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Incremental Silviculture Strategy For British Columbia

Working Paper 4: Proposed Log Quality Framework, Timber Supply and Demand

PREPARED FOR

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Incremental Silviculture Strategy For British Columbia

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This document is one of seven reports prepared as background to the preparation of an incremental silviculture strategy for British Columbia.

The working papers are individually subtitled as follows:

- *Working Paper 1: Project Information, References*
- *Working Paper 2: Concepts of Strategy and Planning, Proposed Planning Framework*
- *Working Paper 3: Government's Goals, Proposed Guiding Principles*
- *Working Paper 4: Proposed Log Quality Framework, Timber Supply and Demand*
- *Working Paper 5: Proposed Financial and Socio-economic Analysis Framework*
- *Working Paper 6: Summary of TSA Basic Data*
- *Working Paper 7: Review of TSA Issues and Planning Processes*

This report covers two topics:

<u>Proposed Log Quality Framework</u>

proposes a log quality framework to support incremental silviculture planning, specifically:

- the establishment of a Year 2000 quality benchmark;
- three proposed quality classes of softwood timber; and
- two proposed quality classes of hardwood timber.

<u>Timber Supply and Demand Analysis</u>

contains:

- a review of global timber supply and demand;
- a review of North American timber supply and demand, focusing on the United States;
- a review of British Columbia timber supply and demand; and
- strategic conclusions regarding timber supply and demand.

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1 A Proposed Log Quality Framework

1.1 Introduction

This report contains a proposed quality framework to enable measuring the quality of the timber resource and the setting of a quality target.

1.2 Year 2000 Quality Benchmark

The first step in measuring the quality of British Columbia's forests is to establish a benchmark quality profile for reference purposes. A *Year 2000* benchmark is proposed. This particular year has very high prominence, being the beginning of a new millennium.[1] However, the ministry should probably not base an estimate of the current log quality profile on just a single year but rather on an average of the annual harvests over several years, such as from 1998 to 2000.

While it is possible to 'turn back the clock' to use some earlier date for a benchmark, this may not be practical nor appropriate. On the practical side, grading rules change over time, so relating the quality profile of today's harvest to that of the distant past may be difficult. Another reason is that the harvest profile of earlier times did not represent the standing inventory profile as closely as it does today. For example, in 1960, lodgepole pine was only 4% of the total provincial harvest (BC MOF, 1960 Annual Report). In contrast, in 1994/95 lodgepole pine was 25% of the total harvest

[1] Some argue that technically the new millennium does not begin until 2001, but 2000 is the symbolic date accepted by most.

(BC MOF, 1994/95 Annual Report), which is close to its 24% proportion of standing timber volume in timber supply areas (BC MOF, 1995:47).

In any event, if government ultimately wishes to strive for a higher quality level than that of the year 2000, doing so is a simple matter of setting targets to exceed the benchmark. At that point the psychology of such a target (that is, exceeding the benchmark) becomes very positive.

1.3 Example of a Year 2000 Quality Profile

Figure 1 and Figure 2 contain hypothetical examples of a Year 2000 quality profile (the next section contains a description of the quality classes shown). These examples illustrate a high softwood fibre volume in the Vancouver and Prince Rupert forest regions and a high hardwood fibre volume in Prince George Forest Region.

Initially, it may be more feasible to set strategy targets for quality at the regional rather than management unit level. Regions may then disaggregate these to management units, possibly disproportionately depending upon the species, growth rates and economics of each management unit. (See *Working Paper 2: Concepts of Strategy and Planning, Proposed Planning Framework* for an example of a management unit quality profile projection over time.)

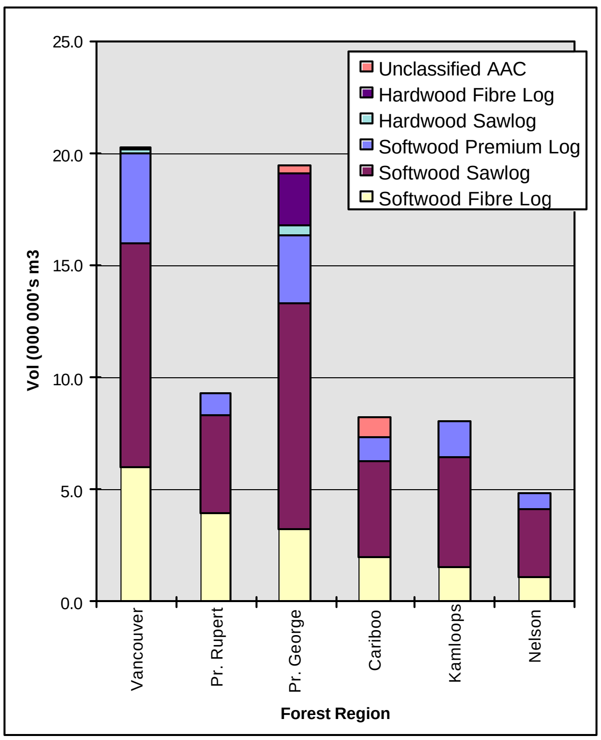

Figure 1. Hypothetical Example of a Year 2000 Forest Quality Profile - By Volume

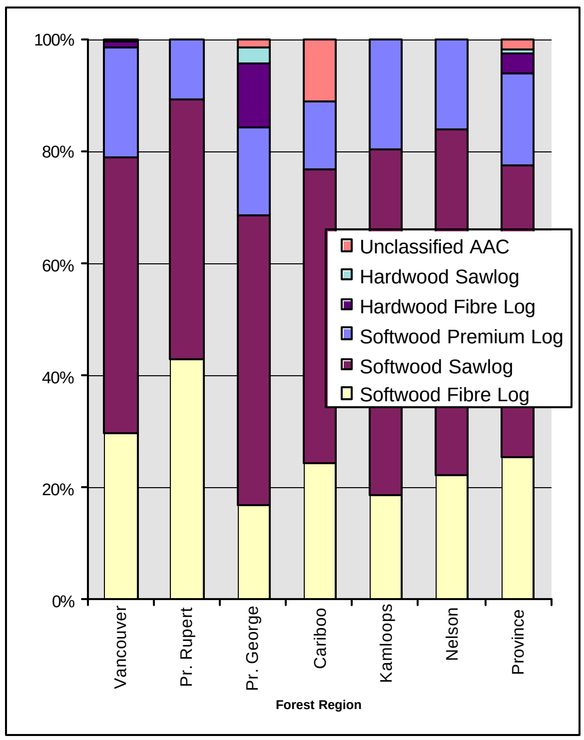

Figure 2. Hypothetical Example of a Year 2000 Forest Quality Profile - By Percentage.

1.4 Proposed Quality Classes

Introduction

In keeping with the fact that long-term future demand is impossible to predict, a few broad quality classes are proposed, following an assessment of quality classes used by others.[2] These may require further refinement before final adoption. Separate definitions are proposed for coniferous and deciduous quality classes.

Proposed Coniferous Species Quality Classes

Quality Classes Used by Others

Reid Collins (1993:15) identified five quality classes for coastal conifer logs as follows.

> **Quality** - Logs 5 m or more in length, 25 cm or more in radius, capable of cutting out 75% of the gross scale in merchantable lumber, and where at least 25% of the lumber will be clear.
>
> **Large Merch.** - Logs 5 m or more in length, 20 cm or more in radius, capable of cutting out 75% of the gross scale in merchantable lumber, and where at least 50% of the lumber will be #2 or better.
>
> **Intermediate Merch.** - Logs 5 m or more in length, 10 to 20 cm in radius, capable of cutting out 75% of the gross scale in merchantable lumber, and where at least 50% of the lumber will be #2 or better.
>
> **Small Merch.** - Logs 3.8 m or more in length, 5 cm or more in radius, capable of cutting out 75% of the gross scale in merchantable lumber and where at least 50% of the lumber is #2 or better.
>
> **Utility** - Logs lower in quality which can still yield lumber or chips.

Simons and Cortex (1993:7) developed three log grade "bundles" for the coast based on grade groupings used by the Council of Forest Industries (COFI):

Bundle 1	High-grade sawlog and peeler logs
Bundle 2	Average-grade oversized sawlogs
Bundle 3	Average grade undersized and utility sawlogs and chipper logs

They further subdivided COFI's Bundle 3 into bundles 3A (log grades I and J) and 3B (log grades X and Y) to "…provide a better reflection of prices for second-growth stand, which contain a relatively high proportion of I and J grade logs."

[2] "In forecasting, simplicity usually works better than complexity. Complex forecasting methods mistake random noise for information. Moderate expertise proves as effective as great expertise." (Mintzberg, 1996:230)

For the interior, where logs are not graded as on the coast, Simons and Cortex (1993:52) used two tree quality classes developed by Middleton and Munro, for which they then developed log prices by diameter class.

In conclusion, the evidence from existing studies is that for the coast three to five quality classes are likely to be appropriate, and for the interior there are no existing quality classes.

Proposed Quality Classes

While the Reid Collins or the Simons and Cortex quality classes could no doubt be used, they cannot be applied in the interior of B.C. Therefore, only three simple, generic quality classes for coniferous species are proposed in Table 1. Ministry planners should develop specific definitions for each management unit using these definitions as a reference.

Softwood Quality Class	Definition	Reid Collins Equivalent	Simons & Cortex Equivalent	Lumber Grade Equivalent
Premium Log	Logs having one or any combination of the qualities of: larger size, narrow ring width, high specific gravity, low taper, and/or few or no knots, such that the particular quality or combination of qualities commands higher than average prices in a free market. Specifications may vary by tree species and forest region.	• quality class • upper 25% large merch class	Bundle 1 + upper 25% bundle 2.	good proportion of premium structural and appearance grades.
Sawlog	Logs having at least 50% sound wood and large enough diameters that: • make them viable to harvest and transport; and • yield sawn two by four or larger lumber, mostly above utility grade. Harvesting and transportation costs may result in a sawlog being larger in some areas of the province than others.	• lower 75% large merch class • intermediate merch class • small merch class	lower 75% bundle 2 and bundle 3A	small proportions of lumber of premium structural and appearance grades, a large proportion of number 2 grade and a small proportion of utility lumber.
Fibre Log	Logs not meeting the sawlog definition.	mostly utility class lumber or wood chips	Bundle 3B	mostly utility class lumber or wood chips

Table 1. Proposed Softwood Log Quality Classes

Proposed Deciduous Species Quality Classes

Quality Classes Used by Others

The literature review did not uncover any studies having quality classes for deciduous species. There has been little need. Deciduous species have only recently become merchantable in British Columbia.

Proposed Quality Classes

Massie (1996:6) developed a listing of potential products and markets by individual hardwood species that currently exist or may develop in the next few years. Using Massie's list as a guide, and until deciduous markets create further differentiation in demand, usage, and consequently price for deciduous species, only two quality classes are proposed.

Hardwood Sawlog

A hardwood sawlog is any merchantable log of which at least one-third can be converted into sawn lumber, minor specialty products, or veneer.

Hardwood Fibre Log

A hardwood fibre log is any merchantable log which is sufficiently sound to be converted into wafers or chips or used for fuelwood or hog fuel.

Estimate of Current Quality Profile

Studies of the current quality profile are scarce and do not cover the entire province. However, from the information available, coastal BC harvests in the recent past have contained roughly 15% premium logs. These studies also indicate that over time as new forests replace the remaining old-growth the proportion of sawlogs will increase with a corresponding decrease in fibre logs. (Reveley, 1996)

The 15% estimate of premium logs is derived from two sources as follows.

- Table 2 on the following page shows how an estimate of 13% premium logs can be derived from data from Simons and Cortex (1993). This study contains historical percentages of volumes by grade bundles for the years 1981 to 1989 (1993:8 - Fig 8) as well as data for the percentage of the 1990 log production by species. (1993:4 - Fig 4).
- An estimate of 17% premium logs can be derived from data from Reid Collins (1994b). This study indicates the percentages of total volume for all species for the 'quality' and the 'large merch' classes for the year 1990/92 to be 5.9% and 44.6% respectively (1994b:8 - Table 3). Assuming 100% of the 'quality' class and 25% of the 'large merch' class to be premium logs, the total premium log component is roughly estimated at 17% (5.9 + (.25*44.6) = 17).

	Douglas-fir	Cedar	Hemlock	Balsam	Total
100% Bundle 1	3	10	4	8	
25% Premium Log Component of Bundle 2	.25 * 41 =10	.25 * 36 =9	.25 * 13 =3	.25 * 19 =5	
Total % Premium logs	13	19	7	12	
% log production by species, 1990	14	24	38	17	93
% premium logs	2	5	3	2	12%
Adjustment to 100% log production					100/93 * 12 = 13%

Table 2. Derivation of 13% Estimated Premium Log Component of Harvests

The two results of 13% and 17% average to a 15% premium log component. *This 15% estimate is exceedingly rough. The sole purpose of deriving this estimate is to provide an interim working estimate until such time as an in-depth analysis is undertaken to create the proposed Year 2000 quality class profile.*

The following problems with the above analysis are acknowledged:

- The Simons and Cortex data for percentages of grade bundles and of log production are for two different time periods. The 25% premium log component of Bundle 2 is solely a ‘guesstimate’ by this consultant.
- The Reid Collins data is for a different year than those of the Simons and Cortex data. Also, the coastal log grading system changed in 1990 (Simons and Cortex, 1993:7), so the data is derived from two different systems. The 25% premium log component of the Reid Collins ‘large merch’ class is solely a ‘guesstimate’ by this consultant.
- Both the Simons and Cortex and the Reid Collins data are for coastal BC. There is no quality class data for interior BC. In the absence of data, the 15% coastal portion is assumed to also be applicable to the interior.

2 TIMBER SUPPLY & DEMAND ANALYSIS

2.1 Introduction

Why Review Timber Supply and Demand?

Programming strategy to ensure it is accomplished in the most efficient and effective manner requires further background analyses. The following questions require investigation. Can British Columbia's future timber supply be increased and how? What are the trends in forest management within British Columbia that may affect this? If we produce more timber will there be a demand for it? Will the demand be different for different grades and species of timber? Are we likely to get a return on our investment?

An enigma of strategy and planning is the matter of forecasting the future.[3] Predictably, the literature review of studies of future timber supply and demand finds conflicting opinions. While assessments of timber supply are generally more realistic than those of timber demand, both can change dramatically in a short time. Demand for industrial roundwood is subject to revolutionary technological developments. The long-term nature of forest growth has not permitted rapid adjustments in timber supply in the past, but this may change in the future with intensive plantation management and fibre farming. The diversity of ownership amongst many nations mitigates against any one nation substantially altering global timber supply through policy.[4] However, large-scale disruptive economic events do occur. The collapse of the USSR has greatly affected timber supply in eastern Europe and Asia. The recent Asian economic crises has had a significant effect on pacific rim forest product markets and trading.

In spite of the above uncertainties, due diligence requires a broad analyses of timber supply and demand, the main purposes of which are to check for signs that would indicate a major shift in strategy is warranted or to "red flag" something for further investigation in the near future.

Information Sources

Information in this report comes primarily from the following sources:

- the B.C. Ministry of Forests' *1994 Forest Range and Recreation Resource Analysis* (the 'resource analysis,' which derives its information from several other sources);

[3] See *Working Paper 2: Concepts of Strategy and Planning, Proposed Planning Framework* for a discussion of the generally acknowledged failure of forecasting.
[4] Although Delcourt et al (1996:2) indicate that change in BC lumber production alone is sufficient to affect prices.

- the United Nations Food and Agriculture Organization's *State of the World's Forests 1997* (the 'FAO report');
- three discussion papers issued by Resources for the Future, a Washington, DC 'think tank':
  - *Timber Supply Model 96: A Global Timber Supply Model with a Pulpwood Component* (Sedjo and Lyons, 1997),
  - *An Analysis of Global Timber Markets* (Sohngen et al, 1997),
  - *The Forest Sector: Important Innovations* (Sedjo, 1997); and
- the Canadian Forest Services' annual *State of Canada's Forests* reports for the past several years.

The reader is referred to these sources for additional detailed information (see *Working Paper 1: Project Information, List of References*).

Terminology and Definitions

Demand, Supply, Consumption and Production

The term 'demand' tends to be used interchangeably with 'consumption' as is the term 'supply' with 'production.' However, there are important differences between these terms.

At the global level, production always meets consumption.[5] Thus, when the term 'production' is used, an equal 'consumption' is implied, and vice versa. Some analysts use 'equilibrium models' to project future global production and consumption. In such models, as in the 'real' world, production equals consumption. Nonetheless, at any level below global, production is not necessarily equal to consumption.

Some analysts prefer to project demand and supply independently to determine where there may be potential for theoretical shortages or surpluses. From this, they speculate on the potential for future changes in real log prices. Thus, when the term 'demand' is used in this context, an equal 'supply' should not be assumed to be readily and immediately available.

At the world level, this paper follows the FAO's terminology for categorizing forest products. The structure of demand is illustrated in Figure 3. While final demand is in the form of manufactured forest products, this ultimately translates into demand for roundwood log products. These categories are described further in the next sections.

[5] This is discussed in more detail in "Market Factors Determining Log Prices," in *Working Paper 5: Proposed Financial and Socio-economic Analysis Framework*.

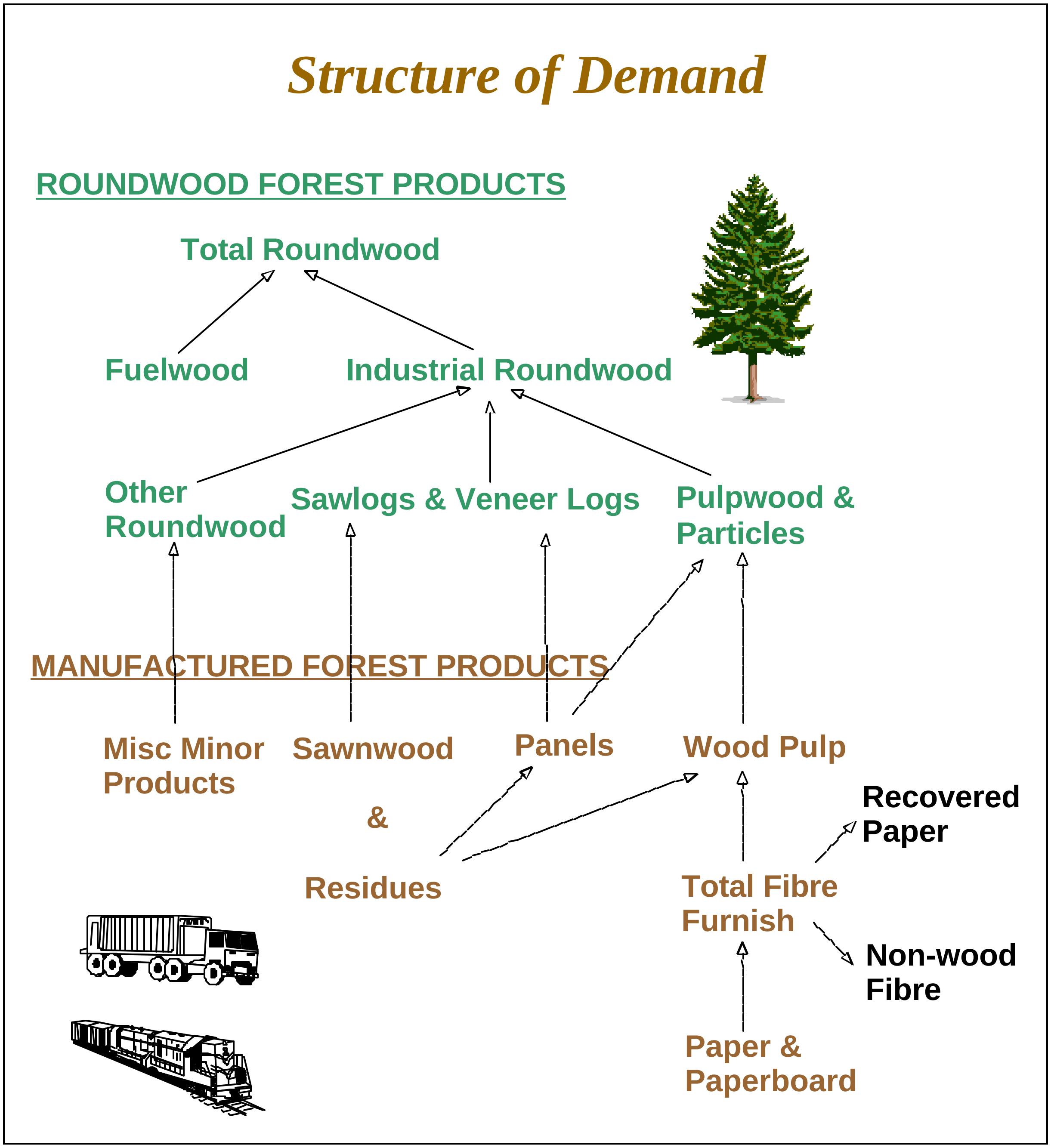

Figure 3. Structure of Global Demand for Forest Products

Roundwood Forest Products

The grand total of all log production is termed 'total roundwood.' Total roundwood is broken into the two major categories of:

- industrial roundwood, and
- fuelwood.

Because fuelwood has little relevance to British Columbia it is not addressed further here.[6] All references to roundwood consumption in this report are references to industrial roundwood.

The FAO further breaks down industrial roundwood into the three categories of:

- sawlogs and veneer logs,
- pulpwood and particles,[7] and
- other industrial roundwood.[8]

"Any of these categories of roundwood can go directly into domestic processing or into international trade." (FAO, 1997:46)

Manufactured Forest Products

The FAO tracks the manufacture of industrial roundwood into the following three basic categories of forest products:

- sawnwood,
- wood-based panels, and
- wood pulp for paper and paperboard manufacture.

While all sawnwood comes from sawlogs, the same direct relationship with a particular roundwood source does not exist for panels and wood pulp. Wood-based panels include veneer sheets, plywoods, particle board and fibre board. Veneer sheets and plywood are manufactured from veneer logs. Particle board and fibreboard can be manufactured from lumber manufacturing residues or from pulp logs.[9] Wood pulp can be manufactured from pulplogs and from sawmill residues.

Because not all paper and paperboard is manufactured from wood pulp, the FAO also collects and publishes data for total fibre furnish for paper and paperboard. Total fibre furnish consists of:

- wood pulp,
- recovered paper, and
- non-woodfibre pulp.

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[6] Fuelwood usage is very important elsewhere, however. Slightly more than half of total global roundwood production is fuelwood (FAO, 1997:50).
[7] Includes pulpwood, chips, particles and wood residues. In production, the commodities included are pulpwood. In trade, the aggregate also includes chips or particles and wood residues.
[8] Includes roundwood used for tanning, distillation, match blocks, gazogenes, poles, piling, posts, pitprops, etc.
[9] The *State of the World's Forests* does not indicate the fibre source for panels such as MDF and OSB. Because fibre for OSB in particular can come directly from roundwood (as opposed to sawmill residue), it is assumed that such roundwood would be in the FAO pulplog (rather than sawlog) classification.

Products, Markets and Trends Most Relevant to BC

British Columbia's Major Products

Of the categories identified in the preceding section, those of most relevance to British Columbia are:

1. At the log level:
   - industrial roundwood, and
   - sawlogs.
2. At the manufactured product level:
   - sawnwood,
   - wood-based panels,
   - wood pulp,
   - total fibre furnish, and
   - paper and paperboard production and consumption.

The forest product trends within these categories as well as between them are of interest.

Only the pulp and paper markets display the characteristics of a globalized market. Therefore, global trends are the most significant with respect to these market segments.[10] Softwood lumber and wood-based panels are more regional in nature, and global trends therefore have less significance for them.

British Columbia's Major Markets

Table 3 shows the destination of BC's forest products in 1996. The United States is by far British Columbia's largest market, followed by Asia, of which Japan has a significant market share. The next most significant market is the Canadian domestic market. Europe is only a significant market for BC pulp, paper and paperboard exports.[11]

[10] The primary characteristics of a globalized market are: universal product standards and specifications, production capacity is concentrated within fewer and larger multi-national firms, and trade between principal exporting and importing regions is active and balanced (Canadian Forest Service, 1996:49).
[11] Recent economic developments in southeast Asia no doubt will result in market shifts from those reported in Table 3.

Product	Destination (%)					
	US	Japan	Other Asia	Canada	Europe	Other
Solid Wood (% by value)	54	26	-	14	3	3
Newsprint (% by volume)	51	11	17	11	2	8
Pulp, Paper & Paper-board (% by volume)	20	16	24	9	27	5

Source: Council of Forest Industries, 1997

Table 3. Destination of British Columbia Forest Products, 1996

Significant shifts in markets can and do take place within relatively short time periods, however. Table 4 shows the destination of BC's forest products in 1988. Note that the reporting methods for pulp, paper and newsprint are different between this and Table 3, and so direct comparisons for these products cannot be made. Significant market shifts are nevertheless evident, for example, the doubling of the percentage of solid wood exports to Japan over this time period, and the commensurate reduction in the Canadian domestic market.

Product	Destination (%)					
	US	Japan	Other Asia	Canada	Europe	Other
Solid Wood (% by value)	48	13	1	28	9	1
Pulp & Paper (% by value)	31	13	3	14	22	17

Source: Council of Forest Industries, 1997

Table 4. Destination of British Columbia Forest Products, 1988

2.2 Global Timber Supply and Demand

Global Demand

Historic Global Consumption: 1970 to 1994

The following quotes from *State of the Worlds Forests 1997* (FAO) serve to provide an overview of recent trends in global consumption:

- From 1970 to 1994 "…industrial roundwood consumption grew by 15 percent [from almost 1 300 million m3] to almost 1 500 million m3, although actually declining from a high of 1 720 million m3 in 1990." The recent reduction is a product of a 50% reduction of output in the Russian Federation as well as weak demand in industrialized countries. (50)

- "The slow growth for industrial roundwood masked the fact that coniferous roundwood production only increased by 1 percent, while that of non-coniferous roundwood grew by 48 percent." (50)
- Developing countries "…have increased their share of industrial roundwood from 17 percent to 33 percent." (50)
- "…it was the growth of consumption in Asia that transformed the global balance: from consuming 15 percent of world industrial roundwood in 1970, Asia came to account for 21 percent (compared to about 20 percent for Europe) in 1994." (50)
- "Notwithstanding the growth of both population and incomes, sawnwood seems to have reached a plateau, with long-term consumption nearly stagnant relative to other processed forest products." (53)
- "Production of wood-based panels (veneer, plywood, particle boards, and fibreboards) has been particularly dynamic. Production in the developing countries has grown more than five-fold. New types of panels have competed with traditional ones and have also created new opportunities for use." (53) Wood-based panels "…were equivalent to only 17 percent of sawnwood in volume but this ration climbed to … 30 percent by 1994. This may have contributed to the slow-down in demand for sawnwood, although some of the increase in the use of panels may reflect new markets altogether." (54)
- "There has been particularly rapid growth in the consumption of pulp and paper products and, in parallel, greater recycling. So rapid has this growth been, that world per caput consumption has increased by about 40 percent; consumption in developing countries is up more than three-fold, the fastest gains being in Asia." (53) [12]
- The production of total world fibre furnish increased about 100% between 1970 and 1994, rising from 134 to 271 million tonnes. (57) However, in the same period, wood pulp increased only about 50%, rising from approximately 100 to 150 million tonnes, the balance coming from dramatic increases in recovered paper and non-wood fibre sources. (55 - fig. 4)

In summary, between 1970 and 1994 total world industrial roundwood consumption only increased about 15%, consumption of sawnwood has stagnated, while production of panels increased dramatically and wood pulp increased by 50% (Figure 4). At the same time the production of total world fibre furnish has virtually doubled, with most of the increase occurring in developing countries. Recovered paper and non-wood fibres are significant sources of fibre furnish. Growth in consumption in Asia is responsible for many of these trends.

[12] No doubt this will fall off due to the recent "Asian meltdown," but data will not be available for several years.

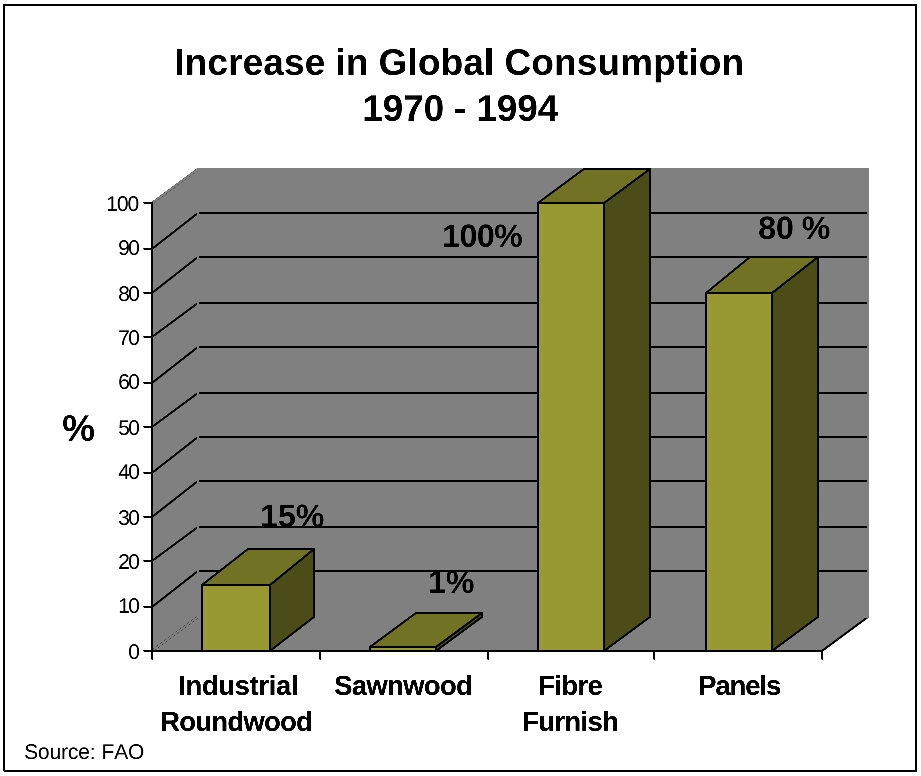


Figure 4. Global Consumption Patterns, 1970 - 1994

Global Demand Forecast to 2010

Virtually all studies indicate a steadily growing global demand for industrial roundwood, ranging from 0.5% to 1.5% per annum. The MOF resource analysis forecasts total industrial roundwood demand to the year 2020 to increase at the rate of 1.4% per year, with the softwood component at 1% per year and hardwood at 2.2% per year. (217) The FAO forecasts total industrial roundwood consumption to increase at a slightly lower rate of 1.2% per year, from 1.5 to 1.8 billion cubic metres. (78) This is less than historic growth in consumption, which the FAO reports as being 1.48% per year for the years 1970-1990 (78). Sohngen et al use a baseline demand growth rate of 1% and create high and low demand scenarios of 1.5% and 0.5% respectively (1997:14, 20). Sedjo and Lyon assume a base case world demand for industrial roundwood of 1.0% and for pulpwood of 2.25% (1996:17). It's important to note that most forecasts tend to be a take-off of older (and higher) FAO forecasts.

The FAO study "took particular account of population, income, prices and the availability of forest resources." (77) "Between 1960 and 1995, world population almost doubled in size and the world economy (as measured in GDP in real terms) increased three and a half times. Over the same period, world production…of sawnwood tripled, and of paper more than tripled. Looking ahead, today's population of 5 716 million is expected to grow to 7 032 million by the year 2010." (5) According to the FAO, "…it seems likely that the current trend of proportionately higher economic growth in the developing world will continue." (6) This all leads to FAO's ultimate conclusion that "The combined impact of economic growth and increasing population size on demand for forest products is likely to be significant, particularly so since per capita consumption of industrial forest products is especially responsive to income change at low levels of income." (6)

Once again demonstrating the perils of forecasting, both the FAO and MOF forecasts did not foresee the recent economic crises occurring in southeast Asia and the resultant reduction in demand. Both forecasts would now appear optimistic.

To conclude, the lower FAO rate of growth in demand, 1.2% per annum, is accepted here, being a more recent projection than the MOF's as well as the lower of the two. Due to the recent reduction in demand in southeast Asia, actual consumption will likely be lower than this.

MOF Global Demand Forecast to 2020

The FAO report only projects to the year 2010 while the MOF resource analysis goes to 2020. The MOF forecast maintains a compounded annual increase in demand of 1.4% right through to 2020. As a result, by this date, the MOF forecasts a significant excess global demand over supply for both softwoods and hardwoods.

> Scarcity of hardwood sawlogs will likely increase around the turn of the century, as harvests from natural tropical stands are curtailed. Harvests from plantations of tropical hardwoods will not make up the deficit. By the end of the forecast period the sawlog deficit will extend to softwoods. Although pulpwood supplies are expected to increase, demand for pulpwood is forecast to increase faster. Scarcity of pulpwood will develop by the middle of the forecast period and increase in severity through 2020. (BC MOF, 1995:219)

Other than the above quote, the resource analysis provides little discussion as to the causes of the projected imbalances. The only direct reference to a cause is that after 2000, demand for pulp logs will increase as the limits to recycling are reached and the pulp industry faces increased competition for milling residues from the producers of non-structural panel boards. (BC MOF, 1995:217)

Global Demand Beyond 2020

Neither the FAO nor MOF analyses project demand beyond the year 2020. The Resources for the Future studies, as a matter of methodology, use a declining demand function whereby the annual increase in demand (1% at the beginning) declines to 0.0% in 50 years (something to note in comparison to the MOF resource analysis methodology).

Meeting Global Demand: The Supply Side

How Recent Global Consumption Growth Has Been Met

The FAO reports that during the period 1970-94, "…although processed products grew very rapidly (by two-thirds for pulp for paper,[13] two-fold for total fibre furnish, and more than two-fold for

[13] Wood pulp production, however, only grew by 50%, indicating the use of other fibre sources in the making of pulp for paper.

paper and paperboard), consumption of the roundwood raw material itself was practically stagnant, having only increased by 15 percent."[14] (53-54)

How have these increases in the consumption of industrial roundwood and in pulp and paper products been met? In brief, increased recycling, technological improvements, increasing use of non-wood fibre in paper manufacturing, and a substantial increase in fast-growing plantations (Figure 5).

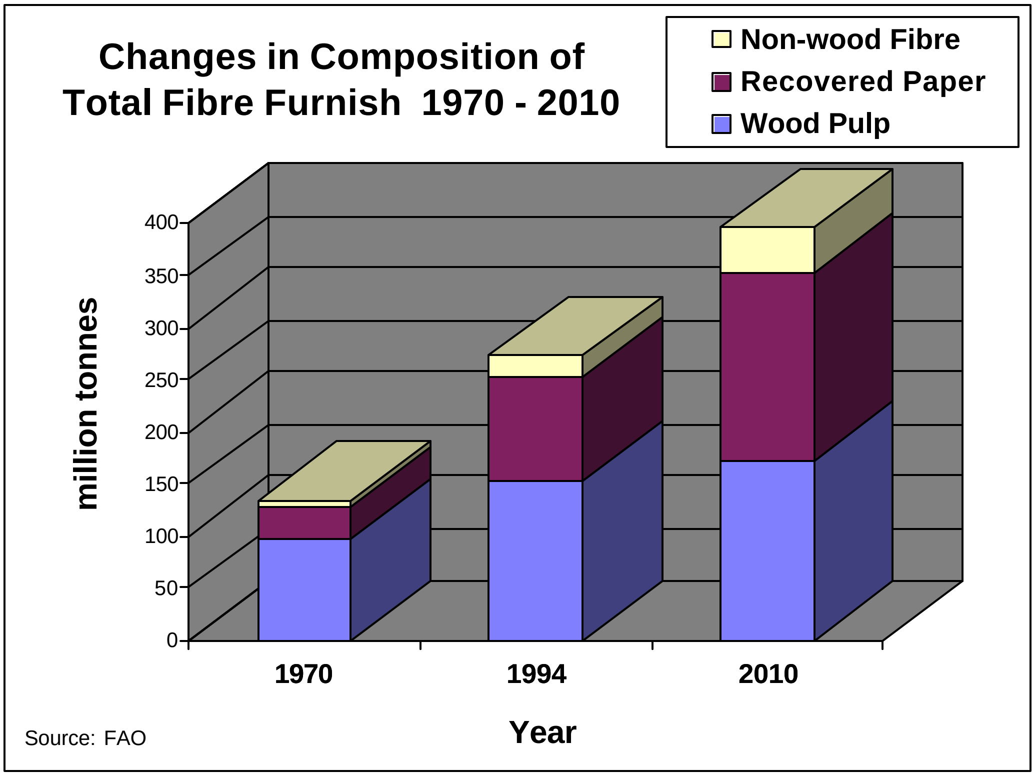


Figure 5. Changes in Consumption of Total Fibre Furnish, 1970 - 2010

Increased Recycling

Between 1970 and 1994 recovered paper more than tripled from 31 to nearly 100 million tonnes. Recycling rates are 50% in Japan, 51% in the European Economic Community and 33% in the United States. (FAO, 1997:31)

Technological Improvements

In North America, increased consumption was satisfied to a significant degree through technological improvements and recycling (see "The US South

[14] Industrial roundwood, had actually declined from a high of 1 720 million m3 in 1990 to 1 500 million m3 in 1994, mostly due to dislocation of output in the former USSR. The 15% growth rate is based on the 1994 level. (FAO:50) For further information, see "Historic Global Consumption: 1970 to 1994," page 12.

Although the FAO predicts maturing plantations in the US South will help ease potential supply problems in the US domestic market, Wear (1996:1) found production in this area is already showing signs of leveling off.

> From the early 1950's until the early 1980's forest inventories as well as rates of production have increased in the region. Since this period of expansion, the region's production shows signs of leveling off. While capacity for expansion exists, recent levels of investment do not portend extensive growth in the immediate future.

On the other hand, the significant unmanaged land area in the US South offers substantial potential to expand forest inventories, given the right incentives.

> …a full 90% of the timberland in the South is controlled by private landowners. Of this private share, 22 percent is held by firms that produce wood products ("forest industry") and the remainder is held by a wide variety of individuals and other corporations. This latter group of owners, generally labeled the nonindustrial or other private ownership group, represents a wide range of objectives and forest management. (Wear, 1996:2)

> …private producers, including those in the "other private" category, can and do respond to market signals in the production of timber. (Wear, 1996:6)

While the market can respond to demand, recent information would indicate that significant expansion in timber demand is not anticipated by landowners in the US South.

> These three indicators of sustainability, inventory, dynamics, timberland investment, and price trends, all seem to suggest a well-organized timber producing sector in the southern United States. That is, the sector appears to have grown in an orderly manner between the 1950's and 1980's and leveled off in the late 1980's and early 1990's. Unfortunately, data are not yet compiled that would provide insights into the sector's response to recent structure changes in national timber markets. However, investment history does not indicate that landowners anticipate significant expansion in the timber growing sector. (Wear, 1996:8)

Wear (1996:3), referencing Alig, states the principal competitors for timber land in the US South are agriculture and urbanization.

> While the share of agricultural land in the South has declined substantially since the beginning of the century, much of the region's timberland could revert to crop production in response to strong markets for agricultural products (Alig 1986). In addition, increasing demands for residential, commercial and other non-rural uses of land are anticipated as the South continues to experience the highest rate of population growth in the U.S. (Alig 1986)

As noted previously Sedjo sees the US South as a favourable location for increased plantation forestry management, although at a disadvantage to plantations in the semi-tropics (see "Discussion Papers by Resources For the Future," page 19).

Technological Improvements," page 24).

Increasing Use of Non-wood Fibre

Globally, "Wood pulp (i.e., fibre made from pulpwood logs or chips) used to account for more than three-quarters of raw material in 1970 but, by 1994, was only 56 percent, although in absolute terms the quantity had grown by more than one-half." (FAO, 1997:31) It attributes this change to high rates of recycling as well as a 350% increase in the use of non-wood fibre (mostly straw and bamboo pulp) in Asia. This non-wood fibre usage was a doubling at the world level, growing from about 4% of total world furnish in 1970 to 8% in 1994. The FAO concludes these trends ***"…are effectively making the paper manufacturing industry less directly dependent on forests."*** (1997:31 - emphasis added)

Increased Plantations

See "Discussion Papers by Resources For the Future," page 19.

Meeting Projected Global Demand

FAO and MOF Studies

The FAO report reviews the findings of five other recent global outlook studies, including a 1995 study by the Council of Forest Industries of British Columbia. The FAO concludes:

> Most projections of future adequacy of supply fall within the same orders of magnitude [as that of demand], but a few project major supply gaps. Consensus appears to be heading towards a 'non-crisis' future situation. However, no study foresees plentiful supplies. (76)

The MOF resource analysis predicts that by the year 2010 there will still be a 60 million m^3/year excess supply of softwood but hardwood will have an excess demand of 39 million m^3/year. (219:Fig 7.36[15])

While not segregating softwoods from hardwoods, the FAO concludes, "Present indications are that, at least until 2010, there will be adequate wood globally to meet both industrial and fuelwood needs, although local level shortages will exist simultaneously with surpluses elsewhere." (74)

Figure 6 shows historic and forecast industrial roundwood consumption.

[15] Actual numbers are contained in MacKinnon and Still, 1996:65 - Table A122.

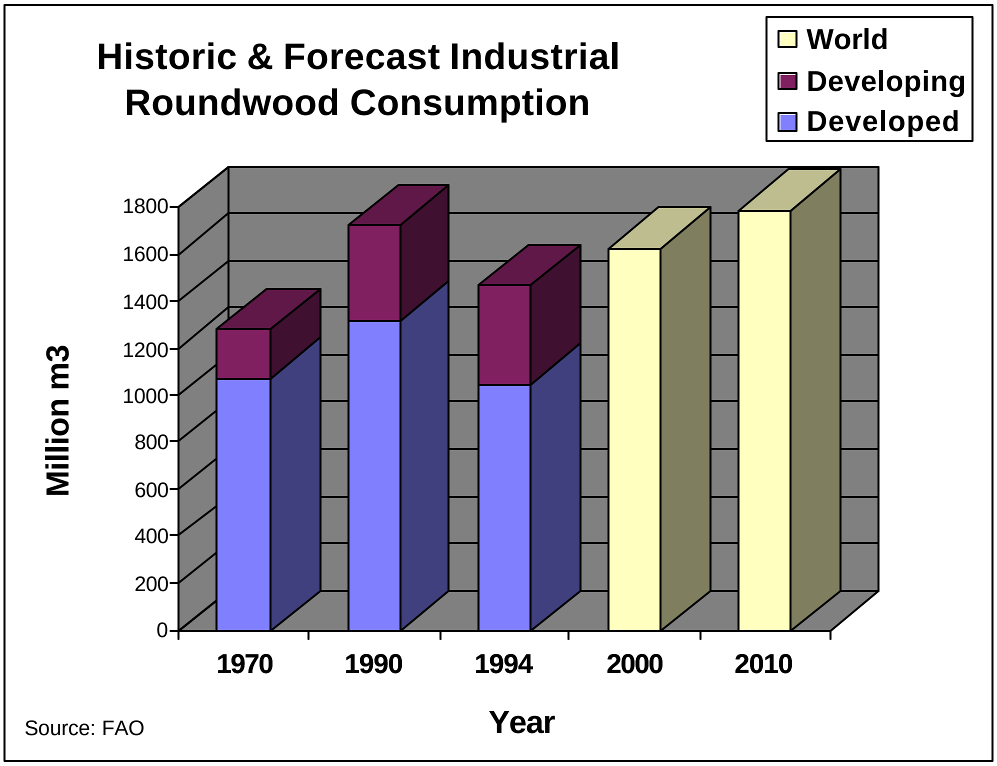


Figure 6. Historic and Forecast Industrial Roundwood Consumption

The MOF resource analysis, however, makes projections to the year 2020. By this date, it forecasts a significant excess global demand over supply for both softwoods and hardwoods. See "MOF Global Demand Forecast to 2020," page 15.

Discussion Papers by Resources For the Future

Recent discussion papers by Resources for the Future (RFF) place more emphasis on the role of intensively managed plantations and fibre farms[16] than do the FAO and MOF studies.

In a recently released paper, Roger Sedjo (1977) of RFF maintains there are few expansion opportunities left from natural forests and that the major trend is into intensively managed forests, particularly in tropical and subtropical regions but also in temperate zones. He presents the reasons behind this trend as follows.

- "At the margin total timber production can be expanded by a) increasing harvests from native forests; b) increasing forest management in second-growth and other forests; c) expanding the area of tree planting and plantation forest; or d) increased intensity of forest management on plantation forest." (30)
- There are few natural forests left for exploitation, and those that are available are costly to access and of poorer quality. "The largest remaining forest areas that have not been developed for large-scale commercial logging are found in the Amazon and in interior Asian Russia." (8) Neither of these areas are likely to be utilized in the near future; the Amazon because of the diversity of tree species, most of which do not have a current industrial use, and in Russia due to their economic inaccessibility. (9-10)

[16] The term fibre farm is often used when referring to very intensively managed tree plantations growing on lands that traditionally would be in agriculture or that have rotation lengths of less than 10 years. (Sedjo, 1997:7)

- There appears to be little room to increase labour productivity in timber harvesting. "All regions examined have been introducing new techniques and technologies in their logging efforts, however, the study concludes that there is no single dominating new technology in logging and that productivity levels have, at best grown modestly. … Technology seems to provide lower costs on flat accessible sites and fewer cost advantages on steep difficult terrain." (44)
- Changing land use policies create uncertainty, precluding harvests on some lands, and raising costs on others. (4) "In the US harvests from US public lands have decreased dramatically over the past few years…" (41) "The 1990s have also seen a tightening of forest practices on private sector forests. First, many states have forest practices codes that are legally binding. … Additionally, the forest industry in the US is voluntarily undertaking a 'sustainable forestry initiative' whereby the firms commit to certain forest practices and to meeting certain standards. These voluntary standards are estimated to increase industry delivered wood costs by about 7 percent." (40) "More generally, environmental pressures are resulting in modified logging and other forest practices throughout much of the world. In the Nordic countries of Finland and Sweden, for example, new forest policies have placed biodiversity on an equal footing with industrial wood production." The effects of this are to reduce the area eligible for harvest and increase costs 5 - 10 percent. (43)
- There has been a "…host of technological innovations impacting the forest products industry. … The technological changes have been characterized as a) wood saving; b) wood extending; and c) wood increasing." In his study, Sedjo focuses largely on wood increasing technological changes, which include artificial regeneration, forest plantations and fibre farms. (7)
- "The single dominant innovation within the forest industry in recent decades is the shift to intensively managed forest plantations and fiber farms." (3) Plantations offer "…control of species and resources location, as well as the prospects for the introduction of genetic improvements…." (4)
- "The globe can be viewed as being in a transition in the provision of its industrial wood resource needs away from a gathering and foraging mode in natural forests to an agricultural mode of husbandry and cropping." (9) It "…is driven primarily by financial considerations and concerns about future supplies." (11)
- "The transition to intensive wood management has been underway for only a few decades. Nevertheless the process has become well developed, and plantation management accounts for an estimated one-third of global industrial wood production. … The transition is likely to involve not only shifts within a region to more intensive forestry modes, but also interregional shifts in forestry operations out of regions poorly suited to plantations into regions that have a comparative advantage in intensive plantation forestry." (5)
- "Foreign competitors, e.g., Brazil, Chile and New Zealand, as well as plantations in the US South have demonstrated that financial returns to plantation forestry can be substantial." (4) "The advantages of intensively managed plantation forestry appear substantial and the process is likely to continue in the US indefinitely." (5)
- "…a growing portion of the world's industrial wood basket is coming from plantations in nontraditional wood-producing regions. These regions include several countries in South America, including Brazil, Chile, Venezuela, Uruguay and Argentina; as well as countries such as New Zealand, Australia, South Africa, Spain Portugal, Indonesia, Thailand and China. All of these countries have important industrial tree-growing activities and several have become major wood producers, not only for their domestic markets, but for international markets as well." (10)
- "The fiber farm takes plantation forestry to its logical extension in that fiber is grown as an agricultural crop in very intensively managed short rotations on sites that typically until recently were used for agricultural crops. Where water is lacking, it is provided through "drip irrigation" and where nutrients are lacking they are provided through appropriate fertilization." (10)
- As agricultural crops fibre farms can be subject to different taxation and different environmental rules. The forest industry "…appears to favor the term fiber farm since harvesting "farm" products is accepted as more politically correct than harvesting trees. (7)

- Fibre farms "…have come upon the scene only in the last decade and already have well over 100,000 acres established in the PNW, BC and the South." (31)[17]
- "…tree planting, *per se*, allows for the introduction of fast-growing species, that may not occur on that site in nature. For example, various types of pine have been introduced into South America, New Zealand, and Australia – areas that do not have indigenous pine. … Similarly, eucalyptus, an Australian genus, has been adopted and flourishes in many regions while exhibiting excellent growth characteristics. … the share of the industrial wood production from plantations in the tropics and sub-tropics, using almost entirely exotic (non-indigenous) species, has roughly doubled in the 15 year period from 1977 to 1992, from about 5 to 10 percent of the world's total production." (30-31)
- Sedjo contends the recent surge in investment in tree improvement coincides with the end of expansion in existing forests. In the past it made "…little sense to invest in activities that produce more rapidly growing trees when there are large volumes of mature timber that are available for the cost of logging." This explanation is similar to that for agriculture in the US where it was found that "…investments in yield-improving technologies were not forthcoming until essentially all of the potentially usable agricultural land was in agricultural use." (32)
- Tree improvement can substantially increase yields. "Growth rates with [hybrid poplar] plantations are impressive with yields of about 7 tons per acre, or about 50 cubic meters per ha. These growth rates are about three times the growth rates on typical pine plantations in the South. In some cases, as in Aracruz in Brazil, yields of hybrid eucalyptus are reported to have more than doubled." (35)
- "Tissue culture techniques provide the tools to produce genetically engineered plants and to regenerate trees with desired traits quickly, without having to wait for the trees to reach sexual maturity." (36)
- "Thus far, tree improvement programs have probably had little effect on fiber production in North America since there is a lag between the introduction of an improved seedling and the capture of that increased productivity in a harvested tree. … However, the advent of fiber farms brings the possibility of a much faster impact on production since rotations are as short as 6 years. Similarly, industrial forest plantations in the semi-tropics, using eucalyptus, often have rotation periods as short as 6-7 years. With short rotations the impacts of new genetic technology embodied in seedlings will have a much more rapid effect on industrial wood volumes." (37) As evidence of this, Sedjo cites anecdotal evidence that in some areas planted eucalyptus stock which was originally expected to generate 3 harvests through coppicing is being pulled out and replaced with superior stock after only the first harvest.
- At the global level, Sedjo concludes, "…plantation management now accounts for an estimated one-third of global industrial wood production. However, the potential for further innovation and expansion, as well as the potential for major advances in genetic improvements appear vast and, compared with agriculture, the process has just begun." (45)
- In terms of North American competitive advantage, with respect to Canada, Sedjo concludes, "Canada has been able to maintain its share of the US lumber market, as well as exporting widely outside of North America, by harvesting heavily from its flat accessible areas. In the difficult coastal area of BC, however, the forest harvest has been maintained at more or less the same levels for a considerable period only because it has a unique market, e.g., the high price Japanese wood market. …Canada can be expected to continue to draw from its native forests…." (45)
- With respect to US competitive advantage, he concludes "…the US will surely find an increasing share of its production coming from intensively managed forests. The US is likely to continue to develop the large land areas that are well suited to plantation forestry." Here, he particularly favours the US south. He goes on to state, "With the demise of the previous basis of the US comparative advantage, old-growth, future forest resource production will be dependent on the tree-growing potential of the US. Although many parts of the US have climate, soils, etc., suitable to very effective intensive forestry, so too do large areas of South America, South and Southeast Asia and Africa. Thus the US has no monopoly on favorable tim-

[17] This estimate was provided the author by Bob Rogers of MacMillan Bloedel Ltd. This number may be low. At a forest management conference attended by this consultant held in Spokane, Washington in November, 1997, it was reported that about 60,000 acres of mostly former Idaho potato fields have been planted to fibre farms.

> ber-growing conditions and its plantations, while competitive, are unlikely to be the low-cost producers worldwide." (45-46)

An estimated 500 000 ha's of new industrial plantations were established annually through the late 1980's and early 1990's in tropical and semi-tropical regions (Sedjo & Lyon, 1996:12), largely with private sector funds, but sometimes aided with local government subsidies or incentives. Rotation ages of these plantations are in the range of 5 to 30 years. In the states of Washington and Idaho, on dry sites east of the Cascade mountains, fibre farms of hybrid poplar are being established where drip irrigation can be applied.[18] "Growth rates with these plantations are impressive with yields about 7 tons per acre, or about 50 cubic metres per ha [per year]." (Sedjo, 1997:35)

Potential Technological Developments

In addition to the tree improvement developments noted in the previous section, on the horizon are a number of new technological developments that can have tremendous impact on fibre growth and fibre use.

Professor Rod Savidge of the Faculty of Forestry and Environmental Management, University of New Brunswick, states

> In my laboratory, an a number of others around the world, methods have been developed to obtain fibres reliably from *in vitro* cultures of cambium or other plant tissues, independently of the tree. … Thus, a day can be foreseen when pulping of wood chips will be looked back upon as a primative (sic) technology, replaced by processing of uniformly consistent high quality free-floating fibres produced in huge industrial vats under controlled conditions. ***Using such advanced technology, even non-forestry nations will be able to become self-sufficient in pulp and paper and various kinds of re-constituted wood products.*** (emphasis added) (Savidge, 1997)

A significant amount of research and development is occurring in the field of composite products. In addition to research into new or better wood-based products, work is ongoing in developing woodfibre-plastic composites and in bonding woodfibres with inorganic binders such as cement and gypsum. (Forest Products Society, undated)

As always, there is the ever present threat of entirely new substitutes for wood products being invented.

It is also likely that improvements in manufacturing technology will enable higher recovery of wood products from the roundwood resource. For example, sawing is so fine in many Swedish sawmills that they do not need lumber planers. Few, if any, BC mills employ this technology. (Barclay, 1998a,b)

[18] About 60,000 acres of mostly former Idaho potato fields have been planted. Source: consultant's notes taken during a November, 1997 forest management conference held in Spokane, Washington.

2.3 North American Timber Supply and Demand

Introduction

The North American region consists of Canada, the United States of America, and Mexico. This section largely focuses on the United States which is "the world's largest market for forest products." (CFS, 1996:55) Because of its dominant position as a customer of BC forest products, trends in the US are of particular significance. "Canada's major competitor in the US market is the US domestic forest sector." (CFS, 1996:62) Mexico, on the other hand, is not important to BC's exports nor is it a significant competitor. Because of this, Mexico is not considered further in this review.

North American Supply/Demand Overview

The FAO predicts local shortages may occur in North America, where it finds, "A potentially tight, but not crisis, softwood supply situation is expected in North America until plantations in the southern USA and the Pacific Northwest mature. In the meantime, greater use of hardwoods can, if consumer tastes permit, ease the tight situation, and shortages in the USA could be met by imports from Canada…." (74)

The Canadian Forest Service also predicts a tightening of North American wood supplies in its *1995-96 State of Canada's Forests* report:

> Timber-supply constraints and higher wood costs in North America can be expected to translate into higher final product prices and reduced consumption, changes in the distribution of harvesting between private and public lands, continued advances in technology to maximize fibre recovery, and possibly, increased substitution of non-wood building materials, such as aluminum, brick, vinyl and cement.

The Canadian Forest Service also states, "In the future, dramatic reductions in timber supply from public lands in the USA will have significant implications for the distribution of U.S. market share between Canadian and U.S. producers." (1996:62)

Canadian Softwood Supply and Harvest

The 1994 total harvest in Canada was 23% below the total softwood and hardwood AAC. Nevertheless, there is little room for expanding the softwood harvest from native forests. Canada's softwood AAC was fully utilized from 1986 to 1989.[19] Unused softwood AAC existed from 1990 to 1995, but the surplus had almost disappeared by 1995, the latest year for which data are available. (Canadian Forest Service, 1996:81, 1997)

In British Columbia, which at 44% has the largest portion of Canada's softwood AAC (Canadian Forest Service, 1995:45), harvests from regulated forests have averaged 94% of AAC between

[19] Although not stated in the 1995/96 *State of Canada's Forests* report, it appears that there was a change of reporting systems in 1990. Assuming the more recent system to be the more accurate, surpluses may have in fact existed in the 1986-1989 period.

1987/88 and 1994/95. (MOF, Various (b)). However, in some areas it is becoming increasingly difficult to find timber that is available to harvest, allowable cut notwithstanding. (BC MOF, 1992 to Present)

Canadian Hardwood Supply and Harvest

The full utilization of Canada's softwood AAC means that there is mostly only Canadian hardwood AAC available to meet anticipated US demand. Most of the hardwood AAC is located in Alberta, Ontario and Quebec (Canadian Forest Service, 1995:45). Historically, Canadian hardwood harvest has been a relatively small percentage of total harvest. Hardwood harvests have been increasing steadily since 1985, however, with a 20% rise in 1994. "This increase can be attributed to greater use of hardwoods such as poplar, in the production of panel products (e.g., oriented strandboard) and pulp products…." (Canadian Forest Service, 1996:81) At current rates of growth, the limits to hardwood harvests could be reached in the not too distant future.

The US South

Although the FAO predicts maturing plantations in the US South will help ease potential supply problems in the US domestic market, Wear (1996:1) found production in this area is already showing signs of leveling off.

> From the early 1950's until the early 1980's forest inventories as well as rates of production have increased in the region. Since this period of expansion, the region's production shows signs of leveling off. While capacity for expansion exists, recent levels of investment do not portend extensive growth in the immediate future.

On the other hand, the significant unmanaged land area in the US South offers substantial potential to expand forest inventories, given the right incentives.

> …a full 90% of the timberland in the South is controlled by private landowners. Of this private share, 22 percent is held by firms that produce wood products ("forest industry") and the remainder is held by a wide variety of individuals and other corporations. This latter group of owners, generally labeled the nonindustrial or other private ownership group, represents a wide range of objectives and forest management. (Wear, 1996:2)

> …private producers, including those in the "other private" category, can and do respond to market signals in the production of timber. (Wear, 1996:6)

While the market can respond to demand, recent information would indicate that significant expansion in timber demand is not anticipated by landowners in the US South.

> These three indicators of sustainability, inventory, dynamics, timberland investment, and price trends, all seem to suggest a well-organized timber producing sector in the southern United States. That is, the sector appears to have grown in an orderly manner between the 1950's and 1980's and leveled off in the late 1980's and early 1990's. Unfortunately, data are not yet compiled that would provide insights into the sector's response to recent structure changes in national timber markets. However, investment history does not indicate that landowners anticipate significant expansion in the timber growing sector. (Wear, 1996:8)

Wear (1996:3), referencing Alig, states the principal competitors for timber land in the US South are agriculture and urbanization.

> While the share of agricultural land in the South has declined substantially since the beginning of the century, much of the region's timberland could revert to crop production in response to strong markets for agricultural products (Alig 1986). In addition, increasing demands for residential, commercial and other non-rural uses of land are anticipated as the South continues to experience the highest rate of population growth in the U.S. (Alig 1986)

As noted previously Sedjo sees the US South as a favourable location for increased plantation forestry management, although at a disadvantage to plantations in the semi-tropics (see "Discussion Papers by Resources For the Future," page 19).

Technological Improvements

Increases in demand for raw materials over the past several decades in North America have been largely met through technological improvements. Examples given in the FAO report include (81):[20]

- US logging residues have decreased from 37 percent in 1962 to less than 10 percent of softwood growing stock volume at the logging site.
- In Canada, it takes only 1.98 m^3 of roundwood to produce 1 m^3 of lumber and plywood, down from 2.67 m^3 in 1970.
- …in Canadian pulp manufacture, consumption of wood residues already surpassed that of roundwood in 1983.
- …recycling of paper and paperboard has reached about 33 percent in the USA from 25 percent in 1988.

Summary

In North America, a potentially tight, but not crisis, softwood supply situation is expected until plantations in the southern USA and Pacific Northwest mature. This may be eased by greater use of hardwoods if consumer tastes permit, and by increased imports from Canada into the USA.

While production in the US South is showing signs of leveling off, intensive plantation management and fibre farming has the capability to supply substantial quantities of US domestic fibre.

2.4 Real Log Price Projections

A "real" log price change over a specified time period is determined by subtracting total price inflation from log price changes to determine whether there has been a real price change.

[20] The examples given in the FAO report are taken from another report, the 1996 North American Timber Trends Study.

Why Forecast Log Prices?

There are two common reasons for forecasting future real log prices. The first is to aid in making forestry investment decisions. The second reason is strategic; nations forecast log prices as part of exercises to determine if there will be sufficient supply at reasonable prices to meet economic and environmental needs (demand).

Forest companies prepare log price forecasts to aid in determining appropriate levels and kinds of investments. Ordinarily, a forest company is looking to achieve a reasonable return on investment.[21] This, of course, is directly dependent upon anticipated future log prices. If investment returns are not forecast to be high enough from forestry, presumably investments are re-directed into some other enterprise which will yield higher returns. In some cases, even if the return on forestry investment is found to be high enough, forestry may not be an attractive investment when the returns cannot be realized for a long period of time. Risk and uncertainty increase exponentially with time.[22]

Forest nations or states that directly own their forest resource (as is the case in British Columbia) are not only concerned about economic and strategic aspects, but also are faced with the direct decision of how much to invest or reinvest in the forest. As with the private sector, forecasts of high demand and anticipated price increases make decisions to reinvest in the forest more appealing. Internal social objectives and realities may also be significant factors in governmental investment decisions. For instance, citizens expect investments to be limited to opportunities lying within the state and may include social alternatives to these investments, such as building more hospitals or schools, or (one could hope) simply a lowering of taxes.

The above give cause to forest companies and governments to forecast regional or global timber supplies and associated log price relationships. While a projected timber supply shortage does not guarantee real log price increases due to the potential of competition and substitution to fill the gap, a shortage is a necessary prerequisite and therefore can be taken as a strong indicator of the potential for price increases.

The sections below focus on the strategic aspect of forecasting log prices. *Working Paper 5: Proposed Financial and Socio-economic Analysis Framework* discusses log prices with respect to financial aspects.

Market Factors Determining Log Prices

Forecasting log prices is not a simple exercise. This is because there are complex interrelationships between a number of factors that determine price.

At the global level, production always meets consumption, after adjusting for storage losses and stocks (FAO, 1997:46).[23] This equilibrium is achieved through the mechanisms of price, trade,[24]

[21] Risk and uncertainty are also key factors in investment decisions, but for simplicity are not included in this discussion.
[22] Inherent with the use of discounting methodologies is probably acceptance of the implied theorem that risk and uncertainty increase exponentially over time, rather than increasing at some constant rate.
[23] Thus a projected difference between future supply and future demand is more of a hypothetical rather than real 'gap'.
[24] Trade is treated in a simplistic manner here. In reality, trade is a much more complex issue, involving tariff and non-tariff barriers, matters of national policy, etc.

substitution,[25] and competition. If regional demand is greater than supply, and cannot be met either through trade (at current prices), substitution, or competition, real timber prices will rise. As prices rise, demand becomes satisfied either through increased trade (higher prices overcoming the costs of transportation, duties and some trade barriers), increased supply (by extending the margin of the accessible timber supply, by increasing supply through intensive forest management, or by extending existing supplies through re-use or better utilization in the forest and/or in manufacture), or through substitution of alternative materials or products that become viable given the now higher real prices for timber. Those unwilling or unable to pay higher prices, unable to locate alternative supplies in a timely manner or to accept substitutes, leave the market either temporarily or permanently, thus creating the production/consumption equilibrium. Higher real prices also tend to attract new entrants into the business, potentially increasing supply. At the same time, new businesses increase competition which normally dampens prices.

Due to the nature of the forestry business, adjustments among the above mechanisms can sometimes take a number of years. New production in the form of new manufacturing facilities can take several years to achieve; in the form of newly accessed existing supplies, several years depending on the nearest existing point of access and regulatory requirements; and in the form of entirely new supplies from plantations, anywhere from five years (if the ground is available and ready in a fibre farm operation) to 150 years (in which case there is effectively no contribution to immediate demand/supply equilibrium and price response).

Lastly, to make matters more complicated, the demand for logs often has to be inferred from the demand for final goods (see Figure 3, page 9).

> "Increasing scarcity is signaled by rising real timber prices while decreasing scarcity is signaled by falling real timber prices. Because of the interplay of regional and global markets, these trends mark the relative availability of timber in the context of a much larger final goods market." (Wear, 1996:7)

Forecasts of Log Prices

FAO and MoF Forecasts

In keeping with its projections of a supply/demand balance until the year 2010, the FAO finds that "a real long-term increase in prices is unlikely or would, on the world scale, be far less than expected if supplies become critically short." (74) However, the FAO report notes the 1996 *North American Timber Trends Study* found that increasing timber demands in North America without having a reserve of high-quality coniferous roundwood "…could cause a rise in prices for wood, and potential for greater substitution by non-wood materials." (FAO, 1997:81)

In contrast to the FAO, but in keeping with its projections of a supply/demand imbalance, the MOF resource analysis finds, "The excess demand predicted after the turn of the century will certainly impact prices. … The outlook is not one of sudden price increases in response to supply shortages, but of gradually increasing prices. These will cause technical substitutions and in turn mitigate the growing scarcity of roundwood. Sawlog prices should be very strong throughout the

[25] Substitution is defined and discussed on page 28. The price response form of substitution is implied here.

forecast period. The technical innovation that blurs the distinction between sawlogs and pulplogs will continue, as will substitution between softwoods and hardwoods." (219)

Conflict Between Forecasts

In addition to the inconsistency noted above between MoF and FAO forecasts, there are many conflicting conclusions reached by other studies of future real log prices. Some indicate real price increases for wood products or timber generally (Heaps and Pratt, 1989:21; Reid, Collins, 1993:14; Sohngen et al, 1997:13); others indicate this may be limited to or greater in larger logs, better grades, or certain species only (Simons and Cortex, 1993:iii-iv; Reid, Collins, 1993:14; Laing & McCulloch, 1993:19); while still another rejects the notion of real log price increases entirely, on the basis that substitution will occur "which would act against real price increases by lowering the demand from products made from wood." (Stone, 1993:20)

Many projections are based on the finding that real log prices have increased in the past. However, at least the Swedes believe that "historical prices do not seem to be relevant to future predictions." (Reid, Collins, 1994:6) Moreover, even retrospective studies do not often agree on whether there have actually been real log prices in the past. The determination seems ultimately to depend on the period the researcher studies. Stanbury, for example, states, "…the real price of logs (other than those with a decorative solid wood component) have been almost flat since the 1950's. It is not clear that they will increase in the near term." (1991:20)

Sedjo (1997:32) appears to feel that real prices will increase but will be constrained by plantation forest production. "One might view plantation forests as providing the technological 'backstop' which constrains the price growth of industrial wood as wood 'scarcity' can be offset by investments in plantation forests. To the extent that the real price of industrial wood continues to rise, the returns to investments in forest plantations increase."

Feltham and Messmer arrive at the following conclusions after reviewing a number of studies:

> Historical and projected growth rates vary among studies. The variation may be attributed to the different time periods over which the rates are calculated, as well as the different products and regions on which they are based. Although there is variation in the expected rates of future price changes, there is consensus that prices will increase at decreasing rates. This is true for almost every study reviewed here regardless if the study covers B.C., the Pacific Northwest or the Southern U.S. It is also true across virtually all species and grades. There is no agreement, however, on whether prices of higher quality species and grades will increase at a rate which is faster or slower than prices of lower quality species and grades. (1996:iii)

Since the Feltham and Messmer report, as noted in the previous section, the FAO has stated it does not anticipate real price increases, for at least until 2010 which is as far out as it projects.

Substitution

Substitution of wood products by other products may occur for any number of reasons. In the classic sense of the term, substitution occurs in response to rising prices. According to Binkley, "Econometric studies suggest that each 1% increase in the price of softwood lumber produces a 0.3% increase in the use of structural steel, a 0.15% increase in the use of cement, and about a 0.65% increase of bricks." (1996:5-6)

A second cause of substitution is the active marketing of competing products. For example, the use of door to door and telephone sales techniques by aggressive aluminum and uPVC promoters in the United Kingdom has resulted in softwood doors and joinery sales consistently losing out to such products. (Woodbridge, 1989:9)

Thirdly, substitution can occur in response to trade barriers, building code standards or product specifications. For example, "Studs fabricated in zinc galvanized sheet steel were mandated by fire codes in light industrial and office building applications." (Woodbridge, 1989:12)

Fourthly, substitution can occur in response to adverse publicity. Brush fires in California and the adverse publicity surrounding the burning of houses having shake and shingle roofs have caused the virtual elimination of these products in this region.

Lastly, substitution can occur when new technology produces an entirely new material that replaces wood. Perhaps the best example of this is plastic, which has taken over from many products formerly made of wood. This is especially true following the explosion of new plastics which came during and following World War II.

Elasticity of Demand

Many studies indicate that timber under various conditions is price inelastic; that is, a price increase will produce a less than proportionate decline in the quantity demanded, so total revenues will rise. Such findings are reported by the FAO (1997: 77) for timber generally; Eastin (1996:3) for softwood lumber; Simons and Cortex (1993:3) for British Columbia timber at the extensive margin; and Messmer (1995:24) for timber after the biological limits of growing it are reached. This is in keeping with the expectation by most studies that in a timber supply shortage, substitution will be limited and there will be future real log price increases.

Beverly and Lempriere, however, find "…consumption projections are heavily dependent upon substitution opportunities as captured by assumptions about price elasticities." (1996:11) They contend most measures of elasticity of demand for industrial roundwood are short-run rather than long-run, and that this may significantly underestimate the long-term effects of price changes. "There is little empirical evidence for assuming that demand is highly inelastic over the long-run. … Wood shortages are not likely to be as serious as some analysts predict if substitute products exist or are assumed to develop. In this case, while wood prices would rise in the future, these price increases would be partially or largely mitigated by increased substitution." (1996:13)

Summary and Conclusion

To summarize the preceding discussion of real log price increases and substitution:

- There is limited consensus on real log price increases. This limited consensus also extends to the findings on price elasticity and substitution.
- Forecasts of future real log price increases are based on the expectation that the future will be like the past. Development of new competing sources of raw material, such as has happened with the development of vinyls, can quickly destroy projections.
- The lack of consensus supports the contention that prices cannot be forecast.

In the final analysis, the primary rationale for incremental silviculture treatments cannot be based upon assumptions about future prices but rather must be to manage forests in a way that maintains future options.

(For further discussion of log prices, see "Premium Log Demand," page 60 and "Forecasting Real Log Prices" in *Working Paper 5: Proposed Financial and Socio-economic Analysis Framework*.)

2.5 The British Columbia Situation

Introduction

This section contains a review of British Columbia timber supply, including:

* the current forecast of timber supply from regulated land;
* a review of quality trends;
* the potential effects of incremental silviculture on harvest forecasts;
* an analysis of factors which may affect future timber supply, ending with a potential timber supply forecast; and
* a review of general trends and issues in forest management which may affect an incremental silviculture strategy.

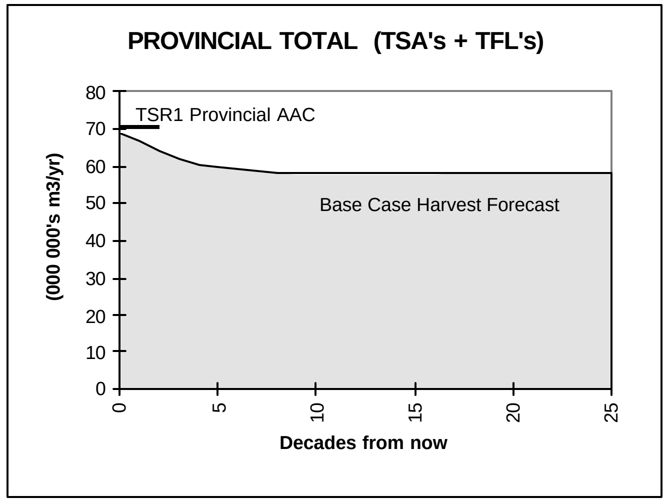
Much of the information used in this section comes from the reports:

- *Regional Long Term Harvest Level Projections and Associated Employment Opportunities* (BC MOF, 1997e); and
- *Working Paper 7: Review of TSA Issues and Planning Processes*.

Current BC Timber Supply Forecast for Regulated Land

Base Case Harvest Forecast

The recently completed Timber Supply Review (TSR) considered a base case harvest forecast for every timber supply area (TSA) and tree farm licence (TFL) in the province; 71 in total. The base case is chosen as the forecast that best meets the criteria of avoiding excessive changes from decade to decade, does not result in significant timber shortages in the future, and ensures the long term productivity of forest stands.



Source: L. P. Atherton & Associates

Figure 7. Amalgamated Base Case Harvest Forecasts for all TSA's and TFL's

Figure 7 shows the provincial amalgamated base case harvest forecast. There is a strong immediate downward trend to a long term harvest level of 58.5 million cubic metres (BC MOF, 1997e:ii), approximately 17% below the TSR1 AAC of 70.9 million cubic meters (BC MOF, 1997b:3). Most of the drop occurs in the next forty years, with the long term harvest level (LTHL) being more or less reached after eighty years. After this, future harvests are expected to stabilize, assuming today's timber harvesting land base and harvest constraints remain constant. As these change, so too will the long term harvest level.

Harvest Forecast Assumptions

The TSR1 base case harvest forecasts employ the following assumptions.

Regeneration of Backlog NSR

The province has made substantial progress in regenerating backlog NSR, having reduced the pre-1982 backlog from 738 000 ha in 1984 to less than 94 000 ha by February, 1997, an 87% reduction. A similar reduction has taken place in the 1982-1987 backlog NSR. (MOF & FRBC, 1997:2) Because of this progress and of the general commitment to eliminate the remainder over the next several years, virtually all TSA base case analyses assume the rehabilitation of the remainder of the backlog within the next 10 to 20 years (BC MOF, 1997d). Failure to maintain the commitment, therefore, would result in the need to reduce future harvest forecasts.

Management of Existing Younger Immature Stands

The base case harvest forecast for some management units assumes that existing younger immature stands (usually those aged 20 years and under) are considered managed stands and therefore have higher yields than unmanaged stands (*Working Paper 7: Review of TSA Issues and Planning Processes*). This presumes stocking control through juvenile spacing. If stocking control is not practiced, presumably the timing and achievement of merchantable yields and log piece sizes will not be as high, especially in high density lodgepole pine stands.[26] (This may not necessarily be the case, however. See "Debate About the Role of Pre-Commercial Thinning," page 51, for a discussion of issues surrounding the practice of thinning.)

Fertilization

A few management units have a history of annual fertilization programs (*Working Paper 7: Review of TSA Issues and Planning Processes*). For some of these units, yield tables used for the base case harvest forecast were adjusted to acknowledge the expected higher yields. Failure to continue to fertilize in the future will result in the need to reduce harvest forecasts in the affected units.

Economic Impact of Reductions in Timber Supply

Manning (1994) summarizes a number of studies regarding the effects of reductions in provincial timber supply as follows:

> The results of these studies show that at a 10% AAC reduction, total provincial employment declines from 1.4 - 2.4%, and GDP declines 2.5 - 2.8%. At a 25% reduction in AAC, employment declines from 3.5 - 6.0%, while provincial GDP declines 6.4 - 8.4%. The impact of such declines on government revenues, and government's ability to provide services would be severe.

The provincial amalgamated base case harvest forecast indicates a potential 17% decline in provincial AAC. Price Waterhouse (1995:66) predicts that a 17% decline:

> …could result in a drop in total employment in B.C. ranging from 1.3% to 4.1% (23,000 to 71,000 jobs). If the rate of 3.8 jobs per 1,000 m^3, as reported in the Price Waterhouse report, "The Forest Industry in British Columbia, 1994" is applied, this would imply job losses in the order of 46,000. The corresponding reduction in GDP could range from 5.1% to 4.3% ($5.1 billion to $4.3 billion).

These impacts would be felt disproportionately throughout the province, with forestry dependent communities suffering the most. Although in the context of more or less a complete termination of timber harvesting, Clark Binkley, Dean of the Faculty of Forestry, UBC, dramatically illustrates this potential for a disproportionate impact. He states, "…a social construction of nature which precludes logging old-growth timber would lead to the collapse of human settlements in most of non-metropolitan B.C." (1997:1)

Quality of the BC Timber Resource

What is 'Wood Quality'?

Wood quality in British Columbia has been largely defined by log grades on the coast, which reflect end product uses and values, and by end products in the interior. Coastal log grades have been based on old-growth timber, but more recently have had to accommodate some second

[26] Personal communication, Ralph Winter. TIPSY yields used in timber analysis were based on initial stocking of 1 200 stems/ha. This presumes stocking control.

growth timber as well. Regardless of the grading system, log quality has historically been judged in the following descending order:

1. Large and mid-diameter ‘clear’ logs having no knots in the outer portion;
2. Larger diameter logs capable of producing a high proportion of structural and appearance-grade lumber;
3. Mid to small diameter logs capable of producing a reasonable proportion of structural lumber;
4. Small diameter logs capable of producing lower grade lumber and residual chips for pulp; and
5. Pulp logs capable of producing mostly chips for pulp and some lower grade lumber.

With the transition to harvesting second growth forests, there is a growing concern about the internal properties of the wood coming from them. These properties govern not only wood quality but also wood recovery. Those of greatest concern are:

- the size and number of knots, with larger and more frequent knots tending to negatively affect lumber structural grades and appearance grades;[27]
- wood density, most often characterized by the width of tree growth rings such that narrower rings (i.e., slower grown and of higher density due to a higher proportion of latewood) are more desirable in some species for structural and appearance grades;
- the proportion of juvenile wood in the total tree stem, which, with increasing proportions, negatively affects lumber strength and drying characteristics;
- the degree of stem taper, which below certain stand densities, increases substantially with decreasing densities, and which negatively affects lumber recovery.

Trends in Quality

There are a number of direct and indirect studies of past trends in the quality of the British Columbia timber supply. Feltham and Messmer report Haley and Constantino (1988) constructed “a measure of wood quality in order to evaluate past quality trends and differences in quality changes across regions.” Their “results support the hypothesis that wood quality in B.C. has been declining for most of this century.” (1996:1) “They found an average annual decrease in wood quality of 0.48% with a total decline of 25% from 1925 to 1980.” The species effect constitutes “about 58% of this decline.”(1996:2) Using different data, Feltham and Messmer found “the extent of the fall in wood quality due to changes in species composition…is not as great as that found by Haley and Constantino,” being exactly half that of their figure. (3) They conclude, “The divergence between the two studies may be attributed to technological change and its role in dampening the transmission of species composition effects from the log market to the lumber market. Substitution between species may account for some of the divergence as well.” (iv)

In a study of Vancouver Forest Region log scale data, Reid Collins found “…that from 1981 to 1992 there was a slight gradual downward trend in the overall physical quality of the annual harvest, with the proportion of the cut in the lower quality grades gradually increasing over the period.” (1993a:7)

[27] Grading rules tolerate larger knots in larger lumber dimensions. Therefore, large knots per se do not always result in lower wood quality.

Statistics from the U.S. Pacific Northwest tend to validate the decline in the quality of B.C.'s forests noted above. There, production of clear wood has declined from 9% of total lumber volume in 1976 to 2.8% in 1990. (BC MOF, undated:4)

Evidence that the decline may continue into the future can be found in the chief forester's *Summary of Timber Supply Review Results*. It states, "Prior to the review, the lower value component accounted for six per cent of the allowable annual cut; that proportion has now climbed to almost 11 per cent." (BC MOF, 1997b:3)

All studies aside, there is the obvious visual evidence of the downward trend in quality. For example, the once substantial tracts of large, sound, old-growth coastal Douglas-fir having large amounts of clear, narrow-grain wood have largely disappeared from the BC inventory.

Wood Quality Concerns Specific to Second Growth Forests

Middleton et al (1995:4) reviewed wood quality concerns as investigated by others, both in British Columbia and elsewhere. While these other studies generally indicate second growth forests will have inferior wood qualities to old growth forests, this is not true for all species. A recent study by Forintek (Josza et al, 1998), for example, indicates that every key wood characteristic of second growth coastal hemlock is comparable to, and in some cases is better than, those of old growth hemlock.

A more important question to foresters, however, is the one of how can silvicultural practices influence the wood quality of second growth stands. This subject is covered in *A Discussion of Wood Quality Attributes and Their Practical Implications* (Jozsa and Middleton, 1994). "In the absence of other significant quality determining attributes, such as oversized knots or high proportions of low density juvenile wood, tree size serves as a proxy for value." (35) Increases in size can generally be achieved by reducing stand density by spacing and thinning so there is less inter-tree competition and by fertilizing to promote tree growth on nutrient deficient sites. "There is a point, however, where the benefits of increased size achieved by a rapid rate-of-growth may not be sufficient to offset the detrimental effects of increased tree taper, larger branches and higher proportions of juvenile wood." (35)

Another important factor influencing the ability to capture a benefit from incremental silviculture is site quality. "For example, decreasing stand density increases both tree size (beneficial) and knot size (detrimental). On a good site the beneficial effect largely overcomes the detrimental as increased tree size keeps pace with knot size by allowing the production of wider lumber for which grade rules permit larger knots. On a poor site wider spacing will be unlikely to achieve the same mitigating result." (Jozsa and Middleton, 1994:39)

Josza and Middleton conclude, "There is an optimal combination of stocking density and harvest age that will produce the highest value combination of volume and quality for each interaction of species and site. The specific prescription will depend on the desired end product." (42)

Current Quality Profile

A log quality classification system is proposed in "1.4 Proposed Quality Classes", page 3. Three log classes for softwoods are proposed: premium log, sawlog and fibre log. The current premium log production is roughly estimated at 15% of total provincial harvest. As the remaining old-growth is harvested and replaced with new forests, the proportion of sawlogs can be expected to increase with a corresponding decrease in fibre logs. (Reid Collins, 1994b:8)

Potential to Improve Timber Quality

Under contract to the Ministry of Forests, Reid Collins investigated the potential to improve the quality of forests in the Vancouver Forest Region. They determined, "Using the stringent criteria for duplication of historical log profile of no real future log price increase, the maximum application of intensive silviculture would probably just duplicate the historical log profile expressed in terms of total value." For only the top log quality class, however, they found "…only the hemlock/balsam historical profile is duplicated. Further investigations with the silvicultural decision model have indicated that longer rotations would duplicate the quality log profile for Douglas-fir but not for western red cedar." Because total value but not all individual log grade profiles by species could be duplicated, and "As it is probably not practical to apply intensive silviculture to all sites…", Reid Collins concluded, "***…the objective of strict duplication of historical log quality profiles generated from harvesting old growth timber probably should not be used to drive silviculture strategy.***" (1994b:10 - emphasis added)

Potential Effects of Incremental Silviculture on Harvest Forecasts

Incremental silviculture may affect the harvest forecast of a management unit by:

1. freeing standing timber that is otherwise unavailable due to adjacency constraints;
2. freeing standing timber for harvest that is otherwise unavailable due to green-up constraints;
3. shifting harvest from one time period to another;
4. rearranging the schedule of harvests in a fashion that optimizes harvesting and manufacturing processes; and
5. increasing future harvest volumes by increasing the merchantable yield of managed stands.

The following sections briefly discuss each of these. A hypothetical 6^{th} effect, the 'allowable cut effect' or ACE is also reviewed.

Relief of Adjacency Constraints

Many management units are sensitive to timber adjacency constraints (*Working Paper 7: Review of TSA Issues and Planning Processes*). Commercial thinning and partial harvesting using alternative silvicultural systems may enable the harvesting of timber otherwise rendered unavailable by adjacency, allowing higher harvest rates in these units.

"Commercial thinning has application in special management areas where clearcuts are not acceptable, where adjacency constraints are preventing harvest and through the access to stand volume in times of shortage of timber above minimum harvest age." (Timberline, 1997:8) Timberline demonstrated for the Arrowsmith TSA that short term benefits of a commercial thinning and fertilization program "range as high as 22 percent per decade and long term benefits of from one to fourteen percent, depending upon the chosen regime." (1997:iv) Similarly, in the Kootenay Lake TSA Timberline found "significant harvest schedule improvements through various applications of commercial thinning and fertilization." Increased harvest rates were "from five to 12% per decade in the short term and one to 12% in the long term." (1997:iv) A financial analysis was not undertaken.

A study of the Nelson Forest Region reviewed the potential for partial cutting to mitigate AAC reductions resulting from the timber supply review. The study found "three of the seven districts in the region … do very little partial cutting and the remaining four districts … use quite a variety of the silvicultural systems. However, closer examination shows that, even in the districts with the greater use of partial-cutting, the majority of silvicultural systems used are low- or no-volume retention ones (clearcutting or seedtree cuts)…." The study also found "…the cutting profile of the Small Business Forest Enterprise Program over the past 8 years has included a greater proportion of higher-volume retention silvicultural systems (on an area basis) than the cutting profile of licensees." (Hawe, 1996:iv) The report concludes, "In general, this analysis showed that districts that currently use little partial cutting may have good potential for increasing the application of partial-cutting silvicultural systems, and therefore mitigating AAC reductions." (1996:vi)

Relief of Green-Up Constraints

Many management units are sensitive to green-up constraints (*Working Paper 7: Review of TSA Issues and Planning Processes*). Silviculture treatment of young stands to achieve required greenup heights earlier offers the potential to increase the AAC in these units.

Reichenback modeled the effects of current management practices and enhanced silviculture practices on the Cranbrook and Revelstoke timber supply areas of the Nelson Forest Region. He found minimal impact in the Revelstoke TSA because "…factors other than greenup delay are far more constraining to short term timber supply." (1996:7) However, he found lowering greenup delays through improved silviculture could increase the short term timber supply in the Cranbrook TSA by 11.6%. Little increase was found in the long run sustainable yield of either TSA.

Shifting Harvest Between Time Periods

Incremental silviculture treatments can shift some harvests from one time period to another.

Barker's 1997 analysis of spacing implications for TFL 24 illustrates this effect. The TFL has a large age class deficit arising from the combined effect of the creation of the South Moresby National Park Reserve and of past harvest patterns in the residual portion of the TFL. Barker found, "Spacing generally gave a small improvement in stand value." However, "At the forest level, the time to merchantable size was reduced by about 10 to 15 years." This resulted in an increased AAC of "…16 000 m^3/year because of the creation of the increased volume of available second growth arising from spacing. This increase occurred despite the fact that spacing reduced the standing volume at time of harvest." Barker found that "On a stand basis, the difference in NPV is…about $102 000 if an area of 150 ha / year is treated. This is a far cry from the $608 000 arising from a forest level analysis."

Rearranging Harvest Schedules

Incremental silviculture treatments can rearrange the schedule of harvests in a fashion that optimizes harvesting and manufacturing processes.

Reid Collins analyzed a number of silviculture strategy scenarios for the West Arm Demonstration Forest (1993c). In one scenario, the imposition of VQO constraints caused a change in the harvesting sequence but not in the overall harvest level. This harvesting sequence change resulted in a negative conversion return in the 21 to 30 year period, while another scenario having the same harvest level (but not the VQO constraints) remained positive. They concluded, "The sequence of harvesting can have a significant effect on economics." (34) While in this case the cause of the sequence change was the imposition of VQO's, the same conclusion could potentially hold true were silviculture treatments used to effect changes in harvesting sequences. The result would, of course, depend upon the timing and cost of the silviculture treatments, the discount rate, and the nature of the resultant harvest sequence changes.

Increasing Future Harvest Volumes

Timber Supply Review sensitivity tests indicate a virtual one to one relationship between increased regenerated stand volumes and long term harvest levels. For every one percent increase in stand volume there was a corresponding one percent increase in the long term harvest level.

There are many direct and indirect silviculture activities that can be employed to increase future stand volumes. These include tree improvement, commercial thinning, reduction of regeneration delays, fertilization, reduction of voids in regenerated stands, intensified forest health management and increased hardwood management. These are discussed under "Potential BC Timber Supply for Regulated Land," page 38. Silviculture can also be used to increase the timber harvesting land base, which would also increase future harvest volumes. The primary activity to accomplish this, the regeneration of backlog NSR, is already included in the timber supply review base case harvest forecasts.

Allowable Cut Effect (ACE)

Brumelle et al (1991:820-1) review the work of others on the topic of the 'allowable cut effect', or ACE. They quote Fraser (1984) as follows:

> One controversial approach which has been pursued in order to circumvent discount rate problems is the use of allowable cut effects in the evaluation of forest investments. This effect results from the common forest management goal of sustainable yield and the calculations made to attain this target. This often implies that present harvests are restricted by the present level of silvicultural investment…

To illustrate ACE, Brumelle et al use an example of "…a 195 m^3 [increase in harvest volume] resulting from a spacing/fertilization project can be converted to an even flow of 4.4 m^3 per annum over the 44-year period until harvest. …this shift of benefits forward in time can have an immense impact on the economics of silviculture."

In BC, an immediate ACE resulting from increasing regenerated stand volumes does not appear available. Extensive sensitivity analysis by the Ministry of Forests in the timber supply review reveals that increasing or decreasing regenerated stand volumes by as much as 20% may affect mid term harvest levels in some management units, but virtually never affects short term harvest levels (*Working Paper 7: Review of TSA Issues and Planning Processes*).

Potential BC Timber Supply for Regulated Land

This section reviews factors which have the potential to increase or decrease future timber supply from managed Crown forests. These are each divided into three groupings:

1. Factors *likely* to increase or decrease timber supply. There is enough preliminary information about these factors to believe that the increase/decrease associated with it will indeed occur. For increases, there is no significant impediment or significant additional investment required in order for the increase to be realized.
2. Factors *having potential* to increase or decrease timber supply. For increases, while there is enough preliminary information about a factor to believe that an increase may be realized, there must be a significant new investment, activity or research required in order for this to happen. For decreases, further information is required before the evidence is considered conclusive.
3. *Unquantified* upward or downward effects. These are factors which may have a significant upward or downward influence on future timber supplies, but for which no reliable estimate of the impact is available.

At the end of this section, all of the above factors are summed into a potential harvest forecast.

Factors Likely to Increase Timber Supply

The following factors are those considered 'likely' to increase timber supply from managed Crown forests.

Remeasurement of Site Indices

Increase – 4.3 million m^3

The Ministry of Forests is undertaking the Old Growth Site Index project (OGSI) to determine if existing site indices for old growth stands are underestimated. Results to date are conservatively extrapolated by the Fibre Targets Task Group by applying 75% of the potential site index adjustment to 100% of the area for age class 8 and 9 for Douglas-fir and hemlock on the coast and spruce and lodgepole pine in the interior (BC MOF, 1997e:17). Since improved site indices largely affects regenerated stand yields, this results in an indicated increase to the long term harvest level of 4.3 million cubic metres. Approximately one-half this amount, 2.2 million cubic metres, is applied to the mid term as regenerated stands are a smaller proportion of the total harvest during this period.

Tree Improvement Program

Increase – 5.0 million m³

The tree improvement program has been steadily making headway over the past few decades. More than 10% of recent plantations now use seed orchard seed.[28] "By the year 2000 seed orchards are expected to provide 50% of the seed needs of the province." (BC MOF 1995:76) The Fibre Targets Task Group reports the Tree Improvement Council of BC estimates a 12% volume gain per rotation from the tree improvement program.[29] (BC MOF, 1997e: 14) Supporting this estimate are the results of trials of plantations of genetically improved seedlings. These trials "…show early height growth superiority averaging 15 percent for western hemlock and 22 percent for Douglas-fir, relative to wild stand seed." (Canada and BC, undated:2)

For comparison, the Swedes anticipate tree improvement programs there to yield a 15 - 25% volume gain over the rotation. (Gilfillan 1990:14) Tremendous yield gains expected from tree improvement programs in other parts of the world. (See "Discussion Papers by Resources For the Future," page 19.)

The Fibre Targets Task Group estimates a potential increase to long term harvest levels of 5.0 million cubic metres if 75% of annually harvested areas are planted with genetically improved stock. (BC MOF, 1997e:3,14) Given the evidence presented above, this seems a reasonable expectation.

Factors Having Potential to Increase Timber Supply

The factors in this section are those considered as 'having potential' to increase timber supply.

While all of the following factors have potential to increase harvest levels in the long term, two factors, expanded operability and increased utilization, offer potential to increase short and mid term timber supplies as well.

Regeneration of Non-Commercial Cover (NCC)

Increase – 0.8 million m³

The Fibre Targets task group estimates a potential future annual harvest increase of 0.8 million m³ on the basis of rehabilitating 50% and 75% of NCC areas in the interior and coastal operable zones respectively, following the application of all other net-down factors.

This assumption may be questioned, however, as none of the TSR analysis reports indicate such practice is happening or contemplated (*Working Paper 7: Review of TSA Issues and Planning Processes*). This estimate is therefore not included in the final tally.

Conversion of Marginal Agricultural Lands

Increase – 0.4 million m³

The Fibre Targets Task Group estimated that approximately 0.4 million m³ could be added to the long term harvest level if it is assumed that 50% of agricultural capability class 6 & 7 land is converted back to forest production.

[28] Based on withdrawal of seed orchard seed as a percentage of total seed withdrawals in the 1995 sowing year, Ministry of Forests 1994/95 Annual Report, Table C-2o.
[29] The 12% gain is assumed to apply to the overall AAC. Yield gains by species and location will vary.

This assumption may be questioned, given that a major cause of deletions from provincial forest is agricultural purposes.[30] Furthermore, the current status of the agricultural land the task force is referring to is not specified; presumably it is Crown land either currently or formerly under lease, but this is not certain. If it is private land, the estimated increase is more appropriately added to private land timber supply. This estimate is therefore not included in the final tally.

Expanded Operability

Increase – 0.25 - 0.75 million m^3

The Fibre Targets Task Group identified the area of productive forest land which was considered physically and economically inaccessible but was not classified as an environmentally sensitive area. It estimated that approximately 1.5 million m^3 could be added to long term harvest levels if 50% of the area in interior TSA's and 25% of the area in coastal TSA's could be brought into the operable land base in the future due to higher timber prices or lower harvesting costs.

Again, this assumption can be questioned. Increased accessibility is dependent upon real log price increases, which are not certain in view of global developments. However, most inaccessible stands contain old-growth timber which will no doubt become increasingly valuable for a number of competing reasons. Both the timber and the wilderness value of such stands are likely to increase. Given these factors, a more conservative estimate of 0.75 million m3, half of the Fibre Targets Task Group estimate is used and applied gradually; i.e., .25 in the short term, 0.5 in the mid-term and 0.75 in the long term, to reflect the possibility of price increases over time.

Expanded Utilization / Commercial Thinning

Increase – 1.4 - 2.8 million m^3

The draft *Stand Density Management Guidebook* (SDMG) states, "In Europe, it is common practice to conduct a series of frequent, light, low thinnings intended to capture wood which would be lost to mortality…" … "A limit of 7 cm is common for both DBH and top diameter." These statements are supported by the findings of a forestry mission to Scandinavia which reports, "Up to three commercial thinnings may take place during a rotation, although the optimum number is not widely agreed upon." (Gilfillan, 1990:21) Also noteworthy is that approximately 25% of the planted radiata pine forests of New Zealand, which constitute over 90% of the total planted production forest, are production thinned (New Zealand FOA, 1997:4, 10).

The draft SDMG (BC MOF, 1997f:18) "indicates that if all mortality in the stand is captured through repeated, light, low thinnings, it is possible to increase the harvest volume (12.5 cm+) by 20% at age 85 years." However, there is some disagreement in the literature as to whether these volumes do in fact exit. After studying commercial thinning in coastal Douglas-fir, Stone concluded "…that commercial thinning will likely provide only a marginal increase in the cumulative merchantable volume available from a stand over a rotation." (1993:iii) This view is also shared by MacMillan Bloedel which reports "…no realizable yield gain is likely from commercial thinning under coastal conditions." (1997:12)

Given that:

[30] See "Other Land Deletions from Provincial Forests," page 45. Ministry annual reports do not specify the capability class of land being deleted.

- such intense utilization in British Columbia as would be required to reach the potential gain indicated in the SDMG would only initially be practiced on the more accessible, available and productive forest land,
- early commercial thinnings tend to yield more pulp logs than sawlogs and the only pulp fibre market likely to exist will be domestic which is not likely to be expanding in the short term due to global competition (see "Conclusion," page 58)
- only late thinnings producing a higher proportion of sawlogs would likely initially be merchantable; and
- some studies indicate little, if any, yield gain from commercial thinning, especially later thinnings,

there is not likely to be a substantial yield gain from commercial thinning, per se.

However, the practice of commercial thinning is anticipated to increase, primarily due to the need to overcome forest cover adjacency constraints and maintain harvest flows.[31] This will result in some increased volume recovery. Also, the high utilization levels attained in some parts of the BC interior region are likely to be achieved on a broader scale over time, implying there may at some time be an increased market for commercially thinned material. Through these mechanisms, higher harvest levels than are currently anticipated may be achieved.

Considering the above factors, a conservative estimate of one-tenth the potential 20% gain indicated by the draft SDMG, or 2%, would result in a 1.4 million m^3 increase in short and mid term harvest levels. Although purely conjecture, improved utilization levels in the long term could potentially be double this amount at 2.8 million m^3.

Reduction of Regeneration Delays

Increase – 1.4 million m^3

The Fibre Targets Task Group estimates a 1.4 million m^3 increase in long term harvest levels can be achieved through the reduction of regeneration delays. The report does not provide detail on how this figure is derived. It is accepted in this review as a potential increase in the long term only.

Fertilization

Increase – 1.8 - 2.8 million m^3

The Fibre Targets Task Group estimates a 1.8 million m^3 increase in long term harvest levels may be achieved through application of a single fertilization treatment to 90% of the potentially available area. This estimate increases to 2.8 million m^3 under a two application regime. Estimates were applied only to those species known to respond to fertilization. It should be noted that there may be a small double-counting of this effect, as a few TSA base case harvest forecasts already incorporate yield gains from relatively modest existing fertilization programs.

For comparison, following a visit to Scandinavia, members of a forestry mission recommended expanding the provincial fertilization program. (Gilfillan et al, 1990:32) They found Sweden annually fertilizes about 1% of its total productive forest (9), and "The increase in growth rates as a result

[31] See "Potential Effects of Incremental Silviculture on Harvest Forecasts," page 35, and "Increased Commercial Thinning," page 53.

of fertilization range from 10 to 30%.[32] Overall, the growth effect is estimated to contribute about 2 to 3 million m^3 to Sweden's annual increment." (22) This is out of a potential annual cut of 90 million m3.

MacMillan Bloedel reports "…a positive net present value (npv) for application of nitrogen to Douglas-fir stands in the mid range of site quality. The benefits are maximized if the additional volume is harvested about 10 years after fertilization either through a commercial thinning or clearcutting." (1997:17)

Fertilization has the potential to increase the volume of stands scheduled for harvest between 10 and 20 years from now. Thus, it could increase harvest levels in the latter half of the short term period. However, recent analysis of all Vancouver Forest Region TSA's indicates there are few fertilization opportunities for this time period. This follows from netting down the potential treatable area for factors such as species, site productivity, location, stand vigour and crown closure and economics. Over time, a greater area of suitable stands will emerge as younger, managed stands become available for harvest.

For the purposes of this exercise an increase of 2.8 million m^3 is used in the long term, with only 1/5 of this (0.6 million m^3) reflecting the short term potential.

Reduction of Voids in Regenerated Stands

Increase – 3.5 million m^3

Most of the timber supply analyses for TSA's use regenerated stand volumes estimated by TASS (*Working Paper 7: Review of TSA Issues and Planning Processes*). The yields for these stands are reduced by an operational adjustment factor of 15% to "account for holes ranging from the area covered by the crown of a single tree up to 2 hectares."[33] The source of the 15% figure is a 1967 study in Sweden comparing yield figures for permanent sample plots with those for the stand as a whole (Mitchell and Grout, 1995:80).

The Forest Practices Code, however, places stringent requirements on the stocking of regenerated stands up to the point of free growing. Minimum stratum size guidelines issued by the Ministry of Forests require that "When non-contiguous patches of [not satisfactorily restocked] or non-[free growing] area, 0.25 ha. or larger in size are present, and if the cumulative area of these NSR or non-free growing areas exceeds the lesser of 2 hectares or 20% of the [net area to be reforested] by [standards unit], silviculture treatments required to increase the stocking of acceptable trees must be undertaken." (Ministry of Forests, 1997:2) Under these requirements, it is highly unlikely that 15% of stands will end up in voids at establishment. Voids can subsequently open up in stands through tree mortality. However, mortality in spaced stands has been found to be low.

A survey technique for measuring the OAF factor has recently been developed by the Ministry of Forests (BC MOF, 1997n), application of which in the field has indicated OAF1's of 5-10%.[34]

A reduction in OAF1 to 10% would result in a 5% increase in long term harvest levels (3.5 million m^3), with a lesser amount in the mid term.[35] However, until a comprehensive statistically valid

[32] In B.C., foresters generally expect the volume increase to hold for an eight to fifteen year period (Timberline, 1997:3-5).

[33] Openings of 2 ha or more are recognized as a separate type on forest cover maps. (Mitchell and Grout, 1995:79)

[34] Ralph Winter, personal communication.

[35] As evidence of the acceptance of a lower OAF1 factor, the draft *Stand Density Management Guidebook* uses 10% in its examples (BC MOF, 1997f: Appendix 2).

study of this matter is undertaken across British Columbia, such an increase is considered as ‘potential’ rather than ‘likely’. Also, voids can be desirable from a wildlife management perspective, placing limits on the potential for aggressive void management.

Intensify Forest Health Management

Increase – 1.0 -2.0 million m^3

The Fibre Targets Task Group (MOF, 1997e) estimated potential increases of one and two million cubic metres “…under two scenarios. Under the first it was assumed that the expanded program could reduce epidemic losses to insect and disease by 25% and endemic losses by 20%. Under the second scenario epidemic losses were reduced by 50% and endemic losses by 40%.” (14) A weighted average epidemic loss to insects, disease, windthrow and fire was calculated for each forest region using information from timber supply review reports. (30) “Gains from reduced endemic losses was estimated by lowering the OAF 2 [for TASS] by 1% and 2% respectively.” (14)

Increase Hardwood Utilization and Management

Increase – 1.5 million m^3

During the timber supply review, hardwood forest types in many TSA’s were fully deducted from the timber harvesting land base. The Fibre Targets Task Group estimated a potential increase of 2.1 million cubic metres “based on the long-term harvest available from 50% of the current deciduous stands…. … Deciduous harvests were subject to the same net-downs … as were the coniferous harvests. For the Prince George Region it was assumed that 15% of the deciduous area was currently being harvested and was included in the base case. A further 50% of the remaining 85% of the deciduous area was assumed to be potentially available for hardwood utilization.” (MOF, 1997e:14)

The literature review under this project found ample support for the above assumptions:

- Advance studies for the 1992 Forest Summit Conference commonly assumed increased utilization of hardwoods throughout the period to the year 2010. “Hardwood utilization is regarded in ‘Vision 2010’ to be a significant opportunity and a positive development for the sector.” (Anon, 1992:v)
- Massie estimated the 1992 total current hardwood utilization in BC to be in the order of 2.0 million cubic metres and the potential harvest to be in the order of 7.0 million cubic metres, based on a 50% availability rate using only mature and near mature inventory volumes. (1996:5)
- Scott Paper reports poplars can be managed on rotations of 12 to 15 years and “for the first 3 years will grow at an impressive rate of over 30 $m^3ha^{-1}yr^{-1}$.” (McAuliffe, 1996:115)

It is unclear, however, exactly how much hardwood harvest has been already included in base case forecasts and AAC determinations. Where opportunity and demand warranted, the Chief Forester established a partitioned AAC for some TSA’s, either entirely or partially for hardwood harvest (*Working Paper 7: Review of TSA Issues and Planning Processes*). To be conservative therefore, only 1.5 million cubic metres, approximately three-quarters of the Fibre Targets Task Force estimate, is used here, starting in the short term. In the long term, no doubt some of the land currently growing hardwood will be converted to conifer. However, it is also possible that

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land currently growing conifers will be found in the future to be better suited to fast-growing hardwoods, which "respond quickly to management."[36] (Massie, 1996:7)

Unquantified Upward Effects on Timber Supply

The following two factors have unquantified potential to increase timber supply.

Alternative Silvicultural Systems

There is no analysis of the cumulative potential provincial impact of the implementation of alternative silvicultural systems. Alternative systems may enable the harvesting of timber otherwise rendered unavailable by adjacency or green-up constraints, allowing higher harvest rates in some management units.

This subject is discussed in "Relief of Adjacency Constraints", page 35. It is clear from this discussion that alternative silvicultural systems present a significant but unquantified opportunity to increase short and mid term timber supplies.[37]

Reduced Green-up Delay

As with alternative silvicultural systems, reducing green-up delays also presents a significant but unquantified opportunity to increase short and mid term timber supplies. This is discussed in "Relief of Green-Up Constraints," page 36.

Factors Likely to Decrease Timber Supply

The factors in this section are considered 'likely' to decrease timber supply; that is, there is enough preliminary information about the factor to believe that the decrease associated with it will indeed occur.

Protected Areas Strategy & Forest Practices Code

Decrease – 6.7 million m^3

The Fibre Targets Task Group estimates the completion of the Protected Areas Strategy (PAS) and the full implementation of the Forest Practices Code will result in reduction of the long term harvest level by 6.7 million cubic metres.[38] In preparing its estimate, the task group assumed that the productive forested land base affected by the PAS consisted of 10% high elevation and 33% low elevation forests. Their estimate for the impacts of the Code are based on another report, *Forest Practices Code - Timber Supply Analysis*, dated February 1996.

Similar to the Fibre Targets Task Group, Price Waterhouse estimates the long term impact of the PAS and Code to be 7 million cubic metres. (1995:60)

[36] See also "Discussion Papers by Resources For the Future," page 19 for more information about the potential of hybrid poplar.
[37] Note: some of this potential has been ascribed to increased commercial thinning – see "Expanded Utilization / Commercial Thinning," page 40.
[38] BC MOF, 1997e:i-ii. 6.7 million m3 is the difference between the TSR LTHL and the Base Case scenario given in Table 1. The report states "The base case was established to reflect the full impact of the Forest Practices Code and the Protected Areas Strategy…"

Other Land Deletions from Provincial Forests

Decrease – 0.1 million m^3

Table 5 shows land deletions from provincial forests over the past five years, excluding those for parks and recreation purposes. The vast majority of deletions were for agricultural use. While there is an upper limit to the amount of potentially arable land, simple extrapolation would indicate 100,000 ha of total deletions may occur every 20 years. This is 0.2% of the 94/95 estimate of total productive forest land. The AAC impact may be proportionately higher, assuming that the land being deleted for agriculture is more productive for growing forests than the average.

Year	90/91	91/92	92/93	93/94	94/95	Total
Area (ha)	12,760	4,871	1,542	40	2,707	21,920

Source: Ministry of Forests Annual Reports

Table 5. Land Deletions From Provincial Forests for Other Than Parks and Recreation Purposes

Factors Having Potential to Decrease Timber Supply

The following factor has the potential to decrease timber supply.

Remeasurement of Existing Stand Volumes

Decrease – 2.0 million m^3

The Resources Inventory Branch of the Ministry of Forests is in the process of auditing the overall accuracy of estimates of the total standing volume in all timber supply areas and tree farm licences. About half of the audit reports had been released at the time this report was prepared. Early indications are that audit results are not statistically different from the inventory for the majority of areas. However a few areas are substantially over or under-estimated. Provincially it appears that there is a slight over-estimation of existing volumes. The impact of over or under-estimation of existing stand volumes on timber supply, however, is management unit specific. That is, while the short and mid term harvest forecasts of some units are sensitive to increases or decreases in existing stand volumes, those of others are not.

A preliminary estimate of the potential impact of remeasurement on timber supply was made by evaluating the released audit results against the timber supply analysis sensitivity results for existing stand volumes by management unit. The results across all management units were then totaled and extrapolated to estimate a total provincial impact. They indicate a short term reduction in timber supply in the order of 2.0 million m3 annually and a mid term reduction in the order of 1.0 million m3. The long term is not affected because timber supply in this period comes from regenerated stands.

This estimation should be viewed with caution as only one TFL audit result in the Vancouver Forest Region had been released. However, as the general trend in volume estimates for existing mature stands is downward, it is unlikely that Vancouver Region TFL results would be sufficiently positive to offset the released results of other management units.

Unquantified Downward Effects on Timber Supply

The following factor has an unquantified potential to decrease timber supply.

Pressure for Preservation and Environmental Protection

Continued or increased pressure for preservation and environmental protection is an unquantified downward effect on future timber supplies. Support for this expectation is found in the *Forest, Range and Recreation Resource Analysis* which identifies a "socio political" forest value as follows:

> Wild lands and the old-growth forests on them are an important manifestation of freedom. As free space decreases, the value of remaining wild lands increases. Wild lands are also importantly symbolically, even for those who do not directly experience a particular wild area. (BC MOF, 1995:35)

As the number of untouched drainages diminishes, preservation pressure can be expected to increase proportionately as each one is about to be entered, until the last drainage is either entered or preserved. After this, the pressure will likely shift to preserving those valleys that have already been entered but still having a significant portion of old growth remaining. The logging/preservation balance will ultimately only be determined at the point the last existing old-growth is either harvested or protected.

See also "Environmental Services of Forests," page 50, for further discussion of environmental issues.

Summary of Factors Affecting Timber Supply

Table 6 summarizes the factors discussed in the preceding sections. Each factor is assigned a full or partial weighting into the short, mid or long term, based on the consultant's judgement. Two factors, the regeneration of NCC and marginal agricultural areas are not given a value because some question to their validity was noted. The results are then interpolated to indicate a potential harvest forecast for the next 250 years.

If it is assumed that the unquantified upward and downward effects balance each other off, Figure 8 indicates:

1. an unavoidable downward trend in timber supply in the short term;
2. a gradual increase in harvests over the mid term; and
3. a long term harvest level similar to today's level.

This is a rough analysis. *Confirmation of the potential timber supply can only come from conducting detailed analyses for all 71 management units in the province and summing the results to the provincial level.*

Some management units have limited potential for recovering from substantial forecast reductions in harvest levels, having implications for the stability of associated forest-dependent communities.

Incremental silviculture is a major player behind the potential to increase future timber supply. The largest set of gains can be achieved through practices and programs such as: tree improvement, expanded commercial thinning, reduction of regeneration delay, fertilization of suitable stands, reduction of voids, and intensified forest health management. The second largest set of gains can be obtained through increased utilization, particularly through expanded hardwood utilization and increased operability.

	Time Period					
	Short		Mid		Long	
	Change	Cumulative	Change	Cumulative	Change	Cumulative
Start		70.9		65.7		58.5
Factors Likely to Increase Timber Supply						
• Remeasurement of Site Indices		70.9	2.2	67.9	4.3	62.8
• Tree Improvement Program		70.9	2.5	70.4	5.0	67.8
Factors Having Potential to Increase Timber Supply						
• Regeneration of NCC	0.0	70.9	0.0	70.4	0.0	67.8
• Conversion of Marginal Agricultural Land	0.0	70.9	0.0	70.4	0.0	67.8
• Expanded Operability	0.3	71.1	0.5	70.9	0.8	68.6
• Expanded Utilization / Commercial Thinning	1.4	72.5	2.1	73.0	2.8	71.4
• Reduction of Regeneration Delays	0.0	72.5	0.0	73.0	1.4	72.8
• Fertilization	0.6	73.1	1.7	74.7	2.8	75.6
• Reduction of Voids in Regenerated Stands	0.0	73.1	1.0	75.7	3.5	79.1
• Intensify Forest Health Management	1.0	74.1	2.0	77.7	2.0	81.1
• Increase Hardwood Utilization and Management	1.5	75.6	1.5	79.2	1.5	82.6
Unquantified Upward Effects on Timber Supply						
• Alternative Silvicultural Systems	?		?			
• Reduced Green-up Ages	?		?			
Factors Likely to Decrease Timber Supply						
• Protected Areas Strategy and FP Code	(6.8)	68.8	(6.8)	72.4	(6.8)	75.8
• Reductions to the Timber Harvesting Land Base	(0.1)	68.7	(0.1)	72.3	(0.1)	75.7
Factors Having Potential to Decrease Timber Supply						
• Remeasurement of Existing Stand Volumes	(2.0)	66.7	(1.0)	71.3	0.0	75.7
Unquantified Downward Effects on Timber Supply						
• Increased Preservation & Protection	?		?		?	

Table 6. Summary of Factors Affecting Future Timber Supply

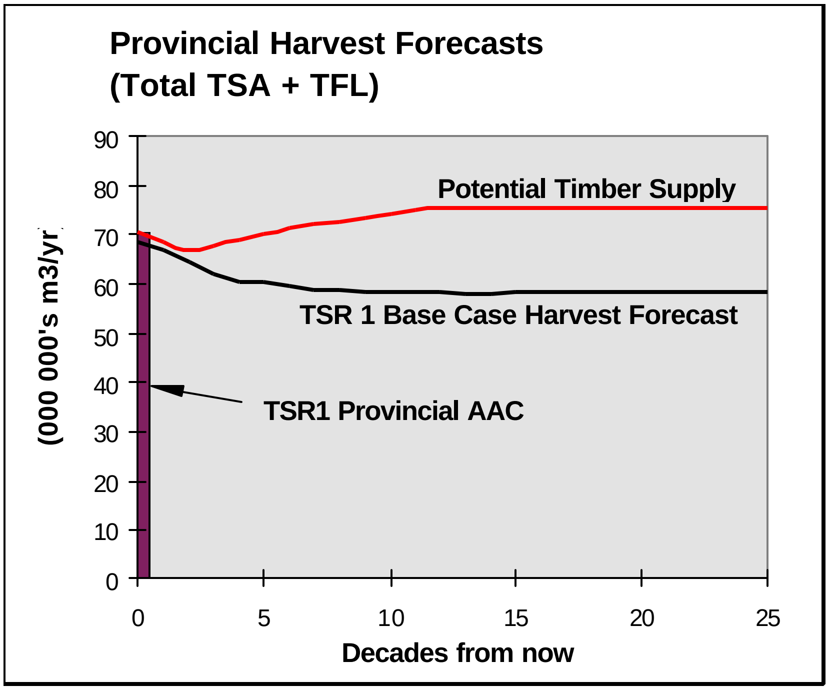

Figure 8. Potential Future BC Timber Supply.

Without intervention, future harvest levels are likely to decline as indicated by the TSR 1 Base Case. With silvicultural and other interventions, as well as improved resource information, the potential exists to increase future timber supply as illustrated by the upper line. Detailed analysis is required for all 71 management units to confirm this potential and to develop specific strategies for attainment. This projection (and the establishment of strategies) should not be confused with the AAC determination process. AAC's are determined for individual management units and are based on actual practice and current information.

Other Timber Supply Forecasts

A forecast of a potential long term harvest level of 75 million m^3 is "in the ballpark" of other timber supply forecasts. Other forecasts are summarized below.

Forecaster	Long Term Forecast (000 000's m^3)	Reference
Fibre Targets Task Group	71.1 to 74.1	BC MOF, 1997e:ii
Ministry of Forests	70 to 75	BC MOF 1995:94
H.A. Simons Strategic Services	85[39]	H.A. Simons, 1992:11

Table 7. Timber Supply Forecasts of Others

Experiences and expectations elsewhere are also supportive:

- From 1952 to 1982 Sweden increased total growing stock and increment by 44% and 46% respectively, through the application of "modern forest management." (Gilfillan, 1990:3)

[39] Simons' actually estimated a theoretical cut of 90 million m^3, including 5 million m^3 from private land. This is reduced to 85 million m^3 to reflect the cut from regulated land only. Simons' estimate was also based on a then-current AAC of 75 million m^3. Given a post TSR1 AAC of 71 million m^3, this estimate could be further adjusted downwards to 81 million m^3.

- Weyerhaeuser Company expects “By 2020, high-yield forestry will mean a 70% increase in yields per acre from current harvest levels in the [U.S.] South, and a 25% increase in the [U.S.] Pacific Northwest.” (N.Y. Times, 1997)

BC Private Land Timber Supply

There are an estimated 2 million hectares of forested private land in B.C. Of these, 923,000 hectares, approximately one percent of the provincial land base, are classed as managed forest land under the *British Columbia Assessment Act* and are placed in the Forest Land Reserve under the *Forest Land Reserve Act*. (BC MOF, 1997h) For these lands, forest land owners are required to demonstrate an on-going commitment to the growing of trees. For the remaining approximately one million hectares of private forest land there is no requirement or incentive to manage for forest crops.

Timber harvest from private land has averaged approximately 7 million cubic metres annually in the five year period 90/91 to 94/95 (Table 8), equal to almost 10% of the AAC of regulated lands. Information as to how much of this harvest is from managed private forest land versus from non-industrial private forests is not published but Manning estimates the latter at 3.4 million m^3 annually (1994:1).[40] It is likely that a substantial portion of what is coming from non-industrial private forest land is a liquidation harvest, not actively being replaced. Most of this land will regenerate naturally over an extended period, but a certain proportion will likely never be replaced due to the conversion of the land to other uses such as agriculture or residential subdivisions. What the future reduction to the total provincial harvest will be is unknown. With the expiry of FRDA II there is no active program to encourage land owners to reforest and manage for timber. Under present conditions, it must be assumed that the liquidation harvest constitutes a downward pressure on future total provincial harvest.

Year	90/91	91/92	92/93	93/94	94/95	Total	Average
Vol (000’s m^3)	6,781	5,752	6,047	7,583	8,923	35,086	7,017

Source: Ministry of Forests Annual Reports

Table 8. Harvests From Private Land Outside TFL’s and WL’s

Although private land is a significant contributor to the total provincial harvest, mechanisms to improve this contribution are not addressed in this paper, being beyond the project scope.

[40] The term “non-industrial private forests” is used but not defined by Manning (1994). It is used here as forested properties up to 2 000 ha in size which are not owned or managed by a company which also holds a major licence, and which typically form part of small woodlots, farms, or ranches. All forested properties over 2 000 ha are assumed to be managed for timber, even if owned by a company which does not hold a major licence.

General Trends and Issues in Forest Management in BC

Introduction

Because an incremental silviculture strategy is very much about shaping the future, it is necessary to be cognizant of relevant forest management issues and trends in forest practices that may influence the choice of substrategies to achieve government's goals. The following are seen as the key emerging issues and trends.

Management Issues

- The environmental services of forests are growing in importance at the global level.
- A greater proportion of stands improved through tree breeding will likely bring increasing public concern about the narrowing of the genetic resource.
- There is debate amongst foresters as to the value and benefits of pre-commercial thinning.

Forest Practices Trends

There will be:

- more uneven-aged stands;
- more incremental silviculture for purposes other than timber management;
- increased commercial thinning;
- higher juvenile stand densities than in the past; and
- longer rotation ages on a significant proportion of stands.

These are expanded upon in the sections below.

Forest Management Issues

Environmental Services of Forests

The Food and Agriculture Organization's (FAO) 1997 *State of the World's Forests* report discusses 'environmental services' provided by forests. Among other things, it lists services such as the conservation of biological diversity; carbon sequestration and the mitigation of global warming; the provision of shade, amenity and recreation; and protection of coastal areas and coastal fisheries. As these services increase in importance and recognition they are likely to have a downward effect on future harvest levels.

Combating global warming, however, may result in pressures to increase the area in forests and to increase the overall volume of sustainable harvests. The purpose would be to increase storage of carbon in forests and in forest products. Another purpose would be to substitute fossil fuels with fuelwood from sustainably managed forests, and substituting energy-expensive products (e.g., steel, aluminum or concrete) with industrial wood products. (FAO, 1997:42) "…life cycle analyses have indicated that the carbon dioxide emissions from the extraction, processing and disposal of steel-based walls are three times higher than from walls produced from timber." (Canadian Forest Service, 1996:56)

The implications for incremental silviculture of an increased emphasis on the environmental services of forests are unclear. Where a 'service' must be actively managed, such as maximizing carbon sequestration, there is likely a role for increased incremental silviculture treatments. These would be not only to increase growth but also to create more solid wood, which would require less manufacturing for some purposes. Global standing forest inventories would likely increase.

On the other hand, where a 'service' calls for the preservation of a forest area, incremental silviculture is likely to be excluded from management regimes. Further study of the implications may be useful.

The expectation of increasing pressure for preservation and environmental protection and the effect on BC timber supply is discussed on page 45.

Potential Concerns About Narrowing the Genetic Resource

"Most of B.C.'s wood in the future will come from genetically improved stands." (Tree Improvement Council, 1996:4) The Fibre Targets Task Group reflects this expectation in its estimate that tree improvement may increase future harvest levels by 5 million m^3/year (see "Tree Improvement Program," page 39).

While a major objective of the tree improvement program is gene conservation (Tree Improvement Council, 1996:3), this would seem at odds with the expectation that most future wood will come from genetically improved stands. However, initially at least, tree-improvement will actually broaden the gene pool by mating "…seed parents spaced too far apart in nature to cross pollinate." To avoid the potential of tree breeding to reduce genetic variation over the longer term "…breeders design mating schemes to maintain genetic diversity while delivering acceptable long-term gains." (Canada and B. C., undated:6)

As the tree improvement program expands, public concern about the potential narrowing the genetic resource is likely to arise, particularly if there is little disseminated information as to how this is being addressed. Is the level of genetic diversity acceptable to tree breeders and foresters going to be the same level acceptable to the public? As an example of the potential for public concern, in 1992 the BC Ministry of Forests issued a report demonstrating "British Columbia's forests have generally maintained or increased their diversity of tree species after harvesting." (BC MOF, 1992:1) Despite this, there are still statements in the news media claiming B.C. forest plantations to be monocultures. The fact that the public has expressed concern about tree diversity would indicate that the tree improvement program may one day be similarly challenged on genetic diversity. Should these concerns not be adequately and successfully addressed, the degree to which stands are projected to come from improved seed, and the consequent gains expected in timber supply, may not be to the extent anticipated.

Debate About the Role of Pre-Commercial Thinning

The role of pre-commercial thinning (juvenile spacing) in managing forest stands in BC is undergoing debate among forestry professionals. The outcome of this debate may result in the changes to forest practices.

The traditional argument favouring juvenile spacing is that it removes undesirable trees, leaving "a small number of selected superior trees" which "grow to a larger size, reducing logging and manufacturing costs, increasing yields, producing more valuable forest products and enhancing the final value of the stand considerably." (BC MOF, 1980:14)

Opponents of spacing claim “that reducing stocking in dense coastal forests to 1400 stems per hectare or less will result in volume losses at normal harvest ages. Although there may be a few larger trees in the spaced stand, the average diameter will not be significantly bigger than that of the biggest, same number of trees in the unspaced stand. Furthermore, the log “quality” of the spaced stand and hence its value, will be poorer than that of the unspaced stand because of greater stem taper, knot size and proportion of weaker, juvenile wood.” (Brett-Davies, 1997) MacMillan Bloedel finds, “Because juvenile spacing lowers harvest volume without improvements in stand value, no circumstance analysed produces a positive NPV from this treatment, regardless of the discount rate used.” (1997:25) TimberWest reports, “In general, juvenile spaced stands produce a greater proportion of juvenile wood, have greater ring widths, increased taper, larger and more persistent branches (live and dead), and increased callous formation around branch nodes than in untreated stands. Lumber strength is also likely to be lower in stands that have been juvenile spaced.” (Undated (b):3)

Yet juvenile spacing (cleaning) is widely practiced elsewhere. Both Sweden and Finland space approximately 200 000 ha annually (BC MOF, 1997k & 1997l).[41] This is in advance of two or three commercial thinnings over a rotation. (Gilfillan et al, 1990:19-21; Barclay, 1998)[42] New Zealand spaced 244 000 ha in 1995 (BC MOF, 1997m). In contrast, British Columbia spaced about 50 000 ha annually from 1992 to 1994, the latest years for which data are available (BC MOF, various(b)). In the US Pacific Northwest, Weyerhaeuser estimates yield gains of approximately 70% through thinning and fertilizing Douglas-fir (McMahon, 1993).

Are BC’s forests different than elsewhere? Are European practices based on data or on cultural traditions? Is New Zealand not concerned about stem taper, knot size and proportion of juvenile wood, especially in its fast-growing radiata pine forests? Does BC growth and yield modeling need further treatment response refinement?

While it is not within the scope of this project to determine which of the above views on the effects and value of spacing is correct, the debate poses serious questions which warrant further in-depth examination.

Forest Practices Trends

More Multi-storied Stands

More multi-storied stand management regimes can be anticipated in the future because:

1. the strong environmental lobby against clear-cutting is likely to have some effect in increasing the amount of partial harvests;
2. the Vancouver Forest Region has issued a requirement for harvesting a minimum 10% of the overall volume by means other than clearcutting;
3. the portion of total harvest which is partial cutting has edged up to nearly 12% in 1994/95 from 8% in 1990/91.[43]

[41] This is down from approximately 370 000 ha and 250 000 ha of annual cleaning activity in Sweden and Finland respectively in the late 1980’s.

[42] Weetman notes that “The Swedish Forest Act is being revised to remove the compulsory thinning and harvest treatments, and much emphasis is being placed on biological diversity concerns and feasibility, rather than conformity.” (1996:11)

[43] At least some of this increase is due to a classification change and may not result in uneven-aged stands. The 1990/91 *Ministry of Forests Annual Report* figure quoted is classed as “selective cutting” which is undefined,

More multi-storied stands have implications for basic as well as incremental silviculture. For example, multi-storied aged stands tend to be naturally regenerated, reducing the opportunity to establish plantations using genetically improved planting stock. Most of today's incremental silviculture regimes are practiced in single story stands. There is little, if any, experience with pruning and fertilizing multi-storied stands. There are few calibrated models available for assessing the growth and yield of possible stand management prescriptions in multi-storied stands and fewer still for undertaking financial analysis.

More Incremental Silviculture for Purposes Other Than Timber Management

Many trends that occur in British Columbia often develop in the United States a decade or two earlier. One such trend now apparent in the US is the growing use of incremental silviculture for purposes other than timber management. In the Interior Columbia River Basin,[44] for example, there is great concern about changes in the forests. Due to the exclusion of fire over the past half-century, ponderosa pine forests are disappearing in favour of Douglas-fir. White pine has almost completely disappeared due to harvesting and pests. A key strategy is to rehabilitate and restore health and productivity to altered ecosystems by paying attention to and managing ecosystem processes, such as the processes that happen in fire dependent ecosystems. Because fire can be reintroduced only on a limited basis, incremental silviculture, particularly thinning, is seen as another way of accomplishing this.[45]

Another indicator of this trend is the "…shift in program emphasis [of timber sales from US National Forests] from timber commodity to forest stewardship purposes." Approximately 35% of the volume of timber harvested under the national forest timber sale program is for forest stewardship purposes and consists of much non-sawtimber. (Anon., 1998:5) In fact, the Society of American Foresters opposes a proposal for election timber sales (where a buyer can elect not to harvest the timber) on US national forests "…because we believe that if a timber sale of federal lands has no other value than commodity production, it should not be offered." (Cripps, 1997)

Increased Commercial Thinning

The Ministry of Forests' 1994 resource analysis states, "…commercial thinning and fertilization might be used to accelerate the rate at which timber becomes merchantable and so mitigate short-term timber supply declines. Commercial thinning can also increase the value of the stand by increasing tree sizes at final harvest. The ministry projects that in ten years, up to 10% of the harvest volume from Crown land in B.C. will come from commercial thinnings." [46] (BC MOF, 1995:95) This indicates a fundamental change in outlook with regards to thinning, at least in the larger sized, merchantable material. A potentially increased role of commercial thinning also tends to be supported by statements made by the Chief Forester with respect to the future potential of

whereas the 1994/95 figure is classed as "partial cutting" which is defined as "the sum of all variances of intermediate cutting, patch cutting, and seed tree, selection and shelterwood silvicultural systems." (1994/95 Annual Report:99) At least some of these systems will result in stands which are even-aged.

[44] The Interior Columbia River Basin covers large parts of Washington, Oregon and Idaho and smaller parts of four other states.

[45] Information in this paragraph is a synthesis of the author's notes on the subject taken during the a forest management conference held in Spokane, Washington in November, 1997.

[46] No substantiation is provided in the resource analysis for this statement. R. Winter (personal communication) indicates the figure was derived based on commercial thinning taking place on approximately 70 000 ha per year by the year 2004, yielding 80 - 100 m3/ha.

commercial thinning to overcome constraints to harvests in a number of *AAC Rationale Statements*.[47]

Thinning, at least insofar as commercial thinning, is therefore likely to move from being solely a silvicultural practice to improve timber quantity and quality, to being a partial harvest to improve and stabilize wood flows (as is the case in Scandinavia[48]) and to being an ecosystem management/forest stewardship process (as is often the case in US national forests).

Higher Juvenile Stand Densities Than in the Past

Standards for optimum and maximum juvenile stand densities are likely to rise from those of the past because:

- the forest industry, which must pay for pre-commercial thinning (juvenile spacing) of stands which are too dense before reaching free growing, is putting pressure on the ministry to raise the standards;
- research indicates that higher acceptable ranges of densities than are currently allowed would *generally* yield greater final volumes (this is in dispute), smaller knots, less stem taper, and higher density wood; and
- more sites will be planned for commercial thinning and therefore planned for higher initial and juvenile densities than in the past.

Longer Rotation Ages

Many timber supply areas have 'older forest' constraints on timber supply planning (*Working Paper 7: Review of TSA Issues and Planning Processes*). A frequent requirement is that 15% or more of the area in the timber harvesting land base must be in stands aged 150 years or older. Other than on lower productivity sites, this will result in stands being held beyond their optimum financial and biological rotation ages.

The older forest constraint is but one of a wide range of constraints on forest harvesting that are imposed to meet management requirements for forest resources other than timber. Others include visual quality constraints, watershed and streamside constraints, and wildlife thermal cover constraints, to name but a few. Combined, these constraints result in a significant proportion of timber having longer rotation ages than would otherwise be for the timber resource alone. This is evidenced in the timber supply analysis reports, which often project actual harvest ages to be above minimums.[49]

Long rotation ages have implications for the economics of incremental silviculture, as well as for the planning and management of stands. It raises the question of whether such stands should be 'tagged' at their outset, with specific long rotation prescriptions prepared. Certainly, an opportunity presents itself for creating high quality timber on a portion of the timber harvesting land base –

[47] For examples, see Boundary, Cranbrook, Williams Lake, or Arrowsmith TSA rationale statements. Also see "Relief of Adjacency Constraints," page 35.

[48] Gilfillan et al report that in Scandinavia, "Thinning is particularly important to provide much-needed wood flow and can be justified financially because of the high cost of alternative wood sources." (1990:iii)

[49] Not all management units will have longer rotation ages, however. TimberWest, for example, plans to harvest some stands below culmination rotation age during certain time periods to maintain a steady harvest flow and higher harvest levels than would otherwise be possible. (TimberWest, undated(a))

timber reminiscent of the once vast old-growth forests of the province. It also raises the question as to how much active stand management will be necessary to obtain a target percentage of higher quality logs, as this will to some extent be accomplished in a passive way through longer rotation ages.[50]

Conclusions Regarding General Issues and Trends

The preceding sections indicate the following trends in BC forest resource management can be anticipated. All of these have implications for incremental silviculture programs.

1. The environmental services of forests will receive greater prominence, maintaining pressure to further reduce the level of harvesting as well as creating new pressures to practice incremental silviculture for the achievement of non-timber objectives.
2. Harvest volumes of many planted stands will be significantly increased as a result of the selection and breeding of superior native trees for seed for planting stock. Public concerns about narrowing the genetic resource are likely to arise if there is insufficient information as to how this is being addressed.
3. There will be more management for multi-storied forests. The silvicultural regimes for such forests tend to rely more on natural regeneration, potentially reducing the opportunity to benefit from tree improvement programs.[51]
4. Rotation ages of a significant proportion of stands will be longer than the optimum biological and financial rotation ages, necessitating specific stand prescriptions for long rotation management. Long rotations will result in a higher proportion of premium logs than would be achieved under financial or biological rotation age management.
5. Commercial thinning will substantially increase, as much for the reasons of maintaining fibre flow and for ecosystem management/forest stewardship purposes as for silvicultural purposes to improve timber quantity and quality.
6. There is on-going debate as to the effects of pre-commercial thinning (and of initial plantation spacing) on the volume and quality of stands. This debate needs to be resolved so that thinning can be used appropriately.
7. Standards for optimum and maximum juvenile stand densities are likely to rise from those of the past.

[50] TimberWest contends, "…a very broad range of log sizes and qualities should be a natural outcome of current harvest scheduling constraints." (undated (b)).
[51] Improved trees could still be used in the establishment of an understory layer, but overall the opportunity to benefit from tree improvement would be lessened.

2.6 Relating BC Supply to Demand

General

British Columbia has little room to expand its harvest beyond current levels. Therefore, as global industrial roundwood production increases, BC will produce a diminishing share of the world's total forest products and of exported forest products. While BC stays in the 65 to 75 million m^3 per year range, global production of industrial roundwood is forecast to grow from 1 500 million m^3 per year in 1994 to 1 800 million by 2010. This increase alone is more than four times BC's total annual production.

Clearly, BC will not be competing on a volume basis. What BC can produce is high quality softwood from sustainably managed forests; some of which is of relatively uncommon species.

Similarly, as BC's internal economy expands, maintaining forestry's share of provincial gross domestic product can only be accomplished through adding value both in the forest through silvicultural treatments and in manufacturing through secondary and tertiary manufacture.

Demand By Log Quality Class

A log quality classification system is proposed earlier in this report (page 3), consisting of three softwood log quality classes: fibre log, sawlog and premium log. The following sections review anticipated demand for each of these proposed log quality classes.

Fibre Log Demand and Implications for Commercial Thinning

Introduction

British Columbia has a long history of utilizing sources of wood previously thought unmerchantable. Examples are the increased utilization of lodgepole pine starting in the 1960's and aspen in the 1990's, and the gradual institution of smaller merchantable diameter limits over time. Following this historic trend of ever-increasing merchantability, the potential exists that fibre in the form of pulp logs from commercial thinnings may also become merchantable in the future. A review of supply and demand for this type of wood is therefore appropriate.

BC Supply/Demand Factors

A relative increase in demand for fibre logs may be exhibited within BC either through an expansion of capacity or a reduction in supply from traditional sources.

The 1994 Ministry of Forests' resource analysis reports that within BC, "…the historical surplus of wood chips which contributed to the expansion of the pulp and paper sector has now essentially been absorbed by additional pulping capacity." (220) Furthermore, "The utilization of decreasing sizes of sawlogs and remanufacturing of sawmill waste into value-added products … could negatively affect the pulp and paper side [by reducing available fibre]." (221) This expectation is confirmed by Nelson et al (1997:16) who, following a survey of BC forest companies, report, "Most individual companies that provided historic chip recovery factors or discussed their projected chip recovery factor indicated that it had fallen slightly over time as lumber recovery increased."

In terms of the industry's ability to capture small log fibre, MacMillan Bloedel reports small diameter utilization is already taking place in BC. "Anecdotal evidence abounds in the trade press that shows forest product firms using logs as small as 5.0 cm (small end diameter). This has occurred because a shortage of fibre has pushed up local demand and price for small logs. Technology has provided the means of utilising these logs economically." (1997:20)

A 1992 study by NLK Consultants projected that "… (with annual allowable cuts reduced by 18% to 60 million m^3 from present levels) … the existing mills plus those with firm plans to proceed will have **insufficient raw material to run at 95% of capacity**. The deficit will be **more than 4.0 million m^3 per year.** It is expected that the shortfall will have to be made up by harvesting wood presently considered 'non-merchantable'. There will be more use of equipment to debark and chip this material in the woods." (NLK, 1992:22) On the other hand, the same study also reported, "Some British Columbia chemical market pulp capacity may be closed because of inability to justify mandatory capital expenditures." (22) Were this to occur, it would likely reduce the previously quoted fibre demand/supply gap.

A study by Reid Collins indicates that with the transition to harvesting second growth forests the production of utility logs[52] will diminish from a current rate of approximately 13% of the total harvest to 5% in the future (1994b:8). This is because logs from second growth forests will virtually all be sound, having little decay, and will therefore be subject to less breakage and will yield higher lumber recoveries than primary growth timber (for equivalent sizes).

The expected situation appears best summarized by Nelson et al (1997:24):

> While the province has recently tended to have a surplus of pulp fibre, the 1995 supply and disposition analysis suggests that the BC industry faces a significant shortfall in fibre supply. Although the actual magnitude of fibre deficit may vary, the estimated decreases in residual chip production in both the Interior and on the Coast point to the increasing use of roundwood in both regions.
>
> The magnitude of the estimated 17% decline in fibre availability, roughly comparable to the capacity of six 'average' pulp mills, coupled with changes in the nature of that fibre supply, suggest the industry is entering a period of increase volatility as both the sawmill sector and pulp and paper sector attempt to develop alternative supplies. While increased roundwood offers the possibility of replacing some of the lost residual chip supply, the increase in cost associated with roundwood raises the possibility that there will be a reduction in pulp capacity to reflect the reduced pulp fibre supply.

Global Supply/Demand Factors

On a global scale, the FAO is not optimistic regarding demand for fibre from tree thinnings. It reports, "Wood pulp (i.e., fibre made from pulpwood logs or chips) used to account for more than three-quarters of raw material in 1970 but, by 1994, was only 56 percent, although in absolute terms the quantity had grown by more than one-half." (1997:31) It attributes this to high rates of recycling as well as a 350% increase in the use of non-wood fibre (mostly straw and bamboo pulp) in Asia. This non-wood fibre usage was a doubling at the world level, growing from about

[52] See "Quality Classes Used by Others," page 3, for a definition of utility logs.

4% of total world furnish in 1970 to 8% in 1994. The FAO concludes that these trends "…are effectively making the paper manufacturing industry less directly dependent on forests. They have reduced the demand for small-dimension timber (such as silvicultural thinnings), and may in some regions be worsening forest management problems by reducing revenues from thinnings, which are often already unprofitable." (31)

Studies by Resources for the Future also do not bode well for future fibre demand from thinnings. This is because in British Columbia much of this fibre would be high cost, due to factors such as slow growth rates, small piece sizes, distances to mills and steep terrain. This does not compare well with low cost production available in short time periods, principally in semi-tropical regions. For further discussion, see "Discussion Papers by Resources For the Future," page 19.

In contract to the above two reports, with respect to global supply, the Ministry of Forests' resource analysis reports, "Scarcity of pulpwood will develop by the middle of the forecast period and increase in severity through 2020." (219) However, from the evidence presented in other studies, it now appears that the resource analysis has overestimated global demand and underestimated supply.

B.C. has to some extent lost its formerly commanding market position as a producer of high quality northern bleached softwood kraft pulp.

> Papermaking technology now allows high quality paper to be made from southern softwood pulp and from hardwood kraft pulp. Technology is also blurring the line between chemical and mechanical pulps. Bleached chemithermomechanical pulp is now being used to make high quality paper. To a significant degree, B.C.'s producers of northern bleached softwood kraft now compete with these other products. (BC MOF, 1995:208)

Another factor affecting the potential utilization of fibre from intermediate thinnings is that the competitive position of the kraft pulp industry is highly dependent first upon foreign exchange rates and second upon wood costs. (BC MOF, 1995:210)[53] If one or both of these factors becomes overly constraining on profitability, the response in British Columbia may be to close mills or curtail production.

Conclusion

In terms of response to global level factors, it would appear that the case for increased demand for fibre logs from BC commercial thinnings would be weak. Globally, there is currently an oversupply of fibre and there will be an increasing ability to supply cheap fibre from fast growing plantations and fibre farms in other regions. Technological developments are diminishing the quality edge formerly held by BC pulp producers. There is the more remote, but nevertheless real, possibility of vatwood production of woodfibre, not requiring forests at all.[54] All of these factors are likely to have a dampening effect on future world price increases for pulp. As BC capacity diminishes as a percentage of global exporting capacity, BC will become less of a price-setter. For these reasons, there would appear to be a low likelihood of new pulping capacity being built in BC, other than perhaps some relatively minor additions to existing facilities.

On the positive demand side, a fibre shortage for existing plant capacity within British Columbia could potentially arise. This is because of decreased fibre supply due to increased lumber recov-

[53] However, over the long run "it is prices and not exchange rates that are responsible for long-run changes in imports of lumber." (Delcourt, 1996:36)

[54] See "Potential Technological Developments," page 22.

ery at sawmills, competing demand from manufacturers of wood-based panels for sawmills wood residues and for chips, and a gradual reduction in the proportion of pulp logs as the transition to harvesting second growth forests progresses. However, the percent of capacity at which existing mills operate, and therefore the demand for fibre, will still depend upon factors such as world prices for pulp and foreign exchange rates.

In the short term, therefore, income from fibre log sales is not likely to cover the cost of thinning. Under such a scenario, commercial thinnings yielding fibre logs would still be predicated upon other objectives, such as improving the quality, value and timing of harvest of the residual stands, and would require cost subsidization.

It is not possible to predict whether and when the demand for fibre logs from commercial thinnings will overcome the threshold costs of retrieval and manufacture. There is also something of a chicken-and-egg syndrome at play here. Is the manufacturing capacity built first or is the fibre supply developed first? Planning to produce a fibre supply from commercial thinnings first without an assured market can be an expensive gamble, but it is even more of a gamble to build manufacturing capacity without an assured supply (in fact, it is simply not done).

In the near term, other reasons such as maintaining harvest flow, are more likely to drive commercial thinning programs. Given that the industrial structure in British Columbia is such that the primary harvest is sawlog, it would appear to make sense to plan silvicultural regimes based around commercial thinnings that yield small sawlogs rather than fibre logs. Shifting AAC to a higher fibre log component would not help sawmills maintain future harvest levels under their licenses. For most of British Columbia, this would mean planning for a single commercial thinning, which because of a sawlog orientation, would generally be later rather than earlier in the rotation. On high-site suitable stands close to manufacturing facilities, however, more than one commercial thinning yielding sawlog-sized material is likely possible without rendering the final harvest volume uneconomic, provided stand densities are appropriately planned and managed. Market forces at the time of thinning will determine the end use as either a pulp log or sawlog.

The principle of maintaining options and reducing risk also suggests erring on the side of generally maintaining slightly higher stocking levels than would otherwise be optimal for a single final sawlog harvest. This, of course, is a management unit specific strategy; some units may require just the opposite, that is, lower stocking levels in certain stand age groups in order to bring harvests forward in time to fill an age class gap.

Returning to the future fibre log market, it may prove useful for the Ministry of Forests to undertake a long range study of BC pulp fibre supply incorporating some of the factors discussed above. Such a study could also look at the potential for high intensity plantation management and fibre farming within the province, particularly using hybrid poplar species. It would appear that over the long term there will be a diminishing production of pulpwood and residual fibre from within the province. The question becomes, will the pulp industry in BC re-invest capital to maintain its current capacity levels? It most certainly will not if there is not sufficient fibre projected to be available at competitive prices.

(See Expanded Utilization / Commercial Thinning," page 40, for further discussion.)

Sawlog Demand

The FAO reports, “Sawnwood consumption appears to have reached a plateau in most countries.” (1997:54) Of all forest products “only sawnwood had a lower production in 1994 than in 1970.”[55] (50) Consequently, it projects a global growth rate for sawnwood of only 0.9%/yr in the period 1994 - 2010, by far the lowest rate of any product group. (78) The next lowest rate is 2.01%/yr for wood-based panels. (78)

The MOF resource analysis, using older FAO projections along with those of others, indicates growth in softwood lumber demand to be between 0.9%/yr and 2.1%/yr, with a lower range for North America of from 0.5% to 1.2%. (1995:212-213) The resource analysis indicates an even lower growth in demand for sawlogs and veneer logs of 0.8%/yr (MacKinnon and Still, 1996:64), as “a result of anticipated improvements in lumber recovery rates, partly driven by the increasing scarcity of sawlogs.” (217) However, “Even if growth in the U.S. lumber demand is relatively low, the growth rate applies to such a large base that the actual increase in volume will be substantial.” (214) The major competitor for BC lumber is US domestic production. While this production is constrained from public land, private land in the US may have substantial capability in reserve over the long term.

The existing structure of the BC forest industry dictates a basic future demand for sawlogs, at least from its softwood forests. This is because it is the sawmill industry that drives activity in the logging sector. “…75 to 85% of B.C.’s timber is processed by the solid wood products sector.” (Simons 1995b:i) The pulp and paper industry derives its raw materials almost completely from the chip, sawdust and shavings byproducts of sawmilling. “Approximately 40% of a log processed in a sawmill is recovered as lumber. The remainder of the log becomes chips, sawdust and shavings, which constitute over 80% of the fibre used in provincial pulp mills.” (BC MOF, 1995:205)

Barring a large-scale change in the structure of the province’s forest industry, the basic requirement for sawlogs can be expected to hold for at least the near future. The minimum size of sawlogs is directly set for each management unit through the establishment of minimum utilization requirements under timber harvesting agreements. The AAC determination process also reflects a sawlog economy. Minimum harvest ages in the timber supply analysis are based on the minimum tree sizes required for an economically viable harvest. Generally, the higher the harvesting costs the greater the minimum harvest ages to attain a larger tree size.

Premium Log Demand

The literature review did not yield any global studies focusing on future demand for premium logs.[56] However, there are a number of references about the scarcity of higher quality wood resulting in it being directed to high-value end uses (FAO, 1997:33, 54) (BC MOF, 1995:201).

Eastin et al (1996) conducted both an analysis of historical lumber price data and a survey of industry segments that have traditionally used clearwood. Major findings were:

- …clearwood lumber is a differentiated product for which end users are willing to pay a substantial premium. These relative price premiums were quite stable over the 1989-1995 data period.

[55] A number of possible explanations are offered for this, but in the end the FAO states that “more research is needed to clarify the dynamics of the sawnwood industry today.” (54)
[56] See Table 1, page 4 for the definition of a premium log.

- For all the clearwood lumber species/grades combinations with sufficient price data, the real price differences were found to increase modestly over time….
- There is a definite structure of nominal and real (inflation adjusted) prices in the softwood lumber market, indicating that buyers purposefully differentiate lumber on the basis of perceived attributes associated with the intended end use.
- Those respondents who utilize clearwood lumber as a raw material input in their manufacturing process indicated that they value reliability of supply, price, and price stability over timber quality.
- …for more and more manufacturers, clearwood lumber attributes may be available from lower grade lumber products and substitute products.
- The survey results clearly indicate that many manufacturers are switching to substitute products to meet their raw material needs and provide price stability for their manufacturing operation.
- Based on these results, lumber producers and plantation managers can better assess whether to adopt management practices that emphasize the production of clearwood lumber for high-value niche markets, or whether they might be better off focusing on the production of commodity grade products.

Within British Columbia, there is an on-going debate as to whether larger logs will command premium prices. Some believe that past and current trends will continue into the future. For example, Reid Collins (1993:14 - 16) concludes:

- real log prices…will continue to exhibit future increases;
- prices for the better grades will increase at a faster rate than for the poorer grades;
- clears and wider widths are becoming increasingly more valuable than other grades and sizes, which in turn would tend to increase premiums for quality logs and logs of the larger dimensions.

Others feel technology will eventually (if not already) enable the replacement of larger dimension material with composite stock, and therefore past price differentials will not continue into the future. Feltham and Messmer found in their review of the literature, “There is no agreement…on whether prices of higher quality species and grades will increase at a rate which is faster or slower than prices of lower quality species and grades.” (1996:iii)

Simons and Cortex anticipate, “In future, … we can expect that as technology continues to evolve towards the utilization of smaller-diameter logs, the peak of the price curve will shift to the left to smaller diameter classes. At the same time, with our increasing ability to convert lower-quality logs into marketable products, the gap between the two qualities will likely shrink.” (1993:20) These views are shared by MacMillan Bloedel, the largest forest products company in the province. (MacMillan, 1997:5-8)

In 1994, the Ministry of Forests commissioned *A World Review of Strategic Silvicultural Planning Processes that have Potential for Application to British Columbia* (Reid Collins, 1994c). This study looked at the processes employed in Sweden, Chile, New Zealand, the U.S. South, the U.S. Pacific Northwest, and British Columbia. “This review found that the major emphasis of strategic silvicultural planning in other regions of the world is on incorporating the economic effect of wood quality. An important consequence of this has been an increasing emphasis on growing quality sawlogs.” (28)

On a practical note, Middleton et al (1995:3) discuss the 1988 findings of Mooney and Rotherham who had considered three basic schools of thought on forests and wood processing:

> They concluded that foresters should grow larger rather than smaller trees because tree size is far and away the most important factor to both the logger and the sawmill. They suggested that regardless of equipment type, total harvesting costs fall rapidly with an increase in tree size, that product price is the most important variable for any sawmill, and the value of larger dimension lumber is an important factor which depends on log quality and size. They added that the lumber recovery factor (LRF) is the second most important variable to the sawmill, and that LRF increases as the diameter of the log mix increases. Based on a comparison of two stud mills they demonstrated that for the same production time, a shift in average log diameter from 19.1 to 23.9 cm produced an 18% increase in log volume processed, increased LRF by 6% and resulted in an increase in lumber output of 28%. They observed that small dimension material will continue to be more economically produced by traditional sawing, rather than by composite technology.

However, it would appear only ten years later that Mooney and Rotherham may have been optimistic regarding the future of "small" dimension material. Finger-jointed material is one example of composite technology competing with sawn lumber.[57] While perhaps slightly more expensive than sawn lumber, it can be argued to have certain better properties. Composite 'I' beams are now in common usage as floor joists, currently going down to 9.5 inches in depth.[58]

Another aspect of premium logs is tree species. Little discussion of this in a British Columbia context was found in the literature. Yet BC has some relatively unique species that have only limited range outside the province (mostly Washington and Oregon states, some Alaska and California), a partial list of which includes red alder, western yew, amabilis and subalpine fir, subalpine and western larch, western red and yellow cedar, western white pine, western and mountain hemlock, and Sitka spruce. Of these, western yew has recognition in the marketplace for the medicinal properties of its bark, while western red and yellow cedar, western white pine and Sitka spruce have had or have species recognition in the marketplace for their unique wood qualities.

To conclude this discussion of future premium log demand, it would appear that while forecasting far into the future for industrial roundwood alone is dicey enough, forecasting for any specific segment, such as for premium logs, is virtually impossible.[59] There are reasoned and valid, but opposite, opinions regarding future demand and price trends. Rapid change in the marketplace tends to eliminate any trends as fast as they appear. There is likely to always be, however, a segment of the global population for whom only the 'real thing' will do and who are willing to pay whatever the going price is for it. While the structural qualities of wood can, to some extent, be substituted, the true appearance qualities and existence values cannot. Nonetheless, what the demand will be in 50 to 150 years is strictly a guess.

In the final analysis, the sole rationale for targeting the production of premium logs is to maintain options and reduce risk. It must also be remembered that larger diameter is only one of several attributes which may comprise a premium log. Diameter alone "…fails to capture attributes such as juvenile wood content, fibre length, knot frequency and size, and other important

[57] The original Mooney and Rotherham article was not reviewed, so their definitions of 'small dimension material' and 'composite technology' are not available.
[58] Reported by the largest building supplier in the Victoria, British Columbia area. Usage elsewhere is not determined.
[59] See *Working Paper 5: Proposed Financial and Socio-economic Analysis Framework* for a more indepth discussion of future log prices.

factors." (Simons and Cortex, 1993:41) Further, wood quality in BC is relative to wood quality in the rest of the world. The market definition of a premium log can be expected to change over time.

Positioning BC Timber Supply

The Two Schools of Thought

Perhaps the most difficult aspect of an incremental silviculture strategy is determining the positioning of the future BC timber supply. What quantity and what quality will best position the province to meet future demand? How much is BC prepared to invest to obtain the indicated position? What logs will command the best prices? What will be future North American and global demand? Will there be shortages? Will real log prices increase or not?

In attempting to answer these and other related questions two basic schools of thought have formed:

- the *positioning school*, which believes that reasonable forecasts of the future can be made, that future forests and the forest industry can be positioned in view of the forecasts, and that these factors should influence or dictate the amount, type and intensity of incremental silviculture treatments; and
- the *options school*, which believes that reliable forecasts cannot be made, and therefore options should be kept open by maintaining a spectrum of log qualities through incremental silviculture management.

There are two prevalent and somewhat opposite forecasts by the positioning school. [60] One is that *technology* will continue to blur the previously distinct lines between fibre quality, log size and manufactured products, and therefore the focus should primarily be on fibre production from essentially unmanaged stands. The other is that BC should focus on growing *quality* timber and fibre because it will not be able to compete in future low cost commodity markets against those regions capable of growing cheap fibre on short rotations.

The advantages and disadvantages of the technology position and the options school are summarized by Reveley (1996):

Technology - Positive

- …delays the need for investment to the time of harvesting.
- …can react to markets through the use of technology. … No need to use assumptions regarding the future.
- …reduces the costs to the province and could make industry more competitive now. …would reduce the incentive to maximize value from our forests.

Technology - Negative

- …a significant loss of employment to the silviculture contracting community….

[60] Throughout this discussion it should be kept in mind that current management research is not generally supportive of the notion of forecasting and positioning. This is discussed in *Working Paper 2: Concepts of Strategy and Planning, Proposed Planning Framework*.

- …relies on the future generation to invest in technology.
- A portfolio that lacks a variety of piece sizes is risky.

Options - Positive

- Provides jobs today to replace those lost by technological changes to logging and milling, age imbalances and land-use decisions.
- …provides an opportunity to enhance biodiversity and wildlife habitat during early seral stages when diversity is generally low.
- …reduces the risks to future generations by providing options such as to harvest earlier, to use non clear-cut systems, and to produce a wide range of end products without use of expensive technology.

Options - Negative

- The use of funding today is at the cost of this generation for the benefit of future generations, with greater uncertainty surrounding the use of these limited funds.
- With extended rotations we may get some old growth again without investment.
- Without knowing what the future holds there is no way of knowing for certain whether the investments made today will generate a positive financial return.
- We don't have sufficient information on specific products that can be produced from managed second growth forests with its' wider rings and larger knots.

The following sections contain examples from the literature of statements from each school of thought.

Positioning - Technology

Some forest companies believe forecasting to be feasible. For example, MacMillan Bloedel[61] "believes that existing data, financial forecasts and the application of economic theory can lead to plausible indicators of likely futures. (1997:4) It's research has led it to conclude, "Logs bigger than 20 cm (small end diameter) are not expected in the future to command a price premium based on size alone. (1997:7) Along with this expectation, MB finds, "Empirical evidence strongly suggests that pre-commercial thinning will reduce the future timber value of the forest." (1997: covering letter)

Positioning - Quality

After conducting a world review of strategic silvicultural planning processes, Reid Collins concluded that in other forest regions there "…has been an increasing emphasis on growing quality sawlogs. … In short, quality will be a 'winner'." (1994c:iii)

Options

A report by Simons Strategic Services tends to have feet in both schools. After preparing a forecast, the firm ultimately recommends diversification.

> The market and technology trends indicate that while there will be increasing demand for lower quality fibres, the market for high quality fibres will shrink, the supply of these two qualities of fibre will also increase and decrease, respectively. B.C., with the ability to

[61] By categorizing MB as subscribing to the positioning school, it is not intended to imply that MB subscribes directly to or fully meets the preceding descriptions by Reveley. Reveley's descriptions are broad generalizations.

> grow some unique species and qualities, is therefore positioned to meet these shrinking, high quality markets. The mixed view of future market conditions by the experts would further support a diversified strategy in order to respond to unexpected market conditions. … A portfolio strategy includes percentages of both extreme strategies and lessens risk. (1992b:xii)

Forest Renewal BC states a principle of its Enhanced Forestry Program to be a "diversified portfolio of forest products." … "British Columbia can minimize risk and better respond to changing market conditions by treating stands to ensure that forest produce a diversified portfolio of products." (1997:7)

Risk and Uncertainty

The preceding section identifies three outlooks on forest management: technology, quality and maintain options. Each one carries its own set of costs and risks. This section addresses the subject of risk and uncertainty as covered in the literature.

Heaps and Pratt provide useful definitions of both risk and uncertainty.

> A project is risky if the known technological and economic characteristics of the project can be used to develop a model for assigning probabilities to the possible outcomes of the project.
>
> Uncertainty on the other hand refers to situations where there is no generally accepted model for estimating the probabilities of future outcomes. Over the long periods of time involved in forestry projects, there are likely to be major unforeseeable changes in economic conditions and hence future wood product prices and future logging costs must be viewed as being uncertain. (1989:17)

Heaps and Pratt then undertake a discussion of risk and uncertainty. Following are relevant extracts with respect to risk.

> "Financial theorists therefore seem to agree that the appropriate measure of risk is the variance of returns from the project plus the covariance of returns from the project plus the covariance of returns from the project with returns from the total portfolio of the economy (i.e., the market portfolio). … It is also recognized in the financial literature that there are two ways in which risk can be reduced …. One way is through diversification of the current portfolio. The other way is by hedging to reduce the possibilities of losses in the future.

They go on to argue, in the case of silvicultural investments,

> "The ability to respond to opportunities for good returns while conversely being able to avoid poor returns is valuable and reduces the risk faced by the provincial economy. … There are further reasons why silvicultural investments may actually reduce the riskiness of the market portfolio. First of all, these investments may contribute to avoiding or reducing falldown effects. The processing industry will then feel that they will be more able to respond to any changes that take place in the marketplace in the future. … Secondly, there will be less pressure on untreated forest land for wood production. Therefore these lands will be more available for alternative uses such as recreation opportunities….. Thirdly, forest products are an important source of export earnings for the Canadian economy. … The conclusion of these arguments then is that investments in silviculture do not need to be considered as adding to the variabilty (sic) of returns from the market

> portfolio and hence no risk offset needs to be subtracted from the risk free [expected net present value] in the evaluation of these projects. (1989:19-20)

Finally Heaps and Pratt conclude,

> Recent research in finance has actually shown ENPV calculations using the risk free discount rate may understate the net economic benefits of an investment. The understatement occurs when the investment creates options for further growth, for alternative use of assets and for expansion in the chain of value added products. … Since investments in silviculture have these characteristics, it is reasonable to suppose that the understatement applies to these investments." (1989:20)

Brumelle et al also undertake a thorough discussion of risk with respect to silvicultural investments. They start by discussing whether risk can be ignored, based on the "idea that with a large number of investments, statistical laws will predict that the average realized outcome per investment will converge to the expected one. Thus it is asserted that a government with a large number of investments should treat expected values as equivalent to sure returns." (1991:821) They find, though, that this concept ignores several important factors. They then go on to discuss how to incorporate risk preference. In this discussion they state: "Financial experts argue that when portfolios of investments are chosen one should pay attention only to the systematic risk of any alternative investment option, i.e. its contribution to the riskiness of the diversified portfolio. The ability to diversify, of course depends on the size of the referent system and the structure of its objectives. For example, if regional equity is a prime objective then a failure in one region cannot be compensated for by success in another even if the locus of analysis is the province as a whole." (1991: 821)

Brumelle et al conclude their discussion of risk as follows:

> The problem of finding an appropriate characterization for making silvicultural investment decisions at the various levels is one which requires further study. At the stand level the utility approach as practiced by decision analysts may provide an appropriate framework for characterizing choices. At higher levels the choice of which risk and return measures to use for different payoff dimensions becomes problematic. (1991:822)

Catastrophic losses to insects, diseases, or fire are judged as manageable risks. Fire is probably now the least risk, given today's sophisticated detection and control techniques, as well as BC's high commitment to initial attack. Risks, in the form of consequences, are minimal at the provincial level, increase at the regional level, and are the greatest at the management unit level. Therefore, specific risk management strategies are appropriate at the management unit level.

Summary

In summary, the general impression from the literature is that while some consider forecasting and positioning to be plausible, there are a number of reasons to be wary of committing to a position based on a single vision of the future.

- there are two somewhat opposite forecasts - one that focuses on quality to be obtained through active management, the other on commodity/quality to be obtained by more passive management;

- management research no longer supports forecasting and positioning as a means of developing strategy - past attempts at forecasting are seen to have largely failed;
- there is greater risk to British Columbia to commit to a single specific vision of the future.

The literature on silvicultural investment risk leans strongly towards diversification as a means of minimizing portfolio risk. The vast majority of commercial forest land in British Columbia is owned by the province. The investment platform of the province is narrower than any multinational firm. Risks borne by the province generally cannot be diversified beyond its borders. Its citizens expect investments to be made in BC forests, not, for example, in forests in the US South, Chile or New Zealand.

Maintaining options by creating a diversified portfolio of forest stands appears to be the best choice for British Columbia's public forests. Perhaps the greatest reason for this choice is it reduces risk. However, carrying "insurance", so to speak, has a cost. The insurance cost is whatever is spent to incrementally change the forest towards creating such a portfolio. Achieving this diversified portfolio is not costed. However, establishing such a strategy and associated working targets are helpful in determining how and where currently available funding for incremental silviculture is best applied.[62]

2.7 Strategic Conclusions Regarding BC Timber Supply and Demand

As noted by Mintzberg and others, forecasting is a difficult business, fraught with uncertainty. The literature review has tended to support this, finding many conflicting opinions.

In considering the conclusions below, the following must be kept in mind:

- The foreseeable future does not extend beyond the period 2010 - 2020 and is basically an extrapolation of existing trends.[63] While this may have implications for short term markets, it does not provide any insight as to the character of the world marketplace over the range of BC rotation periods, that is, from 40 to 120 years from now.
- Any projection is based on the world as we know it. Dramatic unforeseen changes can destroy such projections in a very short time. New technology could introduce substitutes, or world level demand for forest products could plunge in response to an environmental, population, or economic catastrophe.
- Only the pulp and paper markets display the characteristics of a globalized market. Therefore, global trends are the most significant with respect to these market segments.[64] Soft-

[62] The scope of this project is to "focus on use of available funds."
[63] Many would argue it to be shorter than this, perhaps as short as only five years.
[64] The primary characteristics of a globalized market are: universal product standards and specifications, production capacity is concentrated within fewer and larger multi-national firms, and trade between principal exporting and importing regions is active and balanced (Canadian Forest Service, 1996:49).

wood lumber and wood-based panels are more regional in nature, and global trends therefore have less significance for them.

Global Supply/Demand

1. Total industrial roundwood consumption grew by only 15% from 1970 to 1994 (1.48%/yr between 1970 and 1990). However, processed products grew more than two-fold for paper and paperboard while sawnwood consumption was practically stagnant. Much of this growth was accommodated through improvements in technology, and increased use of recovered paper and non-wood fibre furnishes.
2. The rate of increase in demand for industrial roundwood is slowing and will likely be less than 1.2% per year. Future growth is predicated largely on both an increasing world population and increasing incomes in developing nations. In absolute terms, this growth is staggering – a 1.2%/yr rate of increase will result in a total increase of approximately 300 million m3 per year over 1994 levels by 2010. This growth is over four times the current total AAC of British Columbia.
3. Large tracts of undeveloped forests in eastern Russia, the Amazon and Africa are not likely to be economically available in the foreseeable future, but are potentially available in the distant future. On the other hand, as the economies of these areas improve, domestic demand will also increase, perhaps making little new supply available for trade.
4. Improvements in utilization are likely reaching their known limits. However, technological improvements, particularly in the field of tree improvement, offer opportunity for substantial gains.
5. There is, and will continue to be, a dramatic increase in fast-growing plantations and fibre-farms, which will improve the marketplace's ability to respond to surges in demand through means other than by accessing existing timber supplies at the extensive margin. This has implications for expectations of accessing more remote and high-cost areas for timber harvesting within British Columbia, particularly those with high pulpwood content. Real log price changes will drive developments on both fronts, with expanding the harvest margin in BC being somewhat more dependent upon real log price increases.
6. While no study forecasts excess supply, world level fibre shortages are not likely in the foreseeable future, particularly in the area of fibre for paper and paperboard. This has implications for markets for fibre logs from British Columbia commercial thinnings.
7. On the horizon are technological developments such as *in vitro* fibre production, which does not require forests at all, and wood-plastic composites, which may extend the existing resource (but may, on the other hand, create new markets and increased demand for fibre).
8. Canada, and British Columbia in particular, has little room left to expand AAC. Therefore, as global consumption increases, it will produce an ever- diminishing share of the world's forest products.
9. Concerns about global warming due to the emission of 'greenhouse' gases have given rise to the concept of using forests to act as carbon sinks through their ability to extract carbon dioxide from the atmosphere. Such a role for forests, if it comes about, could create increases in global standing inventory and timber supply.

North American Supply/Demand

1. Because of its dominant position as a customer of B.C. forest products, trends in the United States are of particular significance.
2. A relatively low rate of growth in U.S. lumber demand applies to such a large base that the actual increase in volume will be substantial.
3. A potentially tight, but not crisis, softwood supply situation is expected until plantations in the southern USA and Pacific Northwest mature. This may be eased by greater use of hardwoods if consumer tastes permit, and by increased imports from Canada. Canadian hardwood harvests have increased substantially over the past 5 years.
4. Recent information tends to indicate there may be less availability of timber than the major studies predict. While production in the US South is showing signs of leveling off, intensive plantation management and fibre farming has the capability to supply substantial quantities of domestic fibre.

B.C. Forest Industry

1. In any short term period, foreign exchange rates and wood costs will likely have the greatest impact on the competitiveness and profitability of the forest industry. Over the longer term, the future of the industry will depend on trends in worldwide (generally) and North American (specifically) consumption of various forest products, as well as trends and developments in worldwide and North American timber supplies.
2. Technology is blurring the lines between the quality and acceptance of pulp from different tree species and between different methods of manufacture. Composite wood technology and engineered wood products are competing successfully with sawn lumber, particularly in the larger dimensions. These trends are likely to continue.

British Columbia Supply

- Without intervention, British Columbia's timber supply is headed downward in quantity and perhaps in quality.
- Harvest volumes from regulated lands are forecast to drop from a post TSR1 AAC of 71 million m^3 to an estimated long term harvest level of 58.5 million m^3.
- The quality of harvested timber fell by 25% between 1925 and 1980, and has continued to decline during the period 1980 to 1992. An increase in the lower value component of the AAC from 6% to almost 11% indicates that the trend towards lower quality may continue.
- The contribution of wood from harvests on private land is substantial. The continued liquidation of a large portion of this wood supply is an unquantified downward pressure on total BC supply.
- Over the near term, reductions in harvests appear unavoidable as the timber supply adjusts to factors such as the protected areas strategy, the forest practices code, the transition from primary to secondary forests and improved estimates of operability, forest productivity and forest inventory. Over the long term, with silvicultural and other interventions and as a result of improved resource estimates, the potential exists to increase future timber supplies such that they could support future harvests at near current levels. This can be achieved through greater use of alternative silvicultural systems and through programs to improve tree seedlings

through breeding superior native trees, reduce voids in regenerated stands, reduce regeneration delays and green-up ages, increase yields through fertilization, and rehabilitate the remaining backlog NSR.

British Columbia Demand

- From a global timber supply perspective, there would appear to be a low likelihood of new pulping capacity being built in BC, other than perhaps some relatively minor additions to existing facilities. Within BC, however, a fibre supply shortage for existing plant capacity could potentially arise due to decreased fibre supply due to increased lumber recovery at sawmills, competing demand from manufacturers of wood-based panels for sawmill wood residues and for chips, and a gradual reduction in the proportion of pulp logs as the transition to harvesting second growth forests progresses.
- Maintaining harvest flow is most likely to be the driving force behind commercial thinning activities. Given that the industrial structure in British Columbia is such that the primary harvest is sawlog, it would appear to make sense to plan silvicultural regimes based around commercial thinnings that yield small sawlogs rather than fibre logs. Shifting AAC to a higher fibre log component would not help sawmills maintain future harvest levels under their licenses. Market forces at the time of thinning will determine the ultimate end use, but planning for sawlog thinnings maintains the option of sawlog use.
- The principle of maintaining options and reducing risk also suggests erring on the side of generally maintaining slightly higher stocking levels than would otherwise be optimal for a single final sawlog harvest. This, of course, is a management unit specific strategy; some units may require just the opposite, that is, lower stocking levels in certain stand age groups in order to bring harvests forward in time to fill an age class gap.
- The demand for sawlogs as the primary product at the forest level will continue into the foreseeable future. A sign of change would come from a structural change to the forest industry in B.C. This is as much a provincial policy matter related to the structure of forest tenures, as it is a matter of supply and demand factors.
- Many other competing regions are focusing on the quality of their forests. With silvicultural intervention, the potential exists to improve the quality of future timber supplies. This necessitates programs of spacing, fertilization, commercial thinning, pruning, and combinations thereof.
- It would seem prudent to ensure a certain component of the forest is of higher quality than sawlog. The sole reason for doing so, however, is to maintain future options. Forecasting future marketplace demand in the distant future cannot be done.

Real Log Price Changes

- Forecasting real log price changes is probably the most precarious of all forecasts. Studies have provided conflicting opinions.
- On the balance of probabilities, and given that timber is found to be generally price inelastic, it would *appear* that global real log prices are likely to rise over time, probably later rather than sooner. Predicting with any reliability the rate and timing of price increases, and differentials between grades and sizes is virtually impossible.

- There is a general expectation of higher future real log prices in the North American market, probably sooner than global prices.
- The above points notwithstanding, as with forecasting timber supply and demand, projecting real log prices over the length of BC rotations, that is form 40 to 100 years and longer, is fruitless.

Positioning British Columbia Supply

- Maintaining options by creating a diversified portfolio of forest stands appears to be the best choice for British Columbia's public forests. The greatest reason for this choice is it reduces risk.