Truck freight Receipt
No.48 dt.8-11-1990 for Rs.900/-

We may mention that Malik Arif has collected cash payment of Rs.4,575/- from the mills being the cost of 183 maunds (40 kg each) of wood supplied by him.

Yours faithfully,

Commercial Manager

Encl(as above)

APPENDIX 1.4: Trip Report, Farmer's Field Day (Ref. 12)



FORESTRY PLANNING & DEVELOPMENT PROJECT
Government of Pakistan-USAID

TRIP REPORT

Contract No. 391-0481-00-C-5021-00

1. Prepared by: Gary G. Naughton *Gary G. Naughton*
2. Places Visited: Nowshera
3. Date of Trip: 9 January, 1991
4. Description of Trip Activities
 - a. Purpose of Trip: To attend farmer's field day hosted by Adamjee Paper & Board Mills, Ltd., Nowshera, NWFP.
 - b. Individuals Contacted: 25 tree farmers from Attock District; Project forestry staffs from Punjab and NWFP; USAID and TAT representative; PFI staff; Mr. Abdul Hamid Adamjee, Managing Director AP&BM; and the entire management and production staff of the mill at Nowshera.
 - c. Purpose Achieved: Yes!
 - d. Observations: This meeting was the culmination of a series of events which began in November, 1989, when the Chief Chemist, Mohammad Rafiq received some sample eucalyptus wood from farm plantations and had pulping and paper making laboratory tests conducted at PFI. In May-June, 1990, consultations with TAT special consultant Gerald Wire led Adamjees' to conclude that they needed to make a production test of eucalyptus in their mill.

In October 1990 Adamjee staff met with TAT and agreed to try to purchase 5 truckloads (up to 50 tons) of eucalyptus wood from project tree farmer in Attock district. During November and December a series of 8 field workshops were held with farmers and Adamjee staff to acquire the needed wood. To broaden the market tests, it was further agreed to buy the wood from 5 different farmers. Punjab Social Forestry staff and TAT worked together to mark the trees for felling and to demonstrate the proper harvesting procedures to the farmers.

During the field day today, the farmers and foresters saw the entire process of paper making at the mill, including the wood storage area, de-barking operations, chipping, chip handling, loading of the pulp digester, pulp bleaching and cleaning, and finally, the eucalyptus paper rolling out the other end.



Winrock International

Technical Assistance Team

Pakistan. Tel : 813262 - 813272 Tlx : 54252 WIFPD PK Fax : 824519

1.4: Trip Report, Farmer's Field Day (Ref. 12)

There was an air of excitement throughout the process. At the group discussion period following the mill tour, Mr. Adamjee was presented with a shisham wood plaque from FP&D Project by Khawaja Hameedullah, USAID Project Officer, in recognition of the company's leadership role in farm forestry. The company also received a metal "Lok Shajarkar" sign for the main gate to the plant.

Discussion by the farmers focused on the market price for their wood. Discussion by the company focused on their need for future supply of wood adequate to keep them interested in buying. The company announced that it would make a public offering to purchase eucalyptus on a daily basis as soon as they have completed the analysis of the test run in terms of product value and import costs.

5. Follow up:

1) Technical Seminar on pulping eucalyptus will be held at PFI on 19 January, 1991, 9:30 a.m. to 2:30 p.m., under sponsorship of FP&D Project with local leadership of Director General K. M. Siddiqui and technical presentation by Adamjee Chief Chemist Rafiq and the PFI paper lab staff. Gerald Wire will provide his comments and observations via video tape since the seminar will be held after his return to the U.S.

2) Adamjee P&BM has indicated willingness to conduct the same type of field day for farmers from NWFP. Project Director Rashid Arshad, NWFP, is requested to organize the tour and coordinate with Adamjee. TAT will assist as necessary.

3) Similar marketing and utilization opportunities exist in other industries, notably the particleboard plants at Jhelum. Project Director Punjab Rashid Randhawa is requested to organize such tours and coordinate with the respective mills. TAT will assist as necessary.

4) A small sample of the eucalyptus paper from the test run is attached.

Distribution

IGF Abeeudullah Jan
DIGF Nasrullah Khan
DIGF B. A. Wani
USAID Project Officer Kh. Hameedullah
Director General PFI
Project Director Punjab
Project Director NWFP
Mr. Abdul Hamid Adamjee, Managing Director AP&BM
CCF Anwar Masrur - Lahore
CCF Yar Mohammad Khan - Peshawar
TAT



FORESTRY PLANNING & DEVELOPMENT PROJECT
Government of Pakistan-USAID

December 31, 1990

To: Rashid M. Randhawa
PD: FEFP, Punjab

From: Gary G. Naughton
Field Demo Forester

Sub: Eucalyptus Pulpwood taxes and tariffs

I enclose two copies each of letters from Adamjee Paper & Board Mills, Nowshera dated 11 November, 1990, together with documentation as to export taxes levied by Zila Council Attock and timber imports at NWFP Forest Checkpoint.

Please try to resolve these issues through your normal channels. We don't expect a waiver of taxes, but would request the appropriate authorities to kindly set an equitable tax rate for pulpwood at about the same level as firewood.

Pulpwood is valued at Rs.32 per maund at the plant gate while firewood is typically valued at Rs.32-34 per maund at the wood depot (wholesale price).

I will be glad to accompany you in this undertaking if you feel it is appropriate.

GGN/maa

 **Winrock International**

Technical Assistance Team

58, Margalla Road, F-7/2, Islamabad, Pakistan. Tel: 813262 - 813272 Tlx: 54252 WIFPD PK Fax: 824519

APPENDIX 1.6: Procedure for Pulp (Wood) Sales Negotiations (Ref. 14)

11 Feb 91

FAX message to: Gerald Wixe, 206-644-4145

From: Gary Naughton *Gary Naughton*

1. Procedure for pulp sales negotiations, Adamjee Mills

- Buyers from Adamjee attended the marketing workshops held for the farmers in Attock District

- During the workshops, foresters and TAT encouraged farmers to consider selling some of their trees to cooperate in the pulping test. We worked on the basis that it was a test and that none of us could be certain of the outcome

- Buyers and sellers were put together and given room to negotiate

- The first farmer to sell made it clear that he was not too satisfied with the price, but was doing it out of curiosity and a sense of cooperation. He received Rs 25 per maund, cut and loaded on the truck. He had to arrange for the truck, even though the company paid the bill for hauling, plus the costs of taxes en route. That first load cost Adamjee:

Rs 900 for the truck

" 300 for export tax from Attock

" 525 for import tax to NWFP (on a load which

totalled only 180 maunds).

- The company felt stung over the fact that their estimate of freight had been Rs 600, their estimate of taxes had been 100-200, and that the truck was not fully and carefully loaded (they expected 250 maunds).

- Subsequent sales negotiated by Adamjee were the same, except that a great deal of effort was made to try to get the farmers to really fill the truck, and the fact that they set a limit of Rs 700 on their share of the transport charges. The transport per truck was negotiated pretty well by the later farmers, but only one of the last 4 put on over 200 maunds in loading the truck. Farmers were really out of their element on this part of the work, having a very poor idea of loading efficiency and related costs of transport.

2. Problems:

- All of the farm wood from Attock is under special rules in the forest act which require both cutting permits and transport permits for wood grown on farms. Both permits are "free", but have high nuisance value because they must be issued by the territorial DFO. He is not the same as our project DFO. Also, he moves around a lot and is hard to catch. Some of these farmers took more than one trip of half day each to find the guy before successfully getting their permits. TAT has worked with the FD to get a compromise on this and it now appears that we have this authority in the hands of both our project DFO as well as the Territorial officer.

- The tax situation is still an enigma. We have been working it out through channels, trying to impress on them that we believe that the way in which the wood was classified is what was the problem, and that a fair tax should always be levied. We don't stand much chance of getting

APPENDIX 1.6: Procedure for Pulp (Wood) Sales Negotiations (Ref. 14)

an outright waiver of tax, but are trying to get pulpwood classified in the same value category as fuelwood. In that case, export from Attock would have been Rs 100 per load and import into NWFP would have been Rs 35 per load. The real problem might be that the truckers hauling the wood and the farmers themselves did not know how to negotiate with the tax agents appropriately in order to save a lot of problems. Of course, since the company had agreed to pay all taxes, it was no skin off the farmer. And, by paying what was levied, the farmer got an official receipt which was reimbursed by Adamjee -- there would have been none from a negotiated payment.

As a footnote, the thing that made this exercise work was the feeling of commitment on the sides of both the company and the farmers. Some of the farmers probably felt obligated because they weren't sure just how much authority the foresters had to 'make' them sell. However, there were some farmers that refused outright to sell trees, and some who wanted to sell more than one load, so the price was probably about right. Adamjee later advised me that once their decision was made to go through with the tests, price was no longer a major consideration -- they just didn't want to start too high for the sake of future purchases. Finally, it appears that, using hand tools and unskilled labor, it was costing the farmers about Rs 2.5 per maund to cut and load the wood. This was quite reasonable in my opinion, and could probably be reduced to 50-60% of that by training and practice.

If this doesn't answer your questions, get hold of me today.

Cheers,

Naughton

G.WIRE CO.

APPENDIX 1.7: ADAMJEE WOOD PROCUREMENT AND PROCESSING DATA
(Reference 15)

ADAMJEE PAPER & BOARD MILLS LTD., NOUSHERA

WOOD PULPING & PAPERMAKING TRIALS January 1991

I- Eucalyptus wood procurement and processing

A. <u>Quantity procured</u>	<u>From Punjab</u>	<u>From own plantation</u>
Green wood (logs)	34.13 m.tons	21.60 m.tons
B. <u>Quantity used for pulping trial</u>		
	<u>From Punjab</u>	<u>From own plantation</u>
	m.tons	m.tons
Green wood logs (55% moisture)	29.380	14.518
<u>Less</u> Wt. of bark	4.407	2.178
Debarked wood	24.923	12.340
Loss in chipping		
1) Moisture loss 2.248t	1.290	
ii) Screen losses dust, fines & slivers 4.929t	7.077 2.330	3.620
Wt. of green chips (46% moisture)	17.796	8.720
Wt. of o.d. chips loaded	9.610	4.700
Digesters cooked	2 Nos.	1 No.
o.d. pulp made	3.648	1.608
Pulp yield o.d/o.d	38.00%	32.40%
Green wood per o.d. ton of pulp	8 m.tons	9 m.tons

APPENDIX 1.7: ADAMJEE WOOD PROCUREMENT AND PROCESSING DATA
(Reference 15)

C. Cost, fob Farm and delivered

a) Logs were transported on trucks, hired from market. Distances of procurement points from Adamjee Hill at Nowshera.

1. Attock - 50 km
2. Burhan - 80 "
3. Pindi Ghaib - 140 "

b) **Cost, freight and taxes etc.**

Eucalyptus wood purchases from Punjab

Sr. No.	Date of arrival	Weight		Cost	Freight	Distt Export Tax	NWFP Forest Import Tax	Delivered Total cost
		Mds	Tons					
				(Rs)	(Rs)	(Rs)	(Rs)	(Rs)
1.	9-11-90	183	7.32	4,575/-	900/-	360/-	525/-	6,360/-
2.	6-12-90	125	5.00	3,125/-	700/-	150/-	N11	3,975/-
3.	6-12-90	135	5.4	3,375/-	700/-	250/-	N11	4,325/-
4.	12-12-90	160	6.4	4,000/-	700/-	300/-	275/-	5,275/-
5.	15-12-90	250	10.01	6,250/-	700/-	350/-	275/-	7,575/-
		<u>853</u>	<u>34.13</u>					<u>Rs. 27,510/-</u>

Delivered cost per maund = Rs.32.25
per ton = Rs.806.00

(*) For Timber the Distt. Export Tax is leviable @ Rs.3/- per cft. or maund of 40 kg roughly whereas for fire wood the tax is Rs.120/- per truck load. The variations in our case are the result of bargaining by the suppliers with octroi post staff.

(**) For Timber the Forest Import duty in NWFP is leviable at Rs.5/- per cft or maund of 40 kg. approx. whereas fire wood is chargeable @ Rs.25/- per truck load.

APPENDIX 1.7: ADANJEE WOOD PROCUREMENT AND PROCESSING DATA
(Reference 15)

c) Average cost per ton delivered at the mills.

Price paid to the farmer	Rs.625.00	p-ton (Rs.25/maun
Freight (Truck) charges	112.50	")
Attack District Export Tax	41.50	") Rs.7/maund
NWFP Import Tax	27.00	")

Green wood (logs) delivered
at the mills Rs.806.00 per ton
(Rs.32.25/maund)

d) Cost of debarked wood

Green wood at the mills	Rs.806.00	per ton
Debarking cost -as paid to labour	70.00	
	<u>Rs.876.00</u>	
<u>Less</u> recovery by sale of bark	<u>29.50</u>	

Cost of debarked wood(green)Rs.846.50 per ton

e) Cost of Euca.wood(green logs) per ton of pulp.

Wt.of green wood per od ton of pulp	- 8 tons
Cost " " " at the mill	-Rs.806 per ton
Cost " " " per od ton of pulp	-Rs.6448

D. Comparative data for other fibre sources

Raw Material Type	Rate for green raw material Rs./ton	Cost of green raw- material per ton of o.d. Pulp/Rs.
Euca. wood	806	6448.
Kahi grass	400	1800
Berweza grass	730	2560
Bagasse	a) 560	4200
	b) 260	1950
Wheat straw	815	2850
Waste cotton	1750	3850

APPENDIX 2.

LABORATORY PULPING

- 2.1 Adamjee Data**
- 2.2 Proposed Work**

APPENDIX 3.

MILL TRIAL

- 3.1** **Adamjee Data**
- 3.2** **Preliminary (Exit) Report**
- 3.3** **Adamjee Comments**
 H. Raffiudin

APPENDIX 4.
FARMERS FIELD DAY DATA

Farmer's Field Day
Adamjee Paper and Board Mills
January 9, 1991

- 10:30- Farmers arrive at Plant
Opening introductions and welcome - M. Rafiuddin
General Manger
- 10:45- Discussion of the paper making process- M. Rafiq
Chief Chemist
- 11:00- Begin tour of plant facilities
- Wood yard
- Chipping demonstration
- Pulp digester
- Chemical process
- Paper process
- 12:30- Lunch
* Introduction of Federal Minister for Food, Agriculture &
Cooperatives.
* Introduction of Inspector General of Forests -
Presentation of Awards
- 1:30- Open discussion of marketing of eucalyptus and poplar for
paper pulp.
- 2:30- Adjourn

*These introductions will be made whenever the Minister
arrives. He is cordially invited to join the tour of the
facilities upon arrival.

APPENDIX 3.

TERMS OF REFERENCE

APPENDIX 2.1: ADAMJEE DATA

ADAMJEE PAPER & BOARD MILLS LTD, NOWSHERA.

TABLE NO. I-a

Laboratory Scale Pulping trials on Eucalyptus Wood
(sample collected on 18-12-1990)

Cooking Process Cook No.	Soda Process		Neutral Sulphite	Bi-Sulphite	
	1	2	3	4	
<u>COOKING</u>					
AD Wt of Raw Material	g	1792	2241	2222	2222
OD Content	%	66.9	66.85	54.0	54.0
OD Wt. Raw material	g	1200	1500	1200	1200
% Na ₂ SO ₃ added on OD RM	%	-	-	18	18
% NaOH	%	23	25	7	-
Cooking temperature	C ^o	170	170	170	170
Time on "	Hrs.	3.5	3.5	3.5	3.5
Liquor ratio	Ratio	1:4.5	1:4.5	1:4.5	1:4.5
Residual Na ₂ SO ₃	%	NIL	NIL	NIL	NIL
" NaOH	%	"	"	"	"
<u>CRUDE YIELD</u>	%	42.4	46.29	The Pulp was hard and could not be further processed	The Pulp was hard and could not be further processed
<u>SCREENING</u>					
Losses (i) on OD Pulp	%	6.08	9.08		
(ii) " RM	%	2.40	4.05		
Rejects (i) " Pulp	%	3.44	2.99		
(ii) " RM	%	3.33	1.33		
YIELD after Screening/ EXAMINING on OD RM	%	40.0	42.34		
Kappa Number	No.	34.0	25.9		

G.WIRE CO.

APPENDIX 2.1: ADAMJEE DATA

ADAMJEE PAPER & BOARD MILLS LTD, NOWSHERA

TABLE NO.I - b

Laboratory Scale Pulping trials on Eucalyptus Wood
(Bleaching of soda Cook Pulp)

<u>Description.</u>	<u>Unit</u>		
Cooked with NaOH on OD Raw Material	%	23	25
%age Ca-Hypochlorite added.	%	10	10
OD pulp taken for Bleaching	g	20	20
Consistency maintained	%	5	5
PH "	-	(Above - 10)	
Temperature	C°	(40 - 45)	
Bleaching time	Hrs.	3	3
Bleach exhaust time	"	1.5	2.0
Residual bleach	%	Nil	Nil
Bleach consumed on OD RM	%	100	100
Losses during Bleaching	%	2.0	2.0
Bleached Yield on OD RM	%	38.0	40.24
Brightness	GE°	66	73

MR/JA

APPENDIX 2.1: ADAMJEE DATA

ADAMJEE PAPER & BOARD MILLS LTD, NOUSHERA

TABLE NO. II

Physical Properties of Eucalyptus
Wood Pulp (Lab. Cooked)

		<u>cooked with 25% NaOH</u>				<u>cooked with 25% NaOH</u>			
		0	15	30	45	0	15	30	45
Beating time	Min.	0	15	30	45	0	15	30	45
Drainage "	Sec.	5	7	10	18	6	7	10	14
Degree of Beating	SR ⁰	18	25	41	59	17	27	38	52
Grammage (OD)	g/m ²	61.0	63	62	62.5	64	64.5	63	60
Thickness	micrometers	184	152	122	100	180	142	110	90
Bulk	-	3.01	2.41	1.96	1.60	2.81	2.2	1.74	1.50
Bursting strength	kg/cm ²	0.61	1.63	2.51	2.87	0.406	1.82	2.22	2.485
Burst Factor	-	10	26	40.5	46	6.3	28.2	35.3	41.4
Tearing strength	g	18	33	37	36	14	35	34	29
Tear Factor	-	29	52	60	57	22	54	34 54	48
Tensile strength	kg/15 mm	1.66	4.39	5.97	6.72	1.51	4.45	4.82	5.24
Breaking length	Metres	1830	4630	6420	7170	1574	4600	5100	5820
Folding Endurance	D/Fold	2	26	242	251	2	59	81	124

MR/JA

G. WIRE CO.

APPENDIX 2.1: ADAMJEE DATA

Adamjee Paper & Board Mills Ltd, Nowshera.

TABLE NO. III

Comparative Pulp data and physical properties of Fibers from various raw materials (Laboratory Tests)

Raw Material	Unit	Kahi Grass	Begasse	Wheat Straw	Waste Cotton	Poplar	Eucalyptus
Na ₂ SO ₃ on OD RM	%	12	10	13	-	-	-
NaOH " " (as NaOH)	%	5	3.5	5	10.5	25	25
Temp	C°	170	170	170	160	170	170
Time on Temperature	Hrs.	3.5	3.5	3.5	7 After	4	3.5
Screened Yield	%	38.0	43.7	40.0	61.0 Breaking	46.0	42.24
Kappa No.	No.	18.4	21	20.3	-	19.0	25.0
Brightness after Single Stage Bleaching with 10% Ca-Hypo as Av. Cl ₂	GE°	76.0	77.0	76.0	72.0	80.0	73.0
Brightness after 3 stage bleaching GEH	GE°	80.0	83.0	81.0	Not available	84.0	81.0
Bleached Yield	%	36.00	36.6	38.0	59.32	44.0	40.24

Strength Properties at 45 SR° (Interpolated Values) un-bleached Pulp

Beating Time	Min	27	22	25	11	42	38
Drainage "	Sec.	34	11	24	19	13	12
Bulk	"	1.72	1.78	1.58	2.00	1.28	1.62
Burst Factor	-	30	12.6	33	25	42	38
Tear Factor	-	43	30.0	47	230	45	51
Breaking length	Metres	4700	3100	6500	4600	7200	5400
Folding Endurance	D/Fold	30	7	70	170	27	10

M. RAFIQ
(CHIEF CHEMIST)

(N142)

APPENDIX 2.2: PROPOSED WORK

M E M O R A N D U M

DATE: 6-FEB-91

PAGE 1 of 2

TO:

NAME: Chuck Hatch

COMPANY: Winrock International
Pakistan Forestry Research & Development Project
Petit Jean Mountain
Morrilton, AR 72110

FROM:

Jerry Wire

REFERENCE: YR418-W1020602.M

SUBJECT: Pakistan Forestry Research & Development Project
Pulp and Paper Consulting

As I understood when I left, I would set about to carry out planning and library/preliminary investigation on E.C. sulfite pulping on a continuing consulting basis. This from my office and local resources; also to involve Wm T. McKean as associate. His up-dated AID 1420 sheet one is on the way.

The areas of investigation proposed are:

1. Sulfite process production of bleachable pulp from hardwood, particularly Eucalyptus and E. camaldulensis above pH of 3. (pH below 3 would excessively corrode plant equipment).
2. Use of catalysts in conjunction with 1. Use of small amounts Anthraquinone is known to catalyze pulping reactions, bringing about lower lignin content (easier, cheaper bleaching), better strength and better yields. This is used commercially.
3. Use of cations other than sodium, i.e. ammonia, MgO and potassium. Sodium really needs to be recovered for both economical and ecological reasons; this is not usually viable with small mills. Continued disposal per current Pakistani practice will become ecologically unacceptable (consult your soil scientists). The other cations are less of a problem and might be beneficial, especially ammonia. There are many factors to be considered here. We will get this lined up. Note, a 25 TPD KHSO3 mill is being proposed in B.C., Canada.
4. Practices to minimize chemicals wastage and harmful effluent will be reviewed, e.g., spent liquor recycle. This is common commercial practice.
5. Small scale recovery processes. There are (have been) small scale recovery processes, i.e. partial pyrolysis, fluidized pyrolysis, etc. These were employed prior to the '60s, when small mills were more common. In fact, there are interesting by-product possibilities, e.g. activated carbon, charcoal, road binder and others. (a large portion of U.S. activated carbon is by partial pyrolysis of pulping effluent).

. W I R E C O . U S A
M E M O R A N D U M

Chas. Hatch
Winrock/AID FR&DP

YR418-W1020602.M
Page 2

6. Most of this was prior to 1960. The literature is not available in Pakistan, or many other places for that matter. We have much if not most of it. But it will take a bit of time. Still, I think it very important and worth while for developing pulp and paper economies such as Pakistan. We already have a good handle on most of it.
7. Bill has other Eucalyptus pulping work underway, including camaldulensis from California. We, therefore have a synergistic situation here. We agree, that preliminary pilot work can be done in conjunction with this. The equipment is in place and methodologies standardized and known. All applicable tests can and will be carried out. There are serious omissions in all work I have seen. This will be done in such a way as to transfer to the Pakistani.
8. There are several pulp test procedures not carried out in Pakistan. These are important to both laboratory and commercial practice. I propose to assemble material and procedure such as to "cook-book" these. This will included the reasons, interpretation and application of the information to process and quality improvement. This is very important, since it can bring about substantial improvement in pulp strength, which in turn will enable greater reliance upon and ergo utilization of domestic straw and hardwood pulp.
9. All the above is product of a well planned, singular effort. It also will be fitting and beneficial subject for a pulp producer's seminar. The matter of carrying out more extensive laboratory work at UW and /or PFI could be dealt with later. I will favor preliminary work at UW to settle methodology, then transfer to PFI or other Pakistani, with occasional practices and results review (consultation). There also is some basic E.C.wood and chips mensuration data work needed. This could well be carried out by PFI. We will define this.
10. I also propose a general pulp and paper technology seminar for the FR&DP team, foresters, merchandisers and other non-industry personnel involved. Pulp wood quality, multi-uses and residuals, merchandising , trade practices and processing would be included.
11. I really don't see a great deal of time into this, neither of us have it. However, for sake of estimate, would say a total of 50-60 man-days plus some student labor (as much as possible) which would be at \$5.-10. per hour, mostly on the lower side. With phone, copies, and other expense, I would guess a cost of around \$25,000. based on my contracted rate with Winrock. Monthly review would keep this in line.
12. We are ready to proceed, upon receipt of authorization.

APPENDIX 3.1: ADAMJEE DATA

ADAMJEE PAPER & BOARD MILLS LTD. NOWSHERA

TABLE NO. IV

Plant Scale Pulping of Eucalyptus wood on 8th & 9th January 1991

Cook No. Description	Eucalyptus Wood (Purchased)		Eucalyptus wood (Own plantation)	
	1	2	3	
Cooking				
AD Wt. of Raw Material taken	M. Tons	8.898	8.898	8.720
Moisture content	%	46.0	46.0	46.0
Total OD Wt of Raw Material used	M. Tons	4.805	4.805	4.70
NaOH on OD Raw material	%	26	26	Ist Stage= 20 2nd Stage= *5
Na ₂ SO ₃ OD RM	"	-	-	Ist Stage= 5
Temperature	C ^o	170	170	170
Time on Temp	Hrs.	4	4	2
Ratio	Ratio	-	1:3.8	-
Kappa number	K _p	15.3	15.6	35
Bleaching				
I. Chlorination	%	7.0	7.0	7.9
II. Alkali Extraction	"	2.0	2.0	2.0
III. Ca-Hypochlorite	"	5.6	5.6	6.8
		14.6	14.6	16.7
OD wt. of Bleached pulp	M. Tons	- 3.648	-	1.608
Bld. Yield on OD Raw material	%	- 38.0	-	34.4
Brightness	GE ^o	- 77.0	-	77.0

* since the pulp was hard NaOH 5% was further added and cooked for one hour

APPENDIX 3.1: ADAMJEE DATA

ADAMJEE PAPER & BOARD MILLS LTD

Table No. V

Physical Properties of Eucalyptus Wood Pulp
(Plant Cooked)

		<u>Un Bleached Pulp</u>			<u>Bleached Pulp</u>	
Beating time	Min.	0	15	30	0	15
Drainage "	Sec.	5	7	18	7	17
Degree of beating	°SR	19	36	62	28	52
Grammage (OD)	g/m ²	62	61	65	64	62
Thickness	um	158	130	108	132	98
Bulk	-	2.55	2.13	1.66	2006	1.58
Bursting strength	kg/cm ²	0.157	1.749	2.572	1.518	2.198
Burst Factor	-	2.54	28.68	39.6	23.72	35.4
Tearing strength	g	23	34	36	38	30
Tear Factor	-	37	56	55	59	48
Tensile strength	kg/15mm	1.207	4224	6.012	3.25	5.20
Breaking length	Metres	1300	4640	6170	3390	5600
Folding Endurance	D/Fold	2	27	159	15	42
Brightness	GE°	-	-	-	76.5	73.5
Original Brightness	GE°	-	-	-	77.0	-

MR/JA

APPENDIX 3.1: ADAMJEE DATA

ADAMJEE PAPER & BOARD MILLS LTD. NOWSHERA

TABLE NO.VI

**Physical Properties of Writing Paper Manufactured
From Eucalyptus Pulp (Cooked in Plant On 9-1-1991)**

<u>Description</u>		<u>Paper from Eucalyptus Pulp</u>	<u>Normal Production</u>
Date of production	-	9.1.91	8.1.91
M/c Reel No	-	54 only	(46-51)
Std. grammage	g/m ²	58	58
Actual grammage	"	58.5	59.0
Bulk	-	1.42	1.40
Burst Factor	-	12.7	11.0
Folding endurance MD/CD	D/Fold	8/5	10.6
Tear Factor	"	43.6/47.9	47.4/50.8
Breeding length	"	Meters 4220/2320	4590/2820
Cobb Test	FS/WS	g/m ² 18/21	21/23
Bendtsen Roughness	"	mls/min 550/810	485/650
Brightness	GE ^o	72.5	70.5
Moisture content	%	5.2	5.1
Ash content	%	8.0	9.5
<u>Furnish</u>			
Bl. Eucalyptus	%	50	-
Bl. Lickerin	"	50	45
Bl. Grass	"	-	30
Spl. Cutting	"	-	15
Broke & Reject	"	-	10

GWC

PRELIMINARY REPORT
E. CAMALDULENSIS PULP & PAPER MAKING TRIAL

BY GERALD G. WIRE
PULP & PAPER CONSULTANT

Adamjee Paper & Board Mills carried out trial production of pulp and paper from Eucalyptus camaldulensis at its Nowshera, Pakistan mill January 8-9, 1991. About 35 tons of roundwood was purchased from six tree farmers. This was shipped to the mill in truck loads of 125 to 250 mounds from distances of 50km to over 135km. The wood supply was supplemented from Adamjee plantings adjacent the mill. The wood was hand debarked and chipped with a KMW chipper. Chips wet bulk was 400kg/cm; moisture was 46%.

The pulp was made by soda processing in the mill's rotary batch digesters. Satisfactory bleachable pulp was made from the first batch. It was CEH bleached to 76% brightness and was of satisfactory strength, cleanliness, and other characteristics. Production was without any extraordinary events such as excessive screenings, foam, washer difficulties, etc.

Writing paper was made on the fourdrinier paper machine from 50% Eucalyptus and 50% Licker-in (cotton) pulp plus normal additives as standard furnish for the grade. The changeover was made from standard furnish, without prior shutdown or washup. The change-over caused an immediate break at the wet end, probably from light weight; however, upon wet-end adjustments, paper went through the machine satisfactorily. Within about ten minutes it was on the reel. About 10 tons of paper were made, running at normal speed for the grade/weight. The paper produced was deemed of satisfactory quality, e.g. weight and brightness were at specification; mullin was 110% to 130% of specification.

Extensive evaluation of this trial is underway from both technical, manufacturing and commercial standpoints. A more substantial report will be available in the near future. However, Adamjee has indicated that the results are sufficiently satisfactory and commercially promising to continue and accelerate purchase of Eucalyptus as an added resource for pulp and paper manufacture.

We realize that Adamjee has certain unique circumstances and that aspects of this trial and processing may not be suitable to other Pakistani mills. Neither do we believe this to represent the best for optimum Eucalyptus pulp production. Still, these were good methods, and provide evidence of viability for the acquisition, shipping, handling and processing of this wood, within the existing mill facilities, and production of satisfactory product.

Congratulations go out to Adamjee management and workers, the farmers and truckers for a job well done. Our special thanks to Mr. A. H. Adamjee for his enthusiastic support enabling this pioneering trial.

This report is copied on a sheet of the paper produced.

A3.2

BEST AVAILABLE DOCUMENT

APPENDIX 3.3: ADANJEE COMMENTS

Cost of wood used during the pulping trial in January 1991 works out to Rs.6448, per o.d. ton of pulp, which is on high side. Our observations on the factors contributing to higher cost of wood and the areas where possibilities of reduction exist are briefly outlined below:-

- a) Cost paid to the farmer at his field was Rs.25/ maund or Rs.625/ ton which is high in view of high moisture content in the wood, varying from 50 to 60%. With bulk purchases, negotiations with the farmers and improvement on dry content, a price reduction upto 10% or Rs.62.50 per ton at the farm could be expected.
- b) Freight for the first truck was high at Rs.900 for the load, but later, with due negotiations, Rs.700/truck was paid as freight. Load per truck varied from 5 tons to 10 tons resulting in freight charges per ton ranging from Rs.70 per ton for the heaviest loaded truck to Rs.140 per ton for the light loaded truck. The average freight worked out Rs.112.50 per ton.

With education and experience of the farmers, it is likely that they load the truck properly with atleast 8 tons of wood. This may bring about a reduction of Rs.22.5 per ton of wood. However cost to the transporter at Rs.700 per truck is not likely to come down due to rise in cost of petrol/diesel oil. Fixing of delivered price with the farmer or middleman may also help in some saving in this area.

- c) Export tax from Attock District and import duty charged by the Forest Dept NWFP varied from consignment to consignment. A forceful representation to the concerned authorities for waiving of these levies is necessary but we are not very much hopeful for a positive result. Possibly, the average of Rs.68.50/ton paid for the trial purchase, may come down to Rs.40/ton, a reduction of 28.50/ton.
- d) No change in debarking charges is visualised.

APPENDIX 3.3: ADAMJEE COMMENTS

- e) Loss in weight due to bark averaged 15% while the loss during chipping due to dust, fines and slivers was as high as 17%. Obviously nothing can be done for saving on bark but with proper chipping operations, the losses on account of fines, dust and oversized slivers could be reduced from the present 17% to 10% and below. This will bring down the cost of green wood by at least Rs.42.50/ton.
- f) The pulp yield for the third cook of Eucalyptus wood from our own plantation was 32.4% which is too low due to low chemical dosing and getting a hard cooked pulp which should be ignored. The two digester loads from purchased wood yielded 38% of bleached pulp on 2 of chips which is also low. With more controlled cooking as well as subsequent washing / screening operations, it could be expected to achieve a yield of 42% on plant scale pulping. This will reduce the quantity of green wood for one of ton of pulp from 8 tons to 7.2 tons, bringing down to cost of green wood by Rs.80/- p.ton.
- g) Net impact of the above estimations is summarised below:-

	Cost of wood during trial Rs/ton	Likely reduction Rs/ton	Future Cost Rs/ton
Cost at the farm	625.00	62.50	562.50
Freight	112.50	22.50	90.00
Taxes	68.50	28.50	40.00
Improved chipping	-	42.50	-
	Rs. 806.00	Rs. 156.00	Rs. 650.00
Green wood per of ton of pulp	8.00 tons	0.80 tons	7.20 tons
Cost of green wood per of ton of pulp	Rs.6448	Rs.1768	Rs.4680

- h) Cost of pulp produced during the trial works out to Rs.21850/- which is high and obviously uneconomical. The two main factors responsible for the high cost are 1) cost of wood and

APPENDIX 3.3: ADAMJEE COMMENTS

ii) cost of cooking chemicals, which together constitute 76% of the total cost. It is therefore necessary to endeavour to bring about reduction in these areas.

i) While the useful work done on Farm Forestry under the Govt. of Pakistan / USAID Forestry Planning & Development Project in educating the farmers to grow Eucalyptus wood and the demonstration and trials on pulping of Eucalyptus wood in January 1991, at the Adamjee Hills, Nowshera, have shown the way leading to a workable feasibility for utilization of this wood, a follow up is essential to achieve the final objective of bringing the operations on economic level, acceptable both to the grower and the industry. It is significant to note that prices of wood pulp have crashed in the world market from around US\$ 900 per ton, down to below US\$ 600 per ton C&F Karachi for soft wood kraft pulp. Our recent purchase has been at US\$ 580 per ton which after duty and taxes, works out to Rs.21,000, landed at Factory site. Hence the local pulp produced from Eucalyptus wood should be competitive enough to make it more attractive.

j) The follow up, in our opinion should be on the following lines:-

i) Not only the plantation areas should be extended but the yield of wood per acre should be substantially improved.

ii) Processing technology at the pulp mills should be rationalized and developed in order to achieve optimum yield of pulp and improved physical strength of the fibres. In this connection we fully agree with the proposals from Mr.G.Wire, given in his Memorandum, dated 6th February 1991, addressed to Mr. C.R. Hatch of Winrock International, for further laboratory and pilot plant scale investigations.

MEMORANDUM
WINROCK INTERNATIONAL
FORESTRY PLANNING AND DEVELOPMENT PROJECT

DATE: 3 January 1991

TO: Jerry Wire

FROM: Charles R. Hatch
Chief of Party



SUB: Consultancy

Attached is a revised copy of a draft itinerary while in Pakistan and a copy of a revised scope of work. The itinerary indicates where you will be and when, who will be traveling with you from our office, and a description of your scheduled activity. All in-country travel arrangements have been made.

Given the recent change in events, we will need to do what is possible with respect to the seminar and written report on the pulping and paper making pilot test. We are excited about your assignment and are looking forward to this collaboration.

GERALD G. WIRE

EUCALYPTUS PULP AND PAPER TEST RUN WORKSHOP CONSULTANCY

(Revised 3 January 1991)

SCOPE OF WORK

1. Meet with the Inspector General of Forests, the Technical Assistance Team and USAID for an up-date on pulp and paper activities in Pakistan.
2. Perform the following services:
 - A. Assist in conducting a farmer's field day at Adamjee Pulp & Paper Mills. Nowshera;
 - B. Be in attendance at the Adamjee Pulp & Paper Mill during the test run of 50 tons of Eucalyptus wood, including both the pulping and paper making processes, to collect technical data and evaluate the results;
 - C. Prepare a video taped seminar to be presented at a workshop at PFI for Project Personnel and members of the All-Pakistan Paper Manufacturer's Association to present the results of this test run and discuss:
 - results of the operational trial,
 - opportunities, constraints and problems in pulping of Eucalyptus,
 - quality of the paper produced and its potential marketability, and
 - implications for the future of Pakistan's paper industry.
3. Within ~~two~~^{two} weeks of your departure from Pakistan, prepare a written report on the test run and other activities during this consultancy.

GERALD G. WIRE

DRAFT ITINERARY

4 Jan Fri	6:10	Arrive
5 Jan Sat	9:00 Rest of Day	Meet Abeedullah Jan, IGF Meet with Naughton and Hatch and prepare for the assignment.
6 Jan Sun	Morning	Travel to Adamjee Mill, Nowshera (With Naughton and Hatch)
	Afternoon	Meet with Adamjee Paper Mill personnel
7 Jan Mon	All Day	Prepare for Pulping Trials
8 Jan Tue	All Day	Prepare for Pulping Trials
9 Jan Wed	All Day	Farmer Field Day, Adamjee Paper Mill, Nowshera
10 Jan Thu	All Day	Pulping Trial
11 Jan Fri	All Day	Pulping Trial
12 Jan Sat	All Day Late	Pulping Trial
	Afternoon	Return to Islamabad
13 Jan Sun	All Day	Prepare and Video Tape Seminar Presentation
14 Jan Mon	Morning 12:30 18:45	Exit Seminar with GOP, USAID and TAT PK 311 To Karachi (Arrives 14:25). PK 760 To Bangkok
15 Jan	1:10 7:00	Arrive Bangkok NW 28 To Seattle (Arrives 8:40)

**Demonstration / Trials on Pulping of
Eucalyptus Wood**

6th January 1991

- a) Arrival of Mr.G.Wire and Mr.Gary G.Naughton.
- b) General discussions and planning of the pulping trials.
- c) Mr.Wire to study the plant and equipment available and the pulping conditions being practised.
- d) Laboratory scale pulping test Reports to be studied and to check the facilities available in the Laboratory for carrying out tests during plant scale trials.

7th January 1991

Pulping conditions for Eucalyptus to be specified particularly relating to the following:-

1. Quantity to be loaded per digester
2. Chemicals to be used
3. Liquor ratio
4. Time on Temperature
5. Bleaching conditions

8th January 1991

- a) Loading of wood chips to be started so that bleached pulp passes through the system and in Stock Preparation Section on the morning of 9th
- b) Stock to be transferred to SPP-II and then on Paper machine-II, with 50% Euca.pulp. Efforts should be made that paper with such furnish is on reel on 9th January when the visitors are around the mills.

N O T E: It should be so arranged that both the Machines are in operation