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KENYA .

Technical report: Development of the pulp and paper industry in Kenya
Part I: Summary*

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

Based on the work of T. Jeyasingam,
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United Nations Industrial Development Organization

* This document has been prepared without formal editing.

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ABBREVIATIONS

ADT	AIR DRY TON
ADTPY	AIR DRAY TON PER YEAR
BDT	BONE DRY TON
BL	BLEACHED
CEH	CHLORINE/CAUSTIC EXTRACTION/HYPO
CEHH	CHLORINE/CAUSTIC EXTRACTION/HYPO/HYPO
D.D.	DOUBLE DISC
FTPY	FINISHED TONS PER YEAR
GCV	GROSS CALORIC VALUE
GSM	GRAMS PER SQ.METER
KW	KILOWATT
KSHS.	KENYA SHILLINGS
M^3	CUBIC METER
MPM	METERS PER MINUTE
MM	MILLIMETER
MWH	MEGA WATT HOUR
NCV	NET CALORIC VALUE
OD	OVEN DRY
T	TON
TPD	TONS PER DAY
TPH	TONS PER HOUR
US$	US DOLLAR
WT	WEIGHT

EXPLANATORY NOTES

Value of the local currency - KENYAN SHILLING (K.Shs.) during the period of the mission in terms of United States Dollars:

1 US$ = 15.00 K.Shs.

ABSTRACT

This report presents the results, following the study of the market demand, growth rate and the availability of indigenous resources for the development of the pulp and paper industry in Kenya.

It is concluded based on this study the following projects are techno-economically feasible:

- Production of Fine Paper from Bagasse 30,000 TPY
- Production of Corrugating Medium from Straw 15,000 TPY
- Production of Hard Tissues from Sisal Waste 3,000 TPY
- Production of Hand Made Paper from Cotton Waste 70 TPY

It is recommended that serious consideration is given to implement the above projects.

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RECOMMENDATIONS

1. Intensive Afforestration of Species such as PINUS, CYPRESS, EUCALYPTUS AND GAMELINA is recommended.

2. Pulp and Paper mills should be encouraged to develop their own resources of wood supply.

3. Development of KENAF as a raw material for paper making is recommended in marginal lands not ideal for agriculture.

4. The market demand, growth rate and availability of resources both fibrous and non fibrous indicate the following projects are Techno-economically feasible:

- Fine Paper Mill from Bagasse - 30,000 TPY
- Corrugating Medium Mill from Straw - 15,000 TPY
- Hard Tissue Mill from Sisal Waste - 3,000 TPY
- Hand Made Paper Unit from Cotton Waste - 60 TPY

1.0 INTRODUCTION

Kenya currently has 5 paper mills operating with a total installed capacity of 85,600 TPY of paper and paper board. The afore-mentioned 5 mills have plans to expand to 125,400 TPY within the next 2 to 3 years.

The indigenous pulping capacity is only 58,000 tons of chemical pulp and 8,000 tons of mechanical pulp per year at PANAFRICAN PAPER MILLS, WEBUYE. Therefore, the other 4 mills depend mostly on waste paper for their fibre requirements. The supply of raw material for the PANAFRICAN PAPER MILLS is based on PINE AND CYPRESS from "Man-made plantations". There will be a further demand on this source of supply when the proposed MADHU PAPER MILLS at THIKA goes into production. This mill at THIKA will require wood to produce about 20,000 TPY of chemical pulp.

It is feared Kenya is heading towards a shortage of wood and in particular for domestic fuel requirements both in the form of firewood and wood charcoal. It is, therefore felt at this stage further planning of pulp and paper mills based on wood does not look promising with only 20% of the land area available in Kenya both for agriculture as well as forestry. On the other hand Kenya needs more paper. The demand for paper during the last 5 years has been growing at the rate of 5%. It is expected the future growth will be around 6 to 7%, with a high demand for cultural grades of paper on account of the growth in school going population.

The Department of Industries in the Ministry of Commerce and Industry sensing this problem, initiated the need for a study to look into the

aspect of using non-wood materials for pulp and paper manufacture. To conduct this study a pulp and paper expert was requested from UNIDO. He arrived on 9 November 1984 for a three-month assignment in Kenya.

The following reports therefore covers the investigations and study related to the use of non-woody raw materials for the production of pulp and paper and is made up into 5 parts.

PART I - Development of the Pulp and Paper Industry in Kenya

PART II - A Report on the Feasibility of Producing Fine Paper from Bagasse

PART III - A Report on the Feasibility of Producing Hard Tissues From Sisal Waste

PART IV - A Report on the Feasibility of Producing Corrugating Medium From Straw

PART V - A Report on the Feasibility of Producing Hand Made Paper from Cotton Waste.

2.0 BASIS OF STUDY

2.1 PRESENT STATUS OF THE PULP AND PAPER INDUSTRY

Five mills are currently operating in Kenya. The designed capacity of these mills, the actual performance today and the grades these mills produce are given below:

2.2 EXISTING MILLS AND AVAILABLE CAPACITIES

1. PANAFRICAN PAPER MILLS

- Location - WEBUYE (420 Km from Nairobi)
- Type and No. of Machines - 2 Fourdriniers (TRIM 4260^{mm})
- Original designed capacity - 45,000 FTPY
- Rebuilt designed capacity - 66,000 FTPY
- Actual performance today - 66,000 FTPY (Estimated
- Grades made - No.1 Machine (60-250) g/m^2
  Linerboard, Tetra Liner, MG Kraft, Bag Kraft
  No.2 Machine - (45 - 265 g/m^2)
  Printings, writings, Banks and Bonds, Duplicatings Xerographic, pulp board covers and newsprint
- No. of employees - 1670
- Raw Materials used:- - Pinus Patula, Pinus Radiata Cyprus Lusitanica and Eucalyptus Regnans

2. MADHU PAPER MILLS

- Location - NAIROBI
- **No. of machines** - 3 Machines
- Original designed capacity - 12,000 FTPY
- Actual performance today - 38% to 40% of designed capacity
- Grades made - Toilet Tissue and other soft tissues on No.1 and 2 machines. [illegible]

- No. of employees - NA
- Raw Materials used - 50% Imported wood pulp and 50% waste paper

3. KENYA PAPER MILLS

- Location - THIKA (40 Km from Nairobi)
- No. of Paper Machines - One Fourdrinier
- Existing Capacity - 5,000 FTPY
- Actual Performance - 5,000 FTPY
- Proposed Rebuilt Capacity - 6,500 FTPY
- Grades made - Envelope paper, MG wrappings Kraft Liner Corrugating medium (Bais wt Range 140 to 160 g/m^2)
- No. of employees - 168
- Year of start up - 1957
- Raw Material - 100% waste paper but planning to use about 25% straw pulp using the available spherical digester presently idling

4. HIGHLAND PAPER MILLS

- Location - ELDORET
- No. of paper machines - One Machine (Cylinder/ Vat) with 3 Cylinders (TRIM 1370 mm)
- Designed Capacity - 2,000 TPY
- Actual performance - 500 TPY
- Grades Made - Grey board and chip board (300 to 600 g/m^2)
- Raw material - The mill was originally designed to produce straw pulp and produce straw board. Now it is producing the boards from 100% waste paper.

5. KENYA MATCHES

The Eldoret Agricultural Paper Mills was purchased by Kenya Matches and the equipment has been reinstalled at KISUMU.

- Location - KISUMU
- No. and Type of machine - One machine with single cylinder/vat (TRIM 1370 mm)
- Existing Capacity - 600 TPY
- Rebuilt Capacity - 2400 TPY
  The machine is to be rebuilt shortly adding 2 more forming cylinders and one MG Cylinder for the dryer group.
- Grades Made - Wrapping paper and after rebuilding Duplex and TRIPLEX BOARD.
- Raw material - 100% waste paper. After rebuilding waste paper, straw and bagasse.

SUMMARY OF AVAILABLE CAPACITIES AT EXISTING MILLS

	DESIGNED	ACTUAL 1984	REMARKS
- PANAFRICAN	66,000	66,000	Capacity fully utilized
- MADHU	12,000	4,500	38% of Available Capacity
- KENYA PAPER	5,000	5,000	Capacity fully utilized
- HIGHLAND PAPER	2,000	500	25% of available capacity
- KENYA MATCHES	600	-	Presently doing trial production
TOTAL	85,600	76,000	

2.3 NEW PROJECTS AND ADDITIONAL CAPACITIES

The existing designed capacity of the 5 Mills in Kenya as given above amounts to 85,600 Tons. This available capacity would be further increased by the following projects:

1. MADHU PAPER MILL (THIKA)

This will be a new mill at THIKA (40 Km from Nairobi) and the second mill of Madhu will produce the following:

- 20,000 TPY of Bleached Wood Pulp
- 20,000 TPY of Folding Box Board

Status of Project: The mill is projected to be in production by August 1986.

2. PAN AFRICAN PAPER MILLS (WEBUYE)

PPM has just completed expanding from 45,000 TPY to 66,000 TPY by rebuilding machines I and II under Phase I and Phase IA which are as follows:

PHASE I - Production raised from 45,000 to 60,000 TPY of paper with capability to make news-print with imported mechanical pulp.

Status of Project - Already achieved

PHASE IA - Production raised from 60,000 to 66,000 TPY of Paper

- Integration of a new Mechanical Pulping Unit of Capacity 8,000 TPY

Status of Project - Project completed and mechanical pulping unit getting into commercial production.

PHASE II - Addition of No.3 Machine to manufacture Bleached grades 70 to 80 TPD (22,500 TPY)

Status of Project - Under planning stage

Phase II A - Increasing the pulping capacity by 22,500 TPY to suit No.3 Machine requirements

Status of Project - Under planning stage

3. KENYA PAPER MILLS (THIKA)

The existing capacity of 5,000 TPY is planned to be increased to 6,500 TPY. This will be achieved by rebuilding the existing single foudrinier machine.

Production of straw pulp 1500 TPY and to be blended with waste paper to produce corrugating medium.

Status of Project - Under planning stage.

4. HIGHLAND PAPER MILLS

The mill was originally designed to make yellow straw board but due to a change in market trend the mill is getting geared to produce grey chip board and white lined chip boards.

No increase in production capacity only changes to bring about a change in grade and quality. Also planning on using cotton waste to produce bleached pulp for white lined chip board.

5. KENYA MATCHES (KISUMU)

The ELDORET AGRICULTURAL PAPER MILLS now installed at KENYA MATCHES in KISUMU will be rebuilt and improved. The rebuilding will include 2 additional cylinder formers and MG Cylinder. It is expected the rebuilt capacity would be 2,400 TPY.

Status of Project - Rebuilding is in progress

SUMMARY OF ADDITIONAL CAPACITIES

THROUGH NEW MILLS REBUILD AND EXPANSIONS

	Existing Actual Capacity 1984	Future Capacities
PAN AFRICAN	66,000	82,500
MADHU	12,000	32,000
KENYA PAPER	5,000	6,500
HIGHLAND PAPER	2,000	2,000
KENYA MATCHES	600	2,400
TOTAL	85,600	125,400

2.4 MARKET

The population of KENYA is about 19 Million and the per capita consumption of paper and paper board is about 4.15 Kg. The market requirements presently is around 79,000 TPY. The growth rate in demand for paper and paper products based on the statistics of consumption has been averaging at about 4½ to 5%. The population growth has been a major factor contributing to this demand since this growth has been about 4%. It is expected the paper demand would increase from the present level to about 6% particularly on account of the increase in the school going population and the emphasis given by the Government to education.

One of the factors restraining the growth rate is the exhorbitant price of Imported paper at the consumer point. Some spot checks were made and found the following:

[illegible] GRADE	[illegible] PRICE (CONVERTED [illegible])	[illegible] INTERNATIONAL PRICE (CONVERTED [illegible])
- DRAWING CARTRIDGE	KShs. 31,500 ($2115)	$ 2,100
- LEDGER	261,857 ($17,857)	$ 2,500
- ONION SKIN TISSUE	372,000 ($24,786)	$ 2,750
- CREPE PAPER AS CONVERTED TISSUE	802,000 ($55,444)	$ 5,000
- AIR MAIL	150,000 ($12,024)	$ 2,500
(CONVERSION RATE USED)	1 US $ = KSHS.15/-	

The above prices are extremely high for the consumer as could be found by comparing with international prices. There is at present a 45% duty for most of these grades. Even after allowing for the duty, internal transport, paper merchants profit, etc, it could be found the consumer is forced to pay an extremely high price. If the prices are more realistic the consumer demand could bring a growth of about 7% to 8%.

It is recommended in Parts II, III, IV and V of the study that some of the above imported goods should be substituted by using indigenous raw materials. This should benefit the consumer as most of these grades could be made locally at 1/4 to 1/5 of the imported paper price.

2.5 DOMESTIC PRODUCTION (BY GRADE)

The grades of paper that are presently produced for the domestic market by the paper mills in Kenya are as follows:

PANAFRICAN (Bleached grades)	Tons
- OFFSET PRINTINGS	4,500
- NEWSPRINT	7,300
- BANKS AND BOND	4,600
- MANIFOLD	1,000
- XEROGRAPHIC	1,100
- DUPLICATINGS	2,300
- WRITINGS AND PRINTINGS	6,600
- PULP BOARD	1,800
- BL. [illegible] KRAFT	2,000
- COLOURED MANILLA	1,000
	32 200

[illegible]	TONS
- LINER BOARD	9,100
- SACK AND BAG KRAFT	14,000
- CORRUGATING MEDIUM	6,500
- TETRA LINER	4,500
	34,000

MADHU PAPER	TONS
- TOILET TISSUES	3,000
- WRITING & PRINTINGS	1,500
	4,500

KENYA PAPER		
- CORRUGATING MEDIUM	-)	
- ENVELOPE PAPER	-)	
- NG GRADES	-)	
- WRAPPINGS	-)	5,000
		5,000

HIGHLAND PAPER		
- GREYCHIP BOARD AND WHITE LINED CHIPBOARD	-	500
		500

KENYA & MATCHES	
- WRAPPINGS	600

2.6 IMPORTED PAPER (BY GRADE)

The following grades are presently imported into the country:

- COATED GRADES	-	600 TONS
- PARCHMENT AND GREASE PROOF	-	650 TONS
- WRITINGS (SPECIAL GRADES) AND AS CONVERTED PRODUCTS	-	1,500 TONS
- HARD TISSUES, CIGARETTES, TEA BAGS, ONION SKIN	-	250 TONS
- ASPHALT TREATED PAPER	-	150 TONS
- CARBON PAPER		100 TONS
		3,250 TONS

2.7 DEMAND FORECAST

The market demand in terms of grades are as per Table given below:

PRESENT DEMAND OF PAPER AND PAPER BOARD BY GRADES (DOMESTIC AND IMPORTED)

	DOMESTIC PROD.1983	IMPORTED 1983	TOTAL
- WRITINGS AND PRINTINGS	22,600	1,500	24,100
- NEWSPRINT	7,300	-	7,300
- KRAFT GRADES (UNBL)	27,100	150	27,250
- CORRUGATED MEDIUM	8,100	-	8,100
- BOARD (SOLID, DUPLEX AND TRIPLEX)	7,900	600	8,500
- SOFT TISSUES	3,000	-	3,000
- HARD TISSUES	-	250	250
- OTHERS	-	750	750
	76,000	3,250	79,250

Based on a projected growth rate of 6% per year and assuming all the projects contemplated are pushed through to execution the domestic production capacity of 125,400 TPY would be sufficient to satisfy Kenya's requirements upto the year 1992 as per Table given below:

DEMAND FORECAST (TPY)

YEAR	DEMAND PAPER AND PAPER BOARD
1984	79,200
1985	83,952
1986	88,989
1987	94,328
1988	99,988
1989	105,987
1990	112,346
1991	119,087
1992	126,232
1993	133,806
1994	141,835
1995	150,345

To meet the growing demand new projects will have to be planned out at this stage. The planning of new projects is particularly important to ensure raw material availability. This is all the more important for a country like Kenya which has only 20% of the land suitable for agriculture and forestry and therefore planning of the availability of indigenous raw materials either in the form of man-made plantations or agricultural residues need a good lead in time.

It should be also realized the time required to complete a paper project from planning stage to commercial production in a developing country generally averages 4 to 5 years due to various delays.

3.0 FIBROUS RESOURCES FOR PAPER PROJECTS

Theoretically speaking any material that contains fibrous cellulose which is basically found in all plants and trees could be used for the production of pulp and paper. But the commercial feasibility of making paper would hinge on technological and economical factors. Some materials which are ideally suitable technically are not economically feasible and visa versa. **It has been requested to examine a number of indigenous raw materials such as bamboo, agricultural resudues, etc.. The following paragraphs would therefore evaluate the techno-economic feasibility of using the existing indigenous raw materials for the development of the paper industry in Kenya:**

3.1 WOODY MATERIALS AND AFFORESTATION

Wood is still the preferred raw material for the paper industry because of its suitability considering both the technical and economic factors. It is therefore necessary to first examine the potentials of using this indigenous source of supply.

Kenya is reported to possess 1,210,200 Hectares of indigenous and mangrove forests. The man-made plantations of exotic species such as Pine and Cypress amounts to some 155,200 hectares making a total of 1,365,400 hectares of forest land equivalent to about 3% of the total area of Kenya. It is further estimated out of the 1,365,400 Ha of forest land a large portion of it is protective indigenous for Catchment and natural reserves amounting to 59%, another 15% is grasslands and bush leaving only 18% as productive indigenous and some 8% as man made productive both indigenous and exotic species. In other words 26% of the forest land area or 0.78% of total area of Kenya amounting to 355,000 Ha is expected to meet the various needs of the country. The demand is in the form of wood and lumber for applications such as building construction, plywood. structural fibre board, furniture, pulp and paper, telephone and electric posts, charcoal, firewood etc.

Meeting the requirements of 19 Million people with 355,000 ha of production forests is no easy task and the forest department is already under heavy pressure. It is feared Kenya is heading towards a shortage of fire wood for cooking. The Government of Kenya with the assistance provided by the Australian Government and the FAO has started a firewood plantation project in the semi arid zone of Kenya to grow Eucalyptus and Accacia species. This is only a demonstration project of 800 Ha to provide nursery plants and know how to the people living in the semi arid zone around MARIGAAT.

The only pulp mill of some significance in the country presently is PANAFRICAN PAPER MILLS as per details provided in the preceding paragraph. This mill depends for its production of 58,000 TPY of chemical pulp and 8.000 TPY of Mechanical pulp from man made plantations of PINES and CYPRESS. This mill has plans to expand and will therefore continue to depend on man made plantations for its future requirements.

A second pulp mill is projected, known as MADHU PAPER INTERNATIONAL. This mill will again draw its supply from the existing man made plantation of pines and cypress to produce 20,000 TPY of chemical pulp. A mill of this size has to again expand to be economically justifiable and therefore will continue to depend on forest plantations for its raw material supply.

Taking into consideration the present source of woody material supply for the existing mill and the demands for already projected new mills it could be said the supply is very much strained and it will not be advisable to depend on woody materials for the development of the paper industry from the forest department alone.

A new strategy is recommended where and when new mills are being developed, the mills themselves should develop their own resources of woody supply on the basis of paper mills operating in USA, Canada and Scandinavian countries. Even though the best land with high rainfall is in short supply, Kenya still has ample land suitable for

fast growing species of PINES, EUCALYPTUS and GMELINA on which paper industry could be further developed.

It is therefore recommended a scheme of Afforestation is undertaken to secure woody material supply to the paper industry.

3.2 BAMBOO

Bamboo is widely used for paper making in countries related to the Indian Sub Continent (i.e. India, Burma, Ceylon . Bangla Desh), China, Japan. Phillipines, etc. Although bamboo is technically suitable as a raw material, it is not a preferred material like wood for paper making on account of the following disadvantages compared to wood.

- Frequency of flowering and the forest dying off till it got re-established again. A high allowance has to be made in forestry taking the flowering cycle into consideration.
- Extraction is more laborious and difficult compared to wood
- More bulky and hollow involving a higher transport and handling cost
- Presence of silica in bamboo gives problems in the chemical recovery from black liquor

The extent of bamboo forests available in Kenya is estimated at 150,000 Ha.

Other than the general disadvantages referred earlier, the bamboo specifically under Kenyan conditions have the following drawbacks:

- Bamboo is growing at high elevation in areas which are also best suited for Pines and Eucalyptus. It is therefore better to grow these exctic species instead.
- The growth is scattered and the extraction is difficult on account of the terrain.

It should be however noted there is a new law that has come into effect prohibiting the cutting of bamboo. There are good reasons for introducing this law. The bamboo as mentioned earlier is only growing at higher elevations in the water catchment areas. It is therefore feared the cutting of bamboo would cause environmental problems resulting in soil erosion, poor water catchments etc. In previous years bamboo was allowed to be cut by the villagers to weave baskets and the consumption used to be about 3,701,000 rm. (1976 figures), and this dropped to 52,000 rm in 1982 with the introduction of the ban.

Based on all these factors it is no longer possible to consider bamboo as a raw material for the paper industry in Kenya.

3.3 PAPYRUS (CYPERUS PAPYRUS)

The name paper is associated with Papyrus but the method used in ancient times to produce this writing material is quite different to the method applied today.

However laboratory tests indicate it is technically feasible to make paper out of Papyrus if blended with long fibre pulp to give the adequate strength to run on the paper machine.

Inspite of the abundance of Papyrus in Southern SUDAN, UGANDA, RWANDA, this material has not found its use in the industry up till now. Studies were made for projects in SUDAN and UGANDA by the UNIDO but nothing materialized, by way of commercially operated mills', based on these studies.

The main difficulty connected with this material is related to the economics of harvesting, collecting and transporting this material from the river or lake to the mill site. The economics of harvesting a material that grows in land is quite different to a plant that grows in water. Furthermore, the application of Science and Engineering to develop an efficient mechanical harvester for an aquatic plant like Papyrus has not yet been perfected.

There is awareness of another project
where " [illegible] " commonly known as [illegible] is used by a paper mill. There were a number of problems related to the efficient harvesting and transport of [illegible] to the mills and [illegible] is a better material than PAPYRUS for the paper industry.

Taking all this into consideration PAPYRUS is not recommended for Kenya until such time a suitable mechanical harvester is developed that would most economically and without problems harvest PAPYRUS for paper making.

3.4 COTTON STICKS

Although technically speaking it is possible to make paper out of cotton sticks, this raw material has several drawbacks:

- the yield of pulp compared to wood and other well established materials such as bagasse is relatively low amounting to about 38% for unbleached pulp.
- Harvesting, Collecting and transporting is too expensive due to the bulky nature of the raw material.
- The strength properties of the paper is relatively poor.
- For making bleached grades of paper it requires more bleaching chemicals.

The major consideration above all these factors would be the threat to the cotton industry as well as other agricultural products due to the pests and insects that breed in the cotton sticks while on storage. For this reason some countries like Sudan have brought in legislation that requires mandatory burning or ploughing back of cotton sticks right in the field itself.

Based on another project elsewhere it could be also said the collection, handling and transport of this material as well as certain technological problems contributed to the failure of the project. It is therefore [illegible] considered as a raw [illegible]

3.5 COFFEE STICKS

There are no mills at present commercially operating in the world using coffee sticks. Here again although it may be possible to make some paper out of it technically speaking, the commercial production of paper out of coffee sticks appears to be doubtful. As pointed out in the case of Papyrus and cotton stick it is better for Kenya to stay with commercially proven raw materials such as bagasse, straw etc.

3.6 BAGASSE FROM SUGAR CANE (SACHARUN - officinarum)

Among the non wood fibre materials used in the paper industry, bagasse stand out foremost as a popular raw material. There are several countries that use this agricultural residue for the paper industry such as USA, Latin American countries, Cuba, Taiwan, Phillipines, India etc.

The most significant advantage in the use of this non-woody raw material is its availability at a centralized location and that is at the sugar mills. In consequence all the headaches normally involved in the collection, handling and transport of the bulky material is all handled by the sugar mills at no direct cost to the paper mill.

In Kenya, the area under sugar cultivation amounts to about 80,000 Ha (1983) and the quantity of sugar production annually is 350,000 TPY. This quantity is produced in the seven Sugar mills listed below:

Sugar Mills	Present Capacity (Tons of Sugar)	Future Capacity (Tons of Sugar)	Sugar Cane directly cultivated by Mills (Ha)	Sugar Cane supplied by private Farmers (Ha)
MIWANI	30,000	70,000	NA	NA
MUMIAS	175,000	210,000	3,800	30,300
NZOIA	44,000	60,000	NA	NA
EA MUHORONI	50,000	55,000	"	"
CHEMELIL	60,000	NA	"	"
SOUTH NYANZA	30,000	NA	"	"
RAMISI	15,000	-	4,000	2,400

It could be seen from the above table except for MUMIAS which has an average crushing capacity of about 7,000 TPD of Cane, the other sugar mills are too small with capacity of 2,000 TPD of cane and below.

It is therefore not possible for these small mills to provide the bagasse for paper making.

Bagasse is generally not available for the paper industry under normal conditions of design and conditions of a Sugar Mill. This in particular applies to old sugar mills where the main bulk of the bagasse is burnt in poorly designed boilers to generate steam for process use and power generation.

Therefore the conditions under which bagasse could be made available to the pulp and paper industry depends on the following:

1. Improved thermal efficiency in the sugar mill by means of which bagasse surplus is created.
2. Use of an alternate fuel to release the bagasse for the paper mill.

It is generally accepted both by the sugar industry as well as the paper industry that the converting values are as follows for bagasse replacement fuel:

1 Metric Ton Fuel Oil = 6 Tons of Fresh Bagasse at 50% moisture

1 Metric Ton Fuel Oil = 3 Tons of Fresh Bagasse on OD Basis

The above conversion rate is based on Fuel Oil of gross calorific value of 10,000 KCAL/Kg (18,000 BTU/lb).

If an 80% efficiency is assumed the actual heating value would be 10,000 x 80 = 8,000 KCAL/Kg.

It is also accepted by scientific as well as practical experience that fresh bagasse with 50% moisture has a gross calorific value of 2,300 KCAL/Kg.

50% moisture = 2,300 KCAL/Kg.

If the bagasse boiler operates at 58% efficiency when fired with bagasse containing 50% moisture, the actual used heating value would be 1,335 KCAL/Kg.

Therefore on the above basis the fuel oil replacement value would be calculated as follows:

$$\frac{8,000}{1,355} = \text{6 kg of fresh bagasse (50\% moisture content)}$$

The following arrangements are also made by the paper mill under a separate contract.

- The cost of electricity to operate the depithing, conveying and transport equipment etc.
- The rental of space for the above equipment for bagasse depithing, transport and storage.

The alternate method is not to have a separate contract but include the price in the premium discussed above.

It is also the responsibility of the paper mill to provide the following:

- Installation of all additional equipment for releasing the Bagasse from the Sugar Mill such as depithers, conveyors, bulk transport equipment storage and baling equipment.
- Equipment to return the pith to the boiler
- Any modification needed to the existing boiler
- Cost of improving the thermal efficiency at the Sugar Mills.

Since Mumias is the largest Sugar Mill in Kenya the economics of improving the thermal efficiency and obtaining surplus bagasse appears to be attractive.

The techno economics of setting up an integrated pulp and paper mill to produce 30,000 TPY of cultural

grades of paper such as writings and printings are discussed in part II of this report.

Besides the surplus bagasse at MUMIAS it is also planned to use the fibrous material from the Cane Tops which are presently wasted in the field.

3.7 SISAL (AGAVE)

Sisal-wood is a non-wood plant of the Amarillydaceae family. The agave genus covers more than 250 species. The most common are Agave Sisalana, A. Perrine or A. Rigida.

The sisal plants introduced in 1903 into Kenya were of A. Sisalalana species. This is the most common variety in Kenya. In addition to this variety Kenya has a hybrid variety known as 11 648 produced from a breeding programme using A. Augustifolia and A. Amaniensis and this is widely grown in the lower altitudes.

Sisal has a productive period of 4 to 6 years and produces about 180 to 240 leaves. When there is 3 Meters between rows there are 5,000 plants per hectare. If the distance is 4 metres there are 4000 plants per hectare.

The statistics for Sisal Production in Kenya are as follows for 1983:

- Area under Sisal at the end of 1983	-	48,850 Ha
- Area cut during 1983		1,562 Ha
- Area planted during 1983	-	2,750 Ha
- Total Sisal production	-	49,700 Tons
- Production per Ha	-	1.03 Tons
- Average price per Ton	-	$ 410
- Small holder production	-	21% of total

T. al pulp has special characteristics such as high bow strength, high porosity, high width and folding endurance. Because of these special properties, this could be used to make special high quality grades of paper such as tea bag paper, Cigarette paper, Carbon tissue, bible paper, special air mail bond. The technoeconomics of producing 3,000 TPY of special grades of pulp fibres either in the Coastal Province or the Rift Valley Province where there is a concentration of sisal estates is examined under Part 3 of this Report.

3.8 COTTON LINTERS AND TEXTILE WASTE

Cotton Linters are the short fibres that remain in the cotton seed after the staple long fibres have been removed by ginning. In a Linting Mill after the ginning operation, special cutting saws are used to cut the remaining lint from the cotton seed. The lint that is cut is then graded as first cut, second cut and Mill run. The Lint thus graded could be used by the paper industry to manufacture speciality grades of paper.

Cotton Content paper has a special value in the market since cotton is considered as the purest form of cellulose, and therefore produces the highest quality of paper. Cotton fibre is therefore applied to grades that require durability and high strength such as legal records, bank notes, stock and Academic certificates and high quality writing paper.

Kenya has 15 ginning mills scattered all over the country and the operation is so small it is considered uneconomical to set up a Linting Mill in a centralized location to seperate the linters before sending the cotton seed for milling to extract the oil. In fact about 1/3 of the oil is presently getting wasted due to the fibres absorbing the cotton seed oil and the presence of fibre therefore has a negative influence to the oil miller.

Kenya produces 40,000 to 50,000 bales of cotton per year with an average weight of 165 Kg. per bale equivalent to 8,300 TPY of cotton. About 4% of this cotton remains on the seed as lint and this amounts to only 330 tons of cotton lint from all the 15 ginning mills. It is therefore uneconomical to set up a linting mill and from this available linters to produce paper based on today's technology.

It is however, possible to set up a hand paper making industry based on cotton waste that results in the ginning, spinning and weaving operations.

The techno-economics of such a proposal is examined under PART IV of this report.

3.9 SAW MILL WASTE

It is possible to use saw mill off cuts and saw mill waste to produce paper. In Kenya there are 35 Saw mills in operation. The majority of these mills are under 1,400 m^3/year capacity, 33% of these mills are between 1,400m^3 and 2,800 m^3 and only 3 mills of about 5,600 m^3/ year and above. These mills are scattered and collecting and transporting the waste for processing into pulp is not at all economical. It is also not possible to use this waste, as the rural folk living around these saw mills depend on this waste as fuel for cooking.

3.10 STRAW

There are several pulp and paper mills around the world operating on straw:-

In Europe	-	Holland, Spain, Denmark, Italy, Bulgaria, Hungary, Poland, Romania, USSR, etc.
In Asia	-	India, Ceylon, Korea, Phillipines, China, Taiwan
In Africa	-	Egypt
In South America	-	Mexico

It is possible to use the straw in Kenya to produce paper both from wheat straw and rice straw. The statistics as per tables given in the Statistical Abstracts of Kenya (1983) shows 234,748 Tons of wheat and 38,640 Tons of rice were produced in Kenya. This amounts to approximately 540,000 Tons of wheat straw and 58,000 Tons of Rice straw, making a total of 598,000 Tons of straw. It is possible to make 209,000 tons of paper/year from this quantity of straw, if this quantity could be collected efficiently.

Unfortunately for Kenya the area under cultivation is scattered and in small holdings and it is not possible to economically collect the straw for feeding paper mills of todays standard and capacity.

However with the development of the LOWER TANA Development Scheme the TANA Development Authority will have 16,000 Ha of rice under cultivation all in one location and under one authority. This makes it possible for the operation of a mill around the GARSEN Area.

The techno-economics of producing 15,000 TPY of corrugating medium using the straw that would be available in the GARSEN area is examined in PART 4 of this Report.

There is also a possibility to use the wheat straw in the NAKURU area to produce wrapping and corrugating medium grades for a small scale production. The investigations made by experts on site reveals the new owners of the ELDORET MILL presently known as KENYA MATCHES in KISUMU have plans to utilize this source of supply for producing such grades of paper.

3.11 KENAF (HIBISCUS CANNABINUS)

Kenaf is a fast growing plant that thrives well in Tropical and Sub Tropical countries. It has been recently identified as an ideal raw material for countries that are in short supply of woody materials such as Conifers.

There is experience in developing this raw material to replace the imported long fibre wood pulp in SRI LANKA (Ref. Annex 3). Based on this experience it could be said KENAF could be developed in Kenya as a raw material for paper making.

In Kenya it should be possible for this material to be grown in Marginal lands not ideally suited for agriculture as well as in the coastal areas around GARSEN, MALINDI and RAMISI.

A further study on the potentials of KENAF as a raw material for the paper industry and as a substitute for woody materials is recommended.

3.12 WASTE PAPER

Waste paper is collected and used by the following Mills in Kenya:

- Kenya Paper Mills
- Madhu Paper Mills in Nairobi
- Highland Paper Mills
- Kenya Matches

The basic data concerning these mills and their respective capacities have been discussed already in the preceeding paragraphs.

About 10,000 tons of waste paper is recycled which is approximately 12.6% recovery rate. It may be possible to intensify the collection and increase the recycling rate to about 20 to 25%.

4.0 NON-FIBROUS RESOURCES FOR PAPER PROJECTS

4.1 WATER SUPPLY

Water supply is another important consideration in locating a mill, and both the quantity and quality requirements must be satisfied. The quantity required will depend on the type of process, the grade and the capacity of the mill. This will be discussed in detail

under each project. In respect of quality the TAPPI standard is normally followed which is given below:

TAPPI SPECIFICATIONS

-	Turbidity as SiO2	- Max. PPM -	25
-	Color in platinum Units	- " -	5
-	Total Hardness $CaCO_3$	- " -	100
-	Calcium Hardness as $CaCO_3$	" -	50
-	Alkalinity to MO as $CaCO_3$	" -	75
-	Iron as Fe	- " -	0.1
-	Manganese as Mn	- "	0.05
-	Residual Cl_2 as d_2	- " -	20
-	Silica Soluble as SiO_2	" -	20
-	Total dissolved Solids	- " -	250
-	Free CO_2 as CO_2	- " -	10
-	Chlorides as Cl	- " -	50
-	Magnesium hardness as $MgCo_3$	- " -	50

Once it is decided to go ahead with the project, sample of water must be taken and analysed for each project specified under PARTS II, III, IV and V.

4.2 STEAM SUPPLY

Steam is required both for pulping as well as paper making. Recovery of chemicals and heat will be practised only in the case of Mumias pulp and paper mill, based on bagasse. In addition co generation is also proposed at the mill to generate both steam and electricity and share it with the Sugar Mill. The details are discussed under Part II of the Report.

The hard liner mill based on Sisal pulp will have a simple oil fired package boiler. The corrugating Medium Mill at Lower TANA Basin will also have a simple oil

fired package boiler. The details of capacities are given under the respective projects.

4.3 POWER SUPPLY

The power supply for the proposed MUMIAS MILL will be both by mill generation as well as by purchase from the National grid. The Hard tissue Mill will obtain power from the grid and the corrugating Medium Mill will purchase Hydro power from the Lower Tana Basin Authority.

5.0 OTHER FACTORS

5.1 EFFLUENT DISPOSAL

The water discharged back into the receiving waters will receive adequate treatment to protect the environment and satisfy the standards enforced in the country. In the case of the corrugating medium mill in LOWER TANA the waste water would be either used for irrigation to grow KENAF or other field crops on the West bank or in the alternative it would be piped down into the Indian Ocean at a suitable distance from the coast.

The hard tissue mill and the Hand made paper mill will also use the water for irrigation. The MUMIAS mill will have a complete treatment works before discharge into the accepting water.

5.2 TRAINING

The technology chosen would be so adapted to meet the skills of the local personnel both for operation as well as maintenance. In certain types of operation such as Hand made paper and the manufacture of speciality grades of paper such as Tea bag paper, Cigarette Tissues, Years of experience and craftmanship is required. The mastery of these skills can come only by years of experience, but a beginning must be made, without keeping away from it. Training for such operations would be provided both in a host country as well as locally through on the job training by UNIDO experts who could provide the know how for a specified period of time.

The manufacture of corrugating medium is not very difficult and thepersonnel to operate the machines and equipment could be obtained locally. However, experts would be provided for a limited amount of time to give the training for the initial period of start up and commercial operation.

The skills needed for the Bagasse mills need training overseas which has to be further supplemented by 'on-ghe-job training'.

5.3 TRANSPORT

As far as possible sites would be chosen which will have both road as well as the rail link. In the case of the LOWER TANA BASIN where there is no rail facility, field studies would be conducted to determine whether barge transport would be possible from the Indian Ocean up the river TANA to the mill site. The same would apply to the Mill site for HARD TISSUES up the river GALANA.

6.0 SUMMARY OF PROPOSED PROJECTS

To summarize, the survey of the fibrous and non fibrous resources of Kenya indicate the following projects are Techno-Economically feasible subject to a further detailed study:

(1) FINE PAPER MILL (Writings, Printings and Machine Coated Grades)

Capacity - 30,000 TPY from Bagasse pulp.

(2) HARD TISSUE MILL (Writing and Printing Tissues, Airmail, Carbonizing, Wrappings, Cigarette and Tea Bags)

Capacity - 3,000 TPY from Sisal waste and Sisal Fibre

(3) CORRUGATING MEDIUM (FLUTING PAPER MILL)

(Corrugating Medium and Inner Liner Board)

Capacity 15,000 TPY from Straw.

(4) HAND MADE PAPER (SPECIALITY GRADES) Certificate Paper, Drawing Paper, Invitation Cards).

Capacity 60 TPY from Textile Waste.

The Techno-Economic feasibility of projects identified are now given in PARTS II, III, IV, and V, of this Report.

NOTE:

A preliminary discussion was arranged by the Head of Projects Division (Department of Industries) where the expert was given an opportunity to discuss the findings of his mission. The details of the meeting held and the response of the expert to problems raised are provided in Annex 2 of this Report.

AGRICULTURE

Source: Statistical Abstract of Kenya (1983) Page 100

PRINCIPAL CROPS

Production for Sale, 1976-1983

Table 75

'000 Metric Tons

	1976	1977	1978	1979	1980	1981	1982	1983*
Wheat	136·3	169·9	165·9	201·0	[illegible]	[illegible]	234·7	221·3
Maize**	564·7	424·0	236·3	241·7	217·9	[illegible]	571·3	591·3
Rice paddy	39·3	41·4	35·8	37·5	36·1	[illegible]	38·6	36·2
Pyrethrum extract	0·2	0·1	0·1	0·1	0·2	0·2	0·3	0·3
Sugar-cane***	1,652·7	1,888·1	2,349·2	3,147·6	3,072·2	3,312·0	3,107·7	3,000·0
Seed cotton	15·8	16·3	27·2	27·6	38·1	25·5	22·4	26·3
Clean coffee	80·3	97·1	84·3	75·1	91·3	93·7	88·4	85·0
Sisal	33·6	32·2	31·5	36·5	46·9	41·3	50·0	45·0
Tea	62·0	86·3	93·4	99·3	89·9	90·9	95·6	93·4

Source: National Cereals and Produce Board, Pyrethrum Marketing Board, Sugar Factories, Cotton Lint and Seed Marketing Board, Coffee Board of Kenya, Sisal Board and Tea Board.

*Forecast based on data available for the first two quarters of 1983.

**Deliveries to the Marketing Board only.

***Including cane delivered to the sugar factories for the production of white sugar.

PRINCIPAL CROPS

Average Prices to Producers, 1976-1983

Table 76

Sh. per 100 kg.

	1976	1977	1978	1979	1980	1981	1982	1983*
Wheat	120·30	133·33	133·33	143·64	163·36	166·67	187·53	225·44
Maize	76·59	88·89	77·47	88·89	95·37	100·00	107·74	150·00
Rice paddy	136·88	136·00	144·85	150·83	150·44	147·96	150·07	150·07
Pyrethrum extract	49,249·17	55,869·33	72,046·55	100,815·43	120,000·00	120,000·00	115,000·00	115,000·00
Sugar-cane	10·45	12·71	13·30	13·30	13·30	14·51	17·00	16·30
Seed cotton	208·58	238·26	315·30	328·14	331·23	340·87	351·94	369·54
Clean coffee	2,523·75	3,975·00	2,318·10	2,824·92	2,634·80	2,258·41	2,700·00	3,336·00
Sisal	262·58	306·43	282·42	373·17	423·14	411·96	503·26	511·00
Tea	1,056·93	2,149·20	1,583·20	1,356·69	1,591·10	1,772·34	1,940·78	2,234·86

Source: National Cereals and Produce Board, Pyrethrum Marketing Board, Sugar Factories, Cotton Lint and Seed Marketing Board, Coffee Board, Customs and Excise Department and London Tea Auctions.

*Forecast based on data available for the first two quarters of 1983.

LIVESTOCK

Purchases for Slaughter by Parastatal Bodies*, 1974-1982

Table 77

'000 Head

	1974	1975	1976	1977	1978	1979	1980	1981	1982
Cattle and Calves	159·5	134·1	228·5	158·1	68·0	67·7	85·9	91·2	75·3
Sheep and Lambs	11·3	25·8	12·8	11·2	11·6	20·1	6·2	7·2	11·4
Goats	6·5	7·2	1·6	5·1	10·4	2·0	2·6	1·3	3·2
Pigs									
Baconers	31·5	33·3	38·7	40·7	40·7	34·1	29·3	28·8	33·6
Porkers	4·5	4·8	3·7	4·0	7·1	8·5	6·2	4·0	2·1
Landers**	2·3	2·2	2·3	2·5	2·7	2·7	3·5	3·5	1·0
Total	38·3	40·9	44·6	47·2	51·0	45·4	39·9	36·3	36·7

Source: Kenya Meat Commission, Pig Industry Board and Uplands Bacon Factory Ltd.

*A small proportion of the purchases of the Kenya Meat Commission are sold to Tanzania or exported live.

FORESTRY AND FISHING

Source: Statistical Abstract of Kenya (1993) Page 116

Notes and Definitions

The table on timber production covers timber and other forest produce from forests controlled by the Forest Department. Timber cut on private farms and estates is excluded, and also a very small amount of timber issued free by the Forest Department. The amounts excluded in this way form only a small proportion of total production.

FORESTS*

Land Area, 1973—1982

(as at 31st December)

Table 90

'000 Hectares

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982†
Type of Forest**										
Closed										
Central Government	784	784	746	746	746	746	746	746	746	746
County Council	156	156	207	207	207	207	207	207	207	207
Total	940	940	953	953	953	953	953	953	953	953
Woodland										
Central Government	271	271	266	266	266	266	266	266	266	266
County Council	65	65	73	73	73	73	73	73	73	73
Total	336	336	339	339	339	339	339	339	339	339
Bamboo										
Central Government	128	128	124	124	124	124	124	124	124	124
County Council	23	23	26	26	26	26	26	26	26	26
Total	151	151	150	150	150	150	150	150	150	150
Grassland										
Central Government	162	162	157	157	157	157	157	157	157	157
County Council	49	49	47	47	47	47	47	47	47	47
Total	211	211	204	204	204	204	204	204	204	204
Mangroves										
Central Government	45	45	45	45	45	45	45	45	45	45
Total	1,683	1,683	1,691	1,691	1,691	1,691	1,691	1,691	1,691	1,691
Ownership**										
Central Government										
Gazetted	1,390	1,390	1,337	1,337	1,337	1,337	1,337	1,337	1,337	1,337
Other	17	17	1	1	1	1	1	1	1	1
Total	1,407	1,407	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,338
County Council										
Gazetted	293	293	354	354	354	354	354	354	354	354
Other	85	85	58	58	58	58	58	58	58	58
Total	378	378	412	412	412	412	412	412	412	412
Total	1,785	1,785	1,750	1,750	1,750	1,750	1,750	1,750	1,750	1,750
Private Forests	124	124	124	124	124	124	124	124	124	124

Source: Forest Department and Central Bureau of Statistics.

*Includes gazetted forest areas only.

**Excluding private Forest Land.

†Provisional.

ANNEX 1, cont.

Source: Statistical Abstract of Kenya (1983) Page 187

SCHOOLS

By Type, 1974–1982

Table 171

Number

	1974	1975	1976	1977	1978	1979	1980	1981	1982*
Primary	7,706	8,161	8,544	8,896	9,349	9,622	10,255	10,817	11,497
Secondary	1,019	1,169	1,268	1,473	1,773	1,721	1,785	1,904	2,131
Teacher Training ..	18	18	19	19	20	20	20	20	21
Technical (Secondary Schools)	10	10	13	13	15	16	18	18	18
Total ..	8,753	9,349	9,843	10,401	11,157	11,379	11,978	12,759	13,667

Source: Ministry of Education.

*Provisional.

PUPILS ENROLLED

By Type of School, 1974–1982

Table 172

Number

	1974	1975	1976	1977	1978	1979	1980	1981	1982*
Primary Schools ..	2,705,878	2,881,155	2,894,617	2,971,239	2,994,991	3,698,246	3,926,629	3,991,162	4,184,502
Secondary Schools ..	195,832	226,835	274,838	313,977	354,452	376,782	419,201	409,850	438,424
Teacher Training** ..	8,864	9,154	9,187	8,924	9,011	9,906	12,126	12,596	11,405
Technical	3,659	5,468	6,121	6,333	7,170	7,607	8,575	9,123	9,199
Total ..	2,914,233	3,122,512	3,184,763	3,304,083	3,365,527	4,092,541	4,362,318	4,412,731	4,643,630

Source: Ministry of Education.

**Primary Teachers Colleges.

*Provisional.

TEACHERS IN SERVICE

By Type of School, 1974–1982

Table 173

Number

	1974	1975	1976	1977	1978	1979	1980	1981	1982*
Primary Schools									
Trained Teachers ..	52,132	54,823	56,145	59,640	63,912	68,361	72,029	73,499	80,664
Untrained Teachers	26,208	31,284	32,929	30,124	28,134	24,401	30,460	37,412	34,430
Secondary Schools									
Trained Teachers ..	—	—	6,460	6,727	7,399	7,565	8,229	8,916	8,277
Untrained Teachers	—	—	4,978	5,969	6,887	7,336	7,687	8,110	8,571
Teacher Training Colleges									
Trained Teachers	671	601	639	661	683	692	732	694	720
Technical Secondary Schools									
Trained Teachers ..	—	—	—	—	329	343	390	276	343
Untrained Teachers	—	—	—	—	51	60	43	133	192
Total ..	79,011	85,708	101,151	103,130	107,295	108,758	119,450	129,040	133,197

Source: Ministry of Education.

*Provisional.

ANNEX 2

DEVELOPMENT OF THE PULP AND PAPER INDUSTRY IN KENYA

Presented by Jay T. Jeyasingam (UNIDO Expert) at the Meeting convened by the Industrial Promotion Department of the Ministry of Commerce and Industry (Industries Department) on January 8th, 1984.
Subjects scheduled to be covered:-

- Present Status of the Pulp and Paper Industry
- New Projects and Additional Capacities.
- Market Requirements
  Per Capita Consumption, Growth rate at present, future growth rate, Domestic supply and Imports to meet the existing demand
- Planning for Future Demand
- Where will the Raw Material come from for the future development of the industry?

  An examination of the Indigenous Raw Materials on the basis of:-

  - Availability (Quantitatively)
  - Suitability (Technologically)
  - Acceptability (Economically)

in respect of the following:

Woody Materials
- Softwoods
- Hardwoods

Non-Woody (Plants)
- Bamboo
- Papyrus
- Kenaf

Non-Woody (Agricultural Residues)
- Bagasse
- Straw

Non-Woody (Waste Materials)

- Sisal Waste (Sisal Flame Tow)
- Cotton Waste (Ginning, Spinning, Weavings process)

Secondary Fibre

- Waste Paper
- Deinking Technology
- Recycling Rate

PROJECTS THAT COULD BE IDENTIFIED BASED ON THE EVALUATION OF INDIGENOUS RAW MATERIALS

Project 1	Production of Fine Paper from Bagasse at Mumias
Project 2	Production of Corrugating Medium in Lower Tana River Basin
Project 3	Production of Hard Tissues At Malindi or Naivasha (Malindi Preferred)
Project 4	Production of Hand Made Paper From Textile Waste at Thika and Eldoret or Kisumu

Choice of Technology

The need to apply appropriate technology to suit Kenyan conditions.

Energy

Energy Requirements and Energy Conservation Trend in the Paper Industry.

ANNEX 2, cont.

MINUTES OF THE MEETING ON THE PULP AND PAPER INDUSTRY HELD IN UCHUMI HOUSE CONFERENCE ROOM ON TUESDAY 8TH JANUARY, 1985 AT 2.30 P.M.

PRESENT:

1. Mrs. S. Alambo - Chairperson
2. Mr. S.S. Ali
3. Mr. M.F. Husny
4. Mr. T.F. Abela
5. Mr. J.T. Jeyasingham
6. Mr. F.M. Muraguri
7. Mr. C.G.M. Omao - Taking Notes.
8. Mr. G.M. Siika
9. Mr. K.R. Bikwetti
10. Mr. C.K. Charo
11. Mrs. J.C.A. Obiero
12. Mr. N.C.O. Owaga.

MIN: 001: OPENING OF THE MEETING

The Chairperson opened the meeting and introduced the topic of discussion "Pulp and Paper Industry" which is a study being undertaken by a short-term UNIDO Consultant on Pulp and Paper.

MIN: 002: PRESENTATION OF THE FINDINGS OF THE STUDY

Mrs. Alambo introduced Mr. J.T. Jeyasingham as the consultant and declared the floor open to him to present his paper. The assignment was to cover a period of two and half months and already seven weeks had elapsed.

The expert pointed out that the pulp and paper industry has a good return on investment.

MIN: 003: FINDINGS OF THE STUDY

1. Present Pulp and Paper Industry Status.

It was noted that there are 5 plants in the country with a total installed capacity of 85,600 tpy of paper. However, the operating capacity is 76,000 tons.

The plants are Pan African Paper Mills (PPM) (Webuye), Madhupaper (Nairobi), Kenya Paper Mills (Thika), Highland Paper Mills (Eldoret) and Kenya Matches (Kisumu) with production capacities of 45,000 (to increase to 66,000 after modification of machines), 12,000, 5,000, 2,000 and 600 tpy respectively. Pan African Paper Mills has plans to expand by 22,500 tons in the next 5-6 years. Madhupaper, Kenya paper, Highland and Kenya matches plan to expand to 20,000 6,500, 2,400, 2,400 tpy respectively.

2. Market.

Kenya has a population of about 19 million and the estimated per capita consumption is 4 kilogram which is far below the 30 - 40 kilogram for a good standard of living by UN calculations.

The present growth rate of demand is 4½%. The expert has picked on a 6% growth rate to project future demand to increase to 125,400 tons by 1986 as against the present demand of 79,000 tons (76,000 domestic supply plus 3000 imports).

3. Raw Materials.

The various types of raw materials fall under five groups which are:-

i) woody materials - softwood, hardwood,
ii) non-woody (plants) - bamboo, papyrus, kenaf
iii) non-woody (agricultural residues) - bagasse, straw
iv) non-woody (waste materials) - sisal waste (sisal flame tow), cotton waste (ginning, spinning, weavings process)
v) secondary fibre - waste paper.

Wood:- This is the most popular but there is a high demand for it for competing uses. Only 20% of the land for the whole of Kenya is good for Agricultural and Forestry use.

However, 3% is under forest. There is, therefore, a problem in the use of wood for paper making.

Bamboo: This is a good raw material and there is 150,000 hectares of it available but there is a presidential ban on the cutting of bamboo unless with his written authority.

Papyrus: Available in Lakes Naivasha and Victoria. Its use is limited by the uneconomical costs of cutting and tranporting. Morever, 90% of the material is water.

Cotton sticks. Experience from previous work done on this elsewhere shows that its use is difficult. Its availability quantitatively is limited. It has poor strength and yield which render it economically and technically unacceptaple.

Coffee sticks: No mill in the world is known to use the material. Its use cannot, therefore, be recommended.

Kenaf: It can grow in 3 months and could be a good solution when there is no wood. It grows to a height of 2 metres and its diameter is that of a bamboo rod. The yield is up to 20 tons per hectare.

Bagasse: Not much is available from the sugar factories. However, Mumias which is the biggest plant can supply an amount for a 9,000 tpy of paper capacity plant. 58,000 tons of baggasse is available.

Straw: 540,000 tons of straw is available.

Sisal waste: This can be used for hard tissues e.g. tea bag paper and carbon tissue. Carbon paper is sold very expensively here at 55,000 US dollars per ton while it is possible to produce it at 2,000 dollars.

Cotton waste: This is the best material as it contains 80% cellulose.

Waste paper: Most mills except Pan African Paper Mills use waste paper. The recovery rate is 12.6%.

4. Identified Projects:

Four potential projects have been identified as tabulated below:

1. Product	Raw Material	Location	Capacity (tpy)	Investment (million US $)	Return on Investment
1. Fine paper	bagasse	Mumias	30,000	30.0	35%
2. Corrugating medium		Tana River Basin	15,000	12.0	30%
3. Hard tissues	Sisal waste	Malindi or Naivasha	4,500	14.6	37%
4. Hand made paper	Textile waste	Thika or Eldoret or Kisumu	60	0.127	37%

5. Choice of technology

Simple type of technology is suitable. In U.S.A. highly computerised technology is used which cannot suit Kenya. The technology for Kenya should also generate employment.

6. Energy

Energy conservation methods are recommended.

7. Training

Paper technology is very complex and highly capital intensive. Getting technical management and operation skills is needed. Therefore, proper training and training facilities are recommended.

MIN: 004: OBSERVATIONS AND SUGGESTIONS

1. PAN AFRICAN PAPER MILL TECHNOLOGY

It was observed that the technology used in Pan African Paper mill is based on logs of 10 - 15 cm in diameter and as such renders logs of lesser diameters as waste.

This raises a worry over the appropriateness of the technology. It is, therefore, proposed that the expert provide a suggestion regarding change of technology which will utilize the waste at Pan African Paper Mill.

2. Exported Pulp.

The country's per capita consumption of 4 kg. is much lower that the UN recommended of 30 - 40 kg for a good standard of living. This consumption reflects a shortage of paper. It was also observed that Pan African Paper Mill exports pulp In view of the shortage of paper and the fact that PPM is exporting pulp, the expert is, therefore, required to give a suggestion as to whether the surplus pulp exported could be used to produce more paper to curb the shortage.

3. Price of Paper.

It was observed that the price of paper is quite high and as such is not within the reach of the majority of the people. The expert should propose ways and means of reducing the price.

4. Optimal size of plant.

The expert is required to propose the minimum economic size of a paper plant including calculations on profitability, investment, price, etc.

5. Project profiles.

The expert is required to prepare techno-economic project profiles for the identified projects covering capacity, raw materials, technology, marketing, employment, profitability and pricing based on the use of indigenous trees.

6. Bagasse.

The expert is required to suggest mini-paper plants attached to the existing sugar factories based on the available bagasse.

7. Training.

The expert is finally required to give an indication of the training required for small-scale paper projects and if possible recommend countries of training.

MIN: 005: ANY OTHER BUSINESS

The Chairperson suggested a meeting on 30th January, 1985 at 9.00 a.m. to discuss the final draft of the report which will incorporate the suggestions made above.

There being no other business to discuss the meeting ended at 5.00 p.m.

CGmano 11.1.85

CHARLES G.M. CMAO
Ag. Head: CHEMICAL & ALLIED INDUSTRIES SECTION.

c.c. Mr. J.T. Jeyasingham.

11th January, 1985.

CGMO/evm.

THE EXPERT'S RESPONSE TO PROBLEMS RAISED AT THE MEETING HELD ON JANUARY 8TH WITH THE DEPARTMENT OF INDUSTRIES OFFICIALS

Q. WOOD UTILIZATION AT PPM AND HIGH WOOD WASTAGE AT THE MILL.

A - There appears to be some error in respect to the log size referred in this question. However my comments are as follows, in respect to wood utilization.

If PPM's utilization of wood is based on 10 to 15 Cms as raised in this question, then there is no problem, but I believe, the wood preparation equipment at PPM require logs of diameter much higher than 10 to 15 Cms. I have a feeling the optimum diameter they would like to have would be about 30 to 35 Cms or higher and a length of 12 to 12.25 meters to feed the horizontal chipper.

When the mill was originally planned there was ample supply of such wood available to PPM. Normally for technological reasons this size of wood from mature trees are preferred. They produce a better class of fibre for papermaking compared to, um.tured trees, thinnings and the upper stem of trees.

Now the situation has changed and a large percentage of the wood received at the mills is undersized. It seems to me, there is no other alternative, other than to change the wood preparation equipment at PPM in order to adapt to these new conditions in wood supply. This would mean a new chipper and debarker to handle small diameter logs should be integrated to the wood preparation system.

The world-wide trend in wood utilization is to use as much as possible of the timber harvested and avoid waste both in the forest as well as at the mills. Equipment such as "Mobile Chippers" are used to chew up the stump and covert it into chips for the pulpmill. Likewise the top of trunks are chipped up. A new Technology is also developed known as WTC pulping. This means "Whole Tree Chipping." The idea here is to use the entire tree including, branches along with the bark for pulping. They are mostly applied for unbleached grades of paper where shives could be tolerated.

It seems to me PPM must go in for a mobile chipper and this could be the quickest solution to the problem. This could be subsequently followed by addition of a drop chute chipper for small diameter logs at the mills.

Q. 2 EXPORTING OF PULP BY PPM WHEN THERE IS PAPER SHORTAGE IN KENYA.

A - It is more possible for PPM to export paper rather than pulp. I am therefore a bit confused whether the question is actually referring to Paper rather than pulp. Assuming this question is referring to pulp as given in the minutes, my observations are as follows:-

PPM has capabilities to produce chemical pulp and since of late Mechanical pulp, as well. The entire operation at PPM is not geared to MARKET PULP PRODUCTION. It is therefore difficult for them to compete on the International market with the set up they have, with no facilities to produce pulp in sheet form on a 90:10 basis.

For PPM to export pulp there should be also surplus capacity. In respect of chemical pulp, the production is just sufficient to meet the requirements of both the

machines. In the case of mechanical pulp, there could be some surplus capacity. If this surplus mechanical pulp is converted into wet lap and sold, after producing the domestic market requirements of Newsprint, the consumer in Kenya will not be affected. Normally Mechanical pulp cannot be used on writings and printings that are classed as wood free, so this surplus pulp will not interfere with the local market requirements of writings, printings and kraft paper which has to be produced mostly from chemical pulp.

I should also mention it is not possible to give a straight answer to this question without having a discussion with PPM people since I have based my comments on various assumption which may not be factual.

Q.3. PRICE OF PAPER TOO HIGH FOR THE CONSUMER

A - The price of locally produced paper appears to be matching the local manufacturing cost. The expert regrets there was not sufficient time available during these 3 months mission to fully go into the details of pricing which is a seperate study by itself.

However the price of imported paper appears to be excessively high. Some remedial action should be taken to protect the consumer.

The projects the expert has identified is one approach to solve the problem but this would take a long time. But for immediate action on this problem a study may be needed to determine how and where this excessive pricing is taking place.

Q.4. DETAILS IN RESPECT OF OPTIMUM SIZE OF THE PLANT

A. - This will depend on the type of paper, the type of technology chosen, the type of raw material and above all the local conditions. Based on these factors the optimum sizes have been picked out for all the 4 projects (i.e. Hard Tissues, Finepaper corrugating medium and hand paper).

Please refer to the individual reports for details.

Q.5. DETAILS OF PROJECT PROFILE

A. - More details than what is needed for a Project Profile has been provided. All the data needed for the respective projects could be found in Part II, III, IV and V of the experts report.

Q. 6. FEASIBILITY OF SETTING UP MINI PLANTS BASED ON BASASSE

A. - The techno-economic aspects of seting up mini plants have to be undertaken as a seperate study.

Q. 7. TRAINING FOR LOCAL PERSONELL TO OPERATE NEW MILLS

A. - This has been dealt with under each project as well as under part I as a general subject.

Items taken up at the meeting but not in the minutes

Q.1. USE OF MIXED TROPICAL HARD WOODS LIKE PROJECT IN CAMEROON

A. - Not recommended for Kenya. Technologically speaking Mixed Tropical Hardwoods produce an inferior type of pulp in quality and strength properties. Due to the hetrogenous, nature of the Kenyan wood, maintaining uniformity of pulp quality would be a problem. What Kenya has done so far by planting exotic types of wood such as Pines and Cypress should be encouraged.

What is needed for Kenya is more of Afforestation of Marginal and Semi Arid areas with Eucalytus species and Gmelena species. Im areas where there is sufficient rainfall more of Pine should be planted. Mixed Tropical Hardwood is a poor material compared to all these materials suggested above for papermaking.

It is also NOT advisable to chop off the natural growing trees for pulping, and this will be a serious mistake. Cutting of trees on a large scale would result in soil erosion and affect the National environmental equilibrium. Kenya with only 20% of the land suitable for agriculture as well as forestry should be careful in cutting down indigenous forests.

Q.2. LOCATION OF HARD TISSUE MILL AT NAIROBI IN PLACE OF MALINDI SINCE THE MARKET IS IN NAIROBI

A. - This is not recommended as market alone is not the criteria for selecting a mill site.

It should be also noted, to produce 3000TPY of Hard Tissues, nearly 9000TPY of raw materials has to be transported including moisture, if the mill is located in Nairobi. Besides the extra tonnage involved for transport, there are also problems related to water supply and effluent disposal.

The concept normally applied in pulp and paper manufacture is to take the mills close to the raw material and not to the market.

ANNEX 3

PLANT VISITS IN EXISTING PULP AND PAPER MILLS

(Observations made by the expert)

PAN AFRICAN PAPER MILLS

(Plant Visit made on Nov. 27 1984)

PPM is the largest producer of pulp and paper in Kenya; as per details given on page of this report. This mill has already exceeded the original designed capacity of 45,000 TPY. In an attempt to get the maximum output from the 2 paper machines, the management recently rebuilt the two machines. It is therefore now possible for PPM to achieve an output of 66,000TPY at WEBUYE. This is the most logical and economical way of stepping up the production in an existing facility.

It was also noted, the type of technology applied by PPM is well suited to the local conditions. The mill is efficiently managed and staffed with personnell possessing several years of experience in the paper industry. This has helped the mills to achieve the required operating efficiency within a quick span of time.

The areas where certain improvements could be made by PPM are as follows:-

- Maximum utilization of wood with facilities to use logs of smaller diameter which are presently rejected at the chipper.
- Utilization of wood yard debris, bark and decayed wood to generate steam in a hogfuel boiler and eliminate the present incinerator system.
- Introduction of blow heat recovery system to recover the heat from digester blows.

- Improvements to the Wood Mill as it is presently "Streaky". This appears to be originating due to the inherent basic faults of the Wood Lox itself. It is therefore advisable the manufacturer is committed to rectify this problem.
- Improving the smoothness of printings and newsprint by increasing the number of Nips or increasing the Nip pressure or both.

It should be point d out the mill personell are doing a fine job manufacturing different grades with a wide range of basis weight from 35 to 250 GSM on these machines. Frequent grade changes and basis weight changes are not possible without some loss to both quality and efficiency. However, PPM is able to maintain a good standard in both quality and efficiency inspite of this difficulty.

Another point in favour of good operation is the water conservation steps the mills has introduced producing pulp and paper at 170m^3/Ton. Very few mills in developing countries are able to achieve this target figure. This would mean less pollution load with less effluent discharged from the mills to the receiving water.

PPM has also done a good service to the surrounding community by:-

- Building a road net work connected with logging operations.
- Extending a H.T. Transmission line of 132 K.V., with the mill paying the full cost to a distance of 17½KM.
- Bringing economic prosperity to the mill area, and the surrounding town increasing in population from 600 to 20,000.

MADHU PAPER MILLS (Visit made on Nov. 21st 1984)

Madhu paper mills in Nairobi produces soft tissues for hygienic products. Details are given on Page 9 of this report.

The mill in Nairobi is mostly working at 38 to 40% of its production capacity. This would mean either the consumer is paying for the low efficiency by a higher product cost or the investor is losing money or both.

Madhu paper has also quality problems, and most of it arising out of the poor quality of waste paper. The mills has plans to rectify this problem once the Madhu paper mills at Thika goes into operation. The Thika mill will be then able to supply the chemical pulp needed for the Tissue mills in Nairobi.

The expert is unable to give any Technical comments on its operation as he was not able to see the plant in operation.

KENYA PAPER MILLS (Visit made on Nov. 22nd 1984)

This mills located at Thika produces all types of wrappings, envelope paper, corrugating medium and MG wrappings out of waste paper. The details are given on page 10of this report.

The mill is using an old second hand machine which has been improved and rebuilt locally from time to time. It is producing very suitable grades for the local market at the most economical price using waste paper

The mill has further plans to improve the quality of the product which would mean installation of Deflakers, pressure screens, Centrifugal cleaners etc. The mill has also plans to commission the idle digester to produce straw pulp and improve the quality of the corrugating medium.

It could be said, the mill is making positive steps to improve both quality as well as efficiency.

The mill has also organized a very efficient waste paper collecting system thereby generating employment to several under-priveleged persons.

At the moment the mill appears to be having some effluent handling problems but here again the management is active and is taking steps to recover the fibre before discharging the effluent.

HIGHLAND PAPER MILLS (Plant visit made on Nov. 27 1984).

The mill was originally designed to produce yellow-straw board but presently it produces, chip board from waste paper. The details of this mill could be found on page 10 of this report.

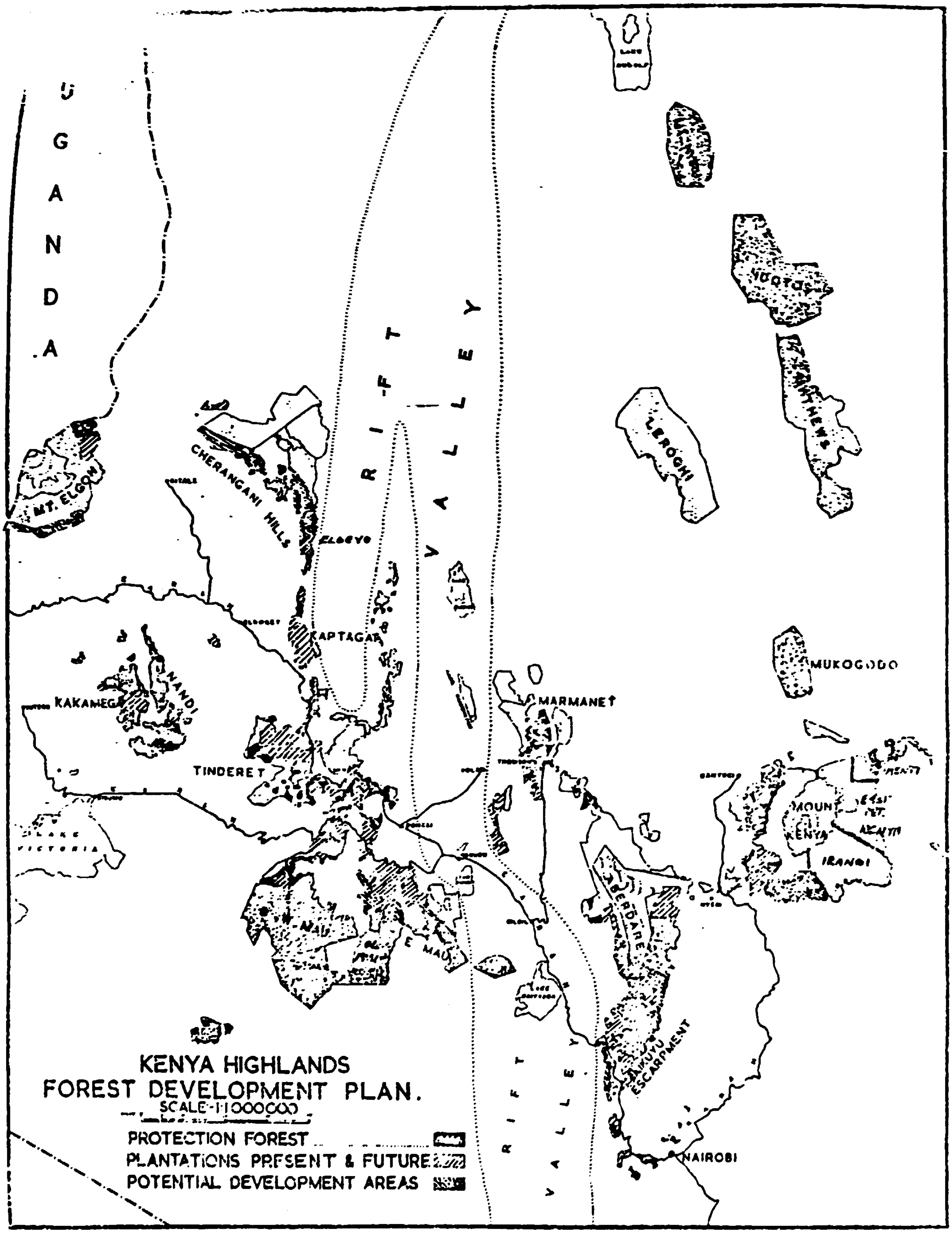
The mill is using a very simple slow speed machine quite suitable for the local conditions. It is also generating steam, using hog fuel from wood waste without using imported fuel. The quality of the product appears to be quite good for making rigid boxes, backings for stationery items, hardcovers for books etc.

KENYA MATCHES

The Eldoret mill which closed down was bought up by KENYA MATCHES. The details of this mill could be found on page 11 of this report.

The equipment was shifted from ELDORET to KISUMU and re-erected. The mill has not gone into commercial production. The equipment used by this mill is also simple like Kenya Matches and Highland Paper.

The management of the mills have plans to rebuild the equipment to make certain grades of MG wrappings. The Technical Director of the mills could not be contacted as he was away overseas, but from the visual observation made by the report, it could be said the management appears to be dynamic and making progressive steps. The mill has even plans to produce straw pulp that could be used for producing corrugating medium.


UGANDA
RIFT VALLEY
MT. ELGON
CHERANGANI HILLS
ELGEYO
KAPTAGAT
KAKAMEGA
NANDI
TINDERET
MAU
E MAU
LEROGHI
MATTHEWS
MUKOGODO
MARMANET
ABERDARE
MOUNT KENYA
IRANGI
KIKUYU ESCARPMENT
NAIROBI
KENYA HIGHLANDS
FOREST DEVELOPMENT PLAN.
SCALE 1:1000000
PROTECTION FOREST
PLANTATIONS PRESENT & FUTURE
POTENTIAL DEVELOPMENT AREAS

ANNEX 5

PERSONS CONTACTED FOR INFORMATION AND DATA

PAPER INDUSTRY

PAN AFRICAN PAPER MILLS

- MR. ARJON J. RIJHWANI	-	GENERAL MANAGER
- MR. B.D. AGARWAL	-	PRODUCTION MANAGER
- MR. M.S. MENON	-	SUPTD. PULP MILL
- MR. S.K. RUNGTA	-	MARKETING MANAGER
- MR. V.B. SACHDVA	-	SUPTD. DEVELOPING AND PLANNING
- MR. G.R. REDDY	-	SHIFT MILL MANAGER

KENYA PAPER MILLS

MR. ALISTAIR G. SCOTT

MADHU PAPER INTERNATIONAL LTD.

- MR. S.K. MACHARIA	-	EXECUTIVE CHAIRMAN
- MR. JOSEPH M. MUTURI	-	GENERAL MANAGER

HIGHLAND PAPER MILLS

- MR. GEORGE DUNDE	-	GENERAL MANAGER
- MR. V.S. JOSHI	-	FACTORY MANAGER

KENYA MATCHES

- MR. H.M. SHAH	-	MANAGER
- MR. DIPAK P. SHAH	-	GENERAL MANAGER

PAPER CONVERTING INDUSTRY

- MR. HUMPRY RUBIA NG'ANG'A	-	PROPRIETOR NAKA INDUSTRIES (OFF. MACHINE COATING)
- MR. CLIVE J.W. VAN RENSBURG	-	GENERAL MANAGER E.A. PACKAGING MOMBASA
- MR. NAREN SHAH	-	COAST PACKAGING, MOMBASA

PRINTING

- MR. S.W.S. MUCHILWA	-	GOVERNMENT PRINTER
- MR. WALTER W. CHESSA	-	ASST. GOVERNMENT PRINTER

FORESTRY

- MR. ONESIMUS MBURU	-	CHIEF CONSERVATOR OF FORESTS
- MR. S.C. MBINDI	-	DEPUTY CONSERVATOR OF FORESTS
- MR. JOHN YAHUMA WAWIYE	-	ASST. CHIEF CONSERVATOR OF FORESTS
- MR. A.D. MATHER	-	TECHNICAL ADVISER FUEL WOOD AFFORESTRATION EXTENSION IN BARINGO MARIGHAT
- MR. D.E.N. NGODA	-	FORESTER GEDE FOREST STATION

AGRICULTURE & IRRIGATION DEVELOPMENT

- MR. G.W. GICHUKI	-	MANAGING DIRECTOR TANA RIVER DEVELOPMENT AUTHORITY
- MR. J.T. LIMIRI	-	ECONOMIST TANA RIVER DEVELOPMENT AUTHORITY
- MR. R.S. JOHAL	-	MINISTRY OF AGRICULTURE
- MR. PIETER C. VANDEN HOUEN	-	PROGRAMME COORDINATOR LOWER TANA VILLAGE IRRIGATION SCHEME GARSEN

SUGAR INDUSTRY

- MR. G.P. SHAH	- WORKS MANAGER E.A. SUGAR COMPANY, MUHRONI
- MR. M.D. SPITTLER	- ENGINEERING MANAGER MUMIAS SUGAR COMPANY
- MR. G.V. RADIA	- GENERAL MANAGER ASSOCIATED SUGAR CO. LTD. MOMBASA
- MR. V.S. DAVE	- FACTORY MANAGER MIWANI SUGAR MILLS LTD.
- MR. HELLINEA	- CONSULTANT FOR MUMIAS SUGAR FACTORY BROOKER AGRICULTURE INTERNATIONAL LONDON

SISAL INDUSTRY

- MR. NDUATI KIGONDU	- DEPUTY CHIEF EXECUTIVE KENYA SISAL BOARD NAIROBI
- MR. GEORGE CHARITATOS	- BANITA SISAL ESTATE NAKURU
- MR. FRITZ KAESTLI	- GENERAL MANAGER ESTATE VIPINGO
- MR. A. KYRIAZI	- MANAGER DEVELOPMENT TEITA ESTATE

COTTON INDUSTRY

- MR. ALI ISLAM ALI	- MANAGING DIRECTOR MALINDI GINNERIES
- MR. SIMON K. MASSIMO	- MARKETING MANAGER COTTON LINT AND SEED MARKETING BOARD
- MR. J.C. NEWNES	- HEAD OF TECHNICAL SERVICES COTTON LINT AND SEED MARKETING BOARD
- MR. JOHN CLEMENTS	- MILLS MANAGER RIVATEX ELDORET
- MR. DIN AMIN	- SPINNING MANACER RIVATEX ELDORET

ANNEX 6

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