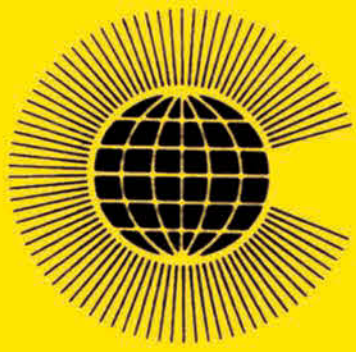
# Paper Production

## Prospects for Commonwealth Developing Countries



Commonwealth Secretariat

# Paper Production

## Prospects for Commonwealth Developing Countries

Commonwealth Secretariat, Marlborough House,
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Publications Section
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# INTRODUCTION

At the Seventh Commonwealth Education Conference held at Accra in March 1977, Ministers of Education and their senior officials expressed concern about the rising cost of paper which, they feared, could threaten the ability of Commonwealth developing countries to maintain their supplies of textbooks. Hopes were expressed that ways could be found by which these countries could become more self-reliant in meeting their paper requirements, either by utilizing hitherto untapped raw materials for local paper production or by making increased use of recycled waste paper. Accordingly the Commonwealth Secretariat was asked to keep in touch with innovations and experiments in paper and book production technology throughout the world, and to communicate whatever information it obtained to Commonwealth governments.

In carrying out this assignment the Commonwealth Secretariat commissioned PIRA (the Research Association for the Paper and Board, Printing and Packaging Industries) to prepare this study of the literature published on the subject. It is in three sections. The first gives an indication of trends in paper prices which, after a long period of stability, multiplied approximately threefold between 1971 and 1977 but which show signs of rising less steeply for the next few years (see also Table 2 on page 29 and Graph 1 on page 33). The second section outlines the supply and demand situation for paper and pulp, showing that there are no immediate signs of scarcity (though this position could change if the requirements of centrally planned economies rise more quickly than predicted). The third and largest section sets out guidelines on raw materials which can be used for pulp and paper manufacture in developing countries - particularly in tropical climates - and contains an annotated list of over forty commercial operations using these raw materials in various parts of the world. It also includes a summary of recent developments in paper recycling, and it ends with a list of over eighty references to publications from which further information can be obtained by any organization desirous of investigating further the use of non-traditional sources of raw materials in the manufacture of paper.

Though this study was initiated in response to a particular educational problem, Commonwealth developing countries will find its contents of much wider significance. Any opportunity they can take to produce paper from tropical hardwoods, bamboo, bagasse, straw, and other locally available raw materials, may lead to a reduction of imports and the saving of foreign exchange. The paper produced may not be of the right specifications for book production, but it could serve many other industrial and commercial purposes of equal importance.

## SECTION 1

# TRENDS IN PAPER PRICES

General trends in world paper and board prices are difficult to estimate because of the instability of the market. Prices are affected by national economies and policies and the regional supply and demand situation. It has perhaps been a little easier to see the recent worldwide trend in market pulp prices which have shown a general reduction, brought about by devaluations in the Scandinavian currencies and the current surplus of pulp.

## EEC

It has been recently reported (1) that reductions in prices of several important grades in Western Europe are likely in the coming year. Outsiders trying to get into the publication market in the UK are likely to cause over-capacity which will result in price reductions. Prices in France are thought to be the lowest in Europe and are due to government controls.

The November 1977 issue of the Economist Intelligence Unit 'Paper and Packaging Bulletin' (2) quotes that the UK paper market is currently very fluid which makes it impossible to give meaningful price guides. Actual paper prices last published were for January 1978 (16). These are given in Table 1 which in some cases includes the comparable figures for May 1976. Graph 1 (16) shows the Department of Industry wholesale price indices for wood pulp, paper and board and cartons from 1970 to March 1978. Table 2 (7) shows the UK wholesale price indices broken down by grade of paper for 1971 to 1977. The price indices show that in the UK the greatest increases have been in the price of coated and uncoated board and household and tissue paper. Comparing the actual prices quoted in Table 1 with price indices in Table 2 is difficult because the grade breakdown is not the same. However, taking kraft wrapping, the price index changed from 232.0 at the beginning of 1976 to 285.8 in the middle of 1977 (an increase of over 20%), and then declined a little to 276.0 in the first two months of 1978.

## North America

Recent views (3) on US paper prices point to an overall increase of 5% in the coming year. For coated papers the increase is expected to be higher (8-10%) due to lack of capacity which is resulting in increased imports. Uncoated papers are expected to rise in price by 5-10%

Table 3 (4) shows prices of pulp and paper in the USA in December 1977 with percentage changes from December 1976. Apart from the reductions in pulp prices, only linerboard and form bond show reduced prices. Greatest increases were for uncoated mechanical (14%) and coated magazine (18%).

Substantial price cutting is expected in the coming year in the USA for tissue and household papers (14). The growth in the market is expected to modify, and overcapacity is expected because of the large number of high-

speed machines on order.

It has been reported (6) that sales of pulp in Canada are taking place well below the list prices.

Scandinavia

Scandinavian prices for pulp as at October 1977 were as follows, but again sales are reported to be currently taking place below these values:

| | |
|---|---|
| Bleached kraft softwood | 350 dollars/ton |
| Bleached sulphite softwood | 350 dollars/ton |
| Bleached hardwood | 325 dollars/ton |

It is thought that a significant recovery in market pulp prices cannot be expected until world inventories have been reduced and operating rates increase to more than 80%. This is not expected to happen before 1979 (6). Another estimate (5) indicates that pulp prices could be lower in 1980 than in the period from late 1974 to 1976.

Brazil

Prices of paper are substantially higher than those in the USA or world markets due to tight import restrictions (5). USA and Brazilian prices are compared in Table 5. These higher prices are thought to be typical of other developing countries in South America.

## SECTION 2

## SHORTAGE OF PAPER

There is no evidence in the literature of any serious shortage of paper. In fact, the reverse is probably true, with most mills working well under capacity.

### Coated paper

The only area mentioned where demand currently outstrips supply is in the USA in the field of coated paper production (3). This lack of capacity is thought to be due to the increase in magazines and catalogues.

A review of coated paper and board production published at the beginning of 1977 (15) shows that coated paper and board production in North America, as a percentage of total paper and board production, was much lower than in other countries in 1974. The average coated paper production was about 11%, but for the USA it was only 1.5% and Canada 7%. Canadian mills have in the past concentrated on newsprint and market pulp production, but with the changing world situation it was recommended that Canada converted some of its mills to coated paper, and try to build up exports to EEC countries.

The statistics for 1976 show that for the USA, coated paper and board production had increased to about 11% of the total production. Figures for Canada are not available for comparison.

The recent survey by English China Clays (8) forecasts a change in the the overall long-term trend in the growth of printings and writings from 7% pa to 3.3% pa. This is likely to be caused by a switch in advertising from print to television, reduced grammage, and reduced pagination. Coated papers are expected to show a slightly higher growth rate (3.5% pa) than uncoated printings and writings (3.1% pa).

### Consumption and capacity utilization

The overall capacity utilization rates from paper and paperboard indicate that there are few countries operating at 100% capacity. Table 6 shows the FAO capacity utilization rates from 1976 in different countries. Figures for 1977 are also given where they are available.

In the EEC countries (1) production and consumption has changed very little over the last year and the overcapacity situation is expected to continue during 1978.

A report (9) on the recent FAO studies on paper and board consumption and capacity up to 1990 points out that paper and board consumption is expected to rise by an average of 3.65% pa during the period 1975-1990, giving total consumption figures of 149m tons in 1975, 180m tons in 1980, 216m tons in 1985 and 256m tons in 1990. Consumption is expected to grow more in

developing countries (5.1% pa), as compared to the developed countries (3.2% pa). A breakdown of these figures is given in Table 4. These figures are based on predictions of lower economic growth than in the period 1960-1975, but in view of the worldwide overcapacity situation these predictions have been criticized by certain paper industry representatives. Such over optimistic forecasts could lead to new plant being installed where it is not required. Consumption of printings and writings is expected to grow by 3.7% pa as compared with 6% for 1960-1975. The USA and Canada are expected to increase exports in this field.

In Brazil (5) expanding education programmes and growth in advertising should lead to above average market growth in white papers. A number of references have been made, however, to a disturbing trend in the South American developing countries, where high inflation and interest rates mean that some companies are finding difficulties in meeting debts for new plant.

Supply of market pulp

Recent reports (6), (10), (12) on the current slump in the world market pulp situation indicate that the following factors have contributed to the situation: (a) less use of paper per billion dollars of GNP; (b) increasing use of waste paper and indigenous fibres; (c) new fibre sources (Spain, Portugal, Brazil); (d) increased fibre recovery by closing-up water systems and increased use of chemicals (the EEC uses 12% less fibre/tonne of paper now as compared to 1970); and (e) failure of the Scandinavians to curtail production of pulp when paper markets were weak in 1975.

The excess of supply over demand is expected to continue for several years, as has been previously mentioned. Canada is estimated to have nearly 1m tons of pulp on hand at the present time.

Total world pulp capacity (13) was slightly more than 141m tons in 1975, and should increase by about 10m tons (based on announced expansion plans) by 1980, and reach 176-177m tons in 1985. Three-quarters of this capacity increase will be in chemical wood pulps. It is estimated that Latin America, Asia (excluding Japan) and Africa will account for about 38% (or 13.3m tons) of the world pulp capacity increase between 1975 and 1985. Graph 2 shows the regional demand/ supply balances for bleached chemical pulp in 1973 and 1985. It is pointed out that the transfer of pulp industries to new areas requires heavy investment in infrastructure, plantations and mills. Relatively high pulp prices would be necessary to yield a satisfactory return on investment.

The difficulties involved in entering the market pulp field have been felt in Brazil, which has been severly hit by the recent slump (11). Export goals have not been reached partly due to the market situation, but also because European paper-makers prefer long fibre pulp to the unbleached short fibre pulp available from Brazil. Pulp and paper-makers in Brazil have called on the government to promote increased domestic paper consumption to help with the problem.

## REFERENCES


1. Paper, Review of the Year, 1977
2. Paper and Packaging Bulletin, No. 91, Nov. 1977
3, Paper Trade J., Vol. 161, No. 24, 15 Dec. 1977, pp 28-36, 38
4. Pulp and Paper, Vol. 52, No. 1, Jan. 1978, p 13

5. Paper Trade J., Vol. 162, No. 1, 1 Jan. 1978, pp 20-24
6. Paper Trade J., Vol. 161, No. 24, 15 Dec. 1977, pp 30-32
7. Business Monitor PM 481, Paper and paper making materials, Jan.-Feb. 1978
8. ECC 'Outlook for printings and writings in Western Europe 1977-1982'
9. Pulp Pap. Int., Vol. 19, No. 13, Dec. 1977, pp 73-75
10. Paper, Vol. 188, No. 10, 21 Nov. 1977, pp 599-622, 626
11. Financial Times, No. 27, 455, 10 Jan. 1978, p.4
12. Paper, Vol. 188, No. 12, 19 Dec. 1977, pp 720, 722-724, 726
13. Paper, Vol. 188, No. 10, 21 Nov. 1977, pp 617, 619-622, 626
14. Pulp and Paper, Vol. 51, No. 12, Nov. 1977, pp 93-95
15. Pulp Pap. Can., Vol. 78, No. 12, Dec. 1977, pp 91-93
16. Paper and Packaging Bulletin, No. 93, May 1978
17. Paper and Packaging Bulletin, No. 91, Nov. 1977

SECTION 3

# MANUFACTURE OF PAPER IN DEVELOPING COUNTRIES

## INTRODUCTION

The following review is intended to give guidelines on raw materials which could be used for pulp and paper manufacture in developing countries, particularly in tropical climates.

The general sections on tropical woods and non-wood fibres (including agricultural wastes) suggest possible sources of information which may be useful in follow-up studies. The literature available in this field is so vast that it would not be possible to prepare a complete literature review.

Details of commercial enterprises, listed by continent and country, have been compiled from published information which is available. This list is not completely comprehensive but should give an indication of raw materials currently being used on a commercial scale.

The last section, on small-scale waste paper recycling, again suggests contacts and sources for further information.

## TROPICAL WOODS

The FAO has published a number of reports dealing with forest resources in developing countries and their potential for papermaking. A report on forest resources in Asia and the Far East (1) covers the current use and future supply potential of woods growing in Australia, Bangladesh, Burma, Fiji, India, New Guinea, the Philippines, Sri Lanka and Thailand.

The ECLA/FAO/UNIDO Forest Industries Advisory Group for Latin America published a report in 1976 (2) on the prospects for pulping mixed tropical hardwoods in Latin America. The report covers plans for using mixed tropical hardwoods in that area, types of pulp and paper which can be produced and wood harvesting problems.

An FAO study (3) published in 1975 summarizes data on the wood characteristics and pulp and papermaking properties of a number of fast-growing wood species. The information was collected from data published in different sources between 1950 and 1972.

A further report by Navarro (18) published by the FAO deals with the evaluation of mixed tropical woods for papermaking from their wood and fibre properties, and includes evaluations of 79 species from a forest area in Surinam. The conclusion with regard to the usefulness of wood and fibre properties for evaluating papermaking potential of individual species was on the whole negative. It was however concluded that, with certain restrictions, wood density could be used as a preliminary indication of some pulping and papermaking characteristics of a wood mixture.

The FAO has also prepared reports for governments of developing countries on the possibility of establishing pulp and paper industries (e.g. reports to the Government of Ghana in 1966 (4) and to the Government of Nigeria in 1968 (5)).

Considerable research has been done on the properties of tropical woods grown in different countries. It is not possible to refer to all the work, but the following examples give some indication of published information which is available.

Jackson and Parkinson (6) have reported on kraft pulping studies of tropical hardwoods grown in Panama. Results indicated that there would be no problems in converting them into acceptable paper products.

Petroff (7) (8) has described work done at the Centre Technique Forestier Tropical in France on the development of pulp and paper industries in French-speaking tropical Africa. Five industrial projects have been carried out in Gabon, the Ivory Coast, Madagascar, the Congo Republic and the Cameroons. The Sogacel project in the Gabon involves the building of a bleached kraft hardwood pulp mill. It has recently been reported that the costs for building this mill have risen sharply, and are likely to be over U.S. $ 565 million. The mill will initially have a capacity of 200,000 tonnes/yr (in 1981) which will rise to 242,000 tonnes/yr by 1984. The company, Sogacel, consists of a number of groups representing the Gabonese government, French, Japanese and Swedish paper companies, and French and African banks.

Eucalypts, of which there are over 600 different species, have been used for some time in the manufacture of paper, particularly in Australia, but also in Brazil, Portugal and Spain. The literature on the use of eucalypts in papermaking is fairly extensive and there have been over 100 major articles published in the last ten years. A general assessment of eucalypt pulps in the Australian papermaking economy has been made by Higgins (9).

Oudshoorn (10) described in 1974 the establishment of plantations of pine, eucalyptus and other species such as Gmelina arborea in South America, and discussed wood yields and costs. More recently Clephane (11) has given quotations for wood costs (pine and eucalyptus) in Brazil, and has analysed the economics of a new eucalyptus based pulp mill built there.

Both Flinta (12) and Haas (13) have reported on the development of pulpwood plantations in Argentina. These include plantations of poplars, willows, eucalypts and US southern pines.

Gmelina arborea, a very fast growing tropical tree originating from South East Asia, which has been used in plantations in South America, has been evaluated by the Tropical Products Institute in London (14). The laboratory pulping trials were based on Gmelina arborea grown in seven countries.

Jeyasingham (15) has reported that attempts to produce paper from rubberwood, a possible tropical wood with papermaking potential, have not been successful due to difficulties in removing the latex from the pulp.

Boyhan (16) has reported on tropical woods growing in Latin America and the Pacific Basin areas, with reference to plantation development costs and potential species. Laboratory evaluations of the properties of mixed tropical and other hardwood pulps are discussed and effects of density variations and pulp yields are mentioned.

Atchison (17) has summarized information on the location of tropical forests and draws general conclusions on the use of mixed tropical hardwoods.

These are:

(a) most mixed tropical hardwoods can be satisfactorily pulped by the kraft process for production of high quality bleached or unbleached pulp;

(b) the quality of the pulps produced from mixed tropical hardwoods appears to be unaffected by plantation location;

(c) the hardwood mixtures can usually be satisfactorily pulped by the NSSC process for the manufacture of corrugating medium;

(d) although yields of individual species vary considerably, the yields from mixtures of the woods are similar to or only slightly lower than those of temperate zone hardwoods.

Since the quantity and quality of tropical woods appears favourable, the most significant factor in their use is likely to be the economics of harvesting and transport.

A conference on improved utilization of tropical forests was held in Madison, Wisconsin, USA from 21 - 26 May 1978. The conference was organized by the US Forest Products Laboratory which has done work on the use of mixed tropical hardwoods in papermaking. Results of research have shown that segregation of different species is not necessary for manufacturing a wide range of materials from tissue to linerboard.

## NON-WOOD FIBRES (INCLUDING AGRICULTURAL WASTES)

A general review of the present status and future possibilities for non-wood plant fibres was made by Atchison in 1974 (19). The non-wood fibres covered in this review include sugar cane bagasse, straw, bamboo, reeds, esparto grass, sabai grass, sisal, abaca, henequen, bast fibres such as hemp and kenaf, cotton linters, flax tow and papyrus. Statistics are quoted, on a worldwide basis, for the availability of the various fibres and the estimated amount of pulp produced from each fibre at that time. A list of existing bagasse pulp and paper mills is given along with the effective production capacity and estimated actual production of each mill in 1972. Some of these mills are included in the list of commercial enterprises given later in this report.

Grant (20) has also reviewed non-wood fibres with papermaking potential, and Judt (21) has covered developments in this field since the Atchison review in 1974, with particular reference to the use of bagasse.

The literature on the use of non-wood fibres is quite extensive but the following may be useful sources for further reading.

PIRA has published a bibliography (22) on the use of bagasse for pulp and paper manufactured covering literature published between 1963 and April 1976. The Institute of Paper Chemistry, Appleton, Wisconsin, USA, also has bibliographies available on cereal straws (23), bast fibres (24), and bagasse and other fibres (25).

Boyhan et al (26) have reviewed processes available for the production of newsprint from bagasse and have proposed a new process using a combined furnish made up of: 60% high-yield semichemical sulphite pulp for strength and brightness; 30% refiner groundwood bagasse pulp for high-yield, opacity, smoothness and printability; and a small proportion (5 - 10%) of imported semi-

bleached kraft for overall strength, especially tear.

Zegarra and Zarate (27) have discussed the characteristics of bagasse papers, particularly bond papers and newsprint, and have reviewed the latest technical developments and commercial plans, covering improvements at the Paramonga mill in Peru, new newsprint mills in Peru and Mexico based on bagasse, and papermaking trials in Europe.

Atchison and Collins (29) have reviewed studies done on the use of kenaf as a papermaking raw material. Although considerable research work and mill trials have been carried out in the USA, Australia, Japan, Europe, Latin America and the Far East, as yet it does not appear that any company is using kenaf for papermaking on a commercial scale.

The current world production of bamboo pulp was estimated in 1972 as 1,240,000 tonnes, and in India it currently provides about 70% of the total pulp production. The main disadvantage in using bamboo is its tendency to flower unexpectedly, when an entire stand can die and take several years to be re-established. Flowering problems are now understood to a greater extent than in the past and are thought to be overcome by selection of the correct species and/or control of copper in the soil.

Bollon (29) has summarized information on the types of bamboo used in papermaking, their characteristics, harvesting and pulping. Haun et al (30) have described studies carried out by the US Department of Agriculture on the preparation and evaluation of bamboo pulps. The bamboo species studied included a number of temperate species from Savannah, Georgia and tropical species from Mayaguez, Puerto Rico.

The possibility of using home-grown bamboo in the UK as a papermaking raw material was studied for some time by Wilson (31). Following on from this work, PIRA collected a considerable amount of information on the use of bamboo, and considered setting up a feasibility study, together with other interested parties, on its growth in the UK. Plantations of bamboo had already been established by the Northern Ireland Department of Agriculture and the Agricultural Institute in Dublin, An Foras Taluntas. Prior to the feasibility study, an overall survey of indigenous sources of UK papermaking fibres was made by Dean and Calver (32). It was finally decided however to drop the feasibility study on bamboo, and studies were continued only on the use of straw and coppice willow.

The use of cereal straw for papermaking was covered in a PIRA Special Report (33) in 1974. This stimulated several British companies and the Department of Industry to fund a project that would, hopefully, lead to the successful exploitation of straw for papermaking. The straw consortium report, published in four volumes by PIRA in 1978 (34), covers information on straw prices and availability, as well as work done on other fibres such as coppice willow and Nothofagus (southern beech). The main part of the work describes studies on possible pollution-free pulping processes for straw, and commercial aspects of setting up a straw pulp mill.

## COMMERCIAL ENTERPRISES

### Africa

#### Algeria

1. SONIC (Societé Nationale des Industries de la Cellulose)
   15 rue Hamani, Algiers
   SONIC has five mills, two of which have pulping facilities. The mill at Medjdoub has facilities for producing 25,000 tonnes/yr straw pulp; the Mostaganem mill can manufacture up to 66,000 tonnes/yr of esparto pulp, 20,000 tonnes of which is used in the mill itself for manufacturing printing and writing papers. A description of the activities of SONIC, and the Mostaganem, El Harrach and Souk Ahras mills has been given by Haas (35).

#### Egypt

1. RAKTA (Societé Generale de l'Industrie du Papier)
   Tabia, Alexandria
   The RAKTA mill has capacity for producing 28,000 tonnes/yr of rice straw pulp which is used in the production of printing and writing papers and duplex and triplex boards. Ibrahim (36) has described the mill's experience in stock preparation and fine paper manufacture from rice straw. A further paper by Ibrahim (37) covers experiences and problems encountered in the bleaching of rice straw pulp.

#### Kenya

1. Panafrican Pulp and Paper Mills Ltd.,
   Broderick Falls, Webuye
   This integrated kraft pulp and paper mill for the production of 150 tonnes/day bleached and unbleached papers has been in operation since 1975. The mill currently uses pine and cypress wood from government plantations as raw materials, but new plantations are being established at Turbo to supply timber to the mill on a 15-year rotation. Singhi (38) outlined the background to the operations prior to start-up in 1974.

#### Morocco

1. Cellulose du Maroc,
   Zankat Tissa, Rabat, Morocco
   The Cellulose du Maroc mill at Sidi Yhia du Gharb which started production in 1957, processes Eucalyptus rostrata and Eucalyptus gomphocephala. The present capacity of the mill is 50,000 tonnes/yr of bleached kraft eucalyptus pulp, of which 90% is for export. The activities of the mill have been mentioned by Rahmani (9) in his review of the Moroccan pulp, paper and board industry, and also by Mezzour (40).

Nigeria

1. Nigerian Newsprint Manufacturing Co.
Oku Iboka
This newsprint mill is scheduled to start up in 1980 to produce 100,000 tonnes/yr newsprint using locally grown Gmelina arborea, pulped by a chemimechanical process.

Tunisia

1. Societé National Tunisienne de Cellulose
Kasserine
The mill, which started up in 1970, has a capacity for 30,000 tonnes/yr esparto pulp, which is used in the manufacture of printings, writings and packaging papers.

## Asia

Bangladesh

1. North Bengal Paper Mill
P.O. Paksey, Dist. Pabna
The mill has a capacity of 15,000 tonnes/yr bagasse pulp for use in the manufacture of printings, writings and packaging papers.

India

1. Orient Paper Mills Ltd.,
Birla Building (13th Floor), 9/1 R.N. Mukherjee Road,
Calcutta 1
The Amlai mill (41) in Madhya Pradesh State produces 85,000 tonnes/yr cover papers, unbleached kraft, and printings and writings from bamboo pulp.

2. Central Pulp Mills
Songad, Gujarat
The mill has a capacity for producing 30,000 tonnes/yr of bamboo market pulp. Sadawarte et al (42) have described the characteristics of bamboo (Dendrocalamus strictus) pulps produced at Central Pulp Mills. In particular, the beating and refining characteristics of bleached bamboo kraft pulps are discussed, as well as the effects of flash drying or slush drying the pulps.

3. Andhra Pradesh Paper and Pulp Mills Ltd.,
Shreeniwas House, Bombay 400001
The mill in Rajahmundry has a capacity of 75,000 tonnes/yr of printings, writings, wrapping and kraft papers. The main raw material is bamboo, but the mill also has an 8 tonnes/day rag plant for the manufacture of high quality bonds and ledger papers. A short description of the mill was given by Aggarwala (43), when the mill expanded in 1968.

4. Ballarpur Paper and Straw Board Mills Ltd.,
Thapar House, 124 Janpath, New Delhi
The company has two mills, one at Shree Gopal in Northwest India, the other at Balharshah in Central South India. Vaid (44) has

described the activities of the Balharshah mill, which makes 35 tonnes/day bamboo pulp by the fractional two-stage process for use in printing and writing papers. A 15 tonnes/day rice straw mill was also commissioned in 1969.

5. National Newsprint and Paper Mills Ltd.,
Nepanagar, E. Nimar District
The mill, the only newsprint mill in India, currently has a capacity of 75,000 tonnes/yr newsprint. It is based on bamboo (Dendrocalamus strictus) and salai (Boswellia serrata Roxb.). The mill had an actual production of 53,800 tonnes in 1975. Sawhney (45) has included a description of the mill in his report on the newsprint industry in India. Groundwood pulp is prepared from the salai wood and a two-stage fractional kraft pulping process is used for bamboo. In 1976, the furnish used for newsprint was 55 - 56% groundwood and 44 - 45% chemical pulp. It was proposed at that time to incorporate a cold soda pulping plant for the salai wood so that the furnish would be 34% groundwood, 33% chemical pulp and 33% cold soda. The incorporation of the cold soda pulp would give increased strength and reduce the costs/tonne of pulp produced.

6. Mandya National Paper Mills Ltd.,
Belagula R.S., P.O. K. R. Sagar, Mysore State
The mill has capacity for producing 10,000 tonnes/yr bagasse pulp. Estimated actual production in 1972 was 3,000 tonnes.

7. Bengal Paper Mill Co.
P.O. Ranigani 713347, District Burdwan, West Bengal
The mill in 1972 was producing 3,000 tonnes/yr bagasse pulp for use in fine papers.

Iran

1. Pars Paper Co. Ltd.,
124 Elizabeth II Boulevard, Tehran
The mill at Haft Tappeh currently has a total capacity of 200 tonnes/day of bleached bagasse pulp, which is used in the production of printings and writings. The mill, the first in the Middle East based on bagasse, was opened in December 1970. The plant (60 tonnes/day) was designed and constructed by Reed Engineering Services (Overseas)Ltd., a member of the Reed Group. The machinery was supplied by Krauss-Maffei. A description of the mill at its start-up (46) covers bagasse storage (using the Ritter process) and depithing, and the pulp and paper mill. Benzinger (47) has described the second bagasse pulping line (140 tonnes/day) which was added in 1975.

Iraq

1. State Company for Pulp and Paper Industries
P.O. Box 248, Basrah
The mill has a bagasse pulping line of estimated capacity 20,000 tonnes/year.

Pakistan

1. Pakistan Paper Corp. Ltd.,
Charsadda, Peshawar District
The mill has a 27,000 tonnes/year bagasse pulping line. In 1972 actual production of bagasse pulp was 15,000 tonnes, which was used in the production of printing, writing and wrapping papers.

Philippines

1. Isarog Pulp and Paper Co. Inc.,
Kilikao, Daraga, Albay
A 20 tonne/day abaca (manila hemp) pulp mill was started up by Isarog in 1976. Abaca is found growing in the Philippines, Central America and South America, but the Philippines produce over 70% of the world supply. Silvario (48) has discussed the background to the mill and the properties of the pulp produced. The abaca fibre is extra long and slender, which thus makes it suitable for production of speciality papers such as tea bag tissues, nonwovens, carbon base papers, filters and various papers for electrical insulation.

2. Central Azucarera de Bais
Bais Central, Negros Oriental
The mill produces 10,000 tonnes/yr bagasse pulp.

3. United Pulp and Paper Co. Inc.,
Calumpit, Bulacan
The mill produces 18,000 tonnes/yr bagasse pulp.

Sri Lanka

1. Eastern Paper Mills Corp. (now National Paper Corp.)
356 Union Place, Colombo 2, Sri Lanka
The mill at Valaichchenai manufactures 23,000 tonnes/yr of different paper and paperboard grades. The mill uses various fibre sources: bleached and unbleached straw pulp, deinked waste paper, mixed waste, bleached and unbleached wood pulp. Pulp is produced from rice straw by the monosulphite process. Jeyasingam (49) outlined the activities of the mill when the new combined board machine started up in 1972. Problems connected with bleaching rice straw pulp have also been discussed (50). Special equipment is needed for washing and bleaching rice straw pulp because of the high percentage of fines in the pulp. It might be possible to increase the brightness level of the pulp by increasing the number of stages and by using bleaching agents such as chlorine dioxide and peroxide along with chlorine and hypochlorite, but costs and other factors need to be taken into account.

Taiwan

1. Taiwan Pulp and Paper Corp.
53 Nanking East Road Sec. 2, Taipei, Taiwan
The mill has capacity for production of 45,000 tonnes/yr bleached bagasse pulp, 25,000 tonnes being available as market pulp. The mill has a chlorine dioxide closed system for bleaching the bagasse

pulp. Sodium acid sulphate is separated as a by-product and converted to salt cake for make-up in the sulphate recovery cycle.

2. Taiwan Sugar Corp.,
25 Pao Ching Road, Taipei, Taiwan 100
Wang (51) has recently described the development of the Pingtung pulp mill with a daily capacity of 300 tonnes of bleached bagasse pulp (100,000 tonnes/yr). An acid wet bulk storage system (improved Ritter process) is used for the bagasse which is then pulped by the kraft process.

Thailand

1. Siam Kraft Paper Co. Ltd.,
518/4 Ploenchit Road, P.O. Box 5-174, Bangkok
A description of the integrated bagasse pulp and paper mill near Bangkok was given (52) in 1970, soon after its start up. The mill has capacity for production of 24,000 tonnes/yr bagasse pulp, most of which is used in the production of kraft wrappings and linerboard.

Vietnam

1. Bai Bang paper mill
The Swedish International Development Authority has embarked on a large programme of assistance to the now united Socialist Republic of Vietnam. Brauns (53) has outlined the largest project, which is setting up a pulp and paper mill at Bai Bang, northwest of Hanoi. The mill is expected to come into operation successively in the late seventies, beginning with one paper machine. The annual production will be 48,000 tonnes of kraft pulp, used in 50,000 tonnes of writing and printing papers and 5,000 tonnes of wrapping paper. The fibrous raw materials for the mill will be Vietnamese mixed hardwoods and bamboo.

## South and Central America

Argentina

1. Ledesma SA
Sarmiento 440, Buenos Aires
Ledesma, an integrated bagasse pulp and paper mill, has capacity for production of 35,000 tonnes/yr bagasse pulp. Wilson (54) has described the mill, which features a Ritter bagasse bulk storage system and a black liquor recovery system. The bagasse pulp is used in the production of high quality printing and writing papers.

2. Papel Misionero S.A.I.F.C.
Santa Fe 220, Posadas, Misiones
Papel Misionero is an integrated kraft mill, started up in 1976, with a capacity of 36,000 tonnes/yr of kraft sack papers and linerboard. The mill aims to use fast-growing pines (Pinus taeda and Pinus elliottii) from local plantations (55).

3. Celulosa Argentina SA
Av. Mate de Luna 1934, San Miguel de Tucuman, Prov. of Tucuman.
The mill has capacity for production of 5,000 tonnes/yr bagasse pulp.

4. Azucarera del Norte SA (Cia)
Ingenio Leales, Province of Tucuman
The mill has capacity for production of 3,000 tonnes/yr bagasse pulp.

Brazil

1. Companhia de Celulose de Bahia
Rua Marquez do Monte Santo 50, CP 472, Salvador, Bahia
A market pulp mill based on sisal is being built in Bahia State, in the north-eastern region of Brazil (56). The mill is being designed for output of 64,000 tonnes/yr. A new crushing process for the sisal leaves has been developed, and the juice collected from crushing will be used in the manufacture of chemical by-products. The pulp will be cooked by a normal alkaline soda process. Sisal pulp is reported to have high tear strength and porosity and it is hoped that when blended with other pulps will substitute for softwood pulp.

2. Industrias de Papel Simao SA
Caixa Postal 172, Rua do Manifesto 931, Sao Paulo
Leonardos (57) has described how problems inherent in using all-eucalyptus furnish in the manufacture of fine papers at Industrias de Papel Simoa were solved. This involved studies on refining and modifications to the paper machine. An earlier paper by Leon and Borges (67) described the production of bleached kraft eucalyptus pulp for printings and writings.

3. Cenibra (Celulose Nipo-Brasiliera S/A)
Minas Gerais
A short description has been given of the Cenibra market pulp mill scheduled to have started in 1977. The mill will have an initial capacity of 750 tonnes/day bleached eucalyptus pulp. About 50% of the output will be shipped to the Japanese owners on a 15-year contract, the rest will be available for other markets.

4. Rio Grande Companhia de Cellulose do Sul (Riocell)
P.O. Box 2896, 90,000 Porto Alegre
It is perhaps worth mentioning that the Riocell market pulp mill based on eucalyptus which started out as part of the Borregaard Group, is now in severe financial difficulties and has had to be rescued by the Brazil National Development Bank.

5. Jari Florestal
Munguba
A market pulp mill, based on Gmelina arborea, is due to be completed in 1980 with an annual capacity of 260,000 tonnes kraft pulp (59). Jari Florestal ê Agropecuária, part of the US based National Bulk Carriers Organisation, is expected to yield some 12,000 tonnes of commercial timber a day. Technical management for the pulp mill will be provided by Kaukas-Kymmene of Finland. The complete pulp mill and power plant has been constructed on floating units in Japan for towing to the site. This overcame problems of attracting and accommodating skilled technicians on the isolated Jari site during construction.

6. Celulose e Papel Refinadora Paulista SA
Bairro Monte Alegre, Caixa Postal 65, Piracicaba, Sao Paulo
Integrated pulp and paper mill with capacity for producing 9,000 tonnes/yr bagasse pulp for use in manufacture of fine papers.

7. Companhia Industrias Brasileiras
Cáis da Alfândega 130, Recife, Pernambuco
Integrated pulp and paper mill with capacity for producing 12,000 tonnes/yr bagasse pulp for use in kraft sack papers. Bamboo and hardwood kraft pulps are also manufactured.

Colombia

1. Carton de Colombia SA
Apartado Aereo 219, Cali
Gomez and Mondragón (60) have described trials in which increasing amounts of Colombian hardwoods were included in kraft linerboard furnish at Carton de Colombia. It was found that it was feasible to increase the proportion of mixed tropical hardwoods in the furnish from 40% to 80%.

2. Productora de Papeles SA (Propal)
Apartado Aereo 4412, Cali
Klass and Evans (61) have described the bagasse handling and pulping system in operation at the Propal mill, when a new paper machine for lightweight papers was installed in 1968. The mill currently has a capacity for production of 70,000 tonnes/yr bagasse pulp and 90,000 tonnes/yr fine papers and tissue wrappings. The bagasse is pulped by a soda process in Defibrator digesters, and a three-stage bleaching sequence is used: chlorination, alkaline extraction, sodium hypochlorite.

Equador

1. Papelera Nacional SA
P.O. Box 7017, Pedro Carbo 304, Guayaquil
The mill produces 15,000 tonnes/yr unbleached bagasse pulp for use in the manufacture of kraft bag and sack papers.

Mexico

1. Celulosa y Papel de Michoacan SA (Cepamisa)
Michoacan
Battenberg and de la Peza (62) described the start up in 1976 of stage one of the Cepamisa mill in Central Mexico. The mill uses local woods, including pine and oak woods, for production of 200 tonnes/day of bleached kraft pulp. A 150 tonne/day fine paper machine is planned for the second stage.

2. Kimberly Clark de Mexico SA
Escamela, Municipio de Ixtaczoquitlan, Vera Cruz
Williams (63) described the Kimberly-Clark Orizaba mill soon after start up in April 1970. The mill can produce up to 40,000 tonnes/yr bagasse pulp; K-C is a licensee of the Grace Peadco process for bagasse pulp and paper manufacture. The bagasse pulp is used in uncoated business papers, coating base papers and tissues.

3. San Cristobal SA
San Cristobal Ecatepec, Edo. de Mexico
Tetlow (64) described the successful manufacture of newsprint from bagasse at the San Cristobal mill. The process which is also used for higher brightness papers and tissues, basically consists of two-stage soda digestion and chlorine and/or hypochlorite bleaching. The second stage digestion is carried out in a disc mill. For newsprint manufacture the digestion soda is lowered to a minimum before the strength and bleachability of the pulp fall to an unacceptable level.

## Peru

1. Papelera Trujillo SA
(Subsidiary of Sociedad Paramonga Ltda)
Casilla 130, Trujillo
A description of the Trujillo plant was given when it started up in 1970 (65). The mill has a plant for production of soda bagasse pulp, which together with waste paper and kraft pulp is used in the manufacture of corrugating medium.

2. Sociedad Paramonga Ltda
Augusto Tamayo 180, P.O. Box 2488, San Isidro, Lima
Evans (66) has given details of operations at the Paramonga bagasse mill of W.R. Grace and Co., as well as mentioning other activities of the company in South America. The Paramonga mill was the first in the world to make pulp and paper from bagasse and started up in 1939. Research on the use of bagasse led to the development of the Peadco process in 1957, and this process is currently used at this and other Grace mills, and by licensees. The pulp is cooked with caustic soda in three horizontal single tube continuous digestor lines, with the necessary refiners and three-stage washers. A three-stage bleaching system is also in operation. In 1968 the mill supplied 60% of the paper market in Peru, including wrappings, writings, printings, tissues, bags and sacks and corrugated boxes.

## Australia

1. Associated Pulp and Paper Mills Ltd.,
459 Collins Street, Melbourne 3000
A summary of the experiences of the company in eucalyptus pulping, particularly at the Burnie mill in Tasmania, was published in 1964 (68). The manufacture of cold soda pulp at the Wesley Vale mill, for use in both machine finished and publication grades has been described by Clarke (69).

2. Australian Newsprint Mills Ltd.,
Boyer, Tasmania 7400
The history of Australian Newsprint Mills and the manufacture and properties of newsprint from eucalypt woods has been described by Pearson (70). The furnish used for the newsprint comprises 18% semibleached kraft from Pinus radiata, 20% semibleached cold soda pulp from eucalypts, and the remainder groundwood from mature eucalypts produced by grinding in the presence of caustic soda, and after washing, brightening with zinc hydrosulphite.

## SMALL SCALE WASTE PAPER RECYCLING

The number of articles written on waste paper recycling must amount to many thousands. The following section will consider only small-scale manufacture of recycled paper, but it may be of use to refer to the following sources which have discussed recent technical developments in waste paper stock preparation.

Norton (79) has summarized recent trends in stock preparation and de-inking and considered future developments in recycled fibre use in different grades.

A general literature review of recycled paper developments was published by Forsythe (80) in 1972, covering the state of the art in process requirements and equipment design.

Felton (81) described in 1974 the current technology of waste paper stock preparation systems with flow diagrams and operating costs of systems for different paper grades.

The current status of small-scale waste paper recycling has been reviewed by Thomas (71) in an appendix to the booklet 'The Paper Chain'. The booklet itself examines the situation of waste paper recycling in the UK and suggests ways in which more secondary fibre might be included in paper products. Reference is made to equipment supplied by I.T. Development Techniques Ltd. (a subsidiary of Intermediate Technology Development Group, 9 - 10 King Street, London WC2). This organization also supplies consultancy advice on small-scale pulp and paper manufacture and is in contact with manufacturers in Britain, Germany and India offering production units in the range 10 - 80 tonnes/day output. The economics of small-scale production and management problems which can occur are referred to. The capital investment for the I.T. Development Techniques plant has been estimated at £200,000 for a 5 or 6 tonnes/day capacity. A similar plant for moulded pulp production is in the region of £35,000 - £40,000.

Anthony Hopkinson, an English businessman, has developed a semi-automatic small-scale paper machine, suitable for developing countries, which costs only £1500 (72). The equipment is being manufactured by an engineering firm in Essex. It is hoped to develop a simple corrugating machine to complement the paper machine. The papermaking unit consists of a semi-automatic waste paper pulping unit and paper forming tank with with pressing and forming roller table. The sheets produced, at about 100/hr, are about the size of a newspaper page; they are hung up to air dry.

A locally built small-scale machine at a converted handmade paper mill at Ambert in France (71) turns locally collected waste paper into packaging paper which is used by local farmers as liners for their fruit boxes.

A West German paper machinery manufacturer, Carl Krafft und Sohne of Duren, have developed a small-scale unit (70 tonnes/day, width up to 2450 mm) for production of containerboard from waste paper. The machine has the following advantages: low building investment costs as the machine does not require basement foundations or a boiler house (an inexpensive steam heater is sufficient); low operating costs, as the Turbo-Formers do not require vacuum pumps, the jet dryer consumes 5% less heating energy than conventional drying systems, and with automatic break control and start-up equipment only a minimum of operators is required. A description of the Krafft machine has been given by Shulman (74), who also mentions that Scyfert Wellpappe, of Reichenbach, West Germany have had extensive experience with the Krafft machine. Another user is Hans Kolb, of Kaufbeuren, West Germany

The economics of small-scale recycling units has been discussed by Iannazzi (75). It is pointed out that a 100 tonnes/day plant could operate with a supply of waste newspapers collected from a population of about 2 million. In this respect the idea of a mini-machine is outlined and details are given of the ECHO machine (Eli Cowan-Holder), a concept developed by Eli Cowan of E. and B.Cowan Ltd. of Montreal and Holder Associates Ltd. of Bury, England. The machine would include a traditional twin-wire forming section and non-traditional modified drying techniques for more efficient water removal. Substantial energy savings could be realised by using a gas turbine drive on the machine, and vapour recompression of the exhaust from the dryers. A table shows the estimated investment, operating costs and profitability of a 100 tonnes/day ECHO machine making recycled newsprint.

A brief reference (73) has been made to the activities of Mr. and Mrs. Kayes Van Bodengraven, a Dutch-born couple now living in Australia, who are operating a handmade paper mill using waste paper as raw material.

In 1967 it was reported (76) that Kartonfabrik Hergiswil in Switzerland was using waste paper to manufacture coated and uncoated boards (0.3 - 6 mm thick, 280 - 560 gsm) on two hand paperboard machines, built by Karstads Mekaniska Werkstad of Sweden.

The technology of making paper by hand has been described in the booklet by Barcham Green (77) and also by Hunter (78) in the McGraw Hill textbook on pulp and paper manufacture.

## REFERENCES


(1) 'Forest resources in the Asia and Far East region'
Rome: FAO, 1976, 100 pp., £2.10

(2) 'Report on prospects for pulping mixed tropical hardwoods in Latin America' B. Kyrklund
Santiago, Chile: ECLA/FAO/UNIDO/RLA/68/435-75/2-E, ECLA/FAO/UNIDO Forest Industries Advisory Group for Latin America, May 1976, 89 pp.

(3) 'Pulping and papermaking properties of fast-growing plantation wood species'
Rome: FAO, 1975, 466 pp., £9.30

(4) 'Report to the Government of Ghana on the possibility of establishing a pulp and paper industry' J.E. Brax
Rome: FAO Report No. TA 2251, 1966, 63 pp.

(5) 'Report to the Government of Nigeria on the feasibility of establishing a pulp and paper industry in Nigeria' F.H.H. Scherpe
Rome: FAO Report No. TA 2529, 1968, 58 pp.

(6) 'Kraft pulps from Central American hardwoods' A. Jackson and J.R. Parkinson Tappi, vol. 51, No. 10, Oct. 1968, pp. 44A - 47A

(7) 'Potential is promising for pulp production in French-speaking Africa and Madagascar' G. Petroff
Pulp Pap. Int., Vol 16, No. 6, June 1974, pp. 41 - 45

(8) 'Production of pulp and paper in Tropical Africa' G. Petroff
EUCEPA Conf. on New Forest Resources for the Paper Industry, Madrid, May 1974 (in French)

(9) 'Technical assessment of eucalypt pulps in the papermaking economy' H.G. Higgins
Appita, Vol. 23, No.6, May 1970, pp. 417 - 426

(10) 'Pine and eucalyptus plantations in South America: their establishment, yield and potential as a source of pulp and or wood fibre markets'
EUCEPA Conf. on New Forest Resources for the Paper Industry, Madrid, May 1974

(11) 'Despite some problems, paper is a fast-growing industry in Brazil' T.P. Clephane
Pap. Trade J., Vol. 162, No.1, 1 Jan. 1978, pp. 20 - 24

(12) 'Argentina' C.M. Flinta
Pulp Pap. Int., Vol. 18, No. 7, July 1976, pp. 34 - 37, 52

(13) 'Argentina: don't underestimate its potential' L. Haas
Pulp Pap. Int., Vol. 19, No. 12, Nov. 1977, pp. 77 - 80

(14) 'Gmelina arborea as a potential source of hardwood pulp' E.R. Palmer
Tropical Science, Vol. 15, No.3, 1973, pp. 243 - 260

(15) 'Rubberwood is abundant and accessible: will it ever be successfully exploited?' T. Jeyasingham
Pulp Pap. Int., Vol. 15, No.6, June 1973, pp. 44 - 47

(16) 'Tropical hardwoods: a fibre bonanza' G. Boyhan
Pulp Pap. Int., Vol. 17, No. 1, Jan. 1975, pp. 43 - 46

(17) 'Where are our future papermaking fibres coming from? Tropical forests and plantations: key to future fibre shortages' J. Atchison
Paper Trade J., Vol. 157, No. 3, 15 Jan. 1973, pp. 34 - 36

(18) 'Report on evaluation of mixed tropical hardwoods for pulp and paper manufacture' J. Navarro
Rome: FAO, 1976, 160 pp., £5.25

(19) 'Present and potential use of sugar cane bagasse and other nonwood fibres for the manufacture of pulp and paper. A worldwide review' J.E. Atchison
EUCEPA Conf. on New Forest Resources for the Paper Industry, Madrid, May 1974

(20) 'Non-traditional pulps for paper and board manufacture' J. Grant
Paper, Vol. 184, No. 6, 22 Sept. 1975, pp. 320, 322 - 325.

(21) 'Worldwide efforts in the field on non-woody fibres' M. Judt
Preprints of the 17th EUCEPA Conf., Vienna, Oct. 1977, Book 1, pp. 65 - 76

(22) 'Use of bagasse for pulp and paper manufacture' compiled by J.V.M. Calver
Leatherhead, Surrey: Pira Bibliography No. 847, 22 pp.

(23) 'Papermaking materials: 1 Cereal straws'
Appleton, Wisconsin, USA: Institute of Paper Chemistry, Bibliography 171, 1949,230pp., 20US dollars, Supplement 1, 1963, 200 pp., 12 US dollars, Supplement 2 1968, 67 pp. 8 US dollars, Supplement 3, 1975, 63 pp., 10 US dollars

(24) 'Papermaking materials. 11 Bast fibers'
Appleton, Wisconsin, USA: Institute of Paper Chemistry, Bibliography 176, 1950, 74 pp., 8 US dollars, Supplement 3, 1973, 81 pp., 10 US dollars

(25) 'Pulping of bagasse and other papermaking fibers' Appleton, Wisconsin USA: Institute of Paper Chemistry, Bibliography 270, 1976, 123 pp., 20 US dollars

(26) 'Newsprint from bagasse: can it be done?' G.E. Boyhan, Y.T. Kao and L. Terziotti
Pulp Pap. Int., Vol. 17, No.11, Oct. 1975, pp. 44 - 47, 59

(27) 'Paper from bagasse' J.R. Zegarra and J. Zarate
TAPPI Non-wood plant fiber pulping, Progress Report No.8, 1977, pp. 3 - 8

(28) 'Worldwide developments in kenaf' J.E. Atchison and T.T. Collins
TAPPI Non-wood plant fiber pulping, Progress Report No. 7, 1976, pp. 15 - 27

(29) 'Bamboos, plants for paper making' A. Bollon
Papeterie, Vol. 97, No.6, June 1975, pp. 400 - 402 (in French)

(30) 'Fiber and papermaking characteristics of bamboo' J.R. Haun, T.F. Clark and G.A. White
Washington, D.C.: US Dept. of Agriculture, Agricultural Research Service, 1966, 19 pp., Tech. Bull. No. 1361

(31) 'Home grown bamboo as a raw material for the production of cellulosic pulps', J. Wilson
1973, 24 pp. (Report in possession of PIRA)

(32) 'Indigenous sources of papermaking fibres' T.W.R. Dean and J.V.M. Calver
PIRA report for Project PB1100, 1976

(33) 'A survey of straw pulping in Great Britain', volumes 1 and 11, Leatherhead: PIRA, Jan. 1974, £25.00 to PIRA members, £75.00 non-members

(34) 'The Straw Consortium Report', Vol.1, 'General background and project summary' Vol.2 'UK fibre sources with potential' Vol.3 'Technical studies' Vo. 4 'Commercial aspects and the future' edited by T.W.R. Dean
Leatherhead: PIRA, Jan. 1978, £4,800 PIRA members, £6,800 non-members

(35) 'Algeria: Goal of self-sufficiency being realised'. L. Haas
Pulp Pap. Int., Vol. 16, No. 10, Sept. 1974, pp. 41 - 47

(36) 'Special problems involved in stock preparation and papermaking when utilising bleached rice straw pulp in fine paper' H. Ibrahim
Atlanta, Ga.: TAPPI, Non-wood fibre pulping, Progress Rep. No.6, CAR No. 58, 1975, pp. 23 - 33

(37) 'Industrial experiences and problems involved in bleaching rice straw pulp' H. Ibrahim
Atlanta, Ga.: TAPPI, Non-wood fibre pulping, Progress Rep. No.6, CAR No.58, 1975, pp. 101 - 108

(38) 'East Africa's first integrated pulp/paper mill prepares for start up in Kenya' H.P. Sunghi
Pulp Pap. Int., Vol. 16, No. 7, July 1974, pp. 40 - 41

(39) 'The development of the pulp, paper and board industry in Morocco' M. Rahmani
Wb 1. Papfabr., Vol. 104, No. 6, end-Mar. 1976, pp. 224, 226 (in German); PIRA Translation (into English) No. 1501, Price: PIRA members £4.00, non-members £8.00

(40) 'Cellulose du Maroc: Today a woodyard, soon a 100,00 t/year bleached pulp mill' M. Mezzour
Papier Carton Cellul., Vol. 26, No. 4, Apr. 1977, pp. 38 - 41 (in French)

(41) 'High speed fine paper making in India: OPM Amlai plant'
Indian Pulp Pap., Vol.21, No. 3, Sept. 1966, pp. 211 - 214

(42) 'Stock preparation aspects of bamboo draft pulps' N.S. Sadawarte et al
Atlanta, Ga.: TAPPI Non-wood plant fibre pulping, Progress Rep. No.6, CAR No. 58, 1975, pp. 49-55

(43) 'Indian mill expands to 70 tons/day' J.C. Aggarwala Pulp Pap. Int., Vol. 10, No. 2, Feb. 1968, p. 43

(44) 'Ballarpur mill bases second pulping line on rice straw' D.D. Vaid
Pulp Pap. Int., Vol. 11, No.11, Oct. 1969, pp. 66, 68

(45) 'Newsprint manufacture in India: the way ahead' R.S. Sawhney
Pulp Pap. Can., Vol. 77, No.1, Jan. 1976, pp. 41 - 46

(46) 'Iran's first modern mill opened by the Shah'
Paper Trade J., Vol.155, No.2, 11 Jan. 1971, pp. 34 - 37

(47) 'Today's bagasse technology' H. Benzinger
Pulp Pap. Int., Vol. 17, No.6, June 1975, pp. 42 - 44, 57

(48) 'Isarog makes speciality pulps from Philippine abaca fibre' B.N. Silvario Pulp Pap. Int., Vol. 18, No. 9, Aug. 1976, pp. 36-37

(49) 'Sri Lanka board production starts; mill's capacity more than doubled' T. Jeyasingham
Pulp Pap. Int., Vol.15, No.1, Jan. 1973, pp. 46 - 47

(50) 'Experience in bleaching of rice straw pulp and the special problems connected with it' T. Jeyasingham
Atlanta, Ga.: TAPPI, Non-wood plant fiber pulping, Progress Rep. No.5, CA Rep. No.53, 1974, pp. 7 - 13

(51) 'Developing and operation of a mill for production of bleached market pulp: a birth of the world's biggest 100% bagasse market pulp mill' J.S.I. Wang
Atlanta, Ga.: TAPPI, Non-wood plant fiber pulping, Progress Rep. No.8, 1977, pp. 55 - 63

(52) 'Integrated mill raises Thailand's output by 400%'
Pulp Pap. Int., Vol. 12, No. 5, May 1970, pp. 41 - 43, 55

(53) 'The Bai Bang paper mill project' O. Brauns
Svensk Papperstidn., Vol. 80, No. 5, 25 Mar. 1977, pp. 129 - 138
(in English)

(54) 'Bagasse pulping in remote Argentina' A.W. Wilson
Pulp Pap. Int., Vol. 13, No.2, Feb. 1971, pp. 50 - 52

(55) 'Papel Misionero: Argentina's newest mill'
Pulp Pap. Int., Vol.9, No.12, Nov. 1977, pp. 80 - 81

(56) 'Bahia builds new market pulp mill: for sisal'
Paper, Vol. 187, No.10, 23 May 1977, pp. 528 - 530

(57) 'Brazilian mill overcomes problems using 100% eucalyptus pulp'
R.B. Leonardos
Pulp Pap. Int., Vol. 11, No. 13, Dec. 1969, pp. 52 - 53, 62

(58) 'Cenibra market pulp mill nears start-up' G. Krogh
Pulp Pap. Int., Vol. 19, No. 2, Feb. 1977, pp. 10 - 11

(59) 'Pulp from the Amazon...'
Paper, Vol. 188, No.9, 1977, pp. 492, 502

(60) 'The pulping of tropical hardwoods for linerboard'
C.H. Gomez and I. Mondragon
Tappi, Vol. 57, No.5, May 1974, pp. 140 - 142

(61) 'New machine boosts fine paper output at Colombia's largest mill'
C.P. Klass and J.C.W. Evans
Paper Trade J., Vol. 152, No.32, 5 Aug. 1968, pp. 44 - 48

(62) 'Michoacan: Mexican bleached kraft mill' M. de la Peza and E. Battenberg
Pulp Pap. Int., Vol. 19, No. 6, June 1977, pp. 51 - 52

(63) 'Kimberly-Clark de Mexico ushers in a new era for bagasse pulp and paper' W.C. Williams
Pulp and Paper, Vol.44, No.4, Apr. 1970, pp. 82 - 87

(64) 'Mexican mill makes successful trials on bagasse for newsprint'
P.N. Tetlow
Pulp Pap. Int., Vol. 14, No. 5, May 1972, pp. 58 - 60

(65) 'New kraft paper machine on stream in Peru'
Wld's Pap. Trade Rev., Vol. 174, No. 12, 17 Sept. 1970, pp. 465, 468 - 469, 473 - 474, 477

(66) 'Grace machine inaugurated, one of three new in S.A. for 1968'
J.C.W. Evans
Paper Trade J., Vol. 152, No. 31, 29 July 1968, pp. 44 - 50

(67) 'The pulping of eucalypts in Brazil: Summary of experience of Industrias de Papel S/A'
Appita, Vol. 21, No.2, Sept. 1967, pp. 41 - 48

(68) 'Australian success story: papers from eucalypts'
Wld's Pap. Trade Rev., Vol. 162, No.23,3 Dec.1964, pp.1786,1790, 1793, 1794, 1796

(69) 'Continuous cold soda semichemical pulping' E.G.A. Clarke
Appita, Vol.29, No.5, Mar. 1976, pp. 383 - 386

(70) 'Production of high quality newsprint from eucalypts' A.J. Pearson
Tappi, Vol. 52, No. 5, May 1969, pp. 865 - 870

(71) 'The Paper Chain' C.Thomas
London: Earth Resources Research Ltd., 40 James St., London W.1, 1977, 104 pp., £2.00

(72) 'How to make paper for £1500'
Paper, vol. 188, no. 11, 5 Dec. 1977, pp. 672, 674

(73) 'Hand-finished paper can be made from waste fibres'
Materials Handling News, No. 212, July 1975, p.105

(74) 'Small, captive paperboard machine making inroads with independent corrugators in Europe' J.J. Shulman
Paperboard Packaging, Vol. 62, No.6, June 1977, pp. 46, 50-51, 54

(75) 'Are smaller-scale recycled paper mills one solution to the industry's capital dilemma?' F.D. Iannazzi
Paper Trade J., Vol. 160, No. 12, 15 June 1976, pp. 88, 90

(76) 'Heavy specialty boards are produced by small mill'
Pulp Pap. Int., Vol.9, No.3, Mar. 1967, pp. 53 - 55

(77) 'Papermaking by hand' J. Barcham Green
Maidstone: J. Barcham Green, 1967, 33 pp. (limited edition)

(78) 'Handmade papers' D. Hunter from 'Pulp and paper manufacture Vol.III Papermaking and paperboard making'
McGraw Hill Book Co., 1970, pp. 1 - 18

(79) 'A waste paper study' S. Norton
Paper, Vol. 185, No.9, 10 May 1976, pp. 524, 526 - 527

(80) 'Recycling of paper' J.J. Forsythe
Tappi, Vol.55, No.5, May 1972, pp. 679 - 690

(81) 'Secondary fibre technology: 1974' A.J. Felton
Tappi, Vol. 58, No.4, Apr. 1975, pp. 78 - 83

## TABLE 1: GUIDE TO PAPER PRICES

The following prices are intended only as a guide. They include shipping rebates, and other discounts as indicated. Surcharges on imports arising out of currency movements or to cover other costs such as ships bunkering and mill energy charges are not recorded unless they are incorporated in the base prices.

| | | January 1978 | May 1976 |
|---|---|---|---|
| **Newsprint** | | £ | £ |
| **British:** any quantity in reels, not delivered | | | |
| Reeds standard | (50 gsm) | 229.36 | 202.95 |
| | (45 gsm) | 254.50 | 225.50 |
| Bowaters standard | (50 gsm) | 229.36 | |
| | (45 gsm) | 254.50 | 224.50 |
| **Scandinavian:** in reels, delivered (no currency parity clause) | | | |
| standard | (48.8 gsm) | 235.00 | 188.00 |
| | (45 gsm) | 254.50 | 225.50 |
| Canadian: in reels, delivered (no currency parity clause) | | | |
| standard | (48 gsm) | 235.00 | 208.00 |
| | (45 gsm) | 254.50 | 225.50 |
| **Mechanical printings** | | | |
| Scandinavian: | SC gravure, 60 gsm, cif, duty-paid, medium-sized contract | 265.00 | 202.00 |
| **MG and Unglazed Kraft** | | | |
| **MG sulphite** | | | |
| Prices too unsettled to allow for meaningful guide | | | |
| **Kraft Linerboard** (unbleached) | | $ | $ |
| US: 200 gsm, import duty unpaid | | 275.00 | 310.00 |
| 150 gsm, import duty unpaid | | 285.00 | 320.00 |
| 125 gsm, import duty unpaid | | 295.00 | 335.00 |
| **Scandinavian:** | 175 + gsm, water finished or dry finish, reels, delivered, duty unpaid 2 per cent cad, calculated at sterling parity of $1.81 | 275.00 | |
| | 150 gsm, water finish, as above | 285.00 | |
| | 125 gsm, water finish, as above | 295.00 | |

NB: Rebates of up to $20 available from most suppliers.

| | | January 1978 £ | May 1976 £ |
|---|---|---|---|
| **Test/Jute liner** | | | |
| British: delivered price | | | |
| Duplex | Most suppliers are attempting to maintain a 5 per cent differential between the price of duplex and the effective cost of 175 gsm kraft liner | | |
| Single ply | 125 gsm | 150.00 | 144.00 |
| **Folding boxboard** | | | |
| Finnish: | 230-244 gsm, reels, 15 ton lots and over, bleached, lined, uncoated, cif duty-paid at EFTA concessionary rate, no currency surcharge | 399.00 | 312.50 |
| | Sheets, as above (less 2% per cent cad) | 413.00 | 324.50 |
| **Semi-chemical fluting** | | | |
| British: | delivered price | £139-£148 | |
| Finnish: | delivered duty unpaid | 147.50 | 125.00 |
| **Waste-based fluting** | | | |
| British: | delivered | | |
| | 112 gsm | £135-£140 | |
| **Greaseproof** | | | |
| Scandinavian: | pure Grade A, unbleached, large reels minimum 15 ton shipments, delivered duty paid, no currency surcharge | | |
| | 38-40 gsm | 524.50 | 425.65 |
| | 41-49 gsm | 513.00 | 415.56 |
| | 50-64 gsm | 495.50 | 400.00 |
| | 65+ gsm | 513.00 | 415.56 |

Premium for sheets depending on size £41.50 to £98.00. Bleaching extra £55.00

Source: EIU 'Paper and Packaging Bulletin' No. 93: May 1978

TABLE 2: WHOLESALE PRICE INDICES (1970 = 100)

| | | | Uncoated Paper | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Paper and board | Coated paper | Uncoated paper | Printings and writings including newsprint | Kraft wrapping paper | Household and other tissues | Industrial and special purpose papers | Coated board | Uncoated board | Paper and board other than building board | Waste paper |
| 1971 | 106.4 | 104.7 | 106.3 | 106.6 | 104.0 | 105.3 | 108.3 | 106.8 | 108.1 | 106.4 | 92.9 |
| 1972 | 110.6 | 108.5 | 110.5 | 110.9 | 111.3 | 110.2 | 111.5 | 110.2 | 112.5 | 110.6 | 95.8 |
| 1973 | 120.4 | 117.3 | 120.8 | 122.3 | 124.1 | 117.7 | 120.3 | 120.4 | 121.3 | 120.3 | 109.2 |
| 1974 | 170.6 | 154.4 | 172.7 | 173.8 | 183.0 | 166.5 | 171.3 | 166.5 | 176.2 | 170.6 | 199.2 |
| 1975 | 219.4 | 205.3 | 222.2 | 221.3 | 230.8 | 228.6 | 222.5 | 214.0 | 221.8 | 219.4 | 155.7 |
| 1976 | 246.7 | 234.3 | 249.6 | 257.3 | 249.1 | 252.9 | 244.8 | 248.0 | 244.3 | 246.9 | 204.0 |
| 1977 | 288.2 | 269.3 | 292.1 | 303.4 | 284.1 | 298.6 | 285.3 | 299.4 | 288.3 | 288.2 | 261.9 |

Extracted from information given in "Paper and Paper Making Materials"

Business Monitor PM 481, January and February 1978, (HMSO)

TABLE 3: PRICES OF SELECTED PULP AND PAPER GRADES

(Approximate price/ short ton as of 1 December 1977)

| Paper/ board grade | Price/ ton | % change from a year ago |
|---|---|---|
| Linerboard (42 lb domestic) | $185 | -5 to -10% |
| Linerboard (42 lb export) | 200* | -2 |
| Unbl. kraft paper (50 lb multiwall) | 290 | 5 |
| Solid bleached paperboard | 405 | 5 |
| Comb. boxboard (20-pt clay-coated) | 320 | 7 |
| No. 4 bond | 588 | 4 |
| Form bond | 500 | -4 |
| Uncoated book (No. 3 offset) | 548 | 8 |
| Coated magazine (34 to 36 lb) | 545 | 18 |
| Newsprint (30 lb) | 305** | 5 |
| Uncoated groundwd paper (25 lb) | 405 | 14 |
| **Pulp grade** | | |
| Bl. kraft softwood (domestic) | 300 | -12 |
| Bl. kraft softwood (export) | 300* | -14 |
| Bl. kraft hardwood (domestic) | 260 | -17 |
| Bl. kraft hardwood (export) | 250 | -22 |

* Excludes insurance and ocean freight charges, estimated to range between $30-40/ ton.

** $300/ ton west of Rockies.

Source: Pulp and Paper (Miller Freeman Publications, San Francisco)

TABLE 4: OUTLOOK FOR PAPER AND PAPERBOARD CONSUMPTION

(million m tons)

Total Paper and Paperboard

| | 1973-75 | 1980 | 1985 | 1990 |
|---|---|---|---|---|
| North America | 57.9 | 69-72 | 80-85 | 91-102 |
| EEC | 28.6 | 34-36 | 39-43 | 45-52 |
| Nordic Countries | 3.1 | 3.2-3.7 | 3.5-4.2 | 3.8-5 |
| Other Western Europe | 5.6 | 7.5-8 | 8.6-10 | 11-13.5 |
| Western Europe total | 37.4 | 45-47 | 52-58 | 60-68 |
| Japan | 14.8 | 19-20 | 24-27 | 30-34 |
| Oceania | 2.2 | 2.4-2.9 | 3-3.4 | 3.7-4.2 |
| Developed Regions | 112.2 | 136-141 | 160-175 | 185-210 |
| Latin America | 6.6 | 8.7-10 | 11-13.5 | 14.5-18.5 |
| Near East (North Africa) | 1.3 | 1.9-2.4 | 3-3.8 | 4.1-5.6 |
| Africa (South of Sahara) | 1.4 | 1.7-1.9 | 2.1-2.4 | 2.6-3.6 |
| Far East | 4 | 5-6.2 | 6.3-8.8 | 8-12 |
| Developing Regions | 13.3 | 18-20 | 23-26 | 30-38 |
| Centrally Planned Economies | 18.1 | 23.5-25.5 | 30-34 | 37-46 |
| World total of which | 134.6 | 177-187 | 215-230 | 250-290 |
| Newsprint | 22.5 | 25.6-28 | 29.0-33.5 | 32.3-41 |
| Other printing/writing | 31.2 | 40-44 | 48-57 | 57-79 |
| Other paper and board | 89.4 | 110-117 | 134-140 | 162-182 |

Source: FAO Secretariat "Demand, Supply and Trade in Pulp and Paper: Trends and Forecasts to 1990".

TABLE 5: PRODUCT PRICE COMPARISION

| | Brazil Prices per short ton | US Prices per short ton |
|---|---|---|
| Linerboard | ₱325 | ₱195 |
| Sack paper | 382 | 240 |
| Bl. eucalyptus pulp | 260 | - |
| Commodity off set paper | 562 | 500 |

Source: Paper (Benn Publications, London)

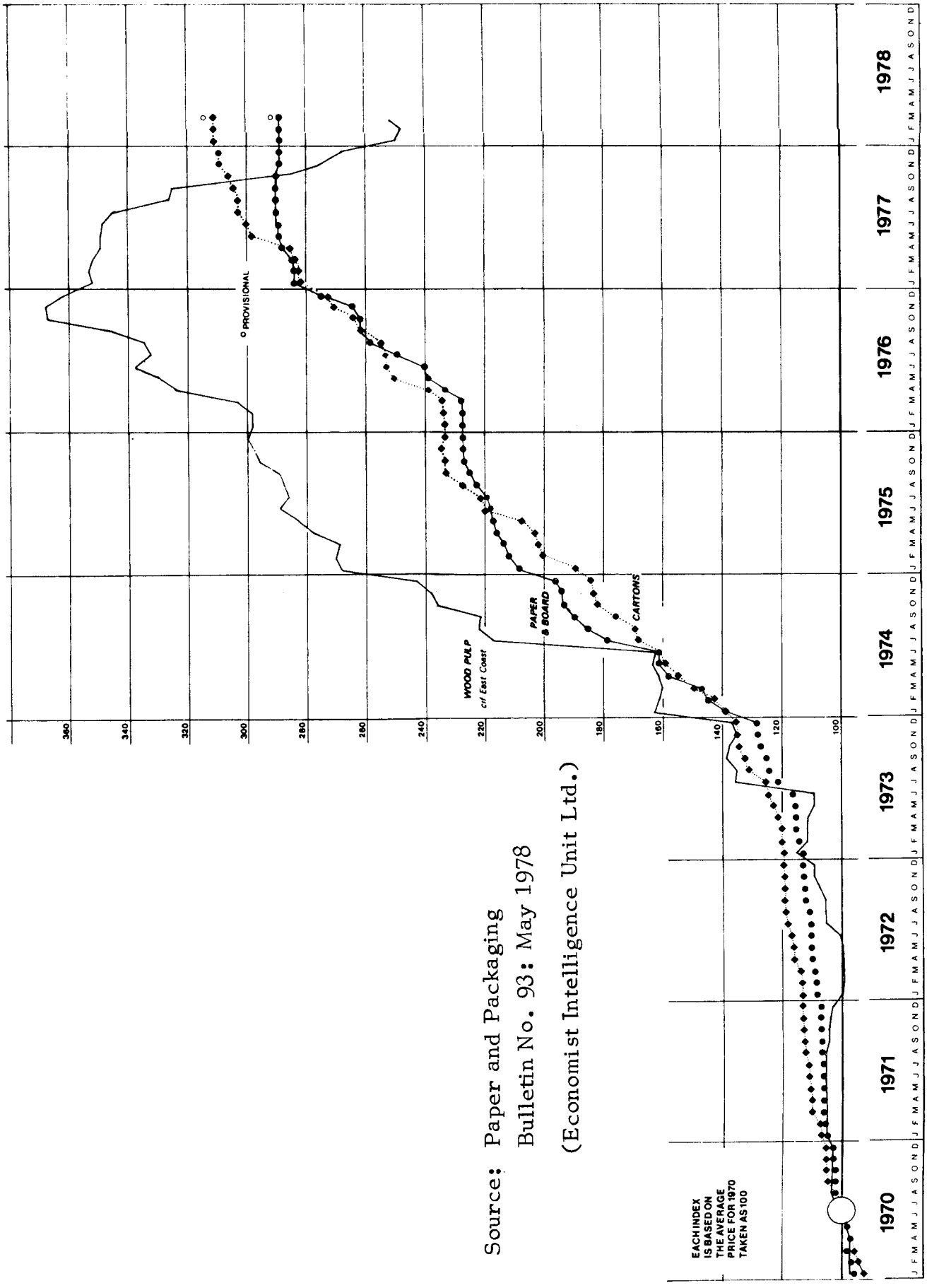
TABLE 6:
CAPACITY UTILIZATION RATES FOR PAPER AND PAPERBOARD

| | FAO 1976 % | 1977 % |
|---|---|---|
| USA | 89.4 | 89 - 90 |
| Canada | 82.9 | 70 - 90 |
| Japan | 75.5 | |
| UK | 83.8 | |
| Norway | 76.2 | 70 |
| Finland | 73.3 | 70 - 75 |
| Sweden | 78 | |
| Netherlands | 77.1 | 82 |
| Italy | 79.6 | 79.6 |
| West Germany | 80.5 | 88 |
| France | 82.2 | |
| Brazil | 77.8 | |
| Israel | 100 | |
| Malaysia | 94.4 | |
| Poland | 99.8 | |
| India | 79.7 | |
| Pakistan | 37.5 | |
| Bangladesh | 39.4 | |
| Turkey | 57.5 | |
| Swaziland | 100 | |
| South Africa | 89.1 | |
| Tunisia | 77.3 | |
| Jamaica | 42.9 | |

Source: FAO (Figures taken from FO: MISC/77/7 Estimated Production of Pulp, Paper and Paperboard in Certain Countries in 1976).

GRAPH I

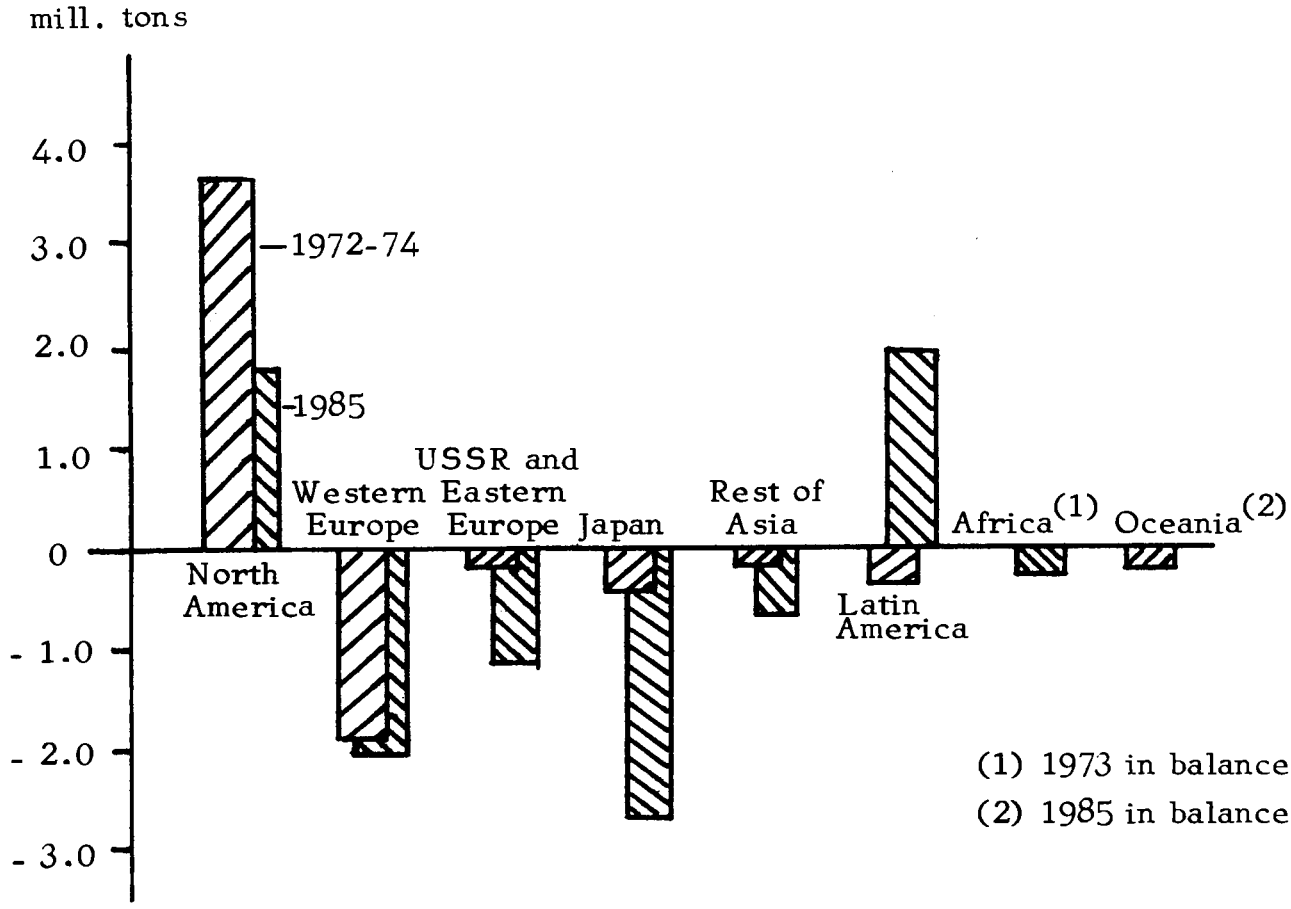
British Wholesale Price Indices (Monthly Averages)




Source: Paper and Packaging Bulletin No. 93: May 1978 (Economist Intelligence Unit Ltd.)

GRAPH 2

Regional Demand/ Supply Balances for Bleached Chemical Pulp in 1973 and 1985

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