C I N T R A F O R

Working Paper

34

Opportunities for Expansion of Alaska's Market Pulp Exports

March 18, 1989

James A. Stevens

Darius M. Adams

College of Forest Resources
Center for International Trade in Forest Products
University of Washington

CENTER FOR INTERNATIONAL TRADE IN FOREST PRODUCTS
UNIVERSITY OF WASHINGTON
COLLEGE OF FOREST RESOURCES AR-10
SEATTLE, WASHINGTON 98195

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James A. Stevens and Darius M. Adams

College of Forest Resources
Center for International Trade in Forest Products
University of Washington
AR-10
Seattle, WA 98195

May 22, 1991

The authors are, respectively, graduate research assistant and professor, College of Forest Resources, CINTRAFOR, University of Washington, Seattle, WA. Funding for this study was provided by a cooperative-aid research grant from the USDA, Forest Service, PNW Research Station, Portland OR and by a grant from the Center for International Trade in Forest Products at the University of Washington.

OPPORTUNITIES FOR EXPANSION OF ALASKA'S MARKET PULP EXPORTS EXECUTIVE SUMMARY

The purpose of this study was to examine the prospects and opportunities for expansion of market pulp exports from Alaska. The focus was on opportunities for the addition of new capacity and expansion of exports in grades not now produced. We provide a brief overview of the existing industry in Alaska, its historical development, the characteristics of its facilities, sources of raw materials, and its financial problems. And we provide a view of the potential markets for expanded pulp exports by grade, the likely competition to be faced by Alaskan producers, and the comparative cost position of Alaskan mills vis à vis other regions. Certain conclusions emerge.

It seems likely that expanded market pulp exports from Alaska will find their principal markets around the Pacific Rim and particularly in the developed or emerging countries of Asia. There is potential for continued growth in pulp demand in the region. Given constraints on domestic fiber supplies, environmental and cost considerations in domestic pulp production, and continued strong growth in domestic paper and board consumption, Asian demands for pulp imports will likely continue to grow similarly to recent historical trends. Japan will be the source of most of this growth. Both FAO and IIASA projections suggest for Asia as a whole that this increase by 2000 could be as much as twice the current pulp imports. For Asia this would amount to imports totaling some 2.0 million metric tons.

A new Alaska mill will produce long-fiber pulp in direct competition with existing major producers in British Columbia and the U.S. Pacific Northwest. Current trends in capacity expansion and the projections of both FAO and IIASA indicate that these regions will continue to figure prominently in Pacific Rim and specifically Asian pulp markets. If the IIASA projections are correct, however, rising wood costs could push the U.S. Pacific Coast into the role of marginal producer, with the bulk of export growth going to British Columbia. It is also clear that Chile and, to a lesser extent, New Zealand are likely to capture growing shares of this trade. And Brazil will be mounting a major effort to substitute its short-fiber pulps for traditional coniferous grades. Both the IIASA and FAO projections suggest that Brazil will have some success in this venture. Cost competition will be keen in this market, particularly within light of the prospect of constant or only limited growth in real pulp prices.

Given the substantial cost advantages of South American producers, a minimum condition for a successful Alaska expansion will be the ability to deliver its product in Asian markets at costs at least as low as those in the Pacific Northwest and British Columbia. We are unable, however, to identify any particular cost advantage for an Alaska mill relative to its closest potential competitors in western North America. Our analysis examined both a traditional bleached kraft mill and a smaller, high yield, thermo-mechanical pulp (TMP) mill. In either case, an Alaska mill seems to face cost problems across the full range of inputs, with major disadvantages in wood, labor, energy, and construction costs. The cost disadvantage is even greater when compared to the U.S. South or major Latin American producers. Thus, although a market may exist, it is not immediately obvious that Alaska is in a position to pursue some share of it.

These results should be viewed only as broad indicators. Given the time and resource constraints of the present study, we have relied exclusively on secondary and published data to support our analysis. A far more detailed and specific study of both the market and cost sides is needed to reach a definitive conclusion on any particular project. Three items merit specific mention for further study.

1. There is a strong need for close attention to resource and capacity developments in the southern hemisphere. The rapid growth of plantation-based mills in South Africa, New Zealand, and South America has dramatically changed the nature of competition in the global market for pulp in the past two decades. In sharp contrast to the dependence in western North America on natural forests, this resource base was designed and grown to meet mill requirements. The mills operate with considerable advantages in wood costs relative to mills in the northern hemisphere using fiber from natural stands.

2. Previous studies note the potential attractiveness of a TMP mill on the basis of lower capital costs, lower environmental impacts, higher pulp yield, ability to tailor pulp characteristics to specific customer needs, and so forth. High-yield pulping technology has been developing rapidly and is characterized by considerable flexibility in its adaption to specific resource and market conditions. Detailed analysis may reveal opportunities for targeting particularly high-valued markets, reducing energy and wood costs through technical adaptations, or lowering transport costs through pooled shipping arrangements with existing pulp facilities. As a consequence, this option would seem to warrant close and continuing evaluation.

3. A final key item relates to the cost and availability of wood fiber. In our analysis, we have identified Alaska as a region of pulp production that is relatively high in wood cost, owing in part to high costs of logging and transport of logs and chips. Though our estimates are admittedly crude, this is a crucial concern, because wood is the main variable input cost in production (outside Latin America). At the same time, it is evident that the bulk of wood supplies to a new mill in Alaska must come from the National Forest and that the Forest Service is under intense pressure to limit both current and future harvest levels. These circumstances seem to warrant a thorough analysis of prospective future wood supplies and costs under several assumptions about prospective Agency policies and levels of operation of existing log, lumber, and pulping facilities.

This study was undertaken through a grant from the USDA, Forest Service, Pacific Northwest Research Station and the Center for International Trade in Forest Products at the University of Washington. The report, part of a larger study of Alaska forest resource opportunities, was completed in 1989. The trends noted in the study have continued and the conclusions, based on data available at the time, remain valid.

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OPPORTUNITIES FOR EXPANSION OF ALASKA'S MARKET PULP EXPORTS

1. Introduction: Problem statement and report objectives

A recent Alaska Region Forest Service report notes that: "...(u)nless a major new market can be found for Southeast Alaska's pulp and/or its lower grade logs, a long term decline in Alaska's timber industry is anticipated, even with a short-term improvement in pulp markets..." (USFS-AK, 1985). Alaska's existing pulp capacity is concentrated entirely in dissolving pulps. These grades have faced declining markets over the past two decades as a result of substitution of petroleum based products in their primary end-uses. At the same time, more efficient and lower cost mills in other parts of the world have captured growing shares of the remaining global dissolving market, forcing Alaska's mills into the role of the marginal producer. Unless cost-reducing improvements are made in Alaska's existing facilities or new capacity is added in some alternative and more competitive grade, the industrial decline suggested in the Forest Service report, at least in the pulp sector, seems almost inevitable.

The purpose of this study is to examine the prospects and opportunities for expansion of Alaska's market pulp exports. Although some background is provided on the extent and causes of the decline in global dissolving markets, the focus is exclusively on opportunities for the addition of new capacity and expansion of exports in grades not now produced. We do not explore the potential costs and returns from efficiency improvements in existing mills. To provide some perspective, the following section gives a brief overview of the existing industry in Alaska, its historical development, the characteristics of its facilities, sources of raw materials, and its financial problems. The remainder of the report provides a view of the potential markets for expanded pulp exports by grade, the likely competition to be faced by Alaskan producers, and the comparative cost position of Alaskan mills vis à vis other regions. The final section summarizes our findings and offers some specific conclusions and comments on future prospects.

2. Alaska's Existing Pulp Industry

The USDA Forest Service manages approximately 73% of the total timber inventory in Southeast Alaska. Other major landowners are Native corporations (24%) and the State of Alaska (3%). As the principal timber owner, the Forest Service began encouraging development of the region in the 1950's. The long range plan for the Tongass Forest was to let four to six fifty-year timber sale contracts. The major attractions to investment were very long term supply commitments from the Forest Service and stumpage prices 70 to 75% lower than in the Pacific Northwest (Haring and Massie, 1966).

Despite these inducements, realized investment has been limited. In addition to the two contracts currently in existence, a contract was negotiated with the Pacific Northern Timber Company, calling for the establishment of an 80-ton per day pulp mill and associated sawmill and plywood plant at Wrangell. Another contract with Georgia-Pacific called for the construction of a 500-ton per day newsprint plant in Juneau by 1961, with eventual expansion to 750 tons per day. The Wrangell project found that the small size of the pulp mill was not economically feasible and that the supply of high-grade logs was inadequate for the proposed lumber and plywood mills. In June 1961, Georgia-Pacific abandoned the project, citing depressed newsprint markets and lack of a suitable external power supply.

After lengthy negotiations, a contract was announced in 1968 with U.S. Plywood-Champion Paper for the construction of a 500-ton per day unbleached kraft mill with output going to Japan (Rogers, 1985; Auchter, 1976). Pulp facilities were to be constructed at Echo Cove near Berners Bay north of Juneau. The timber sale contract called for a total sale volume of 8,750 MMBF to be harvested from 1968-2023 at a rate of 175 MMBF annually. In 1974, however, Champion pulled out of its proposed investment. In cancelling the sale Champion cited delays caused by legal actions concerning the sale, the loss of its pulp marketing contract, increased costs, the approximate $5 million expenditure to date and possible supply reductions due to land selections under the terms of the Alaska Native Claims Settlement Act (USFS, 1976).

The net result of nearly 40 years of development efforts has been the establishment of two pulp mills specializing in the production of dissolving pulp for export. The **Louisiana Pacific (LPK)** mill at Ketchikan (Ward Cove) has a pulp capacity of 600 tons per day or an annual capacity 360 million board feet of timber (actual consumption has never been over 305.7 MMBF). The mill produces a bleached, magnesium-base, sulphite dissolving pulp (Downs, 1986). Originally constructed by the Ketchikan Pulp Company, the mill was purchased by Louisiana Pacific in 1976. Since its acquisition, the facility has faced numerous financial problems and has been beset with labor difficulties (Portland Oregonian, March 9, 1984).

In the fall of 1983, Louisiana Pacific proposed to sell its Ketchikan Division (the pulp mill, three sawmills and long-term timber cutting rights) to an employee stock ownership trust, but negotiations were terminated in mid-1984 (Pulp and Paper, 1985). The LPK mill remains open in spite of heavy losses because it has reduced its labor costs, intensified its sales efforts, and resolved its dispute with the EPA in an apparent bid to remain competitive. Furthermore, its parent company is profitable, so tax considerations partly mitigate the Ketchikan facility's losses (Alaska Pacific Bank, 1985).

A second mill was negotiated and established at Sitka by the Alaska Lumber and Pulp Co. in 1959. The mill has a pulp capacity of 600 tons per day with an annual timber consumption capacity of 300 million board feet, though actual consumption has never exceeded 253.3 million (Darr **et al**, 1977). The mill produces alpha/dissolving sulphite pulp. The company's 198 shareholders are a consortium of Japanese interests including chemical fiber and cotton-spinning companies, pulp and paper manufacturers, trading companies, banks and other corporations and individual (Washington Post, Oct. 4, 1985). The company was reorganized in 1983 and now uses the name Alaska Pulp Co., Ltd. **APC** (Sitka Daily Sentinel, Sept. 9, 1986). Like its counterpart in Ketchikan, the plant has had numerous labor difficulties and a poor financial history. Losses were running at $20 million per year in 1986 and totaled $150 million since opening in 1959 (Juneau Empire, Aug 8, 1986). Both the APC and LPK mills have also faced anti-trust suits arising from charges that they colluded to force small, competing logging companies out of business.

Poor markets, high inventory and a brief labor strike lead to a three month closure of the APC mill in 1985. The mill closed again briefly in July, 1986 due to a labor dispute. Resolution of complaints proved impossible and the mill is now operating with non-union personnel. The resulting lower wages may improve APC's cost position (USFS-AK, 1987). At the same time the recent decline of the U.S. dollar against the yen has also helped to make the mill marginally more competitive. Despite its financial difficulties, there is some speculation that the mill will not be closed in the near future. APC's investors have long been interested in participating in crude oil trade between Alaska and Japan if such trade could be made legal. As a result, there may be some advantage in maintaining a presence in Alaska (Alaska Pacific Bank, 1985).

Pulp from Alaskan mills is shipped to Japan, China, Korea, Taiwan, Mexico, U.S. destinations and many other countries where it is refined into products such as rayon yarn, cellopane, diaper fluff, fiber for printing paper and carbonied fiber. In these markets the combined consumption and production of rayon and acetate has dropped gradually over the past 20 years while synthetic fibers (especially polyester) and cotton have dramatically increased. Direct competition with petrochemical-based synthetics (such as polyester) has also introduced a further element of volatility in dissolving markets. Reductions in petrochemical prices, as occurred during the early 1980's, bring strong downward pressure on dissolving prices.

Competition among existing dissolving suppliers has been intensified by the contraction in global dissolving pulp demand and further exacerbated by the entry of newer and lower cost pulp suppliers in both developed and third world countries. Though Alaskan producers have made some strides in reducing labor inputs and wage costs in recent years, their competitive position has been steadily eroded.[1] As a result both mills have operated with excess capacity since 1981. Dissolving pulp similar to that produced in Alaska is exported from mills in Port Alice, British Columbia; Port Angeles, Washington; and from the large capacity and highly efficient SAICCOR mill in South Africa (USFS-AK, 1987). Rising competition in global markets has lead to some attrition in mill numbers. The Port Alice mill, for example, is only one of two dissolving mills remaining in Canada where production has dropped from a peak of 450,000 tons in 1969 to about 238,000 tons today (Jegr, 1985).

Both of the pulp mills currently operating in Alaska have long term contracts with the Tongass National Forest for stumpage. The APC contract was initiated on Jan. 25, 1956 with effective dates from July 1, 1961 through June 30, 2011. The estimated volume is 4.97 billion board feet with the price subject to redetermination every five years. The primary sale area includes Baranof Island and portions of Chichagof Island (USFS, 1980). APC held a second long term contract, which expired in December 1982 and was for 693 MMBF (USFS-AK, 1983).

The LPK mill has a long term contract that began on July 26, 1951 and is scheduled to terminate June 30, 2004. During that time the Forest Service must make available 8.25 billion

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1. Both mills have become more efficient in recent years as the number of jobs per thousand short ton exported has dropped from a high of 8.25 in 1975 to 2.65 in 1984 (Rogers, 1985). Recent data from the ALP mill shows that output per employee has risen from a low of 250 annual tons in 1982 to close to 500 in 1987 (Maple's Business Newsletter, 1988).

board feet of timber. The primary sale area is the north half of Prince of Wales Island and the northwest portion of Revillagigedo Island. This contract also stipulates five-year stumpage redeterminations (USFS, 1978).

3. Pacific Rim Market Pulp Trade: Current State and Future Prospects.

This section evaluates the potential future market for expanded pulp exports from Alaska to the Pacific Rim. Following a brief description of pulp grades and their production characteristics, we present an overview of the current state of pulp and fiber products consumption and production in Pacific Rim countries and describe recent trends in the pattern of bilateral trade in the region. The evaluation concludes with an analysis of recent projections of future market and price developments and potential trade opportunities in the region.

3.1. Market pulp - general

Market pulp is defined as wood pulp for sale in open competition with pulp from other producers. The pulp market is international in nature, with large volumes of pulp moving duty-free (for the most part) between net producing regions and net consuming regions. International trade in pulp has remained remarkably stable over the past 30 years (Table 1). North America and Scandinavia (cumulatively referred to as Norscan) have been the largest market pulp producing regions (Figure 1), although nontraditional supplying countries such as Brazil, Chile and New Zealand have been growing in importance.

Table 1. Significance of international pulp trade (% total world wood pulp output traded)

	1955	1960	1965	1970	1975	1980	1985
Pulp (%)	16.3	14.5	16.0	16.3	14.4	16.4	16.2

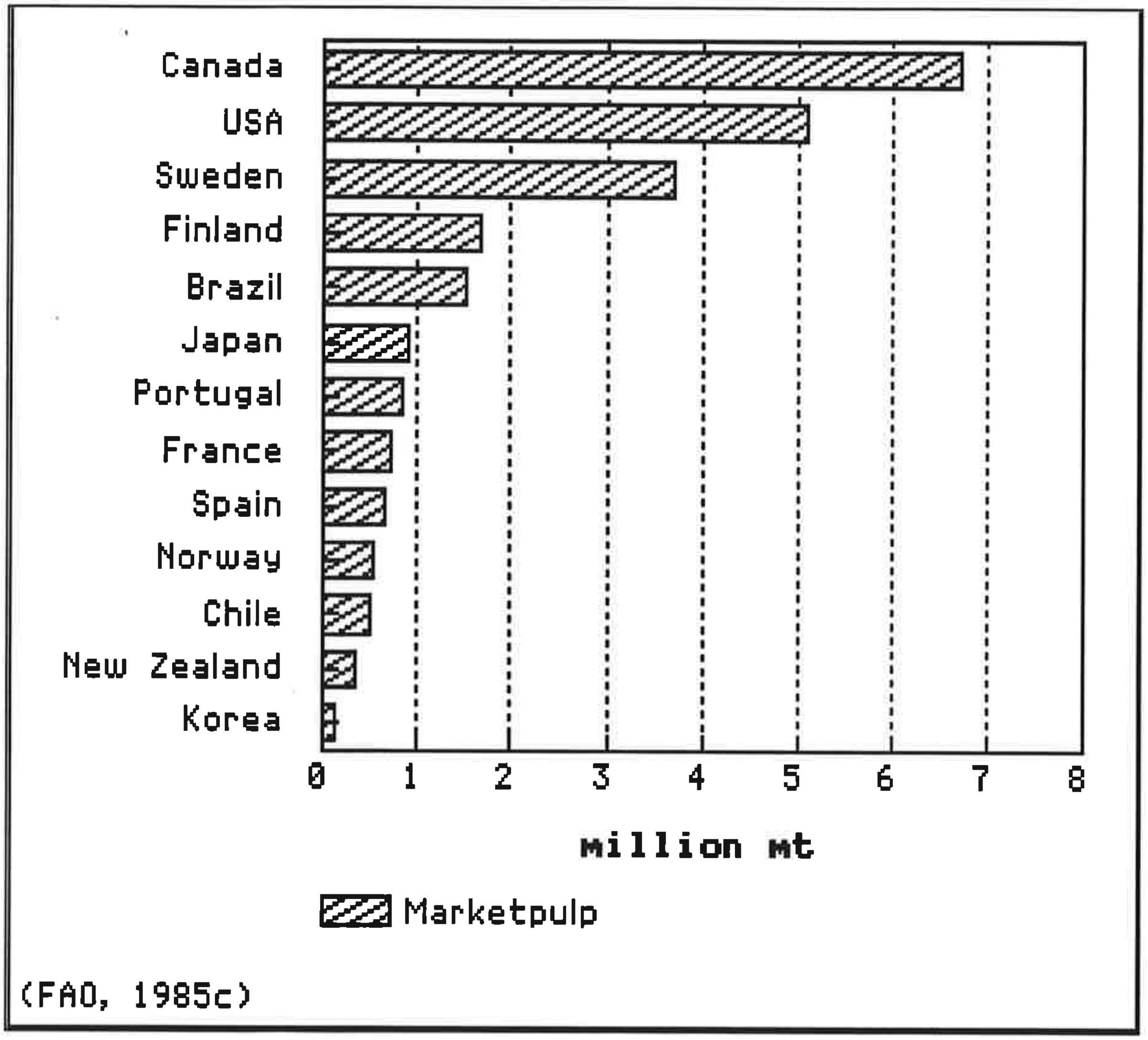
(FAO Yearbooks, 1956-1985)

3.1.1. Pulp furnish

Alaska, coastal British Columbia and the Pacific Northwest supply primarily long-fiber, softwood pulp. Paper pulp furnish, however, can be made of a combination of constituents (including non-wood fibers). The furnish can have from 40% to 80% hardwood component and/or up to 75% wastepaper component depending on the type of product being made. The hardwood component can be higher if the fiber comes from short fiber, thin walled species like aspen, cottonwood or eucalyptus. Southern hardwoods and alder would be used in the lower (40%) proportion and intermediate species would include Northeast hardwoods like beech and birch (McKean, personal communication).

Pulp from hardwoods, such as eucalyptus, birch, poplar, beech, maple, etc. are short-fiber pulps. The average length of fibers in mature hardwood is about 1.0 to 1.9 millimeters, whereas most softwood fibers range in length from 2.5 to 6.0 millimeters. Hardwood pulps produce

Figure 1. World market pulp production, 1984.



paper of low strength, but exhibit valuable characteristics such as higher bulk, improved surface smoothness, and superior printing qualities (Jegr, 1985).

Most paper-grade market pulp is cut into sheets and sold in bale form, but some is sold in rolls and a small amount is flash-dried and baled (Pulp and Paper, 1985). The process of drying pulp for shipment reduces the strength of the material by about 20%, leading most paper makers to utilize the pulp on-site at integrated mills (McKean, personal communication). However, when flash dried, bleached chemimechanical pulp is easy to repulp because of the extractive removal, alkaline pH, and low temperature drying (Pulp and Paper, May 1984).

3.1.2. Pulp processes

There are two basic types of market pulps: (1) dissolving or special alpha pulps and (2) paper-grade pulps. Dissolving and special alpha pulps (the type produced by the two mills currently operating in Alaska) have a high alpha (pure cellulose) content and are used to make rayon, acetate and other cellulose derivatives as well as specialty papers. Most paper-grade market pulps are produced by chemical processes although some are made by high-yield mechanical methods, such as thermo/chemical/mechanical pulping.

3.1.2.1. Dissolving pulp

These non-paper pulps are a small percentage of the world trade in wood pulp. About 80% of the total dissolving pulp shipments is destined for viscose products such as rayon for textiles and tire cord. Rayon staple has been under heavy competitive pressure from polyester, while plastic films such as oriented polypropylene have been displacing cellophane (Jegr, 1985).

3.1.2.2. "High Yield" Pulp

Mechanical pulps are produced by grinding wood billets or refining wood chips. **High yield pulps** are so called because the proportion of usable material derived from the original pulpwood can be as much as twice that of chemical pulp (Slinn, 1988).

Groundwood is conventionally used to describe pulp produced on a pulp stone in a grinder. The manufacture of **mechanical pulp** from wood chips and wood residue (e.g. sawdust) is a relatively recent development. These pulps include refiner mechanical pulp (RMP) or pressurized groundwood (PGW), thermomechanical pulp (TMP), chemi-mechanical pulp (CMP), and chemi-thermomechanical pulp (CTMP). They have found increasing use as substitutes for chemical pulp and stone groundwood (Jegr, 1985).

Traditionally, mechanical pulp use has been mainly for newsprint. In North America during the 1950's, the first mechanical pulps were produced with disc refiners for use in paper making (Pulp and Paper, Dec 1987). Groundwood pulp is the second largest pulp produced in the United States, accounting for about 10% of the total. Because groundwood pulp is made up of the whole wood and not just the cellulosic portions, the paper made from it easily deteriorates and has low mechanical strength. However, it does have high bulk and excellent opacity, two important properties in printing. It is thus used for newsprint, coated and uncoated magazine paper, and other printing and converting papers, either alone in the inexpensive grades or as one constituent in higher grades. It is also used in the production of hardboard and insulating board, hanging stock for wallpaper, and sanitary tissue stock (Huber, 1980).

Thermomechanical pulp (TMP) is a high quality modified groundwood pulp which has been replacing other mechanical grades (Huber, 1980). When refiner-mechanical pulp is produced in pressurized refiners the product is called thermomechanical pulp, because pressurization elevates the temperature of the refining zone (Pulp and Paper, Dec 1987).

Before 1975 thermomechanical pulp was virtually unknown in any major commercial applications. Today it is accepted as practically the only way to build new pulping capacity for newsprint. It now accounts for more than one-third (3 million tons) of the pulp used in Canadian newsprint (Hay-Roe, June 1985).

The TMP process is the fastest-growing process in the pulp and paper industry in the U.S., although there are limitations on its use for some paper products due to damage to the chip fiber in grinding, and high electricity costs (Northwest Pulp and Paper Assoc, 1985). The forecast is that "standard" TMP will cease to exist and that all installations will be tailor-made to fit the end-use of the pulp (Pulp and Paper, May 1985).

The TMP process where there is treatment of the chips with chemicals prior to refining has been widely adopted. The treatment process involves impregnating the chips with sodium sulphite and refining them in a pressurized refiner. This product then is referred to as **chemi-thermomechanical pulp** (CTMP) (Pulp and Paper, Dec 1987). Chemi-thermomechanical pulp uses softwood and hardwood to produce a pulp that competes with bleached hardwood kraft. The yield is 90% and aspen and spruce are the preferred species (Nilsson, 1985a). CTMP pulp is now used widely on a commercial basis for the production of solid board for folding cartons, in various tissue and towel grades and in disposable diapers. It is expected that CTMP will find extensive use in fine paper grades (Jackson, 1988).

CTMP and the other chemically enhanced refiner mechanical pulps have many attractive features when compared with kraft pulp, including a 100% superiority in fiber utilization (1,000 kg. of wood chips can yield 900 kg. of CTMP, but only about 450 kg. of kraft pulp). But the most important advantage is capital cost. Economic-sized kraft mills have become so large, and their capital costs per ton of capacity so high, that most would-be pulp producers are unable to finance one. CTMP has emerged as the alternative. The main advantage of CTMP lies in the possibility it offers of building small capacity lines since investment costs/ton does not decrease much with line size beyond, roughly, 65,000 tons/day (Gundersby and Diesen, 1985). CTMP is also emerging as a serious market-pulp contender, competing directly with the shorter fiber chemical pulps (Hay-Roe, June 1985). Like TMP, CTMP is becoming less of a commodity. It is a specialty pulp which can be and is produced from a variety of hardwood and softwood species to any number of specifications (Pulp and Paper International, Feb 1988).

There is much speculation that CTMP will continue to displace bleached kraft pulp. The potential percentage of use for CTMP in certain products is as follows: fluff 50-85%, toweling 20-100%, tissue 40-50%, bleached board 10-50%, and printing and writing papers 10-30% (Paper Trade Journal, Nov 1985).

Table 2 shows the historical development and a recent projection of global CTMP capacity developed by Woodbridge (1988). It should be noted that no new CTMP capacity is predicted in the U.S. before 1995.

Table 2. Projected changes in market CTMP capacity (%).

	1980	1985	1990	1995
Sweden	100	38	22	15
Canada		32	59	53
New Zealand		15	5	3
South America		1	1	13
Norway		14	9	5
Finland			4	5
Other				6
Annual Capacity (1000 mt)	50	565	1,598	2,878

(Woodbridge, 1988)

A process intermediate to TMP and CTMP is called **chemimechanical pulp** (CMP). Although the fiber is produced primarily by mechanical means, the wood is first mildly treated with sodium hydroxide and sodium sulphite. The chemical treatment reduces the yield, but increases the mechanical strength (Huber, 1980). Chips impregnated with sodium sulphite are refined in an atmospheric refiner. This cooking phase makes the higher temperature used in the TMP process unnecessary to obtain stronger pulp (Pulp and Paper, Dec 1987).

The high-yield pulps' major disadvantage is in their high electricity consumption. Regardless, in areas where there is suitable low cost wood and/or where the electricity cost is low are especially attractive for CTMP and CMP market pulp mills (Croon, 1985).

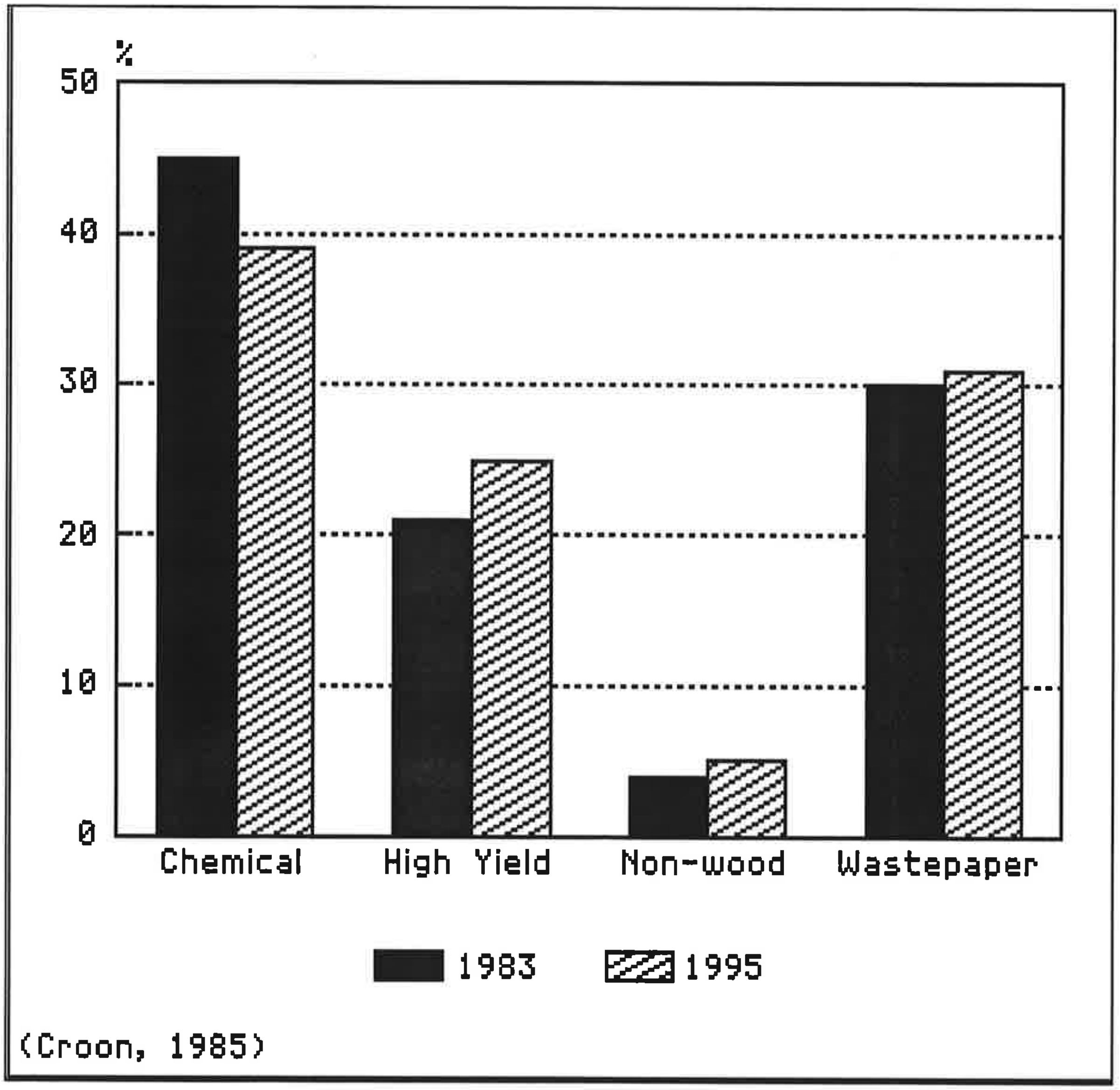
Initially criticized for not producing the desired paper characteristics, the high-yield pulps have benefited greatly by papermaking advances. The papermaker has risen to the challenge by utilizing, to an increasing degree, mineral and synthetic fillers, coatings, and sizes to improve the performance of some papers made from inherently "lower quality" or "weaker" fibers we generally associate with mechanically produced pulps (Slinn, 1988).

3.1.2.3. Chemical pulp

Chemical paper pulps are produced by cooking pulpwood chips in the presence of chemicals and are divided into grades based on whether they are made from softwood or hardwood, northern or southern fiber, sulphate (kraft) or sulphite pulping processes, and whether they are bleached, semi-bleached or unbleached. Fluff pulp goes into non-paper applications, such as baby diapers, but is generally included in paper-grade pulp for statistical purposes.

Chemical pulps in general are used for the manufacture of high quality printing and writing papers and the manufacture of bag papers, container boards, and specialty industrial papers. Chemical pulps are usually made of one of the two basic processes: the sulphite process, which uses an acid-base cooking liquor, or the sulphate (or kraft) process, which uses an alkaline-base cooking liquor (Jegr, 1985).

Figure 2. Projected change in world paper pulp furnish, 1983-1995.



Kraft (or sulphate) **pulp**, produced by an alkaline process, dominates the paper pulp industry today although there have been some changes due to environmental and capital cost problems (Clark, 1982). It is used in the production of so-called "wood free" papers (actually groundwood-free). Between 85-90% of all unbleached kraft pulp is used to produce coarse paper, which is mostly used for wrapping and bagmaking, and paperboard, which is chiefly used for corrugated containers. Kraft paper is currently facing heavy competition with plastic for grocery bags in the United States.

Bleached and semi-bleached grades now account for over 45% of all kraft pulp produced and are used for a variety of papers, including newsprint, printing and writing papers and sanitary tissue stock (Huber, 1979).

Sulphite paper pulp, produced through an acid base process, produces a high quality pulp that dominated the early chemical pulp industry (Clark, 1982). It was once used in all grades of paper other than paperboard, coarse paper and newsprint. Production reached a peak in 1966 but has since lost ground to kraft production (Huber, 1980).

Chemical pulp has dominated international trade due to the product's high value to weight ratio relative to that of competing mechanical or semi-chemical pulp grades. The greater surplus of profit over transportation costs diminishes the constraining influence of this barrier to international trade (Arpan et al, 1986).

3.1.3. Trends

Two of the most significant trends in paper pulp furnish are the increased use of high yield pulps and the increase in the wastepaper component. Figure 2 shows global projections developed by Croon (1985) of changes in paper making fiber furnish. Note the significant rise in high-yield pulp and wastepaper and proportional decline in chemical pulp.

Slinn (1988) and Jegr (1985) (Table 3) have also identified the trend toward high yield pulp. While the chemical technology will continue to be the major wood pulping process, its capacity worldwide is projected to expand by only 7% between 1986 and 1990. Over the same four-year period, the traditional groundwood technology capacity is projected to decline. The newer high yield pulping technologies combined would increase from a small base by more than 22% in this comparatively short period.

Table 3. Projected world demand for paper grade pulp (1000 mt)

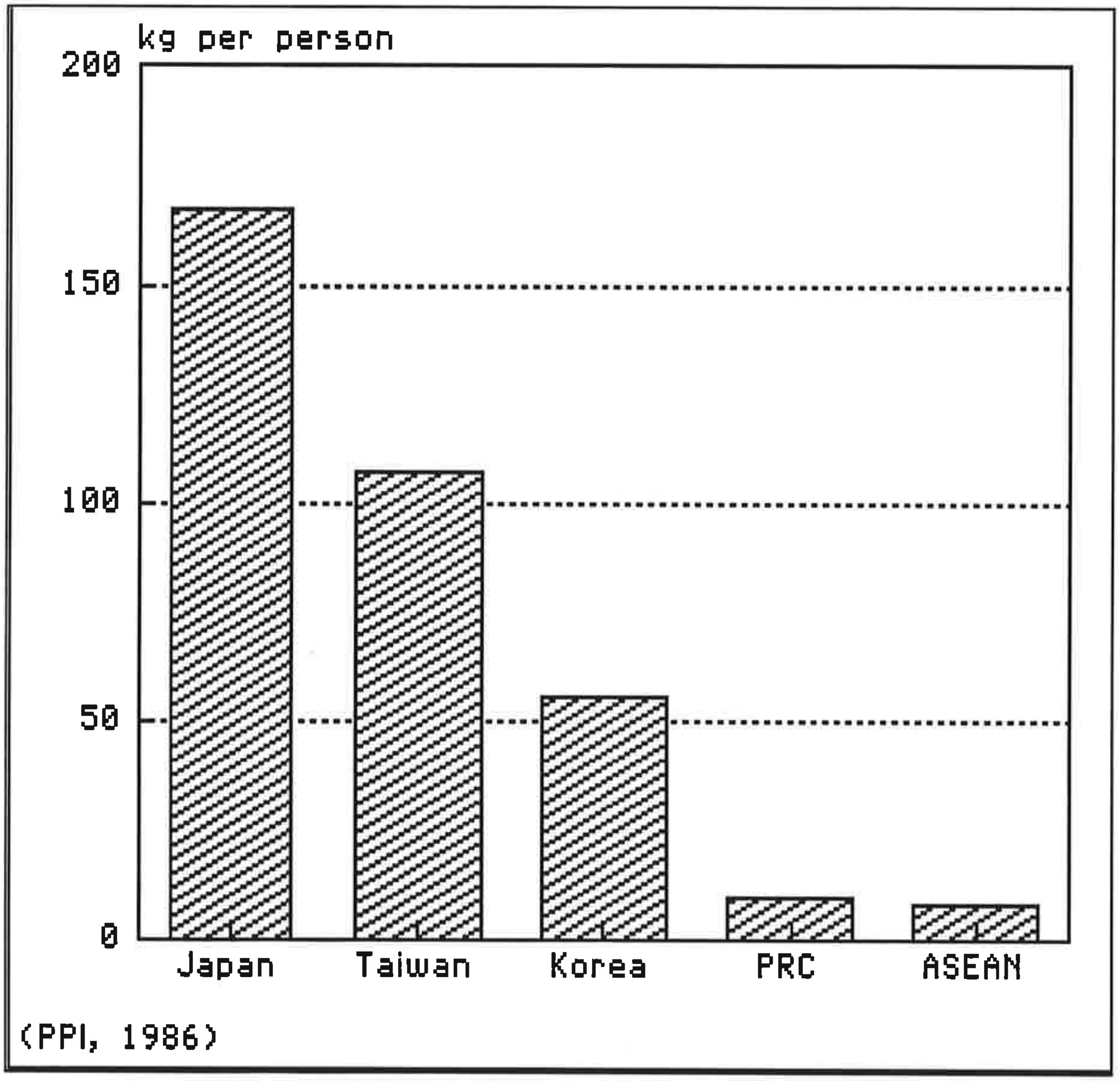
FURNISH COMPONENT	1980	%	1990	%	1995	%
Mechanical/semi-chemical	34,700	19.4	47,900	21.0	54,200	21.3
Unbleached sulphate	33,800	18.9	41,100	18.0	44,900	17.6
White chemical pulps[1]	53,800	30.1	64,900	28.5	71,000	27.9
Paper grade wood pulp	122,300	68.4	153,900	67.5	170,100	66.8
Non-wood pulp	7,100	4.0	10,000	4.4	11,600	4.6
Total paper grade pulp	129,400	72.4	163,900	71.9	181,700	71.4
Wastepaper	49,400	27.6	64,100	28.1	72,800	28.6
Total papermaking fiber	178,800	100.0	228,000	100.0	254,500	100.0

[1]. White chemical wood pulp includes bleached and semi-bleached kraft pulp and both bleached and unbleached sulphite wood pulp.

(Jegr, 1985 from Stanford Research Institute data)

Table 4 shows the significant rise of new mechanical pulping capacity additions with the

Figure 3. Asian per capita paper and paperboard consumption, 1985.



ratio of new chemical to mechanical pulp capacity going from over 7:1 in 1983-86 to almost 1:1 during the 1985-88 period.

Table 4. Planned World Pulp Capacity Additions (1000 mt)

	1983-86	1984-87	1985-88
Chemical Pulps	6,221	5,238	2,955
TMP/CMP/CTMP	876	1,362	2,506
Ratio, chemical/MP	7.1	3.8	1.2

(Hay-Roe, June 1985)

An example of the industry move to lower cost high yield greenfield[2] mills is the CTMP mill being built in Whitecourt, Alberta by Millar Western Pulp Ltd. This market pulp mill which opened in the summer of 1988 has a 210,000 mt/yr capacity and will be flexible in supplying a wide variety of pulp grades (Japan Pulp and Paper, June 1987). Another example is the proposed Makin pulp and paper plant at Squamish, British Columbia, a CTMP mill with a 140,000 mt/yr capacity (Makin Pulp and Paper, 1988).

3.2. Current Conditions in the Pacific Rim Pulp Markets.

3.2.1. Consumption

Although some bilateral market pulp shipments presently span enormous distances (e.g., some shipments reach Japan from Scandinavia), it seems likely that expanded market pulp exports from Alaska will find their principal markets in the Pacific Rim and particularly in the developed or emerging countries of Asia. Accordingly, this section focuses primarily on demand in the largest net pulp importing countries in Asia.

Table 5 shows world paper and board consumption, pulp production and net pulp trade levels by region and selected countries. Asia is the largest global importer of pulp. In 1985 the Asian market area accounted for about 22% of global paper and board consumption, roughly 14% of pulp output, and was a net importer of some 4.3 million metric tons of pulp. As in other emerging world regions, differences in per capita paper and board consumption between developed and developing countries in Asia are dramatic. Figure 3 summarizes per capita paper consumption conditions in five key Asian markets, while Figure 4 gives demand in absolute terms by paper grade.

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[2] Note: Technical definitions and abbreviations can be found in the glossary (Appendix B).

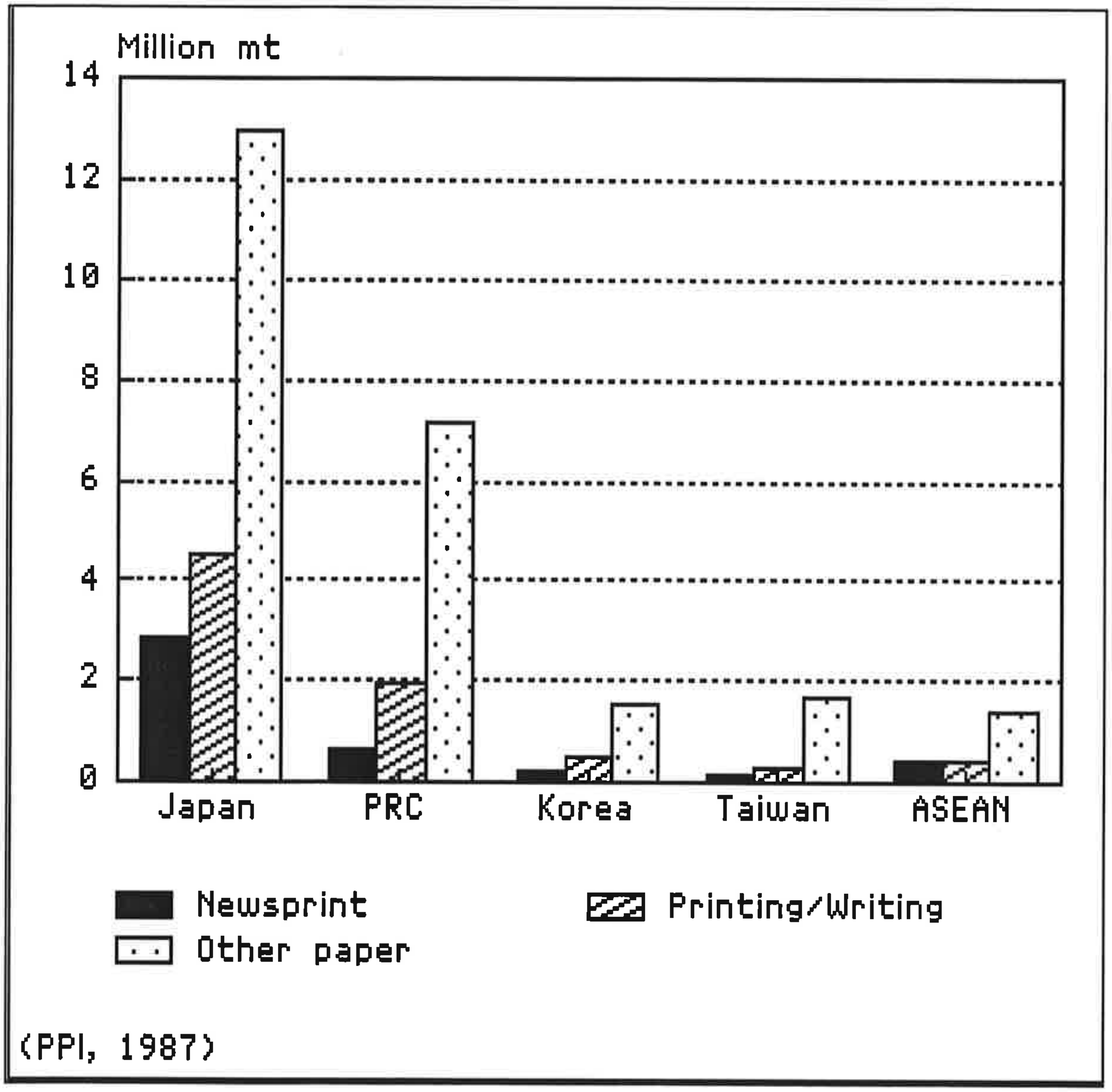
Table 5. World paper & paperboard consumption, pulp production and net pulp trade, 1985.

	per capita paper & board consumption (kg/capita)	total paper & board consumption (1000 mt)	share world total (%)	pulp pro-duction (1000 mt)	share world total (%)	pulp net trade *
Europe	80.9	64,559	32.0	42,907	30.0	-3165
USSR	33.6	9,718	4.8	9,374	6.6	+ 720
Sweden	235.0	2,276	1.1	9,123	6.4	+2910
F. R. Germany	174.1	11,286	5.6	2,203	1.5	-2803
United Kingdom	139.3	8,079	4.0	295	**	-1605
North America	276.3	76,225	37.8	69,563	48.6	+6236
U.S.A.	282.8	71,086	35.2	49,144	34.4	- 568
Canada	202.6	5,140	2.6	20,419	14.3	+6804
Asia	15.3	43,805	21.7	20,463	14.3	-4279
Peo. Rep. China	9.3	9,703	4.8	6,365	4.4	- 529
Japan	167.7	21,107	10.5	9,279	6.5	-2232
Rep. Korea	55.6	2,606	1.3	267	**	- 690
Taiwan	107.2	2,064	1.0	350	**	- 191
Indonesia	4.7	731	**	50	**	- 223
India	2.5	2,029	1.0	850	.6	- 67
Australasia	122.9	2,639	1.3	2,032	1.4	+ 220
Australia	142.1	2,220	1.1	887	.6	-196
New Zealand	181.6	397	**	1,145	.8	+ 416
Latin America	24.7	10,778	5.3	6,553	4.6	+ 642
Brazil	27.1	4,051	2.0	3,722	2.6	+ 902
Chile	24.5	278	**	837	.6	+ 503
Mexico	31.8	2,607	1.3	820	.6	- 318
Africa	5.7	3,767	1.9	1,519	1.1	+ 214
South Africa	51.7	1,618	.8	1,030	.7	+ 109
Egypt	9.2	966	**	42	**	-
World	41.1	201,774	100.0	143,037	100.0	-

* (+ = net export, - = net import)
** (less than .6% of world total)

(Pulp and Paper International, 1986; FAO, 1988)

Figure 4. Paper and paperboard consumption in selected Asian countries, 1985.



3.1.1.1 Japan

The "economic miracle" of post-war Japan brought with it a huge increase in derived demand for forest products, and for paper and paperboard specifically. Per capita consumption today is the highest among Asian nations. Over the period 1965-75, GDP growth averaged 7.9% per year, while paper and board consumption increased by 7.8% per year. From 1975-85, paper and board consumption and GDP both grew at 4.4%. Within the paper grades, Japanese consumption includes a sizeable fraction of newsprint and the printing/writing paper category has shown the most rapid growth in consumption since 1970. This stands in contrast to most other Asian countries (where newsprint use is low and highest growth is in the packaging paper grades) and reflects Japan's high income and literacy levels and its rapidly growing service sector. Japan has consistently produced the bulk of its own paper and board requirements. Imports of all paper and board grades have averaged less than 4% of total consumption over the past two decades.

Japan faces significant limitations in its ability to supply wood fiber for pulping from domestic sources. As a consequence, the dramatic expansion of pulp and paper production capacity in Japan during the mid-1950's led producers to seek additional fiber sources abroad. As paper and board demand has continued to expand in recent years, Japanese producers have turned increasingly to recycled paper as a fiber source. These trends can be seen in Table 6 which gives Japanese consumption figures for paper, pulp (by source) and wastepaper. Domestic pulp production derives in part from domestic wood fiber sources and increasingly from imported pulp logs and chips. Only a small fraction of wastepaper consumption derives from imports (roughly 3.3% of total wastepaper consumption in 1986).

Table 6. Japanese paper, paperboard, pulp and wastepaper consumption (1000 mt).

	PAPER AND PAPERBOARD	PAPER PULP			TOTAL
		TOTAL	DOMESTIC	IMPORTED	WASTEPAPER
1975	13,053	9,040	8,273	767	5,327
1980	17,927	11,138	9,495	1,643	7,976
1982	17,344	9,845	8,339	1,506	8,580
1983	18,389	10,298	8,576	1,722	9,222
1984	19,200	10,660	8,837	1,823	9,827
1985	20,303	10,773	8,918	1,855	10,570
1986	21,079	11,021	9,011	2,010	10,863

(FAO, 1986c; Japan Paper Assoc, 1987)

The current proportion of pulp production constituents is 50% wastepaper, 28% domestic pulpwood and 22% imported pulpwood (Japan Pulp and Paper, June 1988). Over the period 1980-1986, the total consumption of wastepaper increased by 36.2% to 10,863,000 mt, imported pulp increased 19% to 2,281,449 mt, and consumption of domestic pulp declined by 5.1% to 9,101,499 mt (Japan Pulp and Paper, Sept 1987).

3.2.1.2. The People's Republic of China

Per capita consumption of paper and board products in China is among the lowest in Asia. This reflects both its limited industrial development and low income levels. In 1983 the net income per capita was 310 yuan (2 yuan/US$) in rural areas and 826 yuan for wage earners (Zhu, 1987). Economic restructuring begun in the early 1980's, however, has already shown some impacts in the fiber products sector. Between 1970 and 1981, national income growth averaged 3.7% per year, while paper and board consumption increased by 3% per year. Between 1981 and 1984, national income and paper and board consumption grew at 6.3% and 10%, respectively. Other paper and paperboard account for almost 75% of total consumption in China (contrasted with roughly 60% in Japan and the U.S.) and has been the most rapidly growing grade category (11.1% per year), followed by printing and writing (9.3% per year) and newsprint (8% per year). Paper and board imports account for about 8% of total consumption requirements.

China has consistently faced major limitations in wood fiber availability for pulping. In the past, it has solved this problem largely by heavy reliance on non-wood fibers as illustrated in Table 7. More recently, it has turned to pulp imports, though these still account for only about 10% of total paper pulp consumption. Wastepaper consumption in 1987 was a relatively low 2.8 million mt (compared to total pulp furnish of 7.8 million mt).

Table 7. PRC paper, paperboard, pulp and wastepaper consumption (1000 mt)

	PAPER & BOARD	PAPER PULP TOTAL	TOTAL DOMESTIC	NON-WOOD DOMESTIC	IMPORTED	WASTE-PAPER
1965		2060	1996	1588	64	
1970		2900	2700	na	200	
1980	5877	4906	4490	2290	416	1300
1981	5920	4964	4310	2190	654	
1982	6237	4917	4439	2271	478	
1983	7105	na	4725	2480	na	
1984	7880	5967	5348	3499	619	
1985	9703	6894	6364	4211	530	2500

(PPI, 1986)

3.2.1.3. Taiwan

Taiwan (the Republic of China) has experienced rapid economic growth over the past two decades and has the second highest per capita paper consumption level in Asia (see Table 5). During the period 1970-1985, other paper and board have consistently averaged 78% of total consumption while printing and writing paper have decreased from 18% to 15% of consumption. Newsprint has risen to 6%. This pattern reflects the continued emphasis on packaging for exports and a loosening of government controls on the press. The increase in newsprint has come almost exclusively from imports which make up 75% of newsprint consumption but only 3% of other paper and board and 1% of printing and writing paper.

Taiwan is dependent on foreign sources for 52% of its fiber. From 1973 to 1983 pulp log demand increased 118% due to the increase in the demand for paper (Jen, 1985). Imports of pulp have increased rapidly, up 17% in 1986 to 382,000 tons. Most of the imports have come from North America, 50% in bleached kraft (Pulp and Paper International, Sept. 1987). Wastepaper imports have increased dramatically (18% per year) from 1976 to 1986 and are now 1,300,000 mt annually (Jen, 1987).

Table 8. Taiwan paper and board, pulp, and wastepaper consumption (1000 mt).

	PAPER & BOARD	PAPER PULP TOTAL	TOTAL DOMESTIC	NON-WOOD DOMESTIC	IMPORTED	WASTE-PAPER
1965	171	224	206	na	37	na
1970	425	536	533	392	30	55
1975	691	563	542	417	50	181
1980	1412	304	276	86	82	1247
1981	1403	540	350	93	108	1253
1982	1486	281	193	6	160	1400
1983	1704	462	300	7	226	1710
1984	1982	524	325	8	233	1840
1985	2063	541	350	8	267	1860

(PPI, 1986)

3.2.1.4. Republic of Korea

Much like Japan, Korea has experienced something of an economic development miracle in the years since the Korean War. Rapid economic growth and expansion of exports have raised per capita paper and board consumption to nearly four times the average for Asia as a whole, though still well below that in Japan and Taiwan. Over the period 1965-1975, GDP growth averaged 9.9% while paper and board consumption grew at 15%. From 1975 to 1985, paper and board consumption and GDP growth averaged 14.3% and 7.4%, respectively. Within the paper and board aggregate, other paper and board comprises the largest fraction, followed by printing and writing paper, and then newsprint. Over the period since 1970, consumption growth rates by grade have averaged 14.92%, 13.63%, and 5.67% for other paper and board, printing and writing paper, and newsprint, respectively. Imports of paper and board have averaged only 4% of total consumption in recent years.

While Korea has a number of small groundwood pulp mills, it has at present only one chemical pulping facility. With paper and board production growing rapidly, producers have turned increasingly to pulp imports and wastepaper as fiber sources (see Table 9). As of 1984, 80% of total pulp consumption was composed of chemical pulp. Wastepaper consumption has increased from 8,500 tons in 1960 to 1.5 million tons in 1985, a rate of 23% per year. However, Korea has a relatively low recovery rate (36% versus 52% in Japan) due to an inefficient wastepaper recycling system (Youn, 1988). Wastepaper provides 66% of pulp furnish (FAO, 1988b). Roughly 45% of wastepaper used is imported (Pulp and Paper International, Oct 1987).

Table 9. Korean paper and board, pulp and wastepaper consumption (1000 mt)

	PAPER AND PAPERBOARD	TOTAL	PAPER PULP DOMESTIC	IMPORTED	WASTEPAPER
1960	88	36	26	10	na
1965	161	95	65	30	na
1971	438	328	239	89	102
1976	924	400	294	106	698
1981	1640	742	520	222	1172
1982	1660	671	436	235	1118
1983	1935	754	512	242	1259
1984	2194	849	591	258	1410
1985	2290	947	680	267	1518

(Schreuder, Vlosky and Youn, 1987; PPI, 1986; FAO,1988b)

3.2.1.5. ASEAN countries

The Association of Southeast Asian Nations (ASEAN) is comprised of Indonesia, Malaysia, Philippines, Singapore and Thailand. They are a highly heterogenous group in terms of rates of economic growth and per capita use of paper and paperboard. The relatively industrialized and rapidly growing Singapore enclave stands in sharp contrast to the remainder of the group. Between 1965 and 1975, GDP of the ASEAN countries grew as follows: Indonesia, 7% per year; Malaysia, 8.2%; the Philippines, 5.4%; Singapore, 11.2% and Thailand, 7.8%. Meanwhile aggregate paper and board consumption rose at 8.8% per year. Over the period 1975-85, GDP grew at 6% per year for Indonesia, 7.3% for Malaysia, 3.4% for the Philippines, 7.7% for Singapore and 6.8% for Thailand. During this period, paper and board consumption grew at 7.5% for the ASEAN countries as a whole. As a composite, other paper and board comprises some 62% of the consumption of ASEAN countries followed by printing and writing paper (20%), and newsprint (18%). Since 1970, other paper and board has shown the most rapid growth (9% per year), with printing and writing paper and newsprint growing at 6.6% and 4.2%, respectively. Unlike the other Asian countries examined to this point, all of the ASEAN countries import substantial fractions of their consumption of paper and board products.

Table 10. Population and paper and board consumption, trade and capacity in the ASEAN countries, 1985.

	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND
Population (thousands)	165,150	15,680	54,380	2,560	51,300
Consumption/capita (kgs)	4.25	26.00	7.36	87.00	12.25
Consumption (mt)	701,000	407,700	400,200	222,700	628,500
Production (mt)	506,000	73,000	252,000	10,000	432,100
Imports (mt)	233,000	337,700	149,200	295,400	206,000
Exports (mt)	37,200	3,000	1,000	82,700	9,600
Capacity (mt)	853,000	95,000	515,000	31,000	618,000

(Indonesian Pulp & Paper Assoc, 1987)

While the larger ASEAN countries all have substantial forest resources, their production of paper and paper grade pulp is limited. As illustrated in Table 11, pulp imports have more than tripled since the late 1970's and now comprise the largest part of total pulp use. The use of wastepaper has also grown and currently accounts for almost half of total fiber consumption (93% of the furnish in Malaysia, 71% in Thailand, 37% in Indonesia, and 30% in the Philippines) (FAO, 1988b).

Table 11. ASEAN paper and board, pulp and wastepaper consumption (1000 mt)

	PAPER AND PAPERBOARD	PAPER PULP TOTAL	IMPORTED	DOMESTIC	WASTEPAPER
1970	876	156	55	101	86
1975	1103	339	134	207	390
1980	2003	504	150	360	573
1981	2212	598	234	375	607
1982	2073	656	329	328	612
1983	2262	755	391	370	687
1984	2193	877	465	420	749
1985	2271	864	472	399	869

(PPI, 1986)

3.2.2. Production

Roughly 85% of global paper pulp capacity and more than three-quarters of paper and board capacity is concentrated in 10 major producing countries (Table 12). Outside of North America, Japan has the largest capacities in both categories of any Pacific Rim country. The substantial imbalance between Japan's paper making and pulp capacity is suggestive of its extensive dependence on imported pulp and wastepaper in its total fiber furnish. Table 14 provides a more detailed picture of pulping capacity and pulp trade in countries within the Pacific Rim or that export substantial volumes to the Pacific region.

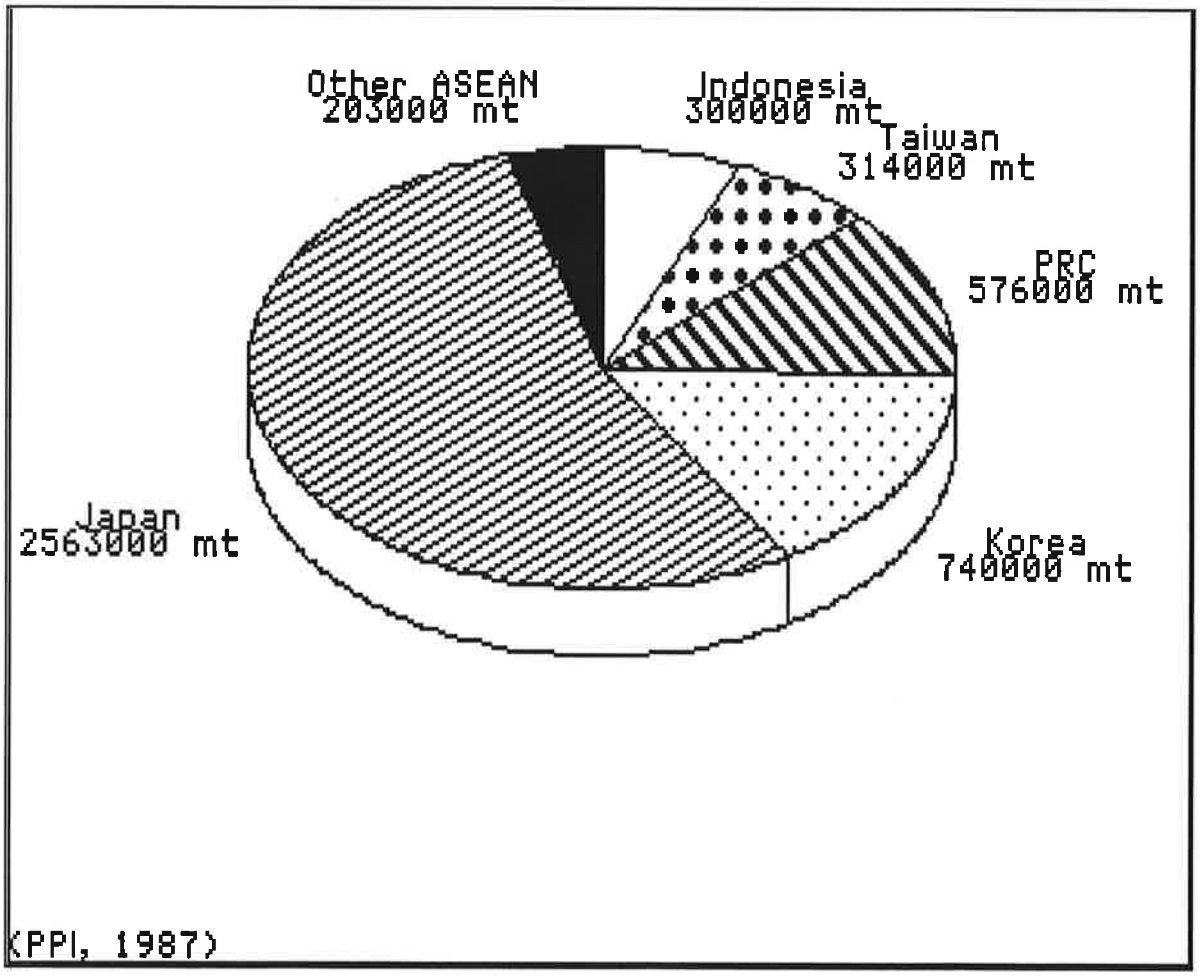
Table 12. Comparison of world pulp capacity and paper capacity 1986 (million mt).

Country	paper pulp capacity	World percent	paper/board capacity	World percent
1. United States	52.8	34	68.8	31
2. Canada	23.7	16	16.1	7
3. Japan	12.4	8	24.1	11
4. U.S.S.R.	12.1	8	14.0	6
5. Sweden	10.4	7	8.1	4
6. Finland	8.8	6	8.3	4
7. Brazil	3.9	3		
8. France	2.3	1	6.2	3
9. West Germany	2.3	1	10.8	5
10.Norway	2.2	1		
China			6.0	3
Italy			6.0	3
Ten country total	130.9	85	168.4	77
World total	153.5	100	219.4	100

(Slinn, 1988)

Pulp imports for the key Asian market countries are illustrated in Figure 5.

Figure 5. Asian pulp imports, 1986.



Comparison of total capacities and numbers of mills indicates that there are substantial differences in the average capacity of pulp mills across countries within the Pacific Rim. There are also major differences in average operating rates among countries. Of particular interest are the relatively low operating rates in those countries which have experienced the most rapid growth in paper and board consumption, viz., Japan, Korea, and Taiwan.

Table 13. World total wood pulp for paper and market pulp production 1986 (1000 mt).

	TOTAL PULP	MARKET PULP
USA	51938	6865
Canada	21686	6601
Sweden	9395	3436
Finland	7928	1819
Brazil	3970	1536
Portugal	1405	1160
Japan	9240	937
Norway	1954	727
France	2022	712
Spain	1504	706
Chile	847	517
New Zealand	1110	417
W. Germany	2219	248
Korea	287	144
Australia	870	16

(PPI, July 1987)

Table 13 indicates the major market pulp producing countries of the world in decreasing order of importance. A comparison of Tables 13 and 14 for the Pacific Rim countries included in both tabulations provides an indication of the volumes of market pulp generated and consumed within the country rather than exported. A high fraction of market pulp production combined with a low fraction of market pulp to export suggests a lower degree of integration in the country's pulp and paper sector. A high fraction of market pulp to export suggests a pulp industry specifically developed for this purpose. In Korea, for example, market pulp represents roughly half of total pulp output, but all of this volume is consumed internally. Chile, in contrast, produces more than 60% of its pulp for the market and exports this entire volume.

Table 14. World pulp capacity, imports/exports (1000 mt).

Country	Capacity	#mills	Operating Rate '86%	'87%	Imports 86	87	Exports 86	87
New Zealand	1437	7	79	77	23	17	504	309
Chile	876	7	94	95	2	1	565	524
Brazil	4474	38	91	91	40	45	896	816
Japan	12571	61	75	76	2268	2563	20	38
Taiwan	500	3	79	65	314	379	394	416
Korea	427	5	67	74	740	799	0	0
USA	55170	219	95	98	4156	4400	4045	4436
Canada	24740	34	90	95	219	198	7859	8252
Australia	1100	19	83	83	223	280	20	70
PRC	9000	50[1]	e85	e85	576	683	7	5
South Africa[2]	2160	10	85	87	40	40	650	650

[1] PRC has about 9,000 pulp mills but only 50 with capacity greater than 30,000 mt/yr.
[2] After 1986 South Africa no longer issues official statistics
e = estimate

(Pulp and Paper International, July 1988)

3.2.2.1. Asian net importers

Japan

Japan has produced paper since the technology was brought to the country from China almost 2,000 years ago. Before World War II the industry developed on the islands of Hokkaido and Sakhalin (now part of the Soviet Union) where there was a rich supply of coniferous wood like ezomatsu (Picea jezoensis) and todomatsu (Abies sachalinensis) (Wood-Products Stockpile Corp, 1986). There was a great increase in pulp and paper capacity in the 1950's with the general economic recovery in Japan. In more recent years, however, the profitability of the Japanese paper industry has lagged behind other manufacturing sectors because of the interest costs from the heavy debt built up during this earlier expansion phase (Pulp and Paper International, Sept 1986).

There are 489 paper and board mills in Japan and 64 pulp mills (Pulp and Paper International, July 1987). They are located mainly in Hokkaido, Tohoku, Tokai, and Kyushu primarily because of ready access to water and raw materials (Japan Lumber Journal, 1983). Table 15 shows recent trends in Japanese pulp production by grade. Seventy-two percent of total paper grade pulp output in Japan was bleached kraft in 1984 compared to 55% in 1970. Production of sulphite and chemical ground pulp has been drastically scaled down (Kato, 1985) because these mills have been the oldest, least efficient and most polluting.

Table 15. Japanese pulp production 1975-86 (1000 mt).

Year	Total[3]	KP	SCP	CMP	RMP	TMP	GW	SP	DP	Other
1975	8,630	5,239	421	1,037	662	0	658	316	280	17
1976	9,518	5,937	468	1,035	775	0	689	276	324	15
1977	9,437	5,973	487	849	861	0	652	271	330	15
1978	9,392	6,018	470	680	1,039	0	632	216	321	15
1979	9,993	6,604	501	589	423	726	607	208	316	17
1980	9,788	6,519	456	546	397	794	579	182	300	16
1981	8,611	5,767	362	435	363	703	572	143	256	10
1982	8,627	6,079	319	303	324	656	560	110	266	10
1983	8,860	6,339	298	254	436	578	580	101	260	13
1984	9,127	6,675	08	231	384	609	570	80	252	17
1985	9,279	6,850	269	227	319	715	595	40	249	17
1986	9,240	6,925	224	228	346	680	620	28	172	17

(Japan Lumber Journal, 1983; Japan Paper Assoc, 1987)

There is a high degree of integration in the Japanese pulp and paper sector with 81% of domestic pulp consumed at integrated mills, an additional 10% in captive consumption and only 9% in domestic sales in 1985 (FAO, 1986c). The degree of ownership and production concentration is also high. As indicated in Table 16, roughly 80% of Japanese pulp production is derived from the ten largest producers.

Table 16. Japanese pulp production by firm (1,000 mt).

Oji Paper Co.	1,389
Daishowa Paper Mfg.	1,263
Jujo Paper Co.	968
Sanyo-Kokusaku Pulp Co.	930
Taio Paper Mfg.	860
Mitsubishi Paper Mills	472
Chuetsu Pulp Industry	424
Honshu Paper Co.	342
Hokuetsu Paper Mills	286
Kanzaki Paper Mfg.	236
Rest of Industry	1,860
Total	9,030

(Morgan Stanley, 1988)

[3] Process abbreviations defined in glossary.

Over the past 25 years, there has also been considerable attrition in the number of mills, particularly market pulp producers and smaller integrated pulp and paper manufacturers (Table 17).

Table 17. Trends in pulp mill concentration 1963-1985 (# mills).

Mills	1963	1969	1974	1979	1985
Pulp	44	29	17	13	10
Pulp & Paper	65	39	29	29	30
Pulp & Paperboard	12	13	17	12	11
Pulp, Paper & Paperboard	16	18	15	18	17

(Japan Paper Assoc, 1987)

Recent developments suggest that most domestic pulp producers are decreasing their involvement in the market (Japan Pulp and Paper, June 1987). The two biggest suppliers, Mitsubishi Paper and Sanyo-Kokusaku, which together supply nearly half of Japan's market pulp, are installing new paper machines to increase their internal consumption rate as domestic market pulp loses international competitiveness (Japan Pulp and Paper, June 1988). Integrated mills plan to increase their pulping capacity in line with the increase of paper production (Japan Pulp and Paper, June 1987).

Operating problems in the Japanese pulp and paper industry are similar to those encountered by the industry in other countries: high capital requirements, cyclical and often inadequate returns, domestic and world overcapacity, and the high cost of capital. Added to these difficulties in Japan are the domestic scarcity of raw materials, the relatively higher cost of energy (Japan imports virtually all her petroleum), and the huge amount of level land required for the manufacturing facility in a country where industrial land is scarce. Year-round clean water is another concern, as is the very high level of pollution-control requirements, comparable to those in the U.S. (Arpan **et al**, 1986). In 1985, Japan enacted a law taxing process water. This levy is intended to secure a source of revenue for protection of forests and rivers and is seen by the industry as a major limitation on future capacity expansion (Pulp and Paper International, 1986).

The Japanese paper industry is characterized by fervent and traditional competition among domestic firms. The five largest firms, most originally family owned, have been in competition with each other for many years, and intense rivalry has been the rule. Although they sometimes work together in ways that seem collusive to Americans, price-cutting and pre-emptive capacity installation are common competitive tactics, which may help account for the low level of profits often shown by Japanese industry. The strategy of installing capacity before demand truly materializes to prevent competitors from planning new capacity is common in Japan. This may be one reason for the overcapacity the industry now faces, as well as part of the reason for industry concentration in some segments (Arpan **et al**, 1986).

As have producers in North America, Japanese pulp and paper manufacturers have moved to create more efficient operating conditions as evidenced by the labor productivity trends in Table

18. Despite these efforts Japanese mills remain relatively high cost producers compared to other countries. Though specific cost data are extremely scarce, one comparison developed by Pulp and Paper (Aug. 1982) suggests that bleached hardwood kraft pulp production costs are 35-50% higher for Japanese producers than other world competitors. As a consequence, Japan has looked increasingly to off-shore sources of paper pulp.

Table 18. Japanese pulp and paper labor productivity value (1975-1985) (10^4 yen/yr, 1980 basis).

	1975	1980	1982	1984	1985
Value of shipments /employee	1,267	3,145	3,090	3,362	3,325
Value added/employee	363	812	823	963	965

(Japan Paper Association, 1987, deflated by domestic price index - see Appendix A.6.)

The amount of domestic pulp produced compared to paper and board output declined from 64% in 1974 to 45% in 1985 (Pulp and Paper International, 1986), while the use of imported pulp and wastepaper expanded dramatically. These trends are evident in Table 19.

Table 19. Paper production and sources of raw material in Japan

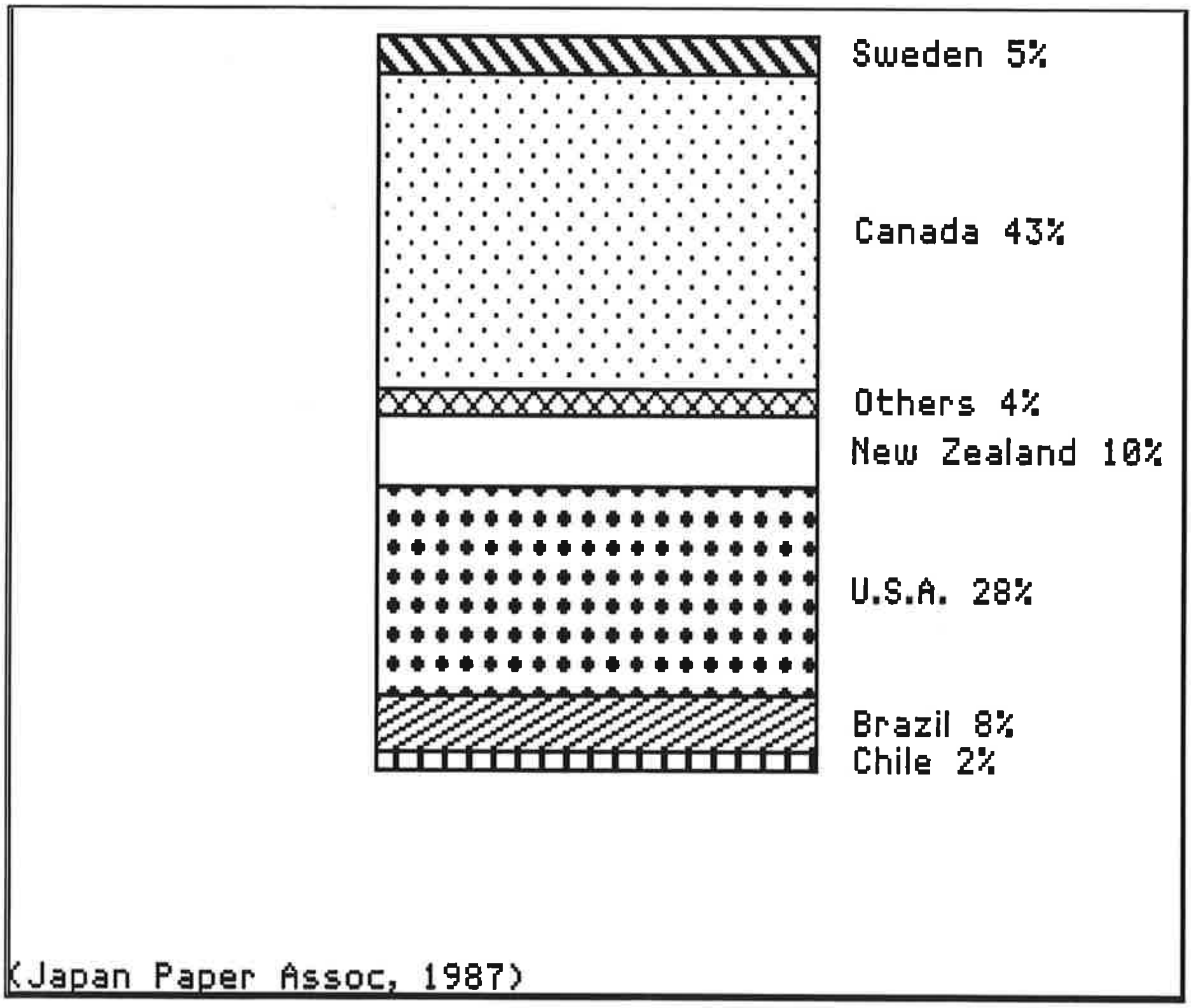
	1955	1965	1975	1985
Paper and paperboard production (1000 mt)	2204	7299	13601	20469
Raw material consumption (%)				
Wastepaper	20.1	34.6	36.6	49.3
Pulp	66.8	60.5	62.9	50.5
Other fibers	13.1	4.9	0.5	0.2
Pulp consumption (% of total raw material consumption)				
Imported	0.5	3.2	5.3	8.7
Domestic	66.3	57.3	57.6	41.8
Pulp consumption (% of total wood pulp consumption)				
Imported	0.5	5.3	8.4	17.2
Domestic	99.5	94.7	91.6	82.8
Pulpwood consumption for domestic pulp production (%)				
Imported	0.0	3.1	40.0	38.4
Domestic	100.0	96.9	60.0	61.6

(Kawake, 1988)

Japanese Pulp Imports

The trend toward increased importation of pulp seems irreversible and "(p)ulp deficits are a permanent feature of the trade profile of Japan." (Arpan et al, 1986). Table 20 shows the

Figure 6. Japanese pulp imports, 1986.



increase in both domestic production and pulp imports from 1960 to 1985. Figure 6 gives the source countries of these imports.

Table 20. Japanese paper pulp production and imports (1000 mt).

	IMPORTS	PRODUCTION
1960	12	3,153
1965	301	4,695
1970	731	8,247
1975	849	8,350
1980	1,935	9,488
1983	1,924	8,600
1984	1,894	8,875
1985	2,006	9,030

(Kato, 1985; Japan Statistics Bureau, 1987)

Japanese paper producers have traditionally preferred bleached kraft pulp although there is a move to invest in mechanical pulp (in Canada and New Zealand) (Pulp and Paper, Aug. 1984). Japan has imported increasing volumes of mechanical pulp. The amounts have grown steadily from 2,800 tons in 1970 to 395,000 tons in 1983, most of this coming from New Zealand (Kaar, 1986). While Japanese imports of wood pulps nearly doubled between 1973 and 1983, mechanical pulp imports showed the greatest increase in demand, rising 420%. Sulphate pulps were the largest wood pulp import, with shipments averaging 975,332 metric tons annually compared to 265,818 metric tons for mechanical pulp. Sulphite pulp declined 11% over the period (Long and Blatner, 1986). Significantly, the increased market pulp imports came while Japan's domestic industry operated at about 80% of capacity (Morgan Stanley, 1987a).

Table 21. Japanese pulp imports (1000 mt).

	1978	1979	1980	1981	1982	1983	1984
New Zealand	198	233	235	213	180	224	213
Brazil	37	103	198	146	153	168	172
USA	218	252	403	363	409	442	462
Canada	619	785	887	688	714	850	810
Sweden	283	115	98	31	43	105	127
Finland	45	73	49	13	32	45	38
Others	74	41	60	25	40	76	56
Total	1475	1602	1925	1478	1570	1910	1878

(API, 1987)

In 1985, imported pulp accounted for 71.2% of the total market pulp used (the rest coming from domestic operations) or 18.2% of the total paper pulp consumption (Japan Pulp and Paper, June 1987). Table 21 shows the historical trend in Japanese pulp imports from 1978 through 1984. During this period, Brazil, Canada and the U.S. gradually displaced Scandinavian producers in the import market, with the combined Swedish-Finnish share dropping from more than 20% to less than 10%. Table 22 gives in more detail the 1986 distribution of pulp imports by Japan.

United States and Canadian kraft pulp (both softwood (con) and hardwood (hwd)) clearly dominate.

Table 22. Japanese paper pulp imports by type and country of origin, 1986 (1000 mt)

	MP	USP	BSP	UBKP	BSKP	BHKP	SCP
Sweden	62	*	*	*	26	21	*
Finland	*	*	*	2	7	27	
Canada	130	*	18	7	693	139	
USA	*		76	5	295	264	
South Africa	*		3	*	*	2	
Swaziland	1			22			
New Zealand	203			3	8		4
USSR		*			*	*	
Australia		*		*			*
Norway			*				
Chile				32	23	*	
Denmark					*		*
Brazil					9	170	
Argentina					2		
Total	397	1	98	72	1,064	628	4

* Less than 1,000 mt

(Japan Tariff Association, 1986)

Japanese fiber supply

The Japanese pulp and paper industry uses pulp logs, market pulp, wood chips and wastepaper in order to make paper and paperboard. Any discussion of market pulp must take into account the other sources as well.

- Domestic forests

A distinguishing feature of the Japanese industry is the lack of backward integration in most companies (Arpan et al, 1986). Japanese pulp producers do not own commercial forests, nor do they have any forests they can control directly by long term lease cutting rights or National Forest timber sale contracts. Even Oji Paper Co., which has the largest industrial forest, owns no more than 100 thousand hectares. As a result, companies depend almost completely on open timber markets (Murashima, 1981).

Throughout the post-war period Japan has sustained an ambitious plantation program. At present there are approximately 10 million hectares of man-made forests, mostly Japanese cedar (cryptomeria) and Japanese cypress (chamaecyparis) (Nomura, 1984). The most important planted species for pulpwood are Japanese larch called karamatsu (Larix leptolepis) and Japanese red pine or akamatsu (pinus densiflora) (Tsay, 1985). The Japanese Forestry Agency has projected that self-sufficiency in wood supply will expand sharply as these plantations mature. Since most of these plantations are confined to mountainous areas with steep terrain, and since most of the forest base is comprised of small parcels held by a large number of non-industrial owners, questions remain as to the ultimate availability of this timber and its cost relative to import sources.

- Wastepaper

In situations where it can be used (lower grade paper products), wastepaper is a strong competitor with imported fiber. The cost of pulp made in Japan from recycled newspaper is reported to be only one-fifth of the cost of pulp from Pacific Northwest wood chips (Saheki, 1984). The Japanese trend toward lighter weight newsprint will require more high quality virgin pulp and tend to limit the inclusion rate of wastepaper. It has been suggested, therefore, that wastepaper inclusion rates in paper and board production have come close to the maximum level (Japan Pulp and Paper, June 1987). Economically, it is extremely difficult to increase wastepaper collection rates above 50%, since transportation costs become prohibitive as the distance required for collection increases. Also, paper quality considerations become a factor as the wastepaper fraction of fiber furnish rises (Schreuder and Anderson, 1987).

Wastepaper accounted for 50% of the total paper-making raw materials in 1984 compared to only 36% in 1970 (Kato, 1985). Table 23 shows the dramatic increase in wastepaper use. The bulk of wastepaper is from domestic recycling, but Japan imported 350,000 tons of wastepaper in 1986, primarily from the U.S. (Japan Paper Assoc, 1987)

Table 23. Japanese wastepaper consumption in papermaking.

	(1000 mt)	(% fiber furnish)
1975	5,327	37.1
1980	7,976	41.7
1982	8,580	46.6
1983	9,222	47.2
1984	9,827	48.0
1985	10,570	49.5
1986	10,863	49.6

(Japan Paper Assoc, 1987)

- Wood chips and Pulp logs

Pulpwood imports by Japanese pulp mills are comprised almost exclusively of wood chips. In 1982, pulpwood logs represented only 1% of the total Japanese pulpwood imports. However, determining the exact breakdown between chips and pulp logs is difficult due to inconsistencies in the way the data are reported (Kaar, 1986). Japanese dependence on imported chips was highlighted in 1979 when Weyerhaeuser, a significant supplier of chips to Japan, suddenly raised its chip prices 67% over six months. The results of this "chipshock" was to encourage overseas investment in fiber sources. A second result was a MITI-assisted industry rationalization plan of modernization and consolidation (Arpan et al, 1986).

Table 24 shows the recent trend in wood chip imports, with the greatest volumes coming from Australia and the U.S. United States wood chips are 85% softwood and 15% hardwood while the Australian chip percentages are reversed (Japan Pulp & Paper, June 1988).

Table 24. Japanese imports of wood chips (1000 mt).

Country	1983	1984	1985
Australia	2,022	2,157	2,061
United States	1,930	1,928	1,896
Canada	340	453	444
South Africa	352	359	382
New Zealand	227	282	273
USSR	155	156	151
Others	288	357	281
Total	5,314	5,692	5,488

(FAS, 1986)

The People's Republic of China

The new Chinese economic order introduced in 1978 adopted a policy of "catching up" with the developed economies of the world by the end of the century. This is reflected in China's plan to double per capita paper and board consumption by 2000. After decades of essentially uncontrolled exploitation, however, China's forest resources are simply incapable of supplying the expanded output required to meet these newly established goals for consumption growth. As a consequence, China has been forced to turn to imports. It has done so cautiously, however, constraining imports to the lowest possible level of manufacture so as to capture a larger share of employment and value-added. In the fiber products sector, output has expanded sharply since 1980 as a reflection of this industrial expansion policy. Nonetheless, many small mills (over 8000) using non-wood fiber, each serving its local area, remain the main base of China's pulp and paper industry.

Table 25 details China's pulp production and pulp imports. The importance of non-wood fibers in total pulp output is clear. While imports have expanded in recent years, the 1985 share of imports in total pulp consumption is only slightly higher than in 1970. Wastepaper consumption data for China are limited, but it is estimated that the apparent recovery rate in 1985 was about 18%, extremely low even by western standards.

Table 25. Pulp production and imports - People's Republic of China (1000 mt).

	DOMESTIC PRODUCTION	IMPORTS	TOTAL PULP CONSUMPTION	NON-WOOD PULP PRODUCTION	WOOD-BASED PULP PRODUCTION
1960	771	73	844	na	na
1965	1996	64	2060	1588	408
1970	2700	200	2900	na	na
1975	4500	200	4700	na	na
1980	4490	416	4906	2290	2220
1985	6365	530	6895	4211	2154

(PPI, 1986)

The major trading partners of the PRC in pulp in 1983 and 1984 were Canada (55%), the U.S. (26% in 1983 and 17% in 1984), and the Scandinavian countries (19% in 1983 and 27% in 1984). Table 26 shows pulp imports by grade.

Table 26. Chinese pulp imports by grade (1000 mt).

	1979	1980	1981	1982	1983	1984
Dissolving	7	35	33	34	12	18
Bl. Sulphite	14	120	95	22	93	43
Unbl. Sulphite	6	16	8	3	21	20
Bl. Sulphate	112	237	205	235	436	242
Unbl. Sulphate	34	22	39	33	48	36
Total	173	429	380	327	610	358

(API, 1987)

Korea

There are five pulp mills in Korea, four groundwood and one chemical, compared to 140 paper mills. Rapid expansion in paper capacity and production in recent years has sharply increased the demand for pulp. With limited domestic forest resources, the result has been continued dependence on imported pulp and wastepaper. Domestic pulp production and pulp imports both rose by roughly 45% between 1980 and 1985. As a result Korea has remained roughly 30% self-sufficient in pulp. Within pulp grades, Korea is 85% self-sufficient in groundwood pulp (used primarily for newsprint), but only 20% self-sufficient in chemical pulp (Youn, 1988). While the wastepaper recycling system has improved as a result of increased demand, Korea still imports roughly half of its requirements.

There is only one market pulp producer (the formerly state-owned Donghae Pulp Mill) that produces 140,000 ton/year of bleached kraft. Under current plans the mill will add a new 200,000 mt/yr bleached hardwood kraft pulp line with a start-up date of 1991. Before recent privatization, paper companies were required to buy 40% of their pulp from the state mill (Donghae) at prices set by the government.

Table 27 gives the major pulp trading partners of Korea. Of the 588,000 mt of pulp imported in 1984, 58% was sulphate pulp, of which 65% was hardwood. Only 7% was mechanical pulp, primarily from Sweden and New Zealand. Over the period from 1978 to 1984, the U.S. share of pulp imports has grown while that of Canada and Scandinavian suppliers has dropped.

Table 27. Korean pulp imports (1000 mt).

	1978	1979	1980	1981	1982	1983	1984
New Zealand			28	31	40	25	28
Chile	46	44	42	40	33	57	45
Brazil	4	20				10	29
Japan	69	79	84	93	52	36	35
USA	77	104	152	171	119	163	217
Canada	112	87	80	73	48	71	89
Sweden	52	38	29	22	41	65	54
Finland	5	10				2	9
Others	65	64	48	87	101	71	82
Total	430	446	463	517	434	500	588

(API, 1987)

With privatization of the Donghae mill, paper mills are no longer constrained to a fixed mix of domestic and imported pulp and market pulp prices move with international cycles. South Korea currently has a 5% import duty on chemical pulp and secondary fibers (Pulp and Paper International, Jan 1988) but that tariff is scheduled to be reduced and finally removed by 1991. There is no tax on the importation of mechanical pulp (Pulp and Paper International, Oct. 1987).

Taiwan

Taiwan's pulp and paper industry comprises some 160 mills, but only 24 have an annual capacity greater than 10,000 mt (Tai, 1985). Like Korea, Taiwan's industry grew behind protective barriers that have only recently begun to come down. Taiwan currently retains a 2.5% tariff on imported wood pulp. With continued strong economic growth and exports, Taiwan paper and board production has grown by more than 5% per year since 1980. Given its extremely limited resource position, pulp production has been unable to keep pace. As a consequence, pulp imports--roughly half of consumption--have grown dramatically (see Table 29, but note that roughly 30% of pulp imports in recent years have been dissolving). At the same time, Taiwan has maintained and expanded a modest flow of pulp exports (Table 28). During the period 1981-1984, exports averaged 59,000 metric tons of bleached or semi-bleached sulphate pulp. Over the same period, Taiwan imported about 79,000 metric tons of bleached or semi-bleached sulphate pulp. Imports are primarily long fiber pulp (coming from Canada, New Zealand, Sweden, and the U.S.), while exports are mostly hardwood and bagasse pulp (going primarily to Indonesia and Korea) (API, 1987; PPI, July 1988).

Table 28. Taiwan pulp production and exports (1000 mt).

	PRODUCTION	EXPORTS	EXPORTS AS PERCENT OF PRODUCTION
1961	22	5	21
1966	38	21	56
1971	107	47	44
1976	149	21	14
1981	272	75	28
1982	222	68	31
1983	231	58	25
1984	240	28	12
1985	261	56	21
1986	314	79	25

(Tai, 1985; FAO, 1987)

To reduce dependence on imported pulp, Taiwan paper producers have also sharply increased use of wastepaper in their total fiber furnish. With limited domestic sources and an emerging recycling system, Taiwan has found it necessary to import wastepaper in increasing amounts (see Table 29). Imports currently comprise roughly half of total wastepaper consumption. A further offset to pulp imports has been the continued strength in consumption of non-wood pulps, primarily bagasse, which presently account for 25% of domestic pulp production.

Table 29. Taiwan pulp and wastepaper imports (1000 mt).

	PULP	WASTEPAPER
1981	112	548
1982	163	672
1983	228	810
1984	236	945
1985	328	959
1986	382	1,266
1987	437	1,243

(Jen, 1987)

Table 30 gives recent figures for pulp imports by country of origin. The U.S. share of imports declined over the 1978-84 period while that of Canada, Sweden and "other" suppliers expanded. In 1984, 41% of pulp imports were sulphate pulps and 29% were dissolving pulps.

Table 30. Taiwan pulp imports by country of origin (1000 mt).

	1978	1979	1980	1981	1982	1983	1984
New Zealand			8	10	7	19	11
Chile	3	8	3	7	13	14	12
Brazil		7	1		5	6	8
USA	52	53	70	54	49	66	75
Canada	19	22	17	15	36	42	49
Sweden	8	10	1	2	19	29	34
Finland	5	10	5	7	14	8	10
Others	11	12	9	23	24	42	35
Total	98	121	104	108	160	226	233

(API, 1987)

3.2.2.2 Exporters to the Pacific Rim

Competition for the Asian pulp market is based on cost and also on the type of fiber supplied. Since Alaska produces long fiber (coniferous) pulp, the prime competitors are other long fiber producing regions. Short fiber (hardwood) pulps, however, can substitute for long fiber in many products. In some instances, products that traditionally have used long fiber pulp exclusively, such as grocery bags, now have a higher short fiber content because of improved printing characteristics with the increased short fiber component (McKean, personal communication). Long fiber producers are considered first followed by a discussion of the short fiber exporting countries. Though some of the countries export both hardwood and softwood pulp (or pulpwood), each is discussed under the category in which it is a leading supplier.

Long Fiber Exporters

- United States

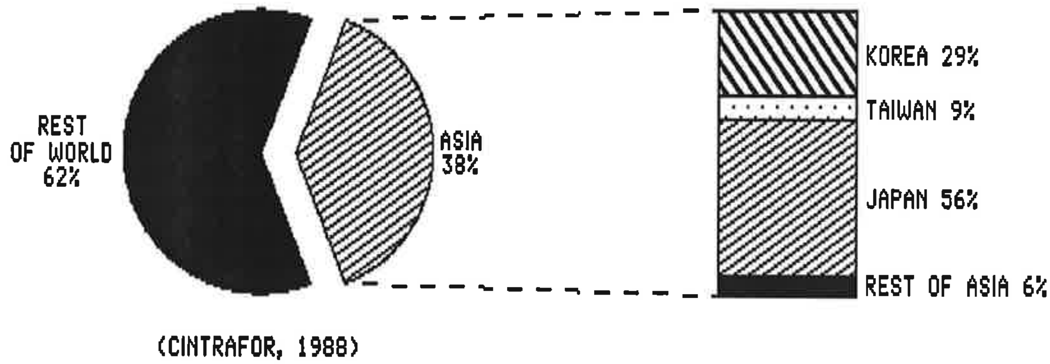
U.S. total pulp production is shown in Table 31. The difference between market pulp totals and exports represent the market pulp sales within the U.S. Sulphate pulps represent 75% of total exports and more than a third of this goes to Asia (Figure 7). The U.S. is the world's second largest pulp exporter (behind Canada). The destination of American pulp exports (Figure 8) has changed significantly from 1976 to 1986. While the absolute trade volume has grown substantially, Japan and other Pacific Rim countries have become much more important while European trade has declined in relative magnitude.

Table 31. US Pulp production, 1986 (1000 mt).

	TOTAL	MARKET PULP	EXPORT
Dissolving/ special alpha	1,133	1,128	645
sulphate	41,314	5,686	3,100
sulphite	1,485	306	312
groundwood	2,805		22
thermomechanical	2,266		
semi-chemical	3,823		32
other	2,453		13
Total	55,279	7,120	4,124

(US Dept Commerce, Bureau of Census, 1987)

Figure 7. U.S. sulphate pulp exports, 1987.



- Pacific Northwest

Table 32. Washington, Oregon and total U.S. pulp and wastepaper export value, 1987 ($1000).

	TOTAL PULP & WASTEPAPER	WASTE PAPER	SULPHATE PULP
Washington	333,717	42,419	109,392
Oregon	39,149	10,178	27,938
Total U.S.	2,897,945	561,788	1,720,803

(CINTRAFOR, 1988)

Pulp trade from the Pacific Northwest represents a small portion of the total U.S. trade in pulp (Table 32) and of the sulphate pulp going to Asia (Table 33) but a significant fraction of the sulphite pulp sold to Asia.

Figure 8. Changes in the destination of U.S. pulp exports.

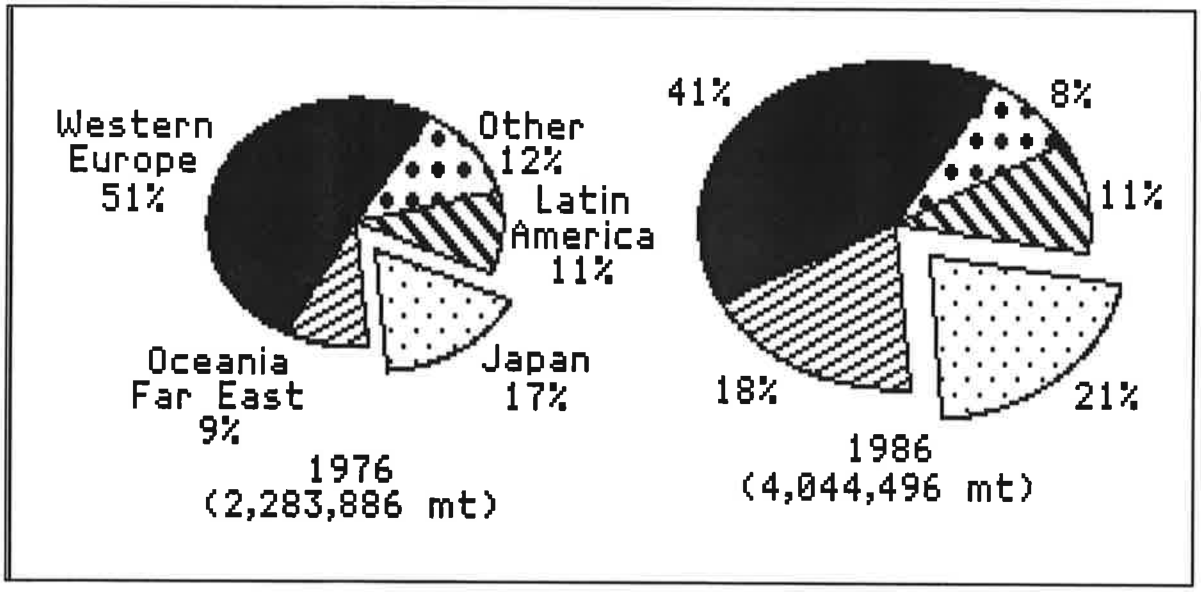


Table 33. Washington, Oregon, and total U.S. pulp exports to Asia (1000 mt)

	PRC	JAPAN	KOREA	TAIWAN	OTHER ASIA
<u>Sulphate pulp</u>					
Washington	14	17	84	47	1
Oregon	2	30	2	-	1
Total U.S.	65	655	343	105	4
<u>Sulphite pulp</u>					
Washington	11	38	2	16	2
Oregon	-	0.2	-	3	0
Total U.S.	20	51	4	19	14

(CINTRAFOR, 1988)

- Alaska

Alaska's contribution to world trade in pulp has been from the two dissolving pulp mills. Table 34 gives volumes for the years 1980 - 1986. The principal destination of Alaska's dissolving pulp exports are Japan (averaging about 60-70% per year) with other Asian countries receiving 90% of the remainder. This pattern has changed little over the past ten years (USFS-AK, 1984-1988).

Table 34. Wood pulp exports from Alaska 1980-1986 (1000 mt).

1980	283.0
1981	260.0
1982	189.8
1983	220.0
1984	198.7
1985	181.7
1986	206.5

(US Forest Service - AK, 1987)

- Eastern and Southern U.S.

In the cost section of this report (section 4.) we discuss the relative unimportance of transportation distance in trade flows. To emphasize this point, the following table shows pulp trade to Asia from the U.S. West Coast and the rest of the country. It should be noted that 70% of pulp volume to Japan, 64% to Korea, and 62% of total pulp trade from the U.S. to Asia comes from Northeast or Southeast ports.

Table 35. Wood pulp exports from the U.S. to Asia, 1987 (1000 mt)

	West Coast ports[1]	Other U.S. ports[2]
Japan	213	490
Korea	122	212
PRC	73	18
Taiwan	95	34
ASEAN countries	14	79
Hong Kong	7	3
Australia	7	7
New Zealand	1	14
Total	531	857

[1] Includes Anchorage, Seattle, San Francisco, Los Angeles, Portland OR
[2] Includes Houston, Miami, New Orleans, Mobile, Tampa, Savannah, Charleston, Wilmington NC, Norfolk, New York, Ogdensburg NY, Buffalo, Philadelphia, Portland ME

(U.S. Dept. of Commerce, 1988)

Canada

Sixty-four percent of British Columbia's pulp production is bleached or semi-bleached sulphate pulp, 22% is mechanical, and essentially all the rest is unbleached sulphate (except the output from the one dissolving pulp mill). The mechanical pulp is used in the province for newsprint production, so almost all the export is sulphate pulp. Only about 3% of the kraft pulp produced in British Columbia is converted into finished products within the province. British Columbia's resultant dependence on one export commodity (Table 36) leaves the industry vulnerable.

Table 36. Canadian and British Columbian pulp production (1000 mt).

	ALL CANADA	BRITISH COLUMBIA	BC MARKET PULP
1977	17,773	4,877	2,775
1978	19,182	5,382	3,239
1979	19,490	5,324	3,095
1980	19,970	5,717	3,324
1981	19,304	4,813	2,854
1982	17,007	4,759	2,662
1983	19,221	5,572	3,221
1984	20,169	5,191	2,837
1985	20,237	5,849	3,298
1986	21,552	6,174	3,627

(Council of Forest Industries of BC, April 1987)

There appears to be a move toward integration but western Canada is likely to remain a major exporter of bleached softwood pulp (Jaakko Poyry, 1987a; Hay-Roe, May 1987). Recent pulp trade data in Table 37 indicate that Japan accounts for about 20% of the value of pulp exports from B.C., roughly comparable to the Japanese fraction of U.S. pulp exports. Outside of British Columbia, shipments to the Far East are much smaller (10% to Japan, 3% to other Pacific Rim countries) while those to the U.S. are correspondingly larger (68%), reflecting the proximity to the major net importing region of the U.S. Northeast.

Table 37. Value of Canadian pulp (all grades) exported, 1986 (million U.S.$).

From:	To: USA	Japan	Other PacRim	UK	Other EEC	All Other	Total
British Columbia	364.1	222.7	217.6	51.3	442.7	88.6	1,387.0
Other Provinces	1048.7	154.6	42.7	95.7	157.5	44.0	1,543.2
Canada	1412.8	377.3	260.3	147.0	600.2	132.6	2,930.2

(Council of Forest Industries of BC, 1987)

New Zealand

Over the period from 1975 to 1985, New Zealand's paper and board output expanded by roughly 40% as domestic consumption, particularly in packaging for export products, burgeoned. Pulp output, in contrast, increased by nearly one-third between 1975 and 1980 but has been nearly stable in the ensuing years. Some capacity expansion has occurred through modernization of existing facilities, and an additional 150,000 tons is anticipated to come on line through improvements by 1990. New Zealand's extensive resource potential, based on exotic plantations, has attracted considerable interest from Asian producers. One joint venture mill operation has been completed (with Korea) and others are being contemplated.

Extensive deregulation of the New Zealand economy in the mid-1980's (particularly elimination of export subsidies, movement to a floating currency, and increases in previously subsidized energy costs) has caused some shocks in the industry and raised concerns about future investment expansion (Jaakko Poyry, 1987a). Industry observers generally expect these difficulties to pass, however, as firms gain experience with a freer economy. It is reported that more than 20 mill expansion projects are presently under consideration for the New Zealand fiber products sector (PPI, 1986).

New Zealand has been a significant exporter of pulp for some time (Table 38), shipping nearly 40% of its total pulp production abroad, primarily to Japan and Australia. Half of exports are groundwood pulps (representing about 75% of its total mechanical pulp output). About 45% of its kraft pulp is exported to Australia (Fletcher, 1988). Exports grew rapidly prior to 1975, but have since been roughly stable. New Zealand is also a major softwood chip exporter to Japan.

Table 38. Recent trends in the New Zealand pulp and paper sector (1000 mt).

	TOTAL PAPER AND BOARD PRODUCTION	PULP PRODUCTION	PULP EXPORTS	PULP CAPACITY
1960	184	266	71	na
1965	355	417	55	na
1970	462	576	98	na
1975	550	921	313	na
1980	683	1147	475	1371
1981	711	1060	517	1385
1982	702	1040	441	1376
1983	669	1073	470	1312
1984	695	1062	486	1475
1985	770	1145	429	1493

(PPI, 1986)

Chile

Major expansion of the Chilean fiber products sector over the past two decades has been based entirely on exports primarily of pulp, although paper and board exports have also increased modestly. Since 1975, pulp capacity and output have more than doubled with exports absorbing some 60% of production in recent years (see Table 39). Primary markets are Asia (45% of exports), particularly the PRC, and Europe (30%). Pulp production is presently comprised of some 35% bleached kraft, 45% unbleached kraft, and 20% mechanical pulps. Exports are entirely of kraft pulps, about evenly divided between bleached and unbleached grades. Although Chilean consumption of paper and board products increased by some 80% between 1975 and 1985, its per capita consumption rate (24.5 kg/capita) has been virtually constant and remains well below even the global average (at 41.1 kg/capita).

Chile's pulp industry is presently based almost exclusively on wood from radiata pine plantations (nearly 97% of wood input), with growth per unit area more than three times that experienced on softwood plantations in the U.S. South. The present radiata base has been established in part through plantings on public lands and through government subsidies of plantations on private ownerships. Extensive plantation establishment is expected to continue in the future. The growing radiata resource base and Chile's cost advantages in labor and energy (see discussion in Section IV) have stimulated considerable interest in further pulp capacity expansion. Some projects are now underway and still more are in planning stages. It has been suggested that Chilean capacity could rise above 1 million mt by the early 1990's. There will be sufficient wood fiber available to support more than twice this level by the year 2000.

Table 39. Recent trends in the Chilean pulp and paper sector (1000 mt).

	TOTAL PAPER AND BOARD PRODUCTION	PULP PRODUCTION	PULP EXPORTS	PULP CAPACITY
1965	191	204	18	na
1970	262	367	102	na
1975	239	412	165	na
1980	327	763	436	768
1981	319	744	387	813
1982	262	667	477	799
1983	324	796	523	851
1984	375	839	493	900
1985	370	837	503	900

(PPI, 1986)

Soviet Union

Rapid expansion of the Soviet fiber products sector occurred in the period 1960 through 1975. Pulp output roughly tripled and paper and board production expanded some 2.5 times. Domestic consumption rose sharply as did exports, paper and board exports expanding more than seven-fold while pulp exports doubled. Pulp export destinations then, as today, were primarily eastern Europe centrally planned economies (roughly 60%) and western Europe (roughly 30%). During this period expansion was characterized by enormous greenfield facilities with capacities in the 500,000 tons/year range. Much of the increase was concentrated in Asian USSR, though significant increments were added in the west as well.

Since 1975, growth in pulp, paper and board output has been much slower. Between 1975 and 1980, paper and board output rose only 16% in total while pulp production rose less than 4%. This decline relative to earlier years has been a reflection of much slower general economic growth within the USSR and, as a result, flagging expansion in domestic consumption. At the same time, exports of paper and board rose by some 50% while pulp exports doubled. Though the USSR remains a net exporter in both pulp and paper and board (exports exceed imports by roughly 2:1 in pulp and 4:1 in paper), imports have risen apace with exports leaving its net trade position little changed. Primary import sources are the Scandinavian countries, particularly Finland.

Despite the enormous forest resource base of the USSR, the post-1975 period has seen the emergence of a number of supply problems related to fiber availability. Particularly in the western regions, softwood supplies are growing increasingly scarce as a result of years of heavy exploitation. In response, western mills have undergone extensive modernization to improve pulp yields, added new lines to utilize large hardwood volumes passed over in earlier logging, and have begun to incorporate growing volumes of wastepaper in their fiber furnish. Localized fiber shortages were also encountered in Asian mills, due primarily to access difficulties and long transportation distances from woods to mill.

With the recent trends toward economic liberalization beginning in the early 1980's, observers report renewed interest in expansion of the Soviet fiber products sector. Plans for new greenfield mills, particularly in Asian USSR have resurfaced. In recent log and chips export negotiations with the Japanese, the Soviets raised the prospect of two joint venture pulp mills in Siberia and Sakhalin. At least part of the output of these mills would go to export to Japan as partial repayment for construction investments. It has been suggested that the Soviet Union is likely to be moving toward more trade in the Pacific as a result of the need for eastbound freight for their new Baikal-Amur railroad, which runs 1900 miles westward from the Pacific (Flora, 1985).

Current Soviet involvement in Pacific Rim forest products trade centers on roundlog and chip export to Japan and the PRC. The Soviet Union and Japan have a 10 year contract for Soviet wood chips and pulp. Prices are set annually and in return the Soviets have agreed to purchase timber harvesting equipment from Japan (USFS-AK, 1987). The contract calls for the importation of 8.2 million m^3 of wood chips over a ten-year period starting with 600,000 m^3 in 1986 and an increase of 50,000 m^3 every year thereafter (FAS, 1986).

Scandinavia

Finland, Sweden and Norway combined produce some 14% of the world's pulp output and provide roughly 25% of global pulp exports. Over the past 10 years the fiber products sectors of all three countries have undergone a major process of concentration (reduction in numbers of mills and firms) and modernization to improve efficiency. There has also been a growing concern for continued exposure to the wide price and volume swings in pulp markets and hence some move toward integration of market pulp facilities with paper and paperboard production. Total pulp output has grown only modestly from levels attained in the mid-1970's and aggregate exports have remained roughly stable. While the Scandinavian countries are considered to have some potential for future expansion of pulp output, it is likely that any growth will be channeled into increments in paper and board production rather than market sales.

The bulk of Scandinavian pulp exports are sent to Europe. In 1985, Sweden, Norway and Finland sold a total of 162,000 mt of pulp to Japan, 30,000 mt to China, 41,000 mt to Indonesia, 70,000 mt to Korea and 32,000 mt to Taiwan (PPI, 1986) out of a total export volume of 5.1 million tons. All Asian destinations have accounted for roughly 6% of Norwegian exports, 16% of Swedish shipments and 11% of Finnish trade during the early 1980's. Over the period since 1975 export shipments to Asia and other Pacific Rim countries have been highly erratic and shown essentially no trend. Given the long transportation distances to the Pacific and Scandinavia's persistent cost control problems, these countries are most likely the marginal suppliers in the Pacific Rim markets.

Short Fiber Exporters

The short fiber pulp producers are primarily exporting eucalyptus pulp, although other hardwood pulps are traded. Eucalyptus pulp is rapidly becoming very significant in total world pulp production representing 5.3% of world chemical pulp production, 9.4% of world bleached chemical pulp production and 23% of world bleached hardwood pulp production (35% of total hardwood market pulp). Bleached eucalyptus market pulp is estimated to grow from 3.3 million metric tons in 1987 to 4.2 million mt by 1995 (Molleda, 1988). Table 40 gives the world summary of pulp production and eucalyptus pulp's share of the world market.

Table 40. World pulp production, 1987 (million mt).

Type of pulp	Total	Integrated	Market
Virgin pulp (all grades)	154	123	31
Non wood pulp	10	9.5	0.5
Wood pulp	144	113.5	30.5
Mechanical,RGP,CMP,TMP,CTMP	32	29	3
Chemical	112	84.5	27.5
Unbleached	50	48.5	1.5
Bleached	62	36	26
Bleached Softwood	36.5	20	16.5
Bleached Hardwood	25.5	16	9.5
Bleached Eucalyptus	5.8	2.8	3.3

(Molleda, 1988)

Brazil, Portugal and Spain lead the bleached eucalyptus market pulp industry. Most of the exports from Spain and Portugal go to Europe (85-90%) while Brazil sends about 60% of its production equally to Europe, North America and Asia (about 20% each).

Australia

While Australia has long been a major supplier of pulping fiber (primarily eucalyptus chips) in the Pacific Rim it has only recently become a pulp exporter (exports of 20,000 mt in 1986). Movement into the export market is based on a major expansion in existing mill capacity of some 40% since 1980. In addition, two new mills for radiata pine thermochemical market pulp with a combined capacity of 236,000 mt and a 40,000 mt expansion for eucalyptus pulp are being completed (FAO, 1986c). As in New Zealand, Asian importers (Japan and Korea) have been exploring options for joint ventures to further exploit Australia's radiata and eucalyptus resource base. Since Australia presently imports nearly 35% of its domestic consumption of paper and board (equally distributed across newsprint, printing and writing, and other grades), export expansion could be displaced by a greater focus on import substitution.

Brazil

Growth of the Brazilian fiber products sector and its emergence as a major world pulp supplier is one of the great modern industrial success stories. Based on extensive eucalyptus and other exotic plantations and planned during the mid-1970's, Brazil's pulp production capacity jumped nearly 50% between 1979 and 1980. Over the period from 1979 to 1985 pulp output rose by more than two-thirds and exports increased more than 45%. After its major surge in the early 1980's, however, domestic economic problems (including a prolonged period of hyper-inflation) stalled further capacity growth. Stringent control measures have been moderately successful in righting the economy, and Brazil has begun to run small surpluses on its trade accounts. With optimism growing, proposals for further pulp capacity expansion have reemerged. Much of the potential investment would come from Latin American companies, but a sizable part would also arise from off-shore (mostly Asian) joint venture participants. If all announced projects come to fruition, capacity could expand by some 40% by the mid-1990's. Though Brazilian domestic paper and board consumption has been growing, it is now mostly self-sufficient with the exception of newsprint and some specialty grades. Continued future growth is expected, but this seems unlikely to limit exports to any significant extent. Major moves toward integration, while their advantages in terms of protection from price volatility and higher value-added are clearly recognized in Brazilian industry, are also considered to be unlikely in the near future.

Brazil's initial entry into global pulp markets was complicated by the need to convince importers that eucalyptus pulp was substitutable for traditional pulp grades. This effort was eased at least in part by Brazil's ability to underprice competing suppliers. Brazilian eucalyptus pulp is substantially cheaper than North American grades. Morgan Stanley (April 26, 1986) rates Aracruz (Brazil's and the world's largest bleached eucalyptus mill) as the world's lowest-cost pulp producer with production costs of $197 per metric ton compared to $450 per metric ton for an average U.S. producer. The success of the substitution process is demonstrated by recent European price movements in which eucalyptus pulp sold at a premium to northern bleached softwood kraft.

Since its 1979 entry into global markets, Brazil has exported pulp primarily to European destinations. The 1979 distribution was 55% to Europe, 6% to the U.S. and 27% to Asia. In the ensuing years, the U.S. has been the most rapidly growing market, with the Asian share roughly stable and the European share declining. Table 41 gives Brazilian shipments to Asian markets since 1979.

Table 41. Brazilian pulp exports to Asia (1000 mt).

	JAPAN	PRC	KOREA	TAIWAN	INDO-NESIA	OTHER ASIA	TOTAL
1979	114	6	13	13	6	4	156
1980	189	14	12	-	4	-	228
1981	165	3	13	-	15	-	198
1982	165	-	5	-	10	14	195
1983	176	18	13	-	19	10	236
1984	194	45	32	-	-	203	280
1985	179	21	38	-	-	202	261

(PPI, 1986; FAO Yearbook)

<u>South Africa</u>

South Africa has only 17 pulp mills but all are large, efficient and internationally competitive. Indeed, four mills have capacities of over 400,000 tons/year (PPI, 1986). Since 1975 pulp production has grown by more than 25% and pulp exports by more than 60%. In 1985 pulp exports were 430,000 mt comprised predominantly of dissolving pulp with a small volume of bleached kraft. The bulk of exports go to an array of developed countries in Europe, a large portion to the U.S. and smaller amounts to Japan and Asian developing countries. The SAICCOR (South African Industrial Cellulose Corporation) mill accounts for 16% of the world production capacity for dissolving pulp, compared to 13% for Alaska's mills (USFS-AK, 1985). In 1985 South Africa exported 74,000 mt of dissolving pulp to Japan and 85,000 mt in 1986 (compared to 182,000 mt in 1985 and 206,000 mt in 1986 from Alaska).

Given its forest resources and highly efficient mills, there is strong reason to speculate that South African production and exports could expand substantially in the future. It is well situated to supply both European and Asian markets. However, its future place in world trade may be as much a political question as one of economic competitiveness, given the pressure for economic sanctions that has been exerted in the recent past. An increased domestic demand has likewise increased South Africa's commitment to domestic pulp production which will somewhat limit future increases in exports (Schreuder and Anderson, 1987).

Indonesia

Indonesia has recently achieved self-sufficiency in paper production and is expanding rapidly to be so in paperboard and pulp as well by the early 1990's. Though it is not presently a net exporter, a recent analysis by Pulp and Paper International (Jan. 1988) argues that it has the clear potential to become a major fiber supplier to the Asian region. Out of all the projected new pulp mills in Southeast Asia, those in Indonesia would appear to have the greatest possibility of success. A key positive element is the country's large timber resource. The Indonesian government and private industry has also shown considerable skill in organizing joint venture funding for large projects, most recently with Taiwan and Japan.

Indonesia presently has an installed pulp capacity of 442,000 annual metric tons. Additionally there is 225,000 annual tons of expansion planned and 513,000 annual tons of new pulp capacity at various stages of planning or construction (Indonesian Pulp & Paper Assoc, 1987).

Iberian Peninsula

Although the Scandinavian countries are the largest producers of market pulp in Europe, the Iberian nations are quickly becoming major players, particularly in hardwood (eucalyptus) pulp. More than half of Spain's production is now eucalyptus, and fully one-third of the world's output of bleached eucalyptus kraft comes from Portugal. Portugal and Spain together manufactured 2.8 million tons of pulp in 1985, up from 1.3 million tons in 1975. Roughly 1.7 million mt of the 1985 output was bleached eucalyptus kraft. Accompanying the doubling of pulp output was a four-fold expansion in pulp exports. The bulk of exports is delivered to European destinations, but small volumes have been shipped to the PRC, Korea, Indonesia, and Australia.

It is generally believed that plantations now in place or which could feasibly be established in the Iberian region could support a substantial expansion in pulp output. While Spanish producers have been coping with a number of financial problems brought on by Spain's struggling economy, Portuguese firms have been moving strongly ahead with plans for expansion. Between the two countries, plans presently exist for several additional pulp mills which could add at least 600,000 tons of capacity by the early 1990's (Morgan Stanley, 1986).

3.2.2.3. Pulp trade

Bilateral flows and market shares

Table 42 summarizes Pacific Rim pulp trade in the early 1980's. Japan is clearly the largest market while Canada and the U.S. dominate the import structure for all countries except Australia.

Table 42. World Pulp Exports to Asia (1983) (1000 mt).

TO	FROM: Australia	Japan	Korea	PRC	Taiwan	Indonesia	Total
New Zealand	96.8	224.2	25	34	19	14	413
Chile	0	34.3	57	91	14	0	196.3
Brazil	0	168.3	10	29	0	18.9	226.2
Japan	0	0	36	0	0	0	36
Taiwan	0	0	0	0	0	33	33
South Africa	0	71.8	0	0	14	0	85.8
United States	13.6	602.5	163	62.6	66	92	999.7
Canada	67.3	863.6	71	333	42	53.4	1430.3
Sweden	9.7	105	65	159.3	29	51.1	419.1
Finland	20.4	51.2	2	56.2	8	21	158.8
Others	7.2	37.3	71	23.9	34	0	173.4
Totals	215.0	2158.2	500.0	789.0	226.0	283.4	4171.6

(API, 1986)

Table 43 gives time series data on imports for the three largest importers by supplier. Few significant trends are evident (in part because of the major recession during this period). Canada and Chile have made some inroads in the Chinese market (primarily in the PRC). Canada and the U.S. have supplied the bulk of the growth in Korean imports.

Table 43. Trends in Asian wood pulp trade patterns (1000 mt).

Imports From:	USA	Canada	New Zealand	Brazil	Chile	World Total
Japan 1980	672	901	241	204	28	2199
1981	559	696	233	165	4	1755
1982	535	687	198	174	18	1752
1983	650	789	198	181	34	2022
1984	669	805	239	194	23	2146
1985	683	873	223	173	46	2144
China (including Taiwan)						
1980	139	163	26	13		418
1981	158	167	25	3	88	510
1982	42	188	5	16	56	400
1983	63	350	5	29	91	815
1984	124	185	36	53	120	667
1985	147	244	30	53	120	704
Korea						
1980	140	89	27	12	30	322
1981	146	85	37	12	39	381
1982	141	46	22	5	44	357
1983	198	74	21	15	64	416
1984	186	77	20	30	27	419
1985	237	120	24	30	27	572

(FAO, 1986)

Barriers to Trade in Pulp Products

Examples of trade barriers or restrictions designed to promote domestic pulp sector expansion, or retard its decline, can be found in virtually all of the countries examined in the preceding sections. Such restrictions can have significant impacts on the ability of exporters to gain entry to, or expand their share of, target markets. Jaakko Poyry (1987a) provides a generic list:

- Tax incentives to promote development of forest resources for industrial use.

- Financing with subsidized interest rates, long-term loans and temporary public equity participation.

- Direct investment subsidies and grants including bonuses for employment, special training and transport costs.

- Availability of domestic raw materials (typically pulpwood), sometimes at subsidized prices.

- Export incentives.

- Protective duties and licensing procedures.

There is also strong evidence that some countries in which the pulp and paper sector is a major component of the economy have devalued currencies to gain share in global markets (Moseley, 1988). Sweden in the early 1980's and Korea and Taiwan today are frequently mentioned as using this tactic (Meister, 1988).

As the largest single Asian market at present, and for the immediate future, Japan deserves a closer look for trade barriers and restrictions. Since Japan has no tariff on market pulp imports, concerns center primarily on an array of non-tariff barriers that act to impede import competition and/or subsidize domestic industry. Pulp and Paper International (Sept. 1986) identified four major classes of barriers or institutional arrangements in Japan that effectively limit foreign access:

1) The operation of the Structural Improvement Law, which by permitting cartels, has not eliminated excess inefficient capacity;

2) Financing practices that lead to an artificially depressed market for some products by helping to maintain noncompetitive enterprises;

3) Interlocking relationships between producers, distributors, and financial institutions, which, although legal in Japan, perpetuate the "system" that clearly favors domestic producers; and

4) The absence of companies devoted mainly to imports of pulp and paper, leaving imports to distributors for whom domestic sales are clearly more important.

The Japanese pulp and paper industry had been designated by law as a structurally depressed industry. Moves to assist the industry include mergers, reorganizations, and creation of the Pulp and Paper Research Association to share research and development costs. It should be noted that similar efforts to rationalize the structure of the industry, through concentration and improvement of efficiency, are underway in all parts of the world, though with widely varying degrees of government involvement. Recognizing Japan's basic resource limitations, a further key element of the Japanese reorganization effort is the development of overseas sources of pulp supply either through acquisition or joint venture (Pulp and Paper, May 1984).

Japanese paper and paperboard distribution is managed by three organizations - dairiten, merchants, and sogo shosa. Dairiten are distributors under contract to manufacturers. They carry inventories and sell large volumes of merchandise to either end users or merchants. Merchants usually purchase through dairiten as secondary wholesalers and resell to small to medium size customers. Sogo shosa (trading companies) became involved in the distribution system through paperboard producers in the 1960's and have a similar function to the dairiten (Pulp and Paper International, Sept. 1986).

The gross cash income of the nine main trading companies is equivalent to 22% of Japan's GNP, and they handle almost 50% of all Japanese imports and exports. Trading companies import and distribute over 90% of wood products. C. Itoh is the largest pulp importer of the trading companies (Japan Pulp and Paper, July 1986). The three main functions of the trading companies are, transaction intermediation, financial intermediation (or quasi-banking) and information gathering. Auxiliary functions include transport logistics and warehousing (Kojima and Ozawa, 1984). They give generous credit terms in Japan, usually promissory notes of 150 to 180 days (Pacific Rim Log Market Report, Dec 1986).

Imported pulp is sold to Japanese paper mills in five main ways (Ruz, 1987) and the sogo shosa are involved with 75% of this business. *Joint venture sales* account for 17% of bleached kraft pulp (BKP) imports. This is contracted tonnage sold through three of the major trading companies to Japanese paper companies who have invested in off-shore pulp ventures. Fourteen percent of BKP imports are *bought by trading companies to be sold on a contract basis.* Thirty-eight percent of BKP imports are *purchased directly by trading companies.* Twenty-two percent of BKP imports are *direct sales from suppliers to major buyers* where trading companies are not involved. Finally, 9% of BKP imports involve *semi-direct business between the overseas supplier and the paper mills* where the trading companies act only as a forwarding agent.

3.3 Demand, supply and price prospects over the period to 2000.

To develop some notions of the potential future market for expanded pulp exports from Alaska, this section examines some recent projections of demand, supply and price conditions for pulp in the Pacific Rim region over the period to 2000. The primary objectives in this exercise are to identify centers of demand growth and the likely competitors for any potential expansion in Alaskan exports. Our analysis relies primarily on forecasts of global fiber products markets by FAO (1986; 1988) and IIASA (1987).

3.3.1. Demand

As a starting point on the demand side, we have summarized historical trends in general economic growth and fiber products consumption and production for key Pacific Rim markets in Table 44. Because paper and board are so widely used in communications, cultural and packaging applications in most economies, trends in their consumption tend to parallel trends in aggregate measures of economic activity such as gross domestic product (GDP). This is evident for most of the countries and in the global data shown in Table 44. The two time periods in the table correspond roughly to the decades before and after the major global oil price shocks precipitated by the OPEC cartel. In many, though not all, economies the post-oil price shock period has seen somewhat lower growth as a result of policies designed to slow inflation and raise productivity. Growth in paper and board consumption in most cases has followed this shift in GDP growth.

Across the countries shown in Table 44, variations in rates of paper and board consumption growth reflect differences in both basic demand (GDP) growth and the responsiveness of paper and board consumption to changes in GDP (the elasticity of consumption with respect to GDP). As an example of the first effect, Japan's GDP growth was roughly 2.8 and 1.3 times that in the U.S. during the periods 1965-1974 and 1975-1985 while growth in Japanese paper and board consumption differed by nearly identical multiples over the same periods. In the second instance, we observe countries such as Korea where GDP growth was 3.5 and 2.2 times that in the U.S. for the two periods but paper and board consumption grew at 5.6 and 4.1 times U.S. rates over the same intervals. A number of studies (Buongiorno, 1978; Baudin and Lundberg, 1987; Perez-Garcia, 1987) have demonstrated that the responsiveness of paper and board consumption to changes in GDP varies inversely with the level of GDP. Higher income countries tend to have lower income elasticities of demand than do low income countries, though the trend in elasticities may not exhibit a strictly linear or monotonic decline as one moves upward in the income range. In Table 44, this phenomenon is seen by comparing income and paper consumption growth in the lower income developing countries (Korea, Taiwan, Indonesia) with those in the U.S. or Japan. As in the case of Korea noted above, relative paper consumption growth rates tend to be higher than relative GDP growth rates in all instances. We do not observe this relationship in the centrally planned PRC economy.

The data of Table 44 also illustrate a number of other key elements of the Pacific Rim market, some of which have been previously noted. First, as has been true of many developing economies over the past two decades, GDP growth rates (beginning from much lower bases) in the most important Asian developing economies tend to be far higher than those observed in developed market economies such as the U.S. or Japan. Second, we observe marked differences across countries in the relative rates of growth of paper and board consumption and production and in pulp production. In Korea, Indonesia, and Australia paper production has generally kept pace with or outdistanced consumption, implying stable or expanding self-sufficiency. In contrast, pulp production growth has lagged behind paper output in Japan and Taiwan, consistent with their growing dependence on imports. Australia, Indonesia, and in the most recent decade the PRC, however, have gradually increased their self-sufficiency in pulp production.

Table 44. Paper & paperboard/pulp consumption, production, and economic growth (average % growth per annum)

	1965-1974	1975-1985
Japan		
GDP	7.9	4.4
Total paper and board consumption	7.8	4.4
Paper and board production	7.5	4.0
Wood pulp production	6.6	0.6
Korea		
GDP	9.9	7.4
Total paper and board consumption	15.0	14.3
Paper and board production	17.4	14.3
Wood pulp production	14.4	12.3
PRC	(1970-81)	(1981-84)
GDP	3.7	6.3
Total paper and board consumption	7.3	2.9
Paper and board production	7.5	2.6
Wood pulp production	5.6	3.5
Taiwan		
GDP		7.5
Total paper and board consumption	14.2	10.9
Paper and board production	13.1	10.1
Wood pulp production	9.7	-4.4
Indonesia		
GDP	7.0	6.0
Total paper and board consumption	9.5	10.4
Paper and board production	10.5	28.6
Wood pulp production	*	66.7
Australia		
GDP	4.9	2.6
Total paper and board consumption	5.0	2.1
Paper and board production	4.6	3.2
Wood pulp production	6.0	4.2
USA		
GDP	2.8	3.4
Total paper and board consumption	2.7	3.5
Paper and board production	3.3	3.2
Wood pulp production	3.5	3.4
World		
GDP	4.4	2.7
Total paper and board consumption	3.0	4.0
Paper and board production	2.9	4.0
Wood pulp production	2.9	3.1

* Insignificant volume in 1965-74 period.
(PPI, 1986; FAO Yearbooks)

Projections of prospective growth in GDP form the fundamental basis for forecasts of future paper consumption.[4] GDP projections from both the FAO (1988) and IIASA (1987) studies are shown in Table 45. The FAO projections are based in part on internal United Nations estimates, forecasts derived from a model of the global macroeconomy, and from an array of individual country advisory groups. IIASA's projections are largely based on an extrapolation of trends in growth from the recent past. Despite these differences in methods, the projections in Table 45 are quite similar. For virtually all regions they suggest a modest slowing of growth relative to that observed in the 1975-1985 period but maintenance of relative regional/country differentials.

Table 45. Projections of real GDP growth by FAO and IIASA (% per annum).

FAO	1990-95	1995-2000
Japan	4.0	4.0
China (includes Taiwan)	5.6	5.6
Indonesia	4.5	4.5
Korea	6.5	6.5
Australia	3.0	3.0
United States	3.3	3.3
IIASA		
Japan	3.51	3.15
China (PRC only)	5.41	5.38
Southeast Asia	5.73	5.67
Australia-New Zealand	3.16	3.10
United States	2.44	2.35

(FAO, 1988; IIASA, 1987)

Paper and board consumption, production and net trade projections based on these GDP forecasts are shown in Table 46. The production projections are one of the primary drivers of estimates of future pulp demand. Since countries have the option of expanding paper imports, rather than increasing domestic production, the net trade figures are critical as well. A comparison of relative paper and board consumption growth rates are given in Table 47.

[4] Price, of course, is also critical, but we postpone consideration of this element until the end of this section.

Table 46. FAO (1988) and IIASA (1987) projections of paper and board consumption, production and net trade (1000 mt).

	1990	1995	2000
FAO			
Japan			
Consumption	22296	26089	30664
Production	22919	27598	33384
Net Trade *	623	1509	2720
China (includes Taiwan)			
Consumption	14387	19395	26153
Production	12755	16472	21388
Net Trade *	-1632	-2923	-4765
Korea			
Consumption	2945	4113	5752
Production	2811	3662	4804
Net Trade *	-134	-451	-948
Indonesia			
Consumption	791	1006	1280
Production	546	703	908
Net Trade *	-245	-303	-372
Australia			
Consumption	2398	2695	3045
Production	1756	2028	2351
Net Trade *	-642	-667	-694
IIASA			
Japan			
Consumption	24233	28017	31748
Production	24038	27920	31701
Net Trade *	-195	-97	-47
China			
Consumption	6159	7560	9006
Production	5624	6834	8256
Net Trade *	-535	-726	-750
Southeast Asia			
Consumption	3315	4731	6334
Production	1551	2101	2678
Net Trade *	-1764	-2630	-3656
Australia-New Zealand			
Consumption	3010	3497	3943
Production	3113	3742	4065
Net Trade *	103	245	122

* Net Trade = Production - Consumption = Exports - Imports

Projections of production, for paper and pulp, are based primarily on assumptions about future investment and capacity expansion in the pulp and paper sector. Near-term estimates (1990 and 1995) are aided by information from surveys of existing producers (or governmental agencies in some economies) regarding investment intentions and on-going projects. FAO projections depend on forecasts of net fixed capital expenditures derived from the same sources as its GDP projections.

Table 47. Projected growth rates in total paper and paperboard consumption from FAO and IIASA studies (annual % growth).

	1975-84	1984-90	1990-95	1995-2000
FAO				
USA	3.5	1.4	1.9	2.0
Australia	2.1	2.1	2.4	2.5
Japan	4.4	2.4	3.2	3.3
Indonesia	10.4	3.4	4.9	4.9
Korea	14.3	5.5	6.9	6.9
China	10.5	6.1	6.2	6.2
IIASA				
USA			2.1	1.6
Australia-New Zealand			3.0	2.4
Japan			2.9	2.5
Southeast Asia			7.4	6.0
China (PRC only)			4.2	3.6

(FAO, 1988; IIASA, 1987)

For all of the countries, paper consumption growth rates are lower over the decade of the 1990's than observed in the 1975-85 period, reflecting the forecast decline in GDP growth rates. The directly comparable IIASA and FAO forecasts for Japan differ significantly in outlook for net trade. Japan has been a net paper exporter to countries in Southeast Asia, and FAO projections suggest that this role will grow markedly in the future. The IIASA projection, in contrast, suggests that Japan will lose its net export position and become roughly self-sufficient in paper and board (small net imports). For China, the two projections are dramatically different. From data presented in earlier sections, total China (PRC + Taiwan) consumption in 1985 was estimated at roughly 11,750,000 mt (9,690,000 mt and 2,060,000 mt, respectively). Though the IIASA projections show continued consumption growth in the PRC over the 1990-2000 period (3.9% per year), the levels are sharply lower than recent observations. For combined China, FAO projects consumption growth at 6.2% per year over the decade of the 1990's with expanding net imports. IIASA projects expanding net imports in Southeast Asia in general, while the detailed FAO projections foresee continued growth in Korean imports and slower but still positive growth in Indonesian imports. Taken together, the forecasts suggest an expanding net import position for Asia as a whole, with Japan the primary exception.

Table 48. FAO and IIASA projections of wastepaper consumption (1000 mt).

	1975	1986	1990	2000
FAO				
Japan	5317	10667	12789	20771
China (includes Taiwan)	194	3553	3547	6260
Korea	404	1920	2010	3623
Indonesia	16	234	203	355
Australia	435	486	666	1033
USA	11009	15053	18029	27610
IIASA				
Japan			9508	12587
China (PRC only)			1313	2054
Southeast Asia			739	1136
Australia-New Zealand			991	1336
USA			18418	25063

(FAO, 1988; IIASA, 1987)

Conversion of the projected paper and board output levels to apparent pulp demands requires consideration of likely trends in the aggregate fiber mix employed in the several countries and regions. As previously noted there has been a strong trend toward the use of wastepaper throughout Asia over the past decade. Wastepaper and pulp consumption projections in Table 48 suggest that this trend is likely to continue. In the FAO projections (the IIASA model does not provide an estimate of total pulp consumption), wastepaper rises as a fraction of total fiber consumption (the sum of the wastepaper and pulp projections in Tables 48 and 49) in all countries except Indonesia. There it falls slightly due to the projected rapid expansion in domestic pulp output (see later discussion). Of the Asian countries, Korea has the highest present wastepaper use rate at 66% of total fiber input, and this is projected to rise slowly to 69% by 2000[5]. Growth in Japan's wastepaper inclusion rate is also projected to continue, reaching 54% by 2000. It is interesting to note that China, with large projected increases in fiber consumption, realizes almost no increase in its inclusion rate. The aggregate level by 2030, 32%, is only slightly higher than that in the U.S.. This reflects in part the difficulties and costs of concentration given a highly dispersed population.

[5] Calculated by dividing projected wastepaper consumption (Table 48) by the sum of projected wastepaper consumption plus projected total pulp consumption (Table 49).

Table 49. FAO projections of pulp consumption, production and net trade (1,000 mt).

	1975	1986	1990	2000
Japan				
consumption	9059	11314	12599	18021
wood pulp production	8333	9061	10009	13010
other pulp production	21	22	30	42
net trade	-705	-2231	-2560	-4969
China (includes Taiwan)				
consumption	3399	8086	8656	13517
wood pulp production	873	1658	1673	2131
other pulp production	2340	5685	5965	9215
net trade	-186	-743	-1018	-2171
Korea				
consumption	289	1006	1031	1632
wood pulp production	91	287	318	505
other pulp production	6	11	20	33
net trade	-192	-708	-693	-1094
Indonesia				
consumption	55	402	462	736
wood pulp production	1	137	127	232
other pulp production	45	123	126	187
net trade	-9	-142	-209	-317
Australia				
consumption	863	1147	1173	1473
wood pulp production	571	910	942	1219
other pulp production	1	14	11	15
net trade	-291	-223	-220	-239

(FAO, 1988)

FAO's pulp production projections (see earlier discussion regarding their construction) are also shown in Table 49 together with apparent net pulp trade.[6] Two types of pulp production are shown: wood based pulps and pulp produced from non-wood fibers such as straw and bagasse. Net pulp imports are projected to expand in varying degrees in all countries, with the exception of Australia, despite substantial increases in domestic production and, as noted above, major increments in the use of wastepaper.

[6] The IIASA model does not provide estimates of total pulp output.

Reflecting its highly limited resource position, Japan showed domestic output increasing by only 30% between 1990 and 2000 while imports nearly doubled. Korean domestic output and imports both increase by roughly 60% over this period. In both countries, a portion of the expansion in domestic output is likely to be based on increased domestic fiber supplies from plantation forests. A much larger fraction, however, will be based on imported chips and pulp logs. A recent Japan Paper Association projection, for example, suggests that pulpwood imports will have to double by the mid-1990's to meet pulp output projections of the magnitude shown in Table 49.

A scenario of expanding Japanese pulp imports also seems reasonable in light of the high costs of domestic production. Kato (1981), for example, compared total delivered wood costs for pulp producers in Japan, the Pacific Northwest, and British Columbia. While acknowledging the difficulty in the comparison, he shows delivered costs (including stumpage, labor, transportation and miscellaneous costs) to average 33.5 thousand yen per cubic meter in Japan versus 4.7 - 14.8/m^3 in the Pacific Northwest and 7.9 - 9.0/m^3 in coastal B.C. In addition to wood, energy, labor and chemicals are also more costly in Japan. As the following tabulation indicates, the result is total production costs far higher than in most other producing regions:

Bleached hardwood kraft production
costs, $ US / metric ton, circa 1982

Brazil	$327
Portugal	329
U.S. South	343
Finland	385
Japan	521

(Pulp and Paper, Aug. 1985).

FAO projections for China show a somewhat different picture. Though pulp imports double by 2000, the largest share of pulp demand is met by major increases in domestic production of non-wood pulps. In recent years non-wood pulps have accounted for roughly 70% of total pulp consumption, and the FAO forecast sees only a modest decline in this fraction by 2000. Assuming a continuation of economic policies designed to limit imports, and given China's extremely limited forest base, reliance on non-wood fibers would appear to be a sound strategy. Presuming such an approach is physically feasible, the necessary increment in domestic wood-based pulp output would be less than 30% by 2000.

As noted in earlier discussion, Australia has been steadily moving toward self-sufficiency in pulp output over the past decade. Indonesia has had similar objectives, although capital limitations have largely precluded their realization. FAO projections suggest that Australia's net import position will remain roughly stable over the next decade (much of this volume presently comes form New Zealand). Investment problems will continue to plague Indonesia, and net imports will continue to rise, though at a somewhat slower rate than in the recent past.

In sum, the FAO projections suggest a market for pulp imports in the five key countries of Japan, China, Korea, Indonesia, and Australia of roughly 4.1 million metric tons by the year

2000. This would represent more than a doubling of imports relative to current levels and an annual growth rate in excess of 7% per year. Projections from the IIASA (1987) model give explicit detail only for the bleached pulps, but they show a very similar picture. For combined Japan, China, and Southeast Asia, the IIASA projections show a net import market for bleached pulps of nearly 6.6 million metric tons by 2030. This would also represent a doubling from the projected level for 1990.

3.3.2. Supply and Prospective Trade Patterns

Major participants in global pulp trade have been discussed in a previous section. Here we summarize some of the major near-term trends likely to influence that trade and examine projections of pulp production and pulp trade from the world's net exporting regions.

The traditional dominance of the Norscan countries in long fiber pulp trade faces a significant challenge in the future from southern hemisphere producers utilizing plantation grown radiata pine. Table 50 gives one estimate of potential additions to these plantations by 1995. In addition to rapid fiber growth and low wood costs, the competitive position of many of these producers is enhanced by low labor, energy and chemical costs as well.

Table 50. Radiata Pine Plantations in the World (1,000 hectares)

	1983	1995 (est)
Chile	967	1,600
New Zealand	857	1,400
Australia	546	1,000
South Africa	60	150
Spain	250	400
Total	2,680	4,550

(Pacific Rim Log Market Report, May 1986)

At the same time, the advent of short fiber eucalyptus pulps, and their general acceptance by paper producers world wide, poses a major competitive threat to long fiber softwood pulp trade. Extensive plantation opportunities remain in Brazil, Chile, South Africa, Spain, Portugal, and Australia, and many of these options will likely be exercised in the near future. Long fiber exports may also be reduced by the worldwide trend to integrate paper mills with pulping facilities. One contributing factor is the increasing use of TMP and CTMP, which are well suited for integrated operations (Pulp and Paper Journal, Jan, 1988).

Given the long lead time required to plan and construct a pulping facility, surveys of producer intentions regarding capacity additions provide a useful tool in projecting near-term capacity shifts. The results of one such survey, by Pulp and Paper International (1988) are tabulated below.

Table 51. Estimated World Pulp Capacity Additions 1988-1991 (1,000 mt/yr).

Region	Bleach Kraft	Unbl. Kraft	CTMP/ TMP/CMP	Other	Total
Firm Projects					
Africa	0	0	0	0	0
Asia	45	175	140	416	776
Australasia	80	0	0	0	80
Europe	455	13	865	350	1,683
North America	720	100	825	329	1,974
Latin America	1,165	57	104	20	1,346
Total	2,465	345	1,934	1,115	5,859
Advanced Planning Stage					
Africa	410	0	0	50	460
Asia	270	0	0	19	289
Australasia	0	0	0	150	150
Europe	305	60	130	450	945
North America	340	0	670	0	1,010
Latin America	470	130	0	30	630
Total	1,795	190	800	699	3,484

(Pulp and Paper International, Jan 1988)

Total capacity increments in Asia and Australasia are quite limited, while the largest "firm project" additions in North America and Europe are in the newer, high yield mechanical pulps. Latin American investment is dominated by kraft mills, consistent with earlier discussion of the prospective outlook for producers in Brazil and Chile. If all of the projects in the table were completed, global capacity would expand by some 9.3 million mt, more than half of which would come in kraft grades.

Combining the consumption and production projections from the FAO (1988) analysis, we obtain forecasts of regional net pulp trade over the period to 2000 as shown in Table 52. Despite substantial increments in pulp output in Spain, Portugal, other parts of western Europe and the USSR, import dependence of the combined European/USSR group expands sharply. The U.S. moves from a net import to a net export position. Exports from Brazil and Chile expand dramatically as do the import requirements of the Asian regions.

Table 52. FAO projections of net wood pulp trade position of major consumers/producers (1000 mt).

Region	1986	1995	2000	Incremental Import Demand	Incremental Export Supply
West/East Europe/USSR	-3329	-4726	-6180	-2851	
USA	- 507	+1474	+3740	507	3740
Canada	+7186	+7627	+8101		915
Brazil	+ 843	+2164	+3155		2312
Chile	+ 565	+ 788	+ 969		404
New Zealand	+ 489	+ 543	+ 619		130
Australia	- 223	- 227	- 239	- 16	
South Africa	+ 55	- 9	+ 3	-52	
China (+Taiwan)	- 743	-1505	-2171	-1428	
Japan	-2230	-3601	-4969	-2734	
Korea	- 709	- 868	-1095	-386	
Indonesia	- 142	- 256	- 317	-175	
Rest of Asia	- 168	- 289	- 329	-161	
Rest of World	-1087	-1115	-1287	-200	
Global Total	0	0	0	-7449	7449

(FAO, 1988)

For the bleached pulps only (which constitute more the 75% of global pulp trade) the IIASA net trade projections in Table 53 differ in some key respects from the FAO estimates. The Europe/USSR group imports substantial volumes until 1990, but domestic production expands more rapidly than in the FAO projections making this region a net exporter by 2000. This is due primarily to more optimistic assumptions regarding USSR output in the IIASA forecasts. A further difference is the movement of the U.S. from a net white pulp exporter to a net importer by 2000. In the IIASA projections, capacity and production in the eastern U.S. expand but remain roughly stable in the west. Consumption quickly overtakes total U.S. output leading to the initiation of imports.

Table 53. IIASA projections of net trade position in white pulp (1000 mt).

Region	1990	2000	Incremental Import Demand	Incremental Export Supply
West/East Europe/USSR	-5224	-4532	692	
USA	949	-316	-1265	
Canada	7521	8479		958
Brazil	1301	3911		2610
Chile	404	1133		729
New Zealand-Australia	-152	355		507
China (PRC only)	-319	-588	-269	
Japan	-2849	-5572	-2723	
Southeast Asia	-196	-419	-223	
Rest of World	-1434	-2452	-1018	
Global Total	1	-1	-4806	4804

(IIASA, 1987)

For the remaining world regions, the IIASA and FAO projections present a very similar picture. Canadian, Brazilian, Chilean and Australia-New Zealand net exports all expand (the IIASA forecast is somewhat more optimistic about growth in the latter two regions), while net imports in Asia and particularly Japan rise to nearly twice their current levels.

But while the net trade projections are useful in characterizing potential future supply sources and destinations, the key concern for a potential new producer is the actual development of bilateral flows. In the forecasts, which regions are likely to be trading partners? Unfortunately, the FAO projection methodology does not incorporate such an analysis. The IIASA forecasts do provide this information but for bleached pulps only. It should be noted that the IIASA model employs a competitive spatial equilibrium structure to determine production and consumption volumes, prices and bilateral trade flows. In practical terms this means that relative production costs across potential supplying regions play a key role in establishing the projected flow pattern. The lower cost producers, with exportable volumes, will capture the largest shares of any potential import market.

Results of the IIASA projections for the key Asian regions are shown in Table 54. With the exception of the mix of flows between Canada and the U.S., the general patterns of these projections repeat the historical trends observed in Tables 42 and 43. In Japan and the PRC, Brazil and North America enjoy an expanding share of the market with Brazil providing non-coniferous and North America coniferous grades. Chile maintains a small presence while the flow from Scandinavia continues its historical decline. In other Southeast Asian markets (which would include Korea and the ASEAN countries), North American producers realize the bulk of the market expansion, again with flows from Scandinavian sources declining.

With regard to the Canadian/US composition of these flows, the projections represent a marked shift from recent historical patterns (where the U.S. has gained rather than lost market share). The IIASA analysis foresees world paper demand rising and sawnwood demand steady, leaving Canada with a glut of saw logs that can not be profitably converted to lumber for sale to U.S. markets. Therefore, the model projects that Canadian sawlogs will be downgraded to pulp logs, driving down Canadian wood costs. Given the relative economics of pulp versus chip export in the model, the forecast is for increased exports of pulp from Western Canada displacing U.S. producers whose increased production will go to domestic consumption.

Table 54. Projected bleached pulp trade flows to Asia based on the IIASA analysis (1000 mt).

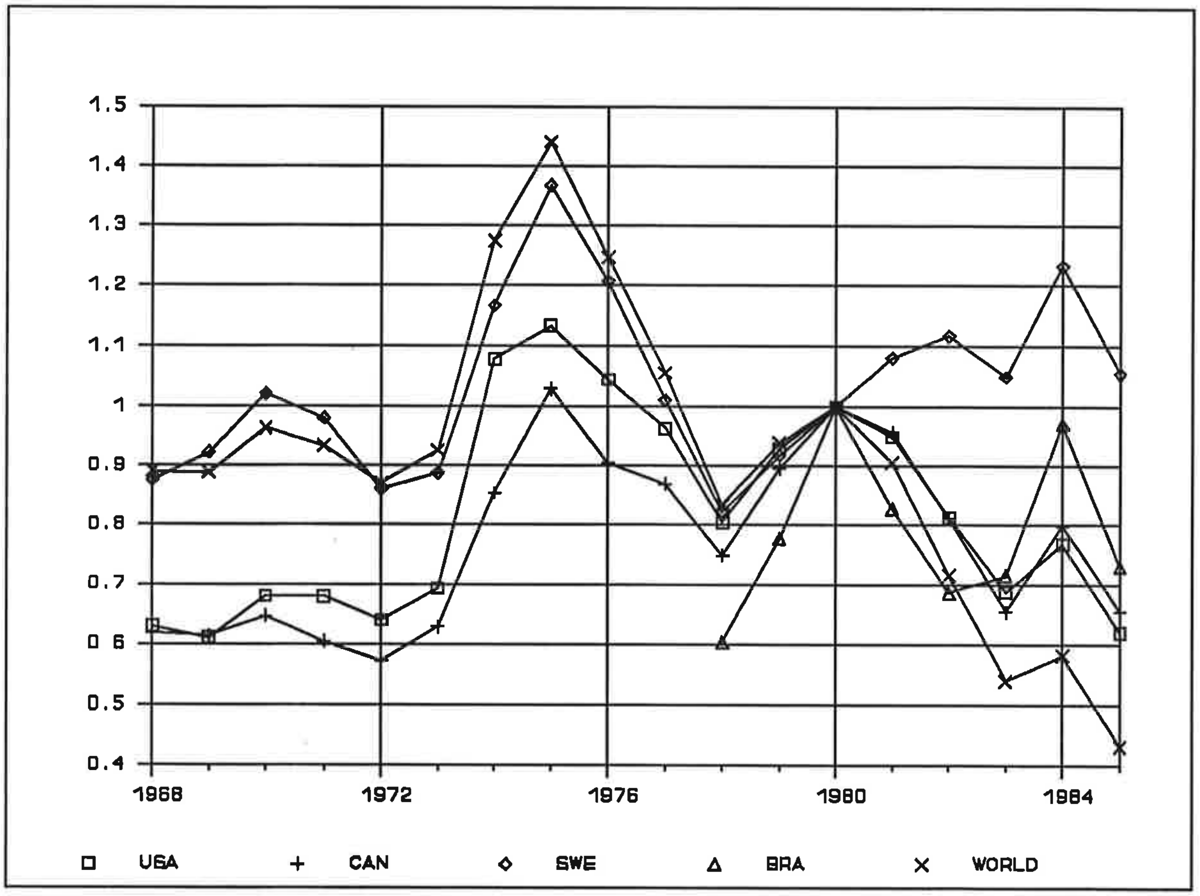
	1980	1995	2000
To Japan			
Canada	770	2210	2960
USA	440	110	50
Chile	0	20	10
Brazil	200	510	1030
Sweden/Finland	80	20	5
Total	1490	2870	4055
To China			
Canada	140	170	220
USA	110	30	15
Chile	10	0	0
Brazil	0	100	210
Sweden/Finland	60	10	5
New Zealand	0	5	60
Total	320	315	510
To Southeast Asia			
Canada	30	150	270
USA	50	10	5
Brazil	0	10	10
Sweden/Finland	50	10	5
Total	130	180	290

(IIASA, 1987)

While the foregoing projections of consumption, production and trade do have some important differences, the general pattern of future markets that emerges is reasonably consistent. First, the Asian region will continue to generate large and growing demands for pulp imports. Even in the IIASA projections, which include explicit consideration of future development of domestic forest resources, Japan's growing forest base does not significantly reduce its potential dependence on fiber imports. Second, trends in the mix of suppliers in the Asian market are likely to accelerate along the lines observed in the recent past. Scandinavian producers, faced with growing demands in Europe, will gradually lose market share in Asia. North America may realize some expansion in its exports to Asia, but the relative roles of the

U.S. and Canada are not clear owing to uncertainties in future wood supplies and wood cost increases. The low cost suppliers, and the primary source of competition for any new entrants

Figure 9. Index of real unit bleached sulphate export prices. (1980 = 1.0)



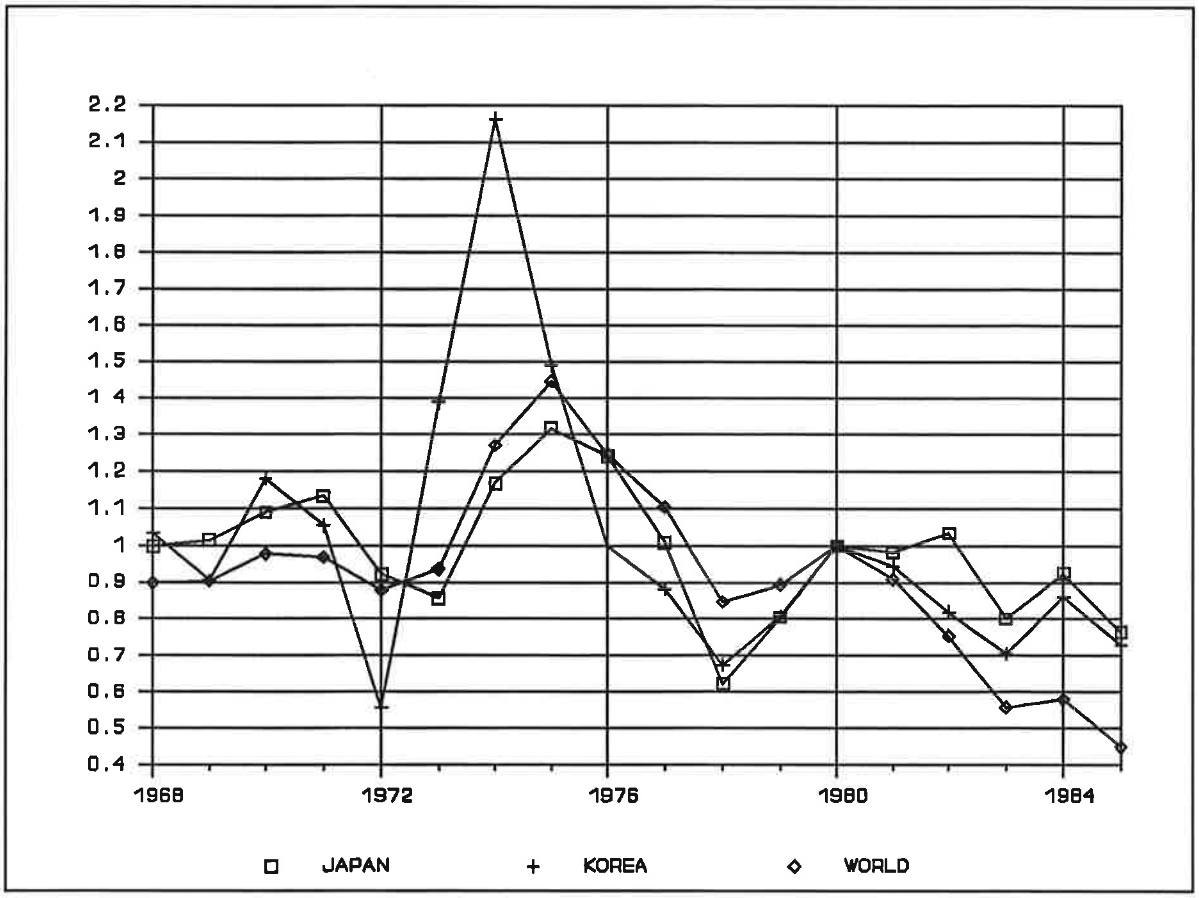
in the Asian pulp market, will be Southern hemisphere producers of both short and long fiber pulps, primarily Brazil and Chile.

3.3.3. Market Pulp Prices

In the short term, prices of market pulp have been traditionally characterized by considerable volatility. Price cycles depend on movements in consumption relative to producers' inventories and utilization of existing pulping capacity. Figures 9 and 10 show indexes of real import and export prices for bleached kraft pulp in major importing and exporting countries and global averages. Peaks in the price cycles in 1970, 1975, 1980, and 1984 correspond to periods of high pulp capacity utilization worldwide and relatively low producer inventories. During the intervening troughs, capacity utilization drops and inventories accumulate. So long as growth in demand, as driven by movements in GDP, and additions to capacity are "out of phase" in a temporal sense, price peaks and troughs will not correspond exactly to boom and recession periods in the global economy. This is evident in the 1975 price peak and the 1978 trough occurring while world economies were experiencing a recession and boom, respectively.

For many years the pricing system for market pulp has involved a price leadership arrangement based on the Norscan countries. A "list price" is established from which some concessions might be given due to the actual market situation and for different pulp grades (Aurell et al, 1985). As a result, accusations of price fixing are endemic to the pulp and paper

Figure 10. Index of real unit bleached sulphate import prices. (1980=1.0)



industry in both the U.S. and Europe (Arpan et al, 1986). In more recent years with the advent of major volumes of southern hemisphere production and new entrants in Europe (Spain and Portugal), the traditional pricing system has begun to break down. Brazilian producers initially priced their eucalyptus pulps well below list as a means of gaining market access for a new and unfamiliar pulp grade. Having gained acceptance, bleached eucalyptus has at some points in the recent past actually sold at a premium relative to long fiber grades. Other producers have taken similar pricing liberties, and it is now suggested that a considerable part of the total market pulp from areas outside Norscan moves at price levels below the list price (Jaakko Poyry, 1987a).

Table 55. Japanese imports of dissolving pulp (CIF delivered prices from all sources)

		mt	YEN/mt	REAL YEN/mt	\$/mt
1988	Apr	27,294	85,912	83,459	683.79
1987	Tot	255,831	85,938	83,629	586.54
1986	Tot	281,822	91,097	88,727	533.95
1985	Tot	262,196	130,012	127,403	539.04
1984	Tot	270,444	130,829	130,829	553.28

(Wood-Products Stockpile Corp.)

Tables 55 and 56 show the most recent movements in market pulp prices in Japan and Europe. Prices denominated in U.S. dollars have recovered sharply from the 1985 trough. In local currencies such as the yen, however, which have experienced considerable appreciation relative to the dollar, prices continue at near trough levels in both real and nominal terms. As in earlier periods, the present price jump results from very rapid demand expansion, particularly in Japan as a result of the high valued yen and in other parts of Asia, coupled with relatively limited capacity expansion over the past few years.

Table 56. Japanese imports of paper-making pulp (CIF delivered prices from all sources).

		mt	YEN/mt	REAL YEN/mt	\$/mt
1988	Apr	227,834	76,419	74,237	608.24
1988	Jan	274,151	69,460	67,653	551.23
1987	Tot	2,454,445	75,425	73,399	516.88
1986	Tot	2,266,867	66,757	65,020	396.53
1985	Tot	1,990,334	90,539	88,722	376.20
1984	Tot	1,878,118	104,834	104,834	442.03

(Wood-Products Stockpile Corp.)

Despite their strong cyclical movements, the data of Figures 9 and 10 reveal no significant long-term trends in bleached sulphate pulp prices. This same result is observed in most other pulp grades and in most categories of paper and paperboard at the global level (see, for example, FAO 1985b). Similar findings have also been obtained in analyses of individual country data. For example, in the U.S., little trend is observed in real fiber products and pulp prices over the period since the 1930's. Though the costs of many inputs to pulp and paper production processes have grown over the past decades, technical improvements and the substitution of new, lower cost inputs have acted to keep the real cost trend per unit of output essentially flat.

Table 57. Recent nominal price movements in bleached kraft pulp (US$ delivered to Europe)

1985 IV	390
1986 I	410
II	450
III	480
IV	525
1987 I	550
II	580
III	615
IV	640
1988 I	680
II	725
III	760

(Hay-Roe, August 1988)

Recognizing this feature of the fiber products industry, and presuming that technical change will continue to keep pace with factor cost shifts in the future, FAO (1988) has based its demand and production forecasts on the assumption of constant real prices over the period to 2000. Since the projection procedures used by FAO do not employ a spatial model (and hence do not consider transport costs or the relationship between prices at production and delivery points), only volumes are projected using price as an exogenous input. In their projection studies FAO has found, however, that forecasts based on the constant real price assumption yield consumption and output volumes which are quite close at the global level. This approximate "supply-demand balance" suggests that even if price were endogenous to the FAO analysis essentially the same volume results would obtain and hence that a constant real price may reasonably represent future developments.

Table 58. IIASA coniferous bleached pulp price projections (1980 real dollar basis).

	1980	1985	1990	1995	2000
Western U.S.	435	377	470	472	500
Western Canada	420	349	442	444	473
Brazil	420	396	535	526	544
Chile	420	386	478	469	486
Australia-New Zealand	450	417	509	444	461
Japan	510	428	506	507	536
Southeast Asia	450	419	513	513	540
China (PRC)	450	412	505	507	524
World Average	453	400	490	497	518

(IIASA, 1987)

In contrast the IIASA analysis employs a full spatial equilibrium framework with volumes, trade flows and prices endogenous. Prices may vary over time in response to explicit assumptions about technology and the costs of various inputs. In the IIASA "base case", from which we have drawn all of our results to this point, technical change is depicted by three alternate pulp production technologies corresponding to "old", "current", and "modern" mills. Over time, "technical change" involves a shifting in the mix of utilization of these technologies, presumably shifting toward the modern technology, as dictated by profitability. These technologies differ only in their wood using efficiency, however, and not in the use of other inputs such as labor, energy, or chemicals. As a consequence, the full impact of technical improvement in the industry may be somewhat understated. Projections for bleached pulps from the IIASA base case are shown in Tables 58 and 59. For coniferous bleached pulps, global real prices rise at something less than .7% per year over the 1980 to 2000 period. For non-coniferous bleached pulps the global price declines in real terms. This differential in price movements is primarily a reflection of rapidly rising softwood fiber costs in the IIASA projection. As a result of increases in coniferous pulp prices, there is a marked shift toward use of non-coniferous pulps in global paper and board manufacture. Weighting coniferous and non-coniferous prices by their shares in global bleached pulp exports, as projected in the IIASA model, yields average prices of $440/mt in 1980, $456/mt in 1990, and $455/mt in 2000. These weighted figures correspond more closely to the aggregate price data used in the FAO projections and depict much the same general future. Over the two decades from 1980 to 2000 real bleached pulp prices rise at less than .2% per year and during the decade of the 1990's are essentially constant.

Table 59. IIASA non-coniferous bleached pulp price projections (1980 real dollar basis).

	1980	1985	1990	1995	2000
Western U.S.	390	376	417	413	416
Western Canada	380	348	389	385	389
Brazil	380	319	369	348	363
Chile	380	316	380	369	420
Australia-New Zealand	410	431	314	353	344
Japan	470	416	466	448	450
Southeast Asia	410	354	445	424	400
China (PRC)	410	397	448	427	439
World Average	414	346	396	380	382

(IIASA, 1987)

3.3.4. Projection Summary

From the projection results examined above, we can now develop a broad scenario of potential future pulp market conditions in response to the two key concerns raised at the start of this section.

> Is there potential for continued pulp demand growth in the Pacific Rim?

The preceding analysis suggests an unequivocally positive response. Given constraints on domestic fiber supplies, environmental and cost considerations in domestic pulp production, and continued strong growth in domestic paper and board consumption, Asian pulp import demands will likely continue to grow along recent historical trends. Japan will be the source of the largest part of this growth, which both the FAO and IIASA projections suggest for Asia as a whole could be as much as a doubling of pulp imports by 2000.

> Which regions are likely to be the principal competitors with any expanded pulp export capacity in Alaska?

A new Alaskan mill will produce long fiber pulp in direct competition with existing major producers in British Columbia and the U.S. Pacific Northwest. Current trends in capacity expansion and the projections of both FAO and IIASA indicate that these regions will continue to figure prominently in Pacific Rim and specifically Asian pulp markets. If the IIASA projections are correct, however, rising wood costs could push the U.S. Pacific Coast into the role of marginal producer with the bulk of export growth going to British Columbia. It is also clear that Chile and to a lesser extent New Zealand are likely to capture growing shares of this trade. At the same time Brazil will be mounting a major effort to substitute its short fiber pulps for traditional coniferous grades. Both the IIASA and FAO projections suggest that it will meet with some success in this venture. Cost competition will be keen in this market particularly in light of the prospect of constant or only limited growth in real pulp prices.

Given the substantial cost advantages of South American producers, a minimum condition for a successful Alaskan expansion would be the ability to deliver its product in Asian markets at costs at least as low as those in the PNW and British Columbia. In the next section, we examine Alaska's costs as a market pulp producer with specific regard to its position vis a vis these two prime competitors.

4. Model of comparative costs for Alaska and competing producers

The pulp and paper industry is one of the most cost-sensitive of manufacturing industries, with very low profit margins. This is clearly reflected in the dramatic geographical dispersion of the industry since World War II as producers have sought new locations with lower wood, energy, labor and other costs. This section presents an analysis of the costs of market pulp production and attempts to establish the degree to which Alaska may have a relative cost advantage or disadvantage vis à vis its two closest competitors, the U.S. Pacific Northwest and Coastal British Columbia. As noted in previous sections, while bleached kraft is the dominant commodity produces and traded in world markets, the newer thermomechanical pulps offer significant alternatives for producers in terms of the characteristics of pulps produced and their requirements for various inputs. Consequently, we examine the prospective Alaskan costs of producing both the traditional bleached kraft and thermomechanical pulp.

Analysis in this section proceeds as follows:

(1) We begin with a comparative evaluation of production costs across major world producing regions. As a result of competitive and regulatory concerns, pulp production costs are difficult to obtain on a regional basis. We have relied, Therefore, on a variety of independent (though unfortunately not fully consistent) studies, all of which deal with bleached kraft. The intent here is to provide some perspective on relative global cost conditions and to establish the position of what are taken to be Alaska's two prime competitors, the Pacific Northwest and Coastal British Columbia, in this context.

(2) Specific cost estimates are then developed for Alaska and its comparators by examining the input requirements for particular factors and their unit input costs (either historical experience or estimates). At this stage we differentiate between the bleached kraft and thermomechanical options on the basis of factor consumption per ton of pulp output. Attention is also given to the costs of mill establishment, environmental protection, and the impacts of variation in exchange rate. In this process we have assumed that investors are considering the relative merits of a 350,000 mt/yr bleached softwood kraft mill and a 120,000 mt/year thermomechanical mill. It is important to note that our input cost estimates are regional averages and could differ considerably due to specific site locations, negotiated prices for wood, labor, transportation, and energy, existing infrastructure and actual mill size.

(3) A final section summarizes the results.

4.1. Estimates of Bleached Kraft Production Costs by Country/Region

Tables 60-65 summarize estimates of bleached kraft production costs (or cost shares) from some recent studies. In tables 60-64, all costs are converted to U.S. dollars and adjusted to reflect conditions in the year 1985. Table 65 shows the shares of total variable production costs as of 1976 as estimated in a study by the Province of British Columbia (1980).

Table 60. Market bleached kraft pulp manufacturing costs, circa 1985 (US$/mt).

	PNW	BC COAST	US SOUTH	BC INTER	EAST CANADA	CHILE
VARIABLE COSTS						
Wood	129	105	113	100	152	73
Energy	35	30	25	26	21	22
Chemicals	32	34	35	37	39	52
Labor	48	60	45	44	45	23
Other Materials	39	43	41	38	32	40
Subtotals	283	272	259	245	289	210
FIXED COSTS						
Overhead	46	37	34	37	39	30
Depreciation	34	24	33	23	26	36
Interest	29	29	28	29	32	36
Subtotals	109	90	95	89	97	102
Totals	392	362	354	334	386	312

(RISI, 1987)

Table 61. Bleached softwood kraft pulp manufacturing costs, circa 1985 (US$/mt).

	PNW	BC COAST	US SOUTH	NEW ZEALAND	BRAZIL	CHILE
VARIABLE COSTS						
Wood	133	131	137	101	70	61
Energy	60	49	45	40	23	26
Chemicals	37	39	41	44	46	54
Labor	49	55	46	41	26	23
Other Materials	42	43	44	41	32	24
Subtotals	321	317	313	267	197	188
FIXED COSTS						
Overhead	52	37	37	25	17	16
Depreciation	29	24	28	22	64	63
Interest	42	43	40	33	46	46
Subtotals	123	104	105	80	127	125
FREIGHT						
To Japan	40	40	60	45	55	45
Totals	484	461	478	392	379	358

(Ewing and Chalk, 1987, from RISI data and independent sources)

Table 62. North American regional kraft pulp costs and Alaskan dissolving pulp costs, circa 1985 (US$/mt).

	BC LOW[1]	BC HIGH[1]	PNW LOW[1]	PNW HIGH[1]	US SOUTH[2]	WEST CANADA[2]	ALASKA[3]
VARIABLE COSTS							
Wood	182	223	136	151	120	109	177
Energy	38	42	53	61	45	36	43
Chemicals	38	63	49	59	50	41	52
Labor	63	107	42	62	60	49	95
Other Mat.	36	57	42	57	60	42	65
Totals	252	345	241	293	335	277	432

[1] (Sandwell, 1977) Figures converted from st to mt and compounded from 1975 to 1985 at relevant annual inflation rate (see Appendix A.6.)
[2] (Pulp and Paper, 1985)
[3] Figures from Dean Argyle USFS, Juneau, based on 1985 Region 10 dissolving pulp production cost of $416.39/MBF, converted to chip tons @ 2.8 t/MBF, converted to pulp yield @ 38% chip to pulp recovery ($391.34), converted to metric tons @ 1.10231 mt/st, then divided by the following percentages; chips 41%, chemicals 12%, labor 22%, fuel 10%, and misc. 15%.

Table 63. Production cost for softwood kraft market pulp, circa 1985 (US$/mt).

	SWEDEN MODERN	SWEDEN MODERNIZED	OLD	US SOUTH	BC INTERIOR	BC COAST
Wood	177	177	177	144	123	137-152
Chemicals	33	39	44	56	51	45-56
Energy	36	28	33	54	39	44-57
Personnel	28	56	72	48	51	62-90
Supplies	26	56	72	49	43	49-56
Totals	300	356	398	351	307	337-411

(Nilsson, 1985a)

Table 64. Production cost for bleached kraft paper-grade market pulp, circa 1985 (US$/mt).

	SOFTWOOD			HARDWOOD	
	WEST CANADA	SWEDEN	US SOUTH	BRAZIL	US SOUTH
DIRECT COSTS					
Fiber	164	252	138	71	120
Chemical	44	---	54	43	38
Wages/salaries	65	101[1]	69	35	69
Energy	45	---	49	30	61
Other direct	44	101	56	--	55
Subtotals	362	454	366	179	343
CAPITAL COSTS					
Interest	29	---	24	--	24
Depreciation	19	---	21	--	21
Other interest	14	---	20	--	20
Subtotals	62	120[2]	65	211[2]	65
Totals	424	574	431	390	408

[1] The sum of the chemical, wages and salaries, and energy direct costs.
[2] The sum of the interest, depreciation, and other interest capital costs.

(Arpan et al, 1986)

Table 65. Bleached kraft pulp mills relative costs, circa 1976 (% of total costs excluding delivery).

	SWEDEN	BC INTERIOR	BC COAST	PNW	US SOUTH
Wood	61	36	41	32	38
Labor	15	15	17	12	13
Energy	4	7	8	13	8
Other	20	42	34	43	41

(Province of British Columbia, 1980)

To simplify the cost comparison, Table 66 converts the estimates in Tables 60-64 to indices using the U.S. South as a base (100). In all categories except chemicals, the estimates indicate that Brazil (bleached eucalyptus kraft) is the global low cost producer. Brazil's advantage appears to be particularly large in wood and labor. Chile has similar advantages in wood and labor, while its costs of energy, supplies and chemicals are roughly comparable with northern hemisphere producers. In most categories, the U.S. Pacific Northwest and Coastal British Columbia rank above Brazil and Chile and at or below costs in Sweden. Differences between the PNW and BC Coast are modest and a recent projection by RISI (1987) suggests that the aggregate costs of these regions may be comparable over the next five years.

Table 66. Relative production cost comparisons by country and region.

	US SOUTH	SWEDEN	CHILE	BC INT	BC COAST	BC AVE.	PNW	E CANADA	BRAZIL
Wood									
RISI	100		65	88	93		114	135	
Nilsson	100	138		85	95-106				
Arpan	100	183				119			59
P & P	100					91			
J Poyry	100	162	41					78	56
Chemicals									
RISI	100		149	106	97		91	111	
Nilsson	100	78-88		90	90-112				
Arpan	100					82			113
P & P	100					82			
Energy									
RISI	100		88	104	120		140	84	
Nilsson	100	58-69		73	81-106				
Arpan	100					93			49
P & P	100					80			
Labor									
RISI	100		51	98	133		107	100	
Nilsson	100	130-167		105	128-186				
Arpan	100					95			50
P & P	100					82			
Supplies									
RISI	100		98	93	105		95	78	
Nilsson	100	130-167		88	100-116				
Arpan	100					94			
P & P	100					70			
Mill Construction									
RISI	100				100		104		

The following sections examine each of the cost elements in Table 66 in detail, deriving separate estimates for Alaska, the PNW and Coastal BC for bleached kraft and thermomechanical pulps.

4.2. Wood Supply

4.2.1. General

There are inherent difficulties in making comparisons between regions and countries in regard to the price paid for wood. These problems include: the differences in logging and transportation costs, the type of wood used, the investment costs for plantation forestry, and the extent of government subsidies involved. For example, Alaskan timber typically involves expensive road building costs and transportation charges for delivery to the mill. Chile's radiata pine plantations, in contrast, have low extraction costs but do incur intensive plantation management costs absent in Alaska. The main source of fiber for pulp mills in the Pacific Northwest is mill residues. Market prices for these residues presumably reflect the costs of logging, debarking and chipping borne by the primary product (lumber or plywood) manufacturer.

Southeast Alaskan pulp production is geared to western hemlock, which makes up an average of 70-94% of the fiber mix. The proportion of hemlock to spruce depends on the mix of species, log grades received at the mill and the export demand for cants. In general, as cant and waney export markets improve, a lower proportion of spruce is pulped. Operating costs increase with greater proportions of spruce because of greater chemical requirements (USFS-AK, 1984). Most utility logs and virtually all cull logs on the Tongass National Forest are removed from the woods and processed into pulp. In general, a portion of all grades are sawn into lumber with the remaining portion processed into pulp (USFS-AK, 1986). It is important, therefore, to keep this in mind when comparing Alaskan stumpage costs to other regions -- that higher grade material is going into pulp. The following table shows the percent composition of log input by grade (for 1975) going into cants and pulp for Sitka spruce.

Grade	Pulp	Cant
Select	1.3	6.4
No. 1	7.8	14.2
No. 2	51.1	70.3
No. 3	39.8	9.1
	100.0	100.0

(Darr et al, 1977)

4.2.2. Forest Service

From 1972 to 1978, stumpage prices on National Forests were higher in the Pacific Northwest than Alaska. Sitka spruce was about twice as high, $100 per MBF in the PNW compared to $50 in Alaska. Hemlock was three to four times greater, about $100 and $25-30, respectively (Alaska Timber Task Force, 1985). These differentials have dropped, reflecting the general decline in stumpage prices since the late 1970's. Ulrich (1987) gives the most recent average Sitka spruce pulp grade price as $18.78/MBF and $5.73 for western hemlock in Alaska.

Lower stumpage rates in Alaska are related in part to higher operating costs. Gruenfeld (1983) estimates that Alaska logging costs are up to 50% higher than in the State of Washington. In 1977, Darr **et al** estimated that the costs of logging in SE Alaska were roughly comparable to Coastal BC but 50 to 60% higher than the Pacific Northwest. Logging is done through logging camps. Timber sales must be large enough to amortize the fixed costs of the camp as well as the operating costs of the logging show. Typically, two to three years are spent establishing a camp before road building and logging begins.

Current low stumpage on pulp wood also reflects the fact that on long-term sales the appraisal includes the costs of operating the pulp plants themselves, the capital investments in the pulp plants, and required environmental protection improvements (Sandor, 1982). The most recent ten-year average redetermined stumpage rate for the two long-term sales in Alaska was $44.78/MBF while the independent sale rate average over the same period was $63.83/MBF (USFS memo, Feb. 11, 1988), reflecting the difference in appraisal methods.

The development of transportation systems and timber transfer sites are major costs associated with harvesting Alaska's old-growth forests. The greatest unit costs are associated with harvesting and yarding systems. Unit logging and recovery costs have increased steadily over the past decade, while the recovery of harvest volume per mile of road built has declined. The causes have been inflation, greater demand for other resources, stricter environmental controls, a greater proportion of permanent or specified roads (designed and constructed to engineering specifications), and a management objective of dispersed harvests (USFS-AK, 1984).

Chipping whole logs, the source of fiber in Alaska, is more expensive than getting raw materials for pulp from by-products from a solid wood plant. This gives some cost advantage to Oregon, Washington and British Columbia mills where the main wood source is sawmill chips (Jaakko Poyry, 1987a). A study referenced by Clark (1982) showed that the APC chipping operation at Rowan Bay delivered chips to Sitka for $93/BDU ($78/st). This included the cost of stumpage for cull or utility logs. The barge haul cost was $5.60/BDU/40 miles. At a distance of 125 miles from Rowan Bay to Sitka, this would be $15/st. The cost of loading this on an ocean going ship would be about $5-12/st. Therefore, the break-even point for exporting chips from the field was approximately $100/st ($120/BDU) fob Alaskan port.

The Washington Agricultural Statistics Service (various issues) collects data on <u>delivered</u> prices of pulpwood in Western Washington. Average prices for southwestern Washington deliveries in recent years were as follows:

	$/BDU
1980	48.35
1981	42.12
1982	48.35
1983	56.78
1984	49.45
1985	45.42

The pulp industry in Washington, however, uses primarily chips and other residues. Ninety percent of the raw material used in 1984 was in this form (Washington State Dept of Natural Resources, 1986). Estimates of mill residue and chip prices for Western Washington and Oregon are shown in Table 67. It should be noted that the above pulpwood costs do not include the costs of barking and chipping, a fact which may explain the lower prices than those in Table 67.

Table 67. Western Washington and Oregon chip and residue prices (nominal $).

	$/BDT	$/BDU
1965	15.28	18.34
1970	16.55	19.86
1975	37.43	44.92
1980	90.10	108.12
1981	75.79	90.95
1982	70.50	84.60
1983	58.00	69.60
1984	61.00	73.20
1985	62.00	74.40

(Adams, **et al**, 1988)

A Forest Service study in 1985 examined logging and transportation costs as well as methods to estimate stumpage values in British Columbia and Southeast Alaska. Existing differences tended to reduce British Columbia's production costs on a volume per unit basis. These differences included higher average timber volumes per acre in British Columbia, as well as larger average log size, easier access, more uphill yarding, fewer environmental mitigating measures and larger clearcuts. The study also suggested a few areas where British Columbia is at a relative disadvantage. These include an overall pricing mechanism which results in slightly higher timber payments due to license and cutting fees, royalties, and differing appraisal procedures (USFS-AK, 1986).

4.2.3. Other sources

Under the Alaska Native Claims Settlement Act, 13 private corporations were created in Southeast Alaska. These corporations are entitled to 572,520 acres of land in Southeast Alaska. Approximately 82 % of this land had been conveyed by late 1986. Much of the Native corporation timber is being harvested and exported (mainly in round log form) or sold to the two pulp mills (USFS-AK, 1987). It seems likely that the village corporations will no longer be major timber supply sources in the near future but Sealaska, the regional corporation, will probably continue to harvest extensive old-growth timber into the 21st century.

Over the last six years Canada has become an alternative source of pulp logs for the Southeast Alaska pulp industry. The trend may not continue because of greater Canadian pulp production and the lowered costs for National Forest pulp logs (USFS-AK, 1987). From 1982-85 logs were imported from British Columbia for approximately $120.00/MBF, or about half the estimated cost of logs from Southeast Alaska (USFS-AK, 1986). The average price of wood chips delivered to the contiguous United States in 1986 from British Columbia was $49.80/BDU (Council of Forest Industries of BC, 1987).

The competing regions with the least expensive wood costs are those that rely on fast-growing plantations. Some pulpwood costs (delivered to the mill and converted from m^3 to BDU) follow:

Chile (softwood)	$32.50/BDU
Brazil (hardwood)	$34.00/BDU
Indonesia (hardwood)	$44.00/BDU
New Zealand (softwood)	$55.00/BDU

(Jaakko Poyry, 1987a)

4.2.4. Wood needs by process

The various pulping processes vary considerably in pulp yield. This is evident in the estimates of wood use by process derived from Nilsson (1985b) as shown in Table 68.

Table 68. Wood consumption by process (m^3 per bone dry mt pulp).

	UBKP	BKP	GW	TMP	CTMP	BSP
Spruce	5.8	6.2	2.9	3.0	3.0	
Hemlock	5.3	5.7	2.6	2.7	2.7	5.3

(Nilsson, 1985b)

4.2.5. Summary

Alaska's historically low stumpage rates are more than offset by higher logging costs and the higher costs of transporting logs to the mill relative to the Pacific Northwest. The near complete dependence on whole logs versus mill residue is a further disadvantage. In comparing bleached kraft to TMP, the pulp yield per ton of wood consumed for the former is roughly half of that for the latter. Given estimates of delivered wood costs and pulp yields, we derive the following estimates for wood costs per ton of pulp output by region and process.

Wood cost calculations

Assumptions

Ave. price of chips delivered to mill

Alaska	$90/BDU
PNW (mill residue)	75/BDU
BC	50/BDU

Yields

TMP yield per BDU chips

2400 lbs chips X .90 pulp/chips = 2160 lbs. pulp = .98 mt pulp

BK yield per BDU chips

2400 lbs chips X .45 pulp/chips = 1080 lbs. pulp = .49 mt pulp

Estimated costs per ton of output

Alaska:

TMP: $90 / .98 = $91.83/mt pulp

BK: $90 / .49 = $183.67/mt pulp

PNW:

TMP: $60 / .98 = $61.22/mt pulp

BK: $60 / .49 = $122.45/mt pulp

BC:

TMP: $50 / .98 = $51.02/mt pulp

BK: $50 / .49 = $102.04/mt pulp

4.3. Labor

Production workers in pulp, paper and paperboard mills are the seventh-highest-paid among U.S. employees in 34 industries surveyed by the Bureau of Labor Statistics (Pulp and Paper, 1985). Table 69 shows the industry-wide wage rates of paper and pulp and other major industrial sectors. Workers on the Pacific Coast earn the highest wages. Their representative base wage rates stood are about $13.00/hr today, while the comparative rate in the South is $9.50/hr and $12.96/hr in British Columbia (Pulp and Paper, 1985). The weighted average cost of labor per short ton of pulp in the Pacific Northwest in 1987 was $101.38 (Northwest Pulp and Paper Assoc, 1988).

Table 69. Average hourly earnings: selected industries.

	1977	1984
Paper	7.16	12.89
Teamsters	7.54	10.80
Auto	8.60	14.69
Steel	8.80	12.97

(Kien, 1985)

Wages at U.S. market pulp mills are about 3% higher than the average for other primary paper producers in the United States. Although West Coast wage rates remain at a much higher level than other parts of the U.S., the rate of growth in these labor costs has slowed considerably in the past five years (Kien, 1985).

Wages in Southeast Alaska are about 40% above those in Washington and Oregon, $14.45 an hour versus $10.58 and $10.01, respectively (Alaska Timber Task Force, 1984). The Juneau Empire (Aug. 8, 1986) lists the average as $13.60 at the Sitka mill and $13.00 at the Ketchikan mill. The difference may be due to recent labor agreements more favorable to management. Wages used by Reaume (1986) in pulp mill cost estimates average $115.42/person/day ($14.43/hr) with wage supplements of $40.40 (based on 35% of the average wage).

4.3.1. Labor needs by process

Total labor costs depend on the pulping process, with thermomechanical pulping having a distinct advantage over kraft pulp as shown in Table 70. Thermomechanical pulping manpower requirements are relatively low at 2 to 2.5 man-hours of operating and maintenance per mt. To this must be added a small supervisory and office staff of perhaps 20 others (Auchter, 1976).

Table 70. Labor requirements by process.

	KRAFT					SULPHITE	GROUND
	PULPING	BLEACH	DRYING	CTMP	TMP	PULPING	WOOD
Fixed # labor (man yrs)	87.5	26.6	38.3	68.9	19.6		
Variable labor /1000 mt (man yrs)	0.145	0.003	0.03	0.85	0.178	1.17	0.47
Overhead %	61	61	61	61	61	61	61

(Nilsson, 1985b)

4.3.2. Summary

TMP requires only 22% of the fixed labor requirement of a kraft pulp mill (assuming both pulps are bleached and dried) and roughly the same variable labor input per 1000 mt. Alaska, with its high labor costs, has a disadvantage compared to other competing regions, as illustrated in the following labor cost estimates.

Labor cost calculations

Assumptions
Ave. Wage per hour (all with additional 35% benefits supplement)
Alaska $14.50
PNW $13.00
BC $13.00

Wages per man year
Alaska 14.50 X 8 hrs = 116 X 260 days/yr = 30,160 X 1.35 = $40,717/man yr
PNW 13.00 X 8 hrs = 82 X 260 days/yr = 27,040 X 1.35 = $36,504/man yr
BC 13.00 X 8 hrs = 96 X 260 days/yr = 27,040 X 1.35 = $36,504/man yr

Labor requirements
Bleached kraft pulp requirements (see Table 70):
87.5 + .145 X 350 = 138.25 man yrs/mill

TMP requirements:
19.6 + .178 X 120 = 41 man yrs/mill

Total labor costs ($/yr/mill)
Alaska:
TMP: 40,717 X 41 = X 1.61 = $2,687,729
BK: 40,717 X 138.25 = X 1.61 = $9,062,892
PNW:
TMP: 36,504 X 41 = X 1.61 = $2,409,629
BK: 36,504 X 138.25 = X 1.61 = $8,125,152
BC:
TMP: 36,504 X 41 = X 1.61 = $2,409,629
BK: 36,504 X 138.25 = X 1.61 = $8,125,152

4.4. Energy

4.4.1. General

The pulp and paper industry is among the top five users of energy in the U.S. Only primary metals production, chemicals and allied product manufacture, and petroleum refining are significantly greater in terms of energy use. One ton of paper consumes about six barrels of oil in its production, which is more than is required to produce a ton of steel (Arpan et al, 1986).

It requires an average of 30 million BTU's to manufacture a ton of pulp and paper with about 40% required for the chipping and pulping operations (Pulp and Paper, 1985).

Wood preparation involves a high level of energy consumption. Debarking consumes 2 to 4 kWh of electrical energy per cubic meter of wood, chipping and screening consumes 10 to 15 kWh/m^3 and materials and handling consume 2 to 4 kWh/m^3 for a total of 14 to 23 kWh/m^3 (Ewing, 1985). Because Pacific Northwest mills use mill residues extensively, they have lower energy requirements than would Alaskan mills.

Purchased energy requirements are offset by the use of process residues for much of the industry's power generation. This is illustrated in Table 71.

Table 71. U.S. pulp & paper industries sources of energy by fuel type, 1985 (%).

Coal	15.3
Fuel oils	7.2
Bark & hogged wood	16.8
Natural gas	14.0
Purchased electricity	6.6
Spent pulping liquor	38.2
Other	1.9

(Standard and Poor's, 1986)

4.4.2. Alaska

Energy costs in Southeast Alaska vary considerably depending on the power source and utility company. The lowest rates (1986) are in the larger towns with hydroelectric power sources (Table 72).

TOWN	AVERAGE COSTS CENTS/kWh	INDUSTRIAL RATES CENTS/kWh
Sitka	6.5	
Juneau	7.2	4.0-3.7
Petersburg	9.6	
Ketchikan	9.8	
Haines	14.8	12.4
Skagway	16.5	11.9
Angoon	34.4	32.2

(Alaska Power Authority, 1987; Alaska Public Utilities Comm, 1988)

As one comparison, the Port Townsend, Washington paper mill purchases electric power at 2.2 cents/kWh.

Table 72. Hydroelectric projects in Southeast Alaska.

PROJECT	CAPACITY		POP.	COMPLETED
Swan Lake	22 MW	Ketchikan	12,600	1984
Lake Tyee	20 MW	Petersburg/Wrangell	6,400	1984
Snettisham	47 MW	Juneau	20,000	1973
Green Lake	19 MW	Sitka	7,750	1981

(Clark, 1982)

The two existing Alaskan pulp mills produce much of their own steam and electrical needs from burning wood wastes or "hog fuel". Still, both must obtain the balance of their needs by other means. Pulp mills generate large quantities of process sludge that must be mixed with the hog fuel and burned. This wet material reduces the heat recovery and requires more oil for supplemental heat. The Sitka mill burns 1,000 to 1,200 bbls. of oil per day for supplemental fuel. Electrical power is sold to Sitka during surplus periods and bought back during deficit periods. The LPK pulp mill at Ketchikan operates similarly (Clark, 1982).

4.4.3. Other regions

Energy costs have traditionally been the Pacific Northwest's primary advantage due to lower electricity rates, but this advantage has decreased as a result of large increases in electricity rates in the 1970's (Northwest Pulp and Paper Assoc, 1985). The average weighted cost of purchased electricity in the Pacific Northwest in 1987 was $.02515/kWh from public utilities and $.03336 from private utilities (Northwest Pulp and Paper Assoc, 1988). The 1987 average price of oil was $105/mt (half of the price in 1985). The average cost of residential electricity for customers of BC Hydro was $.054/kWh compared to $.042/kWh for residential customers in the Pacific Northwest.

4.4.4. Energy needs by process

There are two major trends in the pulp industry today: development along the ultra high yield pulping systems, which unfortunately are a major energy consumer; and development of low yield lines which are self-sufficient in energy but capital intensive (Karlberg, 1985). Two studies (Tables 73 and 74) on energy consumption show the relative rates of energy use for the various pulping processes.

Table 73. Energy consumption by process.

	KRAFT PULP	BLEACH	DRY	CTMP	TMP	SULFITE PULP	GRD WD
Electricity (mWh/mt)	0.1	0.55	0.1	2.0	2.0	0.1	1.3
Other Energy (toe/mt)	0.05	0.06	0.10	0.45	0.07	0.1	

(Nilsson, 1985b)

Table 74. Energy consumption by pulping process.(GJ/mt)

	ELECTRIC	HEAT	CHEMICAL	TOTAL
Sulphate	1.1	6.0	1.8	8.9
TMP	8.6			8.6

(Karlberg, 1985)

4.4.4.1. TMP

Thermomechanical pulping uses large quantities of electrical energy (1,200 to 1,400 kilowatt hours per mt) (Auchter, 1976). If spruce were used, TMP pulp production would require 2,000-2,500 kWh/mt of pulp (Pulp and Paper International, Dec 1987). For thermomechanical pulping, heat in the form of steam may be used to produce hot water for washing and to achieve the desired temperature in each bleaching stage. Electrical energy is used for mechanical drives for pumps, agitators, washers, etc. Typical energy consumption figures are as follows:

Electrical energy (kWh/mt)	130-200
Heat energy (GJ/mt)	1.0-6.0

For pulp drying the typical figures are:

Electrical energy (kWh/mt)	130-190
Heat energy (GJ/mt)	2.5-6.0

(Ewing, 1985)

Today's technology allows up to 80% of the energy to be recovered from refiner pulp processing (Pulp and Paper, May 1984).

4.4.4.2. Kraft

Bleached kraft pulp produced by conventional technology requires 350 kWh/mt of pulp but with improved developments can be reduced to 180 kWh/mt (Pulp and Paper International, Dec 1987). Typical energy consumption calculated by Ewing (1985) for kraft pulping involves electrical energy to operate mechanical drives and steam energy for the pulping process itself as follows:

Electrical energy	100-140 kWh/mt
Heat energy	2.5-5.0 GJ/mt

Tables 75 and 76 summarize the energy use and costs of a typical kraft mill.

Table 75. Typical process energy consumption for bleached kraft pulp mill*.

	THERMAL GJ/mt	ELECTRICAL kWh/mt
Wood Preparation	0.1	65
Pulping & Washing	3.5	120
Bleaching	5.0	190
Pulp Drying	3.6	160
Chemical Recovery	5.2	75
Miscellaneous	1.1	130
Total	18.5	740

*For mills built with 1960's technology
(Ewing, 1985)

Table 76. Energy requirements and costs in the production of bleached kraft pulp.

Total energy consumed (kgoe/mt)[1]	786
Purchased oil (kg/mt)	
Lime kilns[2]	60
Steam generation	120
Purchased power (kWh/mt)	740
Total purchased energy (kgoe/mt)	354
Energy cost (US$/mt)[3]	$58

[1]Power converted to oil at 4.26 kWh/kgoe, and thermal energy at 33.5 GJ/mt
[2]Lime kilns in the kraft chemical recovery system assumed to oil fired
[3]Oil assumed to cost US$200 per mt; power to cost US$0.03 per kWh

(Ewing, 1985)

4.4.5. Summary

Using state of the art technology, a kraft mill can be energy self-sufficient, that is the value of surplus energy sales offset purchased power. A TMP mill can recover 80% of its energy requirements. Southeast Alaska's hydroelectric generation provides reasonably priced power. The key issue is whether a new plant could use power from one of the existing hydro projects and what use rate schedule could be negotiated. Estimates of energy input requirements and costs for Alaska and comparator regions are as follows.

Energy cost calculations

Assumptions
- Ave. cost per kWh:
  - Alaska $.03
  - PNW $.02
  - BC $.025
- Ave. cost of oil per metric ton:
  - Alaska $115
  - PNW $105
  - BC $107

Input requirements (see Table 73 includes pulping, bleaching and drying)
- BK requirements:
  - Electrical energy .75 X 350,000 = 262,500 MWh/yr
  - Other energy .21 X 350,000 = 73,500 toe/yr
- TMP requirements:
  - Electrical energy 2.65 X 120,000 = 318,000 MWh/yr
  - Other energy .23 X 120,000 = 27,600 toe/yr

Total energy costs

Alaska:
- TMP: 318,000,000 X .03 = $9,540,000 + 27,600 X 115 = $12,714,000/yr
- BK: 262,500,000 X .03 = $7,875,000 + 73,500 X 115 = $16,327,500/yr

PNW:
- TMP: 318,000,000 X .02 = $6,360,000 + 27,600 X 105 = $9,258,000/yr
- BK: 262,500,000 X .02 = $5,250,000 + 73,500 X 105 = $12,967,500/yr

BC:
- TMP: 318,000,000 X .025 = $7,950,000 + 27,600 X 107 = $10,903,200/yr
- BK: 262,500,000 X .025 = $6,562,500 + 73,500 X 107 = $14,427,000/yr

4.5. Transportation

Southeast Alaska is 500 miles closer to East Asia than are the closest ports in the "lower 48" and roughly 600 miles closer than shipping points in Coastal British Columbia (Table 77). However, transportation costs of pulp to Japan from British Columbia generally are slightly less than from either Alaska or the Pacific Northwest. The small differences would not appear to give a competitive edge to any specific producer whether it is Alaska, the Pacific Northwest or British Columbia (Alaska Timber Task Force, 1984).

Table 77. Shipping distances to Asia (miles).

to: Yokohama

Vancouver, BC	4,260
Concepcion, Chile	9,336
Tauranga, New Zealand	4,863
Goteborg, Sweden	11,781
Juneau, Alaska	3,700
Seattle, Washington	4,200

(adapted from Fletcher, 1988)

While distance traveled surely is an important determinant of transport cost, especially under competitive conditions, liner freight rates are controlled by conferences, and conferences establish freight rates on the basis of many factors besides distance (Wisdom, 1988). Freight rates from the continental United States and Canada to the Far East and South East Asia are governed by the Transpacific Westbound Rate Agreement. Its membership consists of 19 carriers and provides for agreements on rates, charges and rules for the transportation of cargo (US Senate, 1985). The economies of scale in transport are significant. The trade volumes on overseas routes must be quite large (more than 200,000 t/a in many cases), however, in order to allow rational cargo handling methods and optimum vessel sizes (Jaakko poyry, 1987a).

Transport costs account for up to 20% of the purchase price for pulp (Pulp and Paper International, Nov 1985; Doan, 1983). Market pulp is a low paying cargo, and shippers are reluctant to carry it if higher paying cargoes can be found. Furthermore, the unit size of pulp bales is not well suited for containers and shippers must use specialized cranes for loading them (Pulp and Paper International, Nov 1985).

The cost of shipping to the Far East from West Coast U.S. mills is $60 to $80/metric ton and less than the cost of shipping by rail to northeastern markets (Pulp and Paper, 1985). More specifically, Pulp and Paper (Feb 1988) gave the rate from Seattle to Tokyo as $60.16/mt, including currency adjustment factor and terminal receiving charge (Pulp and Paper, Feb 1988). Doan (1983) gave the rate as $47 per metric ton of baled pulp to Japan for breakbulk charter (an additional $10-15 for Korea) and $70.25 for 20' containers. Typical round-trip time from the Pacific Northwest to Japan is 36 days including loading and unloading (Tussing, 1982). Table 78 gives a breakdown of those handling costs.

Table 78. Typical shipping-related charges for pulp (per mt).

Wharfage	$1.80
Service & facilities	2.57
Load/unload	9.10
Handling	7.68
Stevedoring	2.91

(Usually minimum mill dock or port call 1500-3000 mt)
Productivity on unitized baled pulp ±200 mt per hour

(Doan, 1983)

The Merchant Marine Acts of 1920 ("the Jones Act") and 1936 restrict the nation's "coastwise trade" to ships 1) built in the U.S., 2) manned by U.S. nationals, 3) owned by U.S. nationals,and 4) registered in the U.S. (Tussing, 1982). The freight rate for transport of wood pulp by tug and barge from Southeast Alaska to the Pacific Northwest is estimated by McKetta and Jackson (1988) to be $19/metric ton. Furthermore, they estimate that if the Jones Act were not in effect this cost would be reduced by 19% ($3.61/mt). One important implication of the Jones Act is its effect on the costs of materials shipped to Alaska for construction and maintenance of a mill. The costs of chemicals, supplies and construction materials are all higher as a result.

4.5.1. Transportation needs by process

The cost of transporting pulp is obviously the same regardless of type. However, since kraft pulp is a higher value product (by about 50%), the cost per dollar of product is lower than for TMP pulp. Also, the smaller efficient size output of the TMP process increases the costs of transportation due to the loss of economies of scale.

4.5.2. Summary

Any Alaskan advantage there might be in shorter distances to Asia is outweighed by the less efficient port facilities and the less competitive shipping market from Southeast Alaska to Asia.

Transportation cost calculations (To Japan US$/mt):

	BK	TMP*
BC	58	87
PNW	60	90
Alaska	65	98

* The 1.5 multiplier assumes the mill is located in an isolated area where specialized dock loading equipment is not available and/or other cargo is not commonly shipped.

4.6. Mill construction costs

4.6.1. General

High real interest rates and exchange rate volatility in recent years have contributed to the emergence of a very conservative mood both in the Pacific Northwest (Achohido, 1988) and in Japan (Japan Pulp and Paper, June 1987) concerning the large investments necessary for greenfield mills. The capital investment for a new greenfield mill is normally more than twice the value of a year's total production at full capacity, and in some cases more than three times the annual turnover (Aurell **et al**, 1985). As a result, improving the energy and cost efficiency of existing plants has become the more common investment strategy, and the dominant trend in the industry today is consolidation. The basic principles are outlined by Chao (1988): buy versus build, borrow liberally to boost returns, and shun low-return investments, such as timberlands. He lists the advantages to acquiring a mill: (1) it does not add to capacity, (2) transactions can be timed more closely with the economic cycle, (3) a customer base already exists, (4) there are no risks of start-up problems, and (5) it is cheaper than building.

4.6.2. Alaska

McMahon (1984) estimates that Alaskan construction costs are significantly higher than the "lower 48". Using Boston costs as the index standard (= 1.00), the rankings were as follows:

	Labor	Materials
Anchorage	1.49	1.46
Seattle	1.02	.92
Portland	.99	.96
Vancouver B.C.	.99	.96

A University of Alaska report in 1984 showed the index of costs for large construction projects in Anchorage to be 145 (compared to Boston = 100, Seattle = 91) (University of Alaska, 1984b). The same report quoted a Dept. of Defense cost differential table that shows Anchorage to have an index of 100 (with Washington D.C. at 53).

While pulp mill sites are becoming more scarce in the "lower 48" due to pollution restrictions and other factors, recent experience does not indicate any special advantage for Alaska (Darr **et al**, 1977). Costs of $1,000,000 or more have been mentioned for site preparation for a medium-sized sawmill due to the very expensive excavation and/or filling and dock facilities. Plant construction is perhaps 25% greater in Alaska - largely because of costs of shipping materials and equipment (Darr **et al**, 1977).

4.6.3. Mill construction costs by process

4.6.3.1. High yield pulp mill

Thermomechanical pulping is a high yield, low capital cost and low pollution effect process (Auchter, 1976). Economic-sized kraft mills have become so large, and their capital costs per ton of capacity so high, that most would-be pulp producers are unable to finance one. CTMP (and other high yield pulp) has emerged as the alternative (Hay-Roe, June 1985). The investment in building a greenfield CTMP mill is in the order of $700-900/annual mt (Gundersby and Diesen, 1985). The construction time for chemimechanical mills is at least 25% shorter than for kraft mills (Pulp and Paper, May 1984). Pulp and Paper International (Aug 1988) estimates the average cost of a CTMP mill to be about 40% of a bleached kraft mill, $260,000/mt/day compared to $665,000/mt/day. The range of sizes of current CTMP mills in the world is from the largest at Quesnel River in Canada at 300,000 t/yr to many in Scandinavia which are in the 50,000-80,000 mt/yr range, with the majority in the 120,000 mt/yr range (e.g. the Winstone Samsung mill in New Zealand) (Pulp and Paper, Dec 1987).

4.6.3.2. Bleached Kraft pulp mill

The economic size of a bleached kraft market pulp mill is generally agreed to be in the 1,000 t/day range (Sandwell, 1977). Bleached kraft capital costs have skyrocketed in recent years. The investment costs for a kraft pulp mill have increased five fold over the past fifteen years while the consumer price index has increased three fold (Karlberg, 1985). Capital costs of a world-scale mill have risen so high that a new mill would have to sell pulp at $750/mt, a price plateau just recently reached. This dilemma affects new mills as well as rebuilds of 10 to 20-year-old mills. There have been, however, recent engineering and technological improvements that can reduce these costs by 20% (Pulp and Paper, March 1985).

Various sources have estimated the cost of greenfield kraft pulp mills:

- Fletcher (1988) puts the cost of a new market kraft pulp mill at around U.S.$2,000 per annual metric ton ($700 million for a 350,000 mt/yr mill).

- In 1977 both Darr **et al** and Sandwell estimated that the capital costs of a bleached kraft mill in the 500-750 t/d range would be about $250,000,000 (about $500 million in 1985 dollars).

- Pulp and Paper International (Jan, 1987) puts the cost for a new greenfield pulp mill at $1300 per annual metric ton (or higher) or about $455,000,000 for a 350,000 mt/yr plant (1,000 mt/d based on 350 days/yr).

- RISI (1987) shows current greenfield capital costs to be about $550,000 per daily metric ton for a bleached kraft pulp mill in the U.S. or $550 million for a 1,000 mt/d (350,000 mt/yr)plant and predicts that the greenfield capital costs will reach $639,000 per daily metric ton by 1991 for an average U.S. bleached kraft pulp mill.

- Clark (1982) puts capital costs for an 800 mt/day mill between US$560 million to US$840 million and for a 1,000 mt/day mill between US$700 million to US$1,050 million.

- Jaakko Poyry (1987a) puts the efficient mill size for a chemical pulp mill at 350,000-400,000 mt/yr and an investment cost of $400 to 500 million.

Capital costs of a new sulphate pulp mill in Alaska would probably fall between the rates for industrialized and developing countries due to Alaska's remote location and lack of industrial infrastructure (Clark, 1982). A key issue is financing. It is extremely difficult to find banks in the private sector that are willing to finance such a large project (Luhde, 1988).

4.6.3.3. Comparison

Tables 79 and 80 compare the key investment cost factors between high yield and kraft mills.

Table 79. Investment cost and maximum plant size for new production lines by process.

	KRAFT PULP	BLEACHED PULP	DRYING PULP	SULPHITE PULP	TMP	CTMP
Fixed investment cost (Million US$)	24.3	8.1	18.5	3.74	14.1	22.9
Variable investment cost (Mn US$/1000 mt)	0.423	0.126	0.109	0.18	0.428	0.3
Maximum capacity at investment (1000 mt/production line)	280	265	265	150	120	160

(Nilsson, 1985b)

Table 80. Comparison of bleached softwood pulps by process.

	CHEMIMECHANICAL	KRAFT
Production (adtpd)	600	800
Capital cost (million US$)	110	360
Unit capital cost (US$/adtpd)	180,000	450,000
Manufacturing cost (US$/adtpd*)	225	335
Personnel requirements	70	300
Water usage (US gallon/adtpd)	4,000	24,000
Wood yield (%)	90	45

*excludes indirect costs
(Pulp and Paper, May 1984)

Average capital costs in the U.S. (interest, depreciation and other) is $60/mt (Pulp and Paper, 1985).

Nilsson (1985a) used a capital recovery factor of 0.1175 for investment calculations (see Appendix A.6.). This assumes a rate of return of ten percent, with a 20-year asset life. Reaume

(1986) uses a 12 % required rate of return and a capital recovery period of 8.3 years or a capital recovery factor of 0.1636.

The cost of capital should be no different for an investment in Alaska than one in the Pacific Northwest or British Columbia assuming no government subsidies are involved.

4.6.4. Summary

The high labor costs, high costs of transporting equipment to Alaska, and the expense of site preparation put Alaska at a severe disadvantage in construction costs. The efficient size for a kraft mill is 350,000 mt/yr (1,000 mt/day) while that of a TMP mill is around 120,000 mt/yr (340 mt/day). The investment cost for a kraft mill is about twice that of a TMP mill per ton or about six times the total, given the greater minimum efficient size of the kraft mill. The differences are clear in the following cost estimates.

Mill construction cost calculations

Construction costs
  Bleached kraft mill
    $550,000,000 for 350,000 mt/yr plant
  TMP (see Table 79):
    Fixed costs: 14.1 + 18.5 + 8.1 = $40,700,000
    Variable costs: .126 X 120 + .109 X 120 + .428 X 120 = $79,560,000
    Total costs: 79,560,000 + 40,700,000 = $120,000,000
  Alaskan costs = 1.5 X the cost of BC and the PNW (see text)

Capital recovery annual charge (@ 12% rate of return, 8.3 year period)
Alaska:
  BK: .1636 X 825 = $134,970,000/yr
  TMP: .1636 X 180 = $29,448,000/yr
PNW:
  BK: .1636 X 550 = $89,980,000/yr
  TMP: .1636 X 120 = $19,632,000/yr
BC:
  BK: .1636 X 550 = $89,980,000/yr
  TMP: .1636 X 120 = $19,632,000/yr

Total costs (US$ million)	BK	TMP
Alaska	825	180
BC	550	120
PNW	550	120
Capital recovery costs (US$ million/yr)		
Alaska	135	29
BC	90	20
PNW	90	20

4.7. Chemicals, Supplies and Overhead

4.7.1. Overhead

Reaume (1986) estimates miscellaneous overhead (including travel, telephone and office supplies, while excluding expenditure on replacement parts) to be 40% of payroll. Since labor costs are higher in Alaska, the overhead would be proportionally higher as well.

4.7.2. Chemical and supply costs

Tables 81 and 82 give the necessary inputs and costs of the various pulping processes.

Table 81. Chemical inputs by process (mt/mt pulp).

	BKP	UBKP	TMP	CTMP	BSP
Sulfur			0.006	0.006	0.010
Sodium carbonate	0.016	0.015	0.017	0.017	
Chlorine	0.070				0.040
Caustic soda	0.030				
Sodium chlorate	0.017				
Lime (CaO)	0.009	0.008			
Saltcake	0.021	0.019			

(Nilsson, 1985b)

Table 82. Supply inputs by process ($/mt).

	KRAFT					SULPHITE	GROUND
	PULP	BLEACH	DRYING	CTMP	TMP	PULPING	WOOD
Supplies	26.3	4.5	6.8	27.5	22.8	14.5	14.5

(Nilsson, 1985b)

4.7.3. Summary

The cost of chemicals and supplies would be higher in Alaska than the Pacific Northwest and British Columbia due to the higher shipping costs for these high bulk items and the longer shipping distances from supply sources. Kraft pulping obviously has much higher chemical requirements than thermomechanical pulping. The miscellaneous supply requirements are comparable.

Calculation of supplies cost (see Table 82)

TMP:
22.8 X 120,000 = $2,736,000/yr
BK:
26.3 X 350,000 = $9,205,000/yr

Calculation of chemical costs (see Table 81)

BK:
Sodium carbonate .016 X 350,000 X 103 = 576,800
Chlorine .070 X 350,000 X 154 = 3,773,000
Caustic soda .030 X 350,000 X 192 = 2,016,000
Sodium chlorate .017 X 350,000 X 496 = 2,951,200
Lime (CaO) .009 X 350,000 X 43 = 135,450
Saltcake .021 X 350,000 X 99 = 727,650

Total $10,180,100/yr

TMP:
Sulphur .006 X 120,000 X 110 = 79,200
Sodium carbonate .017 X 120,000 X 103 = 210,120

Total $289,320/yr

Chemicals/supplies costs (US$/mill/year)

	BK	TMP
Alaska (X 1.2*)	23,262,120	3,630,384
BC (X 1.05)	20,401,605	3,176,586
PNW (X 1.0)	19,385,100	3,025,320

* multiplier based on handling and transportation charges

4.8. Environmental Protection

Not a cost component per se, environmental protection is as significant a consideration in Alaska as it is in the rest of the U.S., especially in light of investment decisions versus some other country or region. The Alaskan mills fought EPA regulations to bring discharges into compliance with the 1977 Clean Water Act, claiming that it would cost $67 million for minimal improvement in water quality (Payne, 1984). These effluent problems are described in detail in the two Environmental Protection Agency publications cited in the bibliography (EPA, 1971 and 1970).

There has been an influential conservation movement concerned with timber issues in Southeast Alaska for many years. These groups have been very active in all aspects of the Tongass Forest Management process and have been instrumental in seeing that additional long-term timber contracts similar to those held by the two Alaska pulp mills have not be granted (Southeast Alaska Conservation Council, 1985). The Tongass Timber Reform Act was passed by the U.S. House of Representatives in the 100th Congress but was not voted on by the Senate. It would revise the statute that requires the Forest Service to offer 450 million board feet per year and would repeal the 50 year timber sale contracts with the two pulp companies. It is likely to be an issue in the next Congress.

Although it is difficult to quantify the differences in environmental policies between the U.S. and Canada, it is generally agreed that Canadian producers have lower mitigation costs for adverse environmental effects both related to logging and pulp production. Differences also exist between Alaska and the Pacific Northwest States, reflecting the stricter state requirements in Washington and Oregon. As regarding the two alternative mill types, the costs for pollution mitigation is much higher for sulphate pulping than for TMP. These costs are reflected in the higher construction costs and are also seen in higher operating costs.

4.9. Alaskan cost estimates

Results of the analysis in the preceding sections are summarized in Table 83. Here we have converted the dollar cost differentials to a relative basis, with the South (as in Table 66) taken as 100. A graphical representation is shown in Figure 11. It is evident, on the basis of our analysis, that Alaska faces a relative disadvantage across the full range of cost elements compared to other North American producing regions. Although the extent of the differences vary, the same result is obtained for both bleached kraft and TMP pulps. Table 84 and Figure 12 show the differences between Alaska, the Pacific Northwest, and Coastal British Columbia based on the data in the preceding sections. It should be reiterated that actual costs for a specific mill will almost surely vary greatly from the regional averages developed here. In the Pacific Northwest, for example, an analysis of pulp and paper production costs in 1987 (Northwest Pulp and Paper Mill Survey, 1988) found that costs of purchased electricity ranged from $.014/kWh to $.038/kWh, labor costs went from a low of $47.60/short ton of product to $287.81/short ton and wood costs ran from $28.00/short ton of product to $124.72/short ton.

Figure 11. Comparative index of bleached kraft costs.

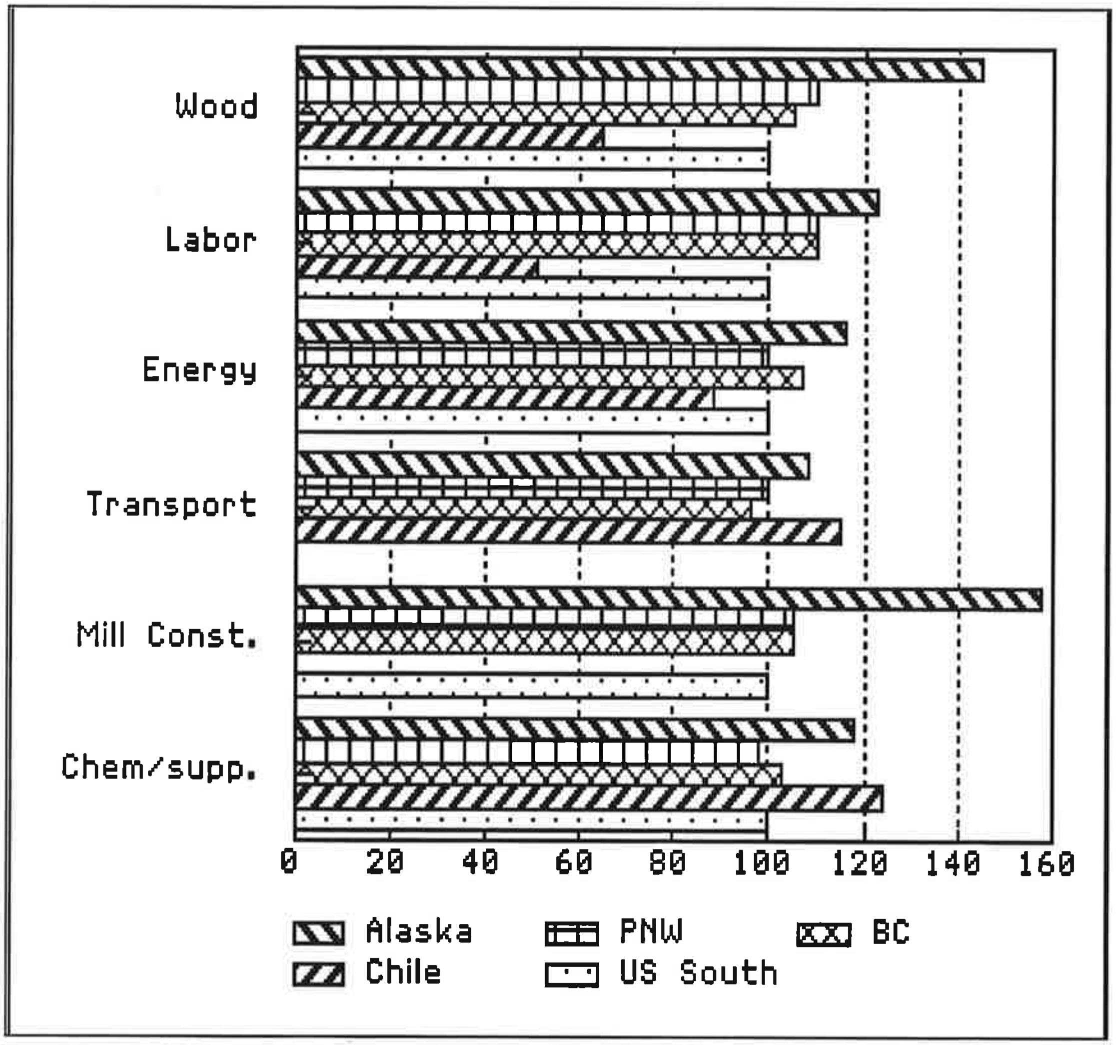


Table 83. Alaskan potential bleached kraft pulp cost differentials as a percent of costs in the U.S. South.

COST COMPONENT	ALASKA	PNW	BC COAST	CHILE	US SOUTH
Wood	145	110	105[2]	65	100
Labor	123	110	110	51	100
Energy	116	100[3]	107	88	100
Transport (Japan)	108	100	96	115	
Mill constr.	158	105	105		100
Supplies/Chem[1]	118	98	103	124	100

[1] Average of supplies and chemicals from Table 66
[2] Modified from RISI based on more recent data (USFS-AK, 1986 & Adams et al, 1988)
[3] Based on data from Northwest Pulp and Paper Assoc (1985).

Figure 12. Comparative index of TMP costs.

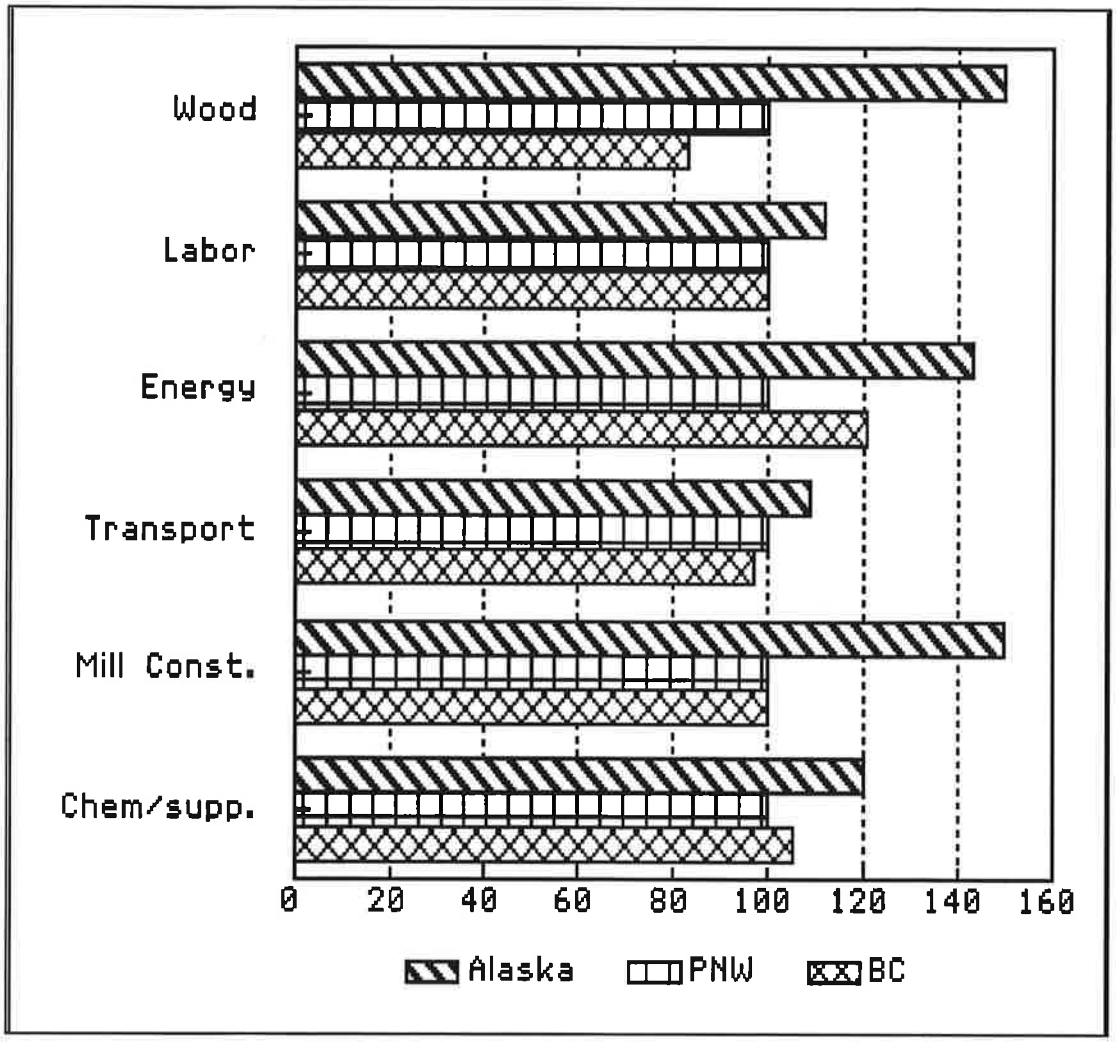
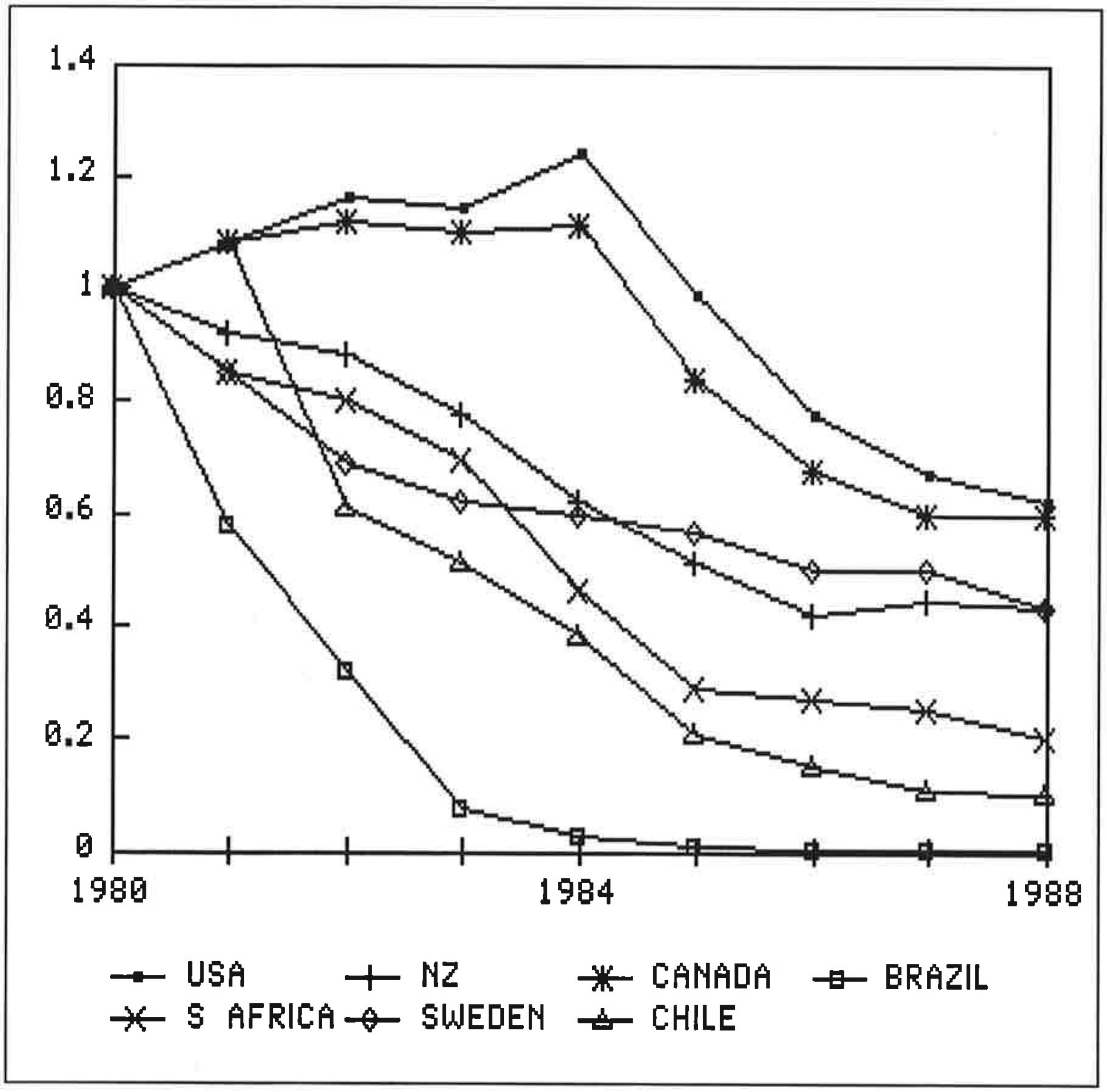


Table 84. Alaskan potential thermomechanical pulp cost differentials as a percent of costs in the U.S. Pacific Northwest.

COST COMPONENT	ALASKA	PNW	BC COAST
Wood	150	100	83
Labor	112	100	100
Energy	143	100	121
Transport (Japan)	109	100	97
Mill constr.	150	100	100
Supplies/Chemicals	120	100	105

Figure 13. Yen/local currency index (1980 = 1.0).



4.10. Exchange rates

As a final point, it is important to note the significant role of international currency markets as a factor in market pulp investments in the Pacific Rim. Fletcher (1988) states that exchange rates can swamp all other factors in determining profitability. "No other factor can so quickly affect the positioning of a mill on the delivered cost curve. A 10% swing in exchange rates can add $30 to $40 per ton to the cost of production of pulp...; a 40% exchange rate swing is the difference between being the low cost producer and the high cost producer" (Hay-Roe, Feb 1987).

Table 85 shows exchange rates of currencies for important pulp exporting and importing countries relative to the U.S. dollar. Figure 13 plots the equivalent data but expressed as an index (1980 = 1.0) of exchange rates for Japanese yen (per unit of local currency). Compared to the base period, these indices can be viewed as multipliers for costs in terms of delivery in the Japanese market. As indices rise or fall, the cost competitiveness of the several exporting countries rises or falls as viewed by potential Japanese importers. The graph shows that the U.S. and Canadian currencies have changed the least versus the yen, while South African, Chilean and Brazilian currencies have depreciated greatly against the Japanese currency. A same relative results against the Korean won hold, although the depreciation since 1984 is not as great for any of the currencies. If we assume that pulp costs have changed similarly in all these producer countries, there has been a distinct advantage gained by the southern hemisphere producers complementing the production cost advantages described earlier.

Table 85. Foreign exchange rates, 1970-1988 (national currency per US $).

	CHILE peso	JAPAN yen	NEW ZEALAND NZ$	CANADA CDN$	BRAZIL cruzado	SOUTH AFRICA rand	KOREA won	SWEDEN krona
1970	.012	360	.89	1.01	.01	.71	317	5.17
1975	8.50	305	.96	1.02	.01	.87	484	4.39
1976	17.42	293	1.05	1.01	.02	.87	484	4.03
1977	27.96	240	.98	1.09	.02	.87	484	4.67
1978	33.95	195	.93	1.19	.02	.87	484	4.29
1979	39.00	240	1.01	1.17	.04	.83	484	4.15
1980	39.00	203	1.04	1.19	.07	.75	660	4.37
1981	39.00	220	1.22	1.19	.13	.96	701	5.57
1982	73.43	235	1.37	1.23	.25	1.08	749	7.29
1983	87.53	232	1.53	1.24	.98	1.22	796	8.00
1984	128.24	251	2.08	1.32	3.18	2.00	827	8.99
1985	183.86	201	2.00	1.40	10.49	2.56	890	7.62
1986	204.73	159	1.92	1.38	14.94	2.17	861	6.82
1987	235.21	135	1.56	1.31	72.25	1.96	796	5.85
1988	244.05	125	1.50	1.23	194.63	2.33	728	6.25

(IMF, 1987)

5. Potential for establishment of a new mill in Alaska (conclusions)

This section summarizes the specific options that have been discussed in the text and assesses the risks and uncertainties involved in the decision to increase Alaskan market pulp capacity.

5.1. Options

The analysis developed in this report does not lead to a clear cut conclusion regarding the opportunities for expanded market pulp production in Alaska. On the one hand, there would appear to be a reasonable prospect of expanding demand for market pulp in the Pacific Rim region. Projections by FAO and IIASA suggest that economic growth in the region over the period to 2000, while somewhat slower than the experience of the past 15 years, will be sufficient to fuel a doubling of net regional pulp imports by 2000. For Asian countries alone this would amount to an increment in imports of some 2.0 million metric tons. Japan, China (both Taiwan and the PRC), South Korea and Indonesia show the greatest market growth potential. This growth will likely be accompanied by little, if any, real growth in pulp prices. There are strong prospects for expansion in pulping capacity in the key South American countries of Brazil and Chile. While much of Brazil's incremental output will flow to Atlantic markets, it is expected to move far more aggressively in the Pacific region than in the past. Review of plans and proposals for new capacity projects reveals that a substantial part of the projected increment is already on the drawing board. As a consequence, pulp markets are expected to remain extremely competitive throughout the remainder of this century, though a niche could be found for a cost competitive producer.

In examining this latter question, however, we are unable to identify any particular cost advantage for an Alaskan mill relative to its closest potential competitors in western North America. Our analysis examined both a traditional bleached kraft mill and a smaller, high yield, TMP mill. In either case an Alaskan mill would appear to face cost problems across the full range of inputs, with major disadvantages in wood, labor, energy and construction costs. The cost disadvantage appears even greater when compared o the U.S. South or major Latin American producers. Thus, while a market may well exist, it is not immediately obvious that Alaska is in a position to pursue some share of it.

In presenting these results, we wish to emphasize that they should be viewed only as broadly indicative. Given the time and resource constraints in the present study, we have relied exclusively on secondary and published data to support our analysis. Clearly, a far more detailed and specific study of both the market and cost sides would be required to reach a definitive conclusion on any particular project. A list of elements deserving additional attention would be lengthy, but three items merit specific mention.

It is difficult to overemphasize the need for close attention to resource and capacity developments in the southern hemisphere. The rapid growth of plantation-based mills in South Africa and South America has dramatically changed the nature of global market pulp competition over the past two decades. In sharp contrast to the dependence on natural forests in western North America, these are facilities for which the resource base was designed and grown to meet mill requirements. Options for additional plantation expansion and greenfield mills exist in both Brazil and Chile, and the governments of these countries are generally committed to industrial development. New Zealand's radiata pine plantations represent a further potential. In all of these instances, mills operate with very considerable advantages in wood costs relative to mills in the northern hemisphere using fiber from natural stands.

Previous studies have noted the potential attractiveness of a TMP mill (see, for example, Darr, et al, 1977) on the basis of lower capital costs, higher pulp yield, lower environmental impacts, ability to tailor pulp characteristics to specific customer needs, etc. Though the present analysis did not suggest a cost advantage for an Alaskan location, our treatment may have been too broad to be definitive. High yield pulping technology has been developing rapidly and is characterized by considerable flexibility in its adaption to specific resource and market conditions. Detailed analysis may reveal opportunities for targeting particularly high valued markets, reducing energy and wood costs through technical adaptations, or lowering transport costs through pooled shipping arrangements with existing pulp facilities. As a consequence, this option would seem to warrant closer and continuing evaluation.

A final key item relates to the cost and availability of wood fiber. In our analysis, we have identified Alaska as a relatively high wood cost region for pulp production, owing in part to high costs of logging and log/chip transportation. Though our estimates are admittedly crude, this is a crucial concern, since wood is the largest single variable input cost in production (outside of Latin America). At the same time, it is evident that the bulk of wood supplies to a new mill must come from the National Forest and that the Forest Service is under intense pressure to limit both current and future harvest levels. These circumstances would seem to warrant a thorough analysis of prospective future wood supplies and costs under a variety of assumptions on prospective agency policies and levels of operation of existing log, lumber and pulping facilities.

6. Appendix

6.1. Conversions and Tables

6.1.1. Metric

short ton (st) - 2,000 lbs.
metric ton (mt) - 2,204.62 lbs.

short tons to metric tons = .90718 st/mt
metric tons to short tons = 1.10232 mt/st

6.1.2. Lumber

1.17 short tons / MBF Scribner (USFS-AK, 1985)
3.48 m^3 / MBF (Int. Nat. 1/4 Rule)

6.1.3. Chips

In general, from 250 to 280 cubic feet of softwood is required to produce a ton of dissolving pulp over the purity range of 89 to 97 percent alpha (Auchter, 1976).

BDU = 2400 lbs.
BDU to metric tons = 1.0886 mt/BDU (USFS-AK, 1983)
BDU to short tons = 0.8387 BDU/st (Clark, 1982)

2.5 cubic meters = 1 BDU softwood chips
2.0 cubic meters = 1 BDU hardwood chips
(Kato, 1985)

Chip recovery coefficients in Alaska (ave. 1974-82 from USFS):
.57 BDU/MBF spruce residual chips from cant/waney slabs and edgings
.69 BDU/MBF hemlock residual chips
2.73 BDU/MBF spruce and hemlock chip production from whole pulp logs

Chip recovery coefficients (industry sources)
2.1 BDU/MBF

6.1.4. Pulp

Pulp mill capacity is quoted in both mt per year and mt per day. Some of the common equivalents (based on a 350 day year):

120,000 mt/yr = 340 mt/day (assumed efficient size for TMP mill)
200,000 mt/yr = 550 mt/day
350,000 mt/yr = 1,000 mt/day (assumed efficient size for bleached kraft mill)

The BDT of fiber to BDT of pulp yield for dissolving pulp grades averages 38% (Clark, 1982).

6.3 m^3/st solid wood to pulp conversion (Gruenfeld, 1983)

One metric ton of dissolving pulp requires 7.2 cubic meters of spruce/hemlock wood (FAO, 1973).

Most sulphate mills recover about 45% of pulp from a given wood supply (FAO, 1973). This compares to 42% for bleached pulp with a 5-6% higher yield for hardwoods (McKean, 1988).

There is a 35% yield of pulp from chips for dissolving pulp. This is because the ultimate chemical conversion of dissolving pulp into rayon and acetate requires a pulp of lower fiber/alpha cellulose content than that required in the manufacture of paper (Reaume, 1986).

Mechanical pulping gives yields of 90% with the yield going down as chemicals are added (McKean, personal communication).

Product	Wood in the rough equivalent cubic meters/mt product
Mechanical pulp	2.5
Chemi-mechanical pulp	3.0
Chemical pulp	4.8

Wood pulp (wet) 1.45-1.56 m^3/mt
(baled) 1.25-1.39 m^3/mt
(Drewry, 1987)

1 bale pulp = 500 lbs (McKean, personal communication)

6.1.5. Energy

toe = metric tons of oil equivalent
1 toe = 4.26 mWh (megawatt hours)
1 toe = 35.5 GJ (gigajoules)
1 mt = 7.2 bbls oil (API 30° gravity oil)

6.1.6. Financial

Table 86. Japan domestic price index (1980 = 100).

	Pulp & Paper	All commodities
1960	35.2	43.7
1965	36.8	44.7
1970	43.5	50.0
1975	74.3	76.3
1980	100.0	100.0
1981	97.0	101.4
1982	95.2	101.9
1983	93.0	101.2
1984	96.1	101.3
1985	95.0	100.5
1986	92.7	95.7

(Japan Statistics Bureau, 1987)

Table 87. U.S. producer price index for wood pulp, 1950-85 (1967 = 100).

	Actual	Relative*
1950	81.0	99.0
1955	95.7	109.0
1960	102.2	107.7
1965	100.1	103.6
1970	109.6	99.3
1975	283.4	162.0
1980	380.3	141.5
1981	397.1	135.3
1982	379.0	126.6
1983	346.9	114.5
1984	397.2	128.0
1985	346.6	112.3

*Derived by dividing actual price index by all commodities price index.
(Ulrich, 1987)

Table 88. Alaska relative price index (1967 US = 100)

	ARPI	ARPI/USCPI*
1961	131.4	1.47
1965	134.1	1.42
1970	156.2	1.34
1975	217.0	1.35
1980	320.1	1.30
1981	344.7	1.27
1982	364.2	1.26

*Ratio: Alaska Relative Price Index to U.S. Consumer Price Index

(University of Alaska, 1984)

The Japanese domestic price of pulp climbed significantly in the past 25 years, especially during the two oil shock periods of 1973-74 and 1979-80 as shown in Table 89.

Table 89. Japan wholesale price of pulp and paper products (1975 = 100).

1965	51.80
1970	58.40
1973	69.80
1974	106.00
1975	100.00
1979	102.30
1980	133.30

(Gallagher and Mehrkens, 1984)

Table 90. Annual inflation rates.

	76	77	78	79	80	81	82	83	84	85
United States	6.5	7.6	11.3	13.5	10.4	6.2	3.2	4.3	3.6	1.9
Canada	8.0	9.0	9.1	10.2	12.4	10.8	5.8	4.3	4.0	4.2
Japan						2.6	1.9	2.3	2.0	.6
Australia						11.1	10.1	4.0	6.7	9.1
Chile						9.9	27.3	19.9	30.7	19.5
Brazil						98	142	197	226	145

(US Dept Commerce, 1988)

Capital recovery factor:

Capital recovery factor (crf) - what annual fraction of initial investment must be recovered each year to amortize the investment cost in X years.
(crf) x (investment cost) = annual charge

$i/(1-(1+i)^{-t})$

E.g. present value of a 20 year series @ 10%

.10/.8514 = .1175 > ac = (.1175) x investment cost

crf = .1175

6.2. Glossary

ADTPD - Air-dry (short) tons (10% moisture, 90% bone-dry fiber) per day

BDT - bone dry ton

BDU - bone dry unit, a 2400 pound standard unit used in the export of wood chips

C&F - cost and freight (buyer pays for insurance)

CIF - cost, insurance and freight (included in the price quoted) to the named destination

FAS - free along side ship: without charge to the buyer for delivering goods alongside carrier

FOB - free on board: without charge to the buyer for placing goods on board a carrier at the point of shipment

Greenfield mills - A new pulp and/or paper mill built on a site on which no other mill exists

Kraft pulp (sulphate pulp) - The strongest chemical pulp ("kraft" means strength in German), made by the alkaline process of cooking wood in a solution of sodium hydroxide and sodium sulfide.

MITI - Japanese Ministry of International Trade and Industry

Pulp Grades:

BHK - Bleached hardwood kraft
BKP - Bleached kraft pulp
BSK - Bleached softwood kraft (sulphate)
BSP - Bleached sulphite
CMP - Chemi-mechanical pulp
CTMP - Chemi-thermo-mechanical pulp
DP - Dissolving and special alpha (non-paper) pulp
DPW - Deinked pulp from wastepaper
GW - Groundwood pulp
KP - Kraft pulp
MP - Mechanical pulp
NWP - Non-wood pulp
RMP - Refiner mechanical pulp
SBSK - Semi-bleached softwood
SCP - Semi-chemical
SP - Sulphite pulp
TMP - Thermo-mechanical pulp
UBHK - Unbleached hardwood kraft
UBKP - Unbleached kraft pulp
UBSK - Unbleached softwood kraft
USP - Unbleached sulphite
Others:
cotton linters
baggase (cane)
esparto (grass)
straw

sogo shosa- Japanese general trading house

6.3. Bibliography

6.3.1. References

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6.3.2. Personal Communications

Dr. William McKean, Professor of pulp and paper technology, University of Washington.

Don Flora, Economist, US Forest Service PNW Experiment Station, Seattle

Lester Miller, Acting Regional Economist, USFS R-10, Juneau

Gary Peterson, Timber Appraisals, USFS R-10, Juneau

Michael Martin, Regional Economist, USFS R-10, Juneau

Franklin C. Roppel, Executive Vice President, Alaska Pulp Corporation

Dr. Philip Wardle, Senior Forest Economist, FAO