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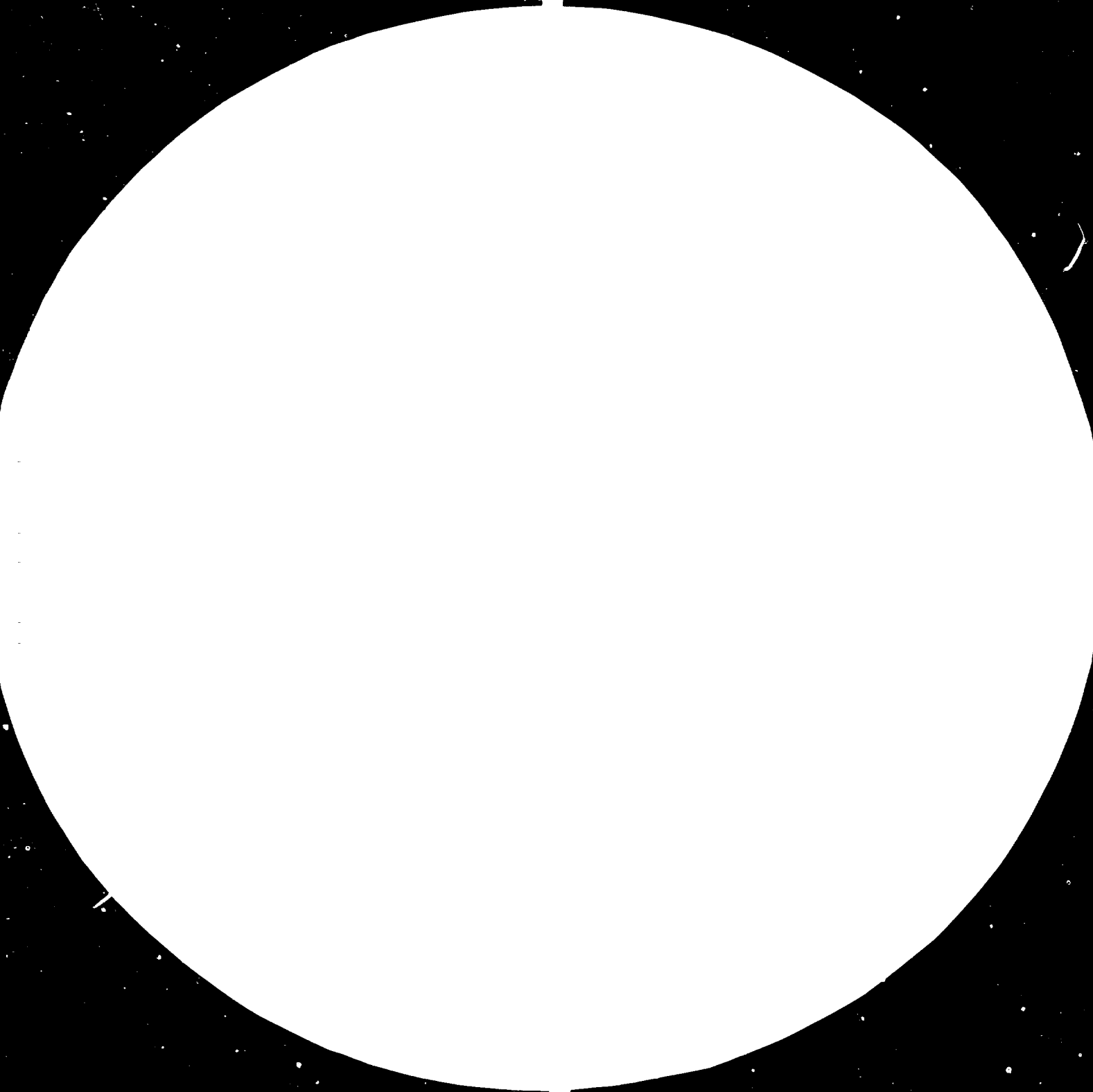
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USE OF MIXED TROPICAL HARDWOODS FOR PULP AND PAPER  
DEVELOPMENT IN THE ASEAN REGION \*

by

Y. Sudhakara Rao\*\*

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\*\* Regional Forestry Economist, FAO Regional Office, Bangkok.

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## 1. Introduction

In 1978, the pulp and paper sector of ASEAN comprised 28 pulp mills having a combined capacity of some 400,000 TPA and 77 paper mills whose aggregate capacity is about 900,000 TPA. The pulp mills in Thailand and Indonesia are mainly oriented towards manufacture of pulp from non-wood raw materials. The only significant experience in the utilization of mixed tropical hardwoods for manufacture of pulp and paper is confined to Philippines where the pulping capacity is some 200,000 TPA (excluding non-wood raw material). The broad picture that emerges is that wood pulp production in ASEAN countries is less than 0.2% of world production in 1978 - a fact which bears no relationship either to the demand for pulp in ASEAN or to the abundance of wood raw materials they possess.

## 2. Demand for pulp and paper in ASEAN

The apparent consumption of paper in ASEAN amounted to an estimated 1.4 million tons per year (Table 1) of which 62 percent was imported at a cost of US\$ 395 million; supplementary pulp imports were valued at an additional US\$ 73 million. In the last decade paper consumption in ASEAN grew at an average annual rate of about 7 percent. A continuation of this vigorous growth is foreseen arising from the economic strength and progressive development policies of the ASEAN countries.

Demand projections were developed at the FPO to estimate the likely consumption by paper grade in the year 2000; such projections are necessary to evolve the strategy for the development of the industry in the next 20 year period. These projections are based on an econometric projection methodology which recognizes the following variables:

- current consumption per caput;
- current income per caput as measured by GDP; and
- population and income growth trends.

The demand projections indicate that unless constrained by supply, the aggregate demand for paper and paperboards in ASEAN in the year 2000 AD is likely to be some 6.8 million tons distributed as follows:

	<u>1000 MT</u>
Linear board	1,050
Sack kraft	795
Newsprint	1,056
Printing/writing	1,763
Corrugating medium	677
Folding boxboard	884
Miscellaneous	533
	<hr/>
TOTAL	6,767
	<hr/>

As can be expected, because of the size of the population, Indonesia accounts for 44 percent of the demand followed by Thailand (17), Malaysia (16), Philippines (16) and Singapore (7).

3. Analysis of the prospects and development of pulp and paper industries in ASEAN

The forecast growth in consumption, together with a growing need for establishing self sufficiency in bulk grades of pulp and paper, strongly suggest that the ASEAN countries seriously consider expansion of their domestic supply adapting a strategy which optimizes the use of mixed hardwoods available in the region. A study, therefore, was undertaken by UNDP/FAO Pulp and Paper Industries Development Programme (PFIDP) to evaluate comparative advantage among different industry locations which have access to the mixed hardwood potential of the region and to formulate the framework for phased development of forest industries in ASEAN.

The approach adopted in formulating the model is the following: The industry is represented by a set of mathematical expressions that capture the essential technical and economic relations that characterize the industry. A range of area - specific restrictions (e.g. availability of wood) are represented in the form of constraints. Given a set of projections of the demand for paper over time and by market centre, the model is used to find the least-cost pattern of investment, production, and transportation to meet those demands.

The econometric model enabled an exhaustive and simultaneous computerised examination of data inputs. The major inputs into this model are:

- the projected demand and consumption point prices of various grades of paper and other forest products;
- the locations to be evaluated and the cost of inputs such as power, oil, coal, chemicals at these locations;

- the cost of labour, administrative overheads and supplies;
- the forest regions with alternative cutting options by type of wood;
- the non-wood collection regions and the level of availability of bamboo, bagasse and straw;
- the centres of waste paper availability and the probable available quantities by grade of waste paper;
- the prices of wood, other fibrous raw materials and waste paper;
- the transport cost matrices specifying units costs of transport of:
  - wood from every forest region to every mill location;
  - other fibrous raw materials from every collection centre to every mill location;
  - waste paper from every collection centre to mill location;
  - intermediates (dry pulps) from every mill location to another;
  - finished products from every mill location to market area;
- the installed capacities of existing mills;
- the time periods to be analyzed;
- the discount factors for the threshold level of internal rate of return expected;
- export bounds and export prices for different products;
- linear capacity dependent equations for calculation of investment costs and investment cost factors to account for differences between location;
- cost of infrastructure and site development at every location.



The more important outputs of the analysis are:

- the most financially favourable combination of locations for manufacture of different grades of pulp and paper, sawnwood, plywood, fibreboard and particle board;
- the optimum phasing of capacity expansion by product at each location and related cost of investment;
- the optimum product mix, cost of manufacture and supply to specified markets, and rate of return from the operations at each location;
- the level of imports/exports/domestic manufacture by grade of paper;
- the least cost combination of fibre furnishes used in the manufacture of pulps;
- the source and type of fibrous raw materials (mixed tropical hardwood, softwood, bamboo, bagasse, straw and waste paper) to be used in fibre furnishes at each location;
- the existing option applicable for each forest region to ensure sustained supply of raw materials to wood-based industries.

The magnitude of the analysis which was undertaken can be illustrated in general terms by the number of different alternatives which were considered.

These were:

<u>Factor</u>	<u>Number Considered</u>
- Pulpwood supply areas	74
- Forest harvesting regimes	6
- Collection points for mechanical wood-based industry residues	65
- Supply areas for other fibres (bagasse, rubber wood, bamboo, straw)	41

<u>Factor</u>	<u>Number Considered</u>
- Collection areas for waste paper	34
- Potential pulp and paper industry sites	52
- Market areas	43
- Intermediate products (pulp, processing chemicals, chips)	10
- Finished paper products	7
- Other final products (plywood, lumber, etc.)	4
- Time periods (within the total planning period of 20 years)	4
- Fibre furnishes	18

#### 4. Fibre furnishes

Among the various factors considered, the most interesting from the viewpoint of utilization of mixed tropical hardwoods is the specification of furnish combinations to manufacture different grades of paper. In view of the severely restricted supplies of locally grown long-fibre, and the abundance of economically available short-fibre, furnishes using hardwoods were specified wherever possible without detriment to paper quality. Some 18 furnishes have been evaluated and the model enables choosing of each or several of the options for each grade of paper; the final selection is made using the criterion of the lowest cost of manufacture.

The following are some of the hardwood based fibre furnish options specified in the model:

Linear Board

Linear board grade hardwood pulp:	63 %
Linear board grade softwood pulp:	19 %
Waste paper browns:	18 %

Sack Kraft

Unbleached hardwood kraft:	50 %
Unbleached softwood kraft:	50 %

Printing and Writing

(i) Bleached hardwood kraft:	80 %
Bleached softwood kraft:	20 %
(ii) Bleached hardwood kraft:	37 %
Bleached softwood kraft:	18 %
Waste paper whites:	45 %

Newsprint

Bleached hardwood kraft:	20 %
Refiner ground wood (hardwood):	80 %

Corrugating Medium

NSSC hardwood pulp:	77 %
Waste paper browns:	23 %

5. The Results of the Analysis

The results obtained with the model were discussed in detail in the UNDP/FAO report "Prospects for the development of pulp and paper industries - ASEAN Volume 1 - Summary of Results". A phased programme covering 20 years (divided into 4 five year periods) has been suggested. If implemented, it

would mean the establishment of new paper manufacturing capacity of some 4.5 million tons by the turn of the century with an investment of US\$ 6,700 million.

Ten potential industry locations, out of thirty tested, were identified as forming an optimal basis for the expansion of the ASFAN pulp and paper sector. These locations have excellent growth potential based on available resources, market demand and competitive advantage. The phased programme for development at each of these locations along with the requirement of fibrous raw materials is summarised below:

Indonesia: Northern Sumatra

The analysis suggests the following production pattern:

Linerboard: starting at 140,000 TPA in 1986 with an expansion to 326,000 TPA by 1996

Sack Kraft: starting at 77,000 TPA in 1991 and expanding to 186,000 TPA by 1996

Folding Boxboard: a mill of 150,000 TPA starting in 1996

Production will be based on locally available wood fibre plus imported wastepaper (browns) until 1996 when some 30,000 TPA of bleached softwood pulp may be required (depending on the successful expansion of the existing plantation programme). Fibre requirements per year when capacity is at full production, are estimated to be:

	<u>1986-1990</u>	<u>1991-1995</u>	<u>1996-2000</u>
Hardwood Pulpwood m <sup>3</sup> /yr	340,000	504,000	1,404,000
Softwood Pulpwood m <sup>3</sup> /yr	120,000	316,000	755,000
Waste Paper - Browns TPA	27,000	27,000	106,000
Waste Paper - Whites TPA	-	-	18,000
Waste Paper - News TPA	-	-	9,000

Indonesia: Southern Sumatra

The lack of immediately available long fibre at this location emphasises the need to base production initially on hardwoods and waste paper with a minimum of pulp imports, until plantations are productive in 1996. The analysis suggests the following production pattern:

Folding Boxboard: Starting with a capacity of 100,000 TPA in 1986 and expanding to 225,000 TPA by 1991.

Printing & Writing: Starting with a capacity of 78,000 TPA in 1991 rising to 139,000 TPA by 1996.

Corrugating Medium: A capacity of 200,000 TPA to be installed by 1991.

Fibre requirements for the above production are estimated to be:

	<u>1986-1990</u>	<u>1991-1995</u>	<u>1996-2000</u>
Hardwood pulpwood m <sup>3</sup> /yr	143,000	974,000	1,161,000
Softwood pulpwood m <sup>3</sup> /yr	none available	none available	168,000
Bleached softwood pulp TPA	20,000	58,000	36,000
Waste Paper - Browns TPA	29,000	115,000	115,000
Waste Paper - Whites TPA	12,000	27,000	27,000
Waste Paper - News TPA	6,000	14,000	14,000

Indonesia: East Kalimantan

The analysis suggests a 131,000 TPA bleached hardwood kraft pulpmill starting in 1986 to be integrated and expanded by 1996. The following paper capacity should be built by 1996:

Printing/Writing grades	305,000 TPA
Corrugating Medium	100,000 TPA
Folding Boxboard	60,000 TPA

This production assumes that 15,000 hectares of pine plantations can be successfully established and will be productive by 1996. Fibre requirements, when the capacity is at full production, are estimated to be:

	<u>1986-1990</u>	<u>1991-1995</u>	<u>1996-2000</u>
Hardwood pulpwood m <sup>3</sup> /yr	580,000	580,000	1,911,000
Softwood pulpwood m <sup>3</sup> /yr	none available	none available	168,000
Bleached softwood pulp TPA	-	-	38,000
Waste Paper - Browns TPA	-	-	25,000

Indonesia: South Kalimantan

The ASEAN analysis indicates that development of a pulp and paper industry in South Kalimantan should not start until 1996, at which time the production of 186,000 TPA of linerboard and 100,000 TPA of corrugating medium is suggested.

Pine plantations totalling 15,000 hectares are assumed. Fibre requirements in 1996 are estimated to be:

Hardwood pulpwood:	660,000 m <sup>3</sup> per year
Softwood pulpwood:	162,000 m <sup>3</sup> per year
Waste paper - Browns:	60,000 TPA

Peninsular Malaysia: Tererloh

The ASFAM analysis suggests the following production pattern:

- Linerboard: Starting in 1986 with a capacity of 57,000 tons and expanding to 157,000 TPA in 1991.
- Sack Kraft: 18,000 TPA to be produced jointly with the linerboard starting in 1986. No expansion is foreseen.
- Printing/ Writing: Starting in 1986 with 78,000 TPA rising to 117,000 TPA in 1991.
- Newsprint: A unit of 100,000 TPA to be established in 1991.
- Corrugating Medium: A unit of 100,000 TPA to be established in 1991.

No expansion of this mill is foreseen beyond 1991.

Fibre requirements, assuming the successful establishment of some 15,000 hectares of pine plantations to be fully productive by 1991, are estimated to be:

	<u>1986-1990</u>	<u>1991-1995</u>	<u>1996-2000</u>
Hardwood pulpwood m <sup>3</sup> /yr	417,000	1,154,000	1,154,000
Softwood pulpwood m <sup>3</sup> /yr	50,000	140,000	140,000
Bleached softwood pulp TPA	13,000	20,000	20,000
Semi-bleached softwood pulp TPA	0	21,000	21,000
Unbleached softwood pulp TPA	10,000	10,000	10,000
Waste paper - browns TPA	11,000	55,000	55,000

Peninsular Malaysia: Kuala Lumpur

The analysis confirms Kuala Lumpur as the best site for manufacture of folding boxboard in view of availability of waste paper and market demand.

The capacity suggested is:

1988: 68,000 TPA  
1991: 113,000 TPA (cumulative)  
1996: 163,000 TPA (cumulative)

Fibre requirements to meet the above growth pattern are estimated to be:

	<u>1986-1990</u>	<u>1991-1995</u>	<u>1996-2000</u>
Hardwood pulpwood m <sup>3</sup> /year	107,000	143,000	215,000
Bleached softwood pulp TPA	15,000	20,000	30,000
Waste paper - Browns TPA	22,000	29,000	44,000
Waste paper - Whites TPA	9,000	12,000	18,000
Waste paper - News TPA	5,000	7,000	10,000

The hardwood pulpwood would be delivered in terms of bleached and unbleached hardwood pulp equivalent from the mill at Temerloh.

Sabah: Tawau

In view of lack of infrastructure, it is to the best advantage of ASEAN if production is started here only in 1991 and follows the following pattern:

Linerboard: the establishment of a linerboard mill in 1991 having a capacity of 186,000 TPA.

Sack Kraft: the establishment of a sack kraft mill in 1996 having a capacity of 109,000 TPA.

Newsprint: the establishment of a newsprint mill in 1996 with a capacity of 200,000 TPA.

Production is based on locally available fibres supplemented by imported pulps. An expansion of the existing plantation programme is assumed to include 15,000 hectares of pine with a sustained yield from 1991.



Fibre requirements are estimated to be:

	<u>1986-1990</u>	<u>1991-1995</u>	<u>1996-2000</u>
Hardwood pulpwood m <sup>3</sup> /year	-	453,000	1,019,000
Softwood pulpwood m <sup>3</sup> /year	-	162,000	162,000
Unbleached softwood pulp TPA	-	-	58,000
Semi-bleached softwood pulp TPA	-	-	42,000
Waste Paper - Browns TPA	-	35,000	35,000

Philippines: Mindanao

The general area of North and East Mindanao has major cost and resource advantages which give it a strong comparative advantage over most other ASEAN localities. The analysis suggests that this area has the potential to support major capacity expansion in the immediate future.

The following production pattern has been identified by the analysis:

Sack Kraft: Install 154,000 TPA in 1986, expand to 231,000 TPA by 1991.

Printing/  
Writing: Increase the existing capacity of 7,000 TPA to 129,000 TPA by 1986 and to 290,000 TPA by 1991.

Newsprint: Increase the existing capacity from 100,000 TPA to 400,000 TPA by 1986 and expand this to 500,000 TPA by 1996.

Folding  
Boxboard: Establish a plant of 25,000 TPA in 1996.

Fibre requirements for the new capacity are based on indigenous hardwoods together with an estimated 15,000 hectares of pine plantations, supplemented by imported pulps. When capacity is at full production, fibre inputs are estimated to be:

	<u>1986-1990</u>	<u>1991-1995</u>	<u>1996-2000</u>
Hardwood pulpwood m <sup>3</sup> /year	1,566,000	2,510,000	2,546,000
Softwood pulpwood m <sup>3</sup> /year	30,000	30,000	56,000
Bleached softwood pulp TPA	15,000	42,000	20,000
Unbleached softwood pulp TPA	32,000	123,000	123,000
Waste Paper - Browns TPA	-	-	7,000
Waste Paper - Whites TPA	-	-	3,000
Waste Paper - News TPA	-	-	2,000

Northern Thailand

The indigenous pine forests of Northern Thailand, which are supplemented by associated hardwood forests, are identified by the analysis as a viable resource having the potential for early development in accordance with the following production pattern:

Newsprint: Establish a mill of 100,000 TPA in 1986 and expand this to 200,000 TPA in 1996.

Sack Kraft: Establish a mill of 62,000 TPA in 1991.

Corrugating Medium: Establish a mill of 65,000 TPA in 1996.

Fibre requirements are estimated to be:

	<u>1986-1990</u>	<u>1991-1995</u>	<u>1996-2000</u>
Hardwood pulpwood m <sup>3</sup> /year	167,000	299,000	600,000
Softwood pulpwood m <sup>3</sup> /year	110,000	205,000	267,000
Unbleached softwood pulp TPA	-	13,000	-
Semi-bleached softwood pulp TPA	-	-	21,000
Waste paper - browns TPA	-	-	16,000

Central Thailand

The analysis indicates that this existing capacity has the potential to expand based largely on the increased use of bagasse. The following production pattern has been identified:

Printing/Writing: Expand the existing capacity of 55,000 TPA to 155,000 TPA by 1991 and to 194,000 TPA by 1996.

Folding Boxboard: Expand the existing capacity of 77,000 TPA to 102,000 TPA in 1996.

The fibre requirements of the new capacity, i.e. in addition to that being used by established capacity, are estimated to be:

	<u>1986-1990</u>	<u>1991-1995</u>	<u>1996-2000</u>
Hardwood pulpwood m <sup>3</sup> /year	-	-	36,000
Bagasse tons/year	-	207,000	287,00
Bleached softwood pulp TPA	-	26,000	41,000
Waste Paper - Browns TPA	-	-	7,000
Waste Paper - Whites TPA	-	-	3,000
Waste Paper - News TPA	-	-	2,000

6. Use of mixed tropical hardwoods

The results clearly show that the most extensive single type of fibre used in the analysis is the short-fibre available from ASEAN's rich resource of mixed tropical hardwoods. Tests undertaken in America, Australia, Europe and India have confirmed the suitability of this resource for the manufacture of paper; this is supplemented by positive production experience in the Philippines.

Estimates of hardwood availability were based on estimates by local Forest Departments and the views of industrialists.

Wood volumes were calculated from forest inventories, forest management plans, logging studies and the views of experienced foresters, loggers and industrialists. Due regard was given to variations in the stocking of both primary unharvested forest and logged-over forest to assess the extent to which the forest resource could contribute to future flows of commercial wood.

Hardwood and softwood resources were quantified separately as peeler logs, sawlogs and pulpwood. In the case of hardwood, the total commercial log output was estimated to contain between 40 and 60 percent of peeler logs depending on the locality, composition of the crop, system of management, demand by grade of log and the nature of timber concession; pulpwood was estimated to comprise logging residues, damaged trees and species above the minimum diameter limit not removed for commercial logs. In some regions provision was made for the removal of small-diameter trees felled specifically for pulpwood.

The projected output of plylogs, sawlogs and pulpwood as derived above represent the best estimate of log and fibre availability based on current forest department philosophy relating to the intensity of forest harvesting, forest management requirements and forest land conversion up to the year 2000. These projections were incorporated into the analysis as a base estimate representing 100 percent of the potentially available output within each fibre region.

A number of alternate cutting options were introduced to facilitate the selection of the most suitable resource output. Initial trials were based on nine alternatives, for hardwood supplies, which ranged from 50 to 120 percent

of the base estimate with different intensities of harvesting in different planning periods. Results from these trials indicated that the final analysis should incorporate three alternatives only; these were 80, 100 and 120 percent for hardwoods and 100 percent only for softwoods due to the scarcity of this resource and its importance as a long fibre.

The final choice was conditioned by the major requirement and priority for the mechanical wood-based industries. For period 2 (1990), only 80 percent of the potentially available resource appears to be required; this rises to 100 percent in some areas during period 3 (1995). The analysis did not identify any locality for which overcutting of the estimated resource would be necessary (i.e. the 120 percent alternative) to meet the projected market demand.

(See Table 2)

During period 2 the annual requirement of hardwood pulpwood varies from 143,000 m<sup>3</sup> in Southern Sumatra to some 1.5 million m<sup>3</sup> in Mindanao. Table 2 indicates that, as a proportion of availability, the requirement ranges from 9 percent in Southern Sumatra to 49 percent in Mindanao, thus confirming ample supplies. The requirement of hardwood pulpwood, as a proportion of the estimated availability for each selected location, is:

<u>Location</u>	<u>P e r c e n t a g e</u>		
	<u>Period 2</u>	<u>Period 3</u>	<u>Period 4</u>
Northern Sumatra	15	22	62
Southern Sumatra	9	62	74
East Kalimantan	23	23	77
Temerloh/Kuala Lumpur	34	83	88
Mindanao	49	70	80
Northern Thailand	14	25	50

If the mechanical wood-based industries develop as envisaged in the analysis, the residues which these industries could supply are as estimated in Table 3, for periods 2 and 3. The wood residues constitute a fibre resource which is available at no cost to the pulp and paper industry and, hence, will be preferred to the extent that they are available.

#### 7. Conclusion

The conclusion derived from the above analysis is that ASEAN has excellent prospects for the establishment, over 20 years, of a viable integrated pulp and paper sector based on the use of indigenous fibre.

ASEAN has an abundant source of mixed tropical hardwoods which, at the present time, is not economically utilized to the fullest extent. Technically, this resource is suitable for the manufacture of pulp and paper and appears to be more cost efficient than other available fibres. Bagasse and straw, for instance, only become acceptable fibres in situations such as Central Thailand and Java, where the wood supply is restricted.

In order to safeguard the efficient supply of hardwood pulpwood it is essential that guidelines for the forest management should be revised, particularly in those areas where the large-scale production of pulp and paper is to be developed. Full advantage should be taken of the ability of the growing stock to produce wood having the best characteristics for pulp and paper in addition to the traditional production of peeler logs and saw logs.

Finally, the comparative advantage of the locations endowed with naturally growing mixed tropical hardwoods will enhance if expanded programmes for raising long-fibre plantations (Pine) are undertaken at these locations.

Table 1  
Consumption in ASEAN, 1978

Unit: 1000 MT

Country	Production	Imports	Exports	Apparent Consumption
Indonesia	72	263	-	341
Malaysia	38	250	13	275
Philippines	341	58	-	399
Singapore	6	188	48	146
Thailand	137	121	6	252
ASEAN	600	380	67	1,413

Table 2

Wood Availability and Requirement by Location and Planning Period

<u>Locality of Production</u>	<u>Code</u> <sup>1/</sup>	'000 m <sup>3</sup>		
		<u>1986 to 1990</u> <u>Hardwood</u> <u>Pulpwood</u>	<u>1991 to 1995</u> <u>Hardwood</u> <u>Pulpwood</u>	<u>1996 to 2000</u> <u>Hardwood</u> <u>Pulpwood</u>
Northern Sumatra		2,280	2,280	2,280
	R	340	504	1,404
Southern Sumatra	A	1,560	1,560	1,560
	P	143	974	1,161
East Kalimantan	A	2,480	2,480	2,480
	P	580	580	1,911
South Kalimantan	A	5,360	5,360	5,360
	R	-	-	660
Temerloh	A	1,560	1,560	1,560
	R	524	1,297	1,369
Tawau (Sabah)	A	1,560	1,560	1,560
	R	-	453	1,019
Mindanao	A	3,190	3,190	3,190
	P	1,566	2,510	2,546
Northern Thailand	A	1,200	1,200	1,200
	R	167	299	600
Central Thailand	A	540	540	540
	R	-	-	36

<sup>1/</sup> A = Availability assumed in the analysis. R = Requirement of new capacity



Table 3

Availability of Wood Residues for Planning Period 2: 1986 to 1990

<u>Locality of Production</u>	<u>Production</u>		<u>Residues</u>		<u>Total Residues</u>
	<u>Sawnwood</u>	<u>Plywood</u>	<u>Sawnwood</u>	<u>Flywood</u>	
Northern Sumatra	72	90	25	28	53
Southern Sumatra	225	210	79	65	144
East Kalimantan	302	375	106	116	222
Temerloh	403	370	140	115	255
Mindanao	316	270	111	84	195
<b>TOTAL</b>	<u>1,315</u>	<u>1,315</u>	<u>461</u>	<u>408</u>	<u>869</u>

'000 m<sup>3</sup>

The estimates for period 2, above are revised as shown below for period 3.

Tawau (Sabah)	225	80	79	25	104
Temerloh	496	511	174	158	332
Mindanao	316	370	111	115	226



