# A CROSSROAD IN THE FOREST:

## *The Path to a Sustainable Forest Sector in BC*[1]

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*I shall be telling this with a sigh*
*Somewhere ages and ages hence:*
*Two roads diverged in a wood, and I —*
*I took the one less traveled by,*
*And that has made all the difference*

Robert Frost, "The Road Not Taken"

BRITISH COLUMBIA LIES AT A CROSSROADS in the transition between forests provided by providence and those created through human husbandry and stewardship. Many of the changes now tormenting BC are predictable consequences of human interaction with primeval forests. Indeed, the earliest recorded story — the *Epic of Gilgamesh,* written in cuneiform on a clay tablet 5,000 years ago — remarks on the dire consequences of forest depletion. Each subsequent civilization — from the Greeks in the Mediterranean, to the wandering bands in Central Europe, to the Swedes late in the last century, to our southern neighbours in the last decade or so — has relived this story with little change in theme.

Large expanses of virgin forest remain in only a few places — in BC and elsewhere in Canada, in eastern Russia, in the Amazon, and in parts of Africa. Those in BC lie on the cusp of an irreversible slide into the established historical pattern of resource depletion and attendant social disruption. But, unlike in most other developed parts of the world, in BC there is still an opportunity to make the changes needed to sustain a vast wild estate while yet maintaining a prosperous society based on forest resources.

This article contemplates BC's predicament by responding to three questions: First, by way of background, what are the predictable elements of resource depletion as they have evolved in other parts of

[1] This article was originally presented at the Harold Innis centenary celebration conference, Trouble in the Rainforest: Community and Crisis in BC's Resource Hinterland, University of British Columbia and Simon Fraser University, 16-18 February 1995.

the world? Second, what are some of the key elements of a sustainable forest sector for the future? Third, how must policies adjust to move from the present uncomfortable position to a preferable future position?

## TIMBER DEPLETION AND FOREST SECTOR DEVELOPMENT

To examine the predictable linkages between timber depletion, forest sector development, and societal evolution, I will use the economist's mode of analysis: hold everything else constant in order to focus clearly on the issue at hand, with full knowledge that the world contains a much richer fabric of complications. In this spirit, consider a sovereign entity (called a "country" below) embedded in a world forest sector. Imagine that this country discovers an old-growth timber resource large enough that its development is significant in the relevant markets. In the absence of policy intervention, how does the forest sector develop?

The first part of this story relates the comparatively old and well-known saga of the adjustment of a timber stock through time (Lyon 1981; Sedjo and Lyon 1990; Sedjo 1990). The second part of this story links the dynamics of this timber stock to the changes in the forest sector, the macro-economy, and the broader environment (Vincent and Binkley 1992).

### *Dynamic Adjustment of the Timber Stock*

In the early stages of development, net growth of the forest is nil: photosynthesis just balances the death of plant tissues and entire trees. Because growth is nil, any harvest at all exceeds the growth of the forest. Since harvest is greater than growth, the timber inventory declines.

As the inventory of old-growth timber declines, timber becomes more scarce. In economics, "scarcity" is a synonym for higher prices. Harvesting costs will increase as logging pushes into increasingly remote sites. Timber rents — the value of the standing timber itself — will increase as a consequence of old-growth depletion and the link between timber markets and capital markets. Prices rise until the purposeful husbandry of second-growth timber and the use of non-wood substitutes (stone, concrete, or steel for construction; fossil fuels, solar energy, and conservation for energy) becomes economical.

Because timber prices have risen, other countries can compete in world markets, either by exploiting their own old-growth reserves (e.g., the Philippines, Indonesia, and Malaysia) or by developing plantations (e.g., New Zealand, Chile, Brazil, and South Africa).[2]

In the absence of subsidies, high-cost old growth is apt to remain unharvested and become economic wilderness.[3] We see this today in remote locations of British Columbia as well as in other parts of the world. What do these adjustment in the timber stock imply for such important concerns as capital, labour, and the environment?

### *Capital and Labour*

In economic terms, harvesting timber transforms *ecological* capital into *economic* capital. The reduction in timber stocks increases the supply of capital to the economy. Because of the increase in the supply of capital, its price will decline relative to the price of labour. Because timber prices are rising, the price of capital relative to the price of timber falls even more.

The technology used to process timber logically adapts to these changes in factor prices: firms substitute capital for labour and capital for timber. Because of the nature of the technologies used in the forest sector, the substitution of capital equipment for timber (e.g., investment in a sawmill that produces more lumber from a given input of logs) typically reduces specific labour utilization as well. The resulting increases in technical efficiency push up output per person-hour (i.e., labour productivity) and open the door for higher wages. But the mathematical inverse of labour productivity is employment per unit of output, so efficiency gains (all else being equal) mean fewer workers per unit of output. As a result of these effects, employment/$m^3$ (cubic metre) of timber harvested in BC has fallen by a factor of two between 1961 and 1989 (Nixon 1991).

[2] In broad lines this is consistent with the development of the forest sector in the United States (Clawson 1979; Sedjo 1990). Harvest exceeded growth until the 1950s. Early in this century, the trends were such that the famous American conservationist Gifford Pinchot (1907, 3) predicted: "If we accept the larger estimate of annual growth and apply it to the present rate of consumption, the result shows a probable duration of our supplies of lumber of not more than 33 years... [It] is certain that the United States has already crossed the verge of a timber famine." Increased scarcity drove up timber prices, and high prices forestalled the predicted timber famine by choking off demand for wood products and encouraging investments in forest management. Timber prices rose at a real rate of about 4.6 per cent/yr between 1910 and the Second World War and by about 3.1 per cent from that period to the mid-1908s (Binkley and Vincent 1988).

[3] This assumes that the cost of harvesting the last old growth is greater than its value once harvested. See Clark (1973) or Page (1977) for a discussion of the economics of extinction.

An iron law of economics holds that the economic return to the addition of any one factor of production declines as more of that factor is used. As firms use more and more capital in an effort to offset rising relative prices of timber and labour, the single-factor productivity of capital will decline. Lower returns on capital mean less capital investment. Unless technical efficiency increases via the application of new technologies, wage rates ultimately must fall (or at least not rise as much as they do in other countries) or the forest sector will fall into a self-perpetuating spiral of declining productivity.

Increases in timber prices will drive up product prices. Higher product prices encourage substitution away from conventional wood-based products. So, for example, the consumption of softwood lumber in the United States has remained roughly constant since 1900, at 40 to 50 billion board feet annually, despite a sevenfold increase in economic activity and more than a doubling of population. Some of this substitution has been pure efficiency gain (e.g., because of improved knowledge about the performance of wood used in buildings, a basic framing member that measured 2" x 4" in cross-section at the turn of the century has now been reduced to 1.5" x 3.5" with no loss of building safety), some has been wood-wood substitution (e.g., in sheathing applications first plywood substituted for lumber, then, more recently, oriented strandboard substituted for plywood), and some has replaced wood with other materials (e.g., steel studs, plastic bags, and concrete buildings).

*Environmental Values*

As per-capita income increases, so too will the demand for the services of natural environments. Empirical evidence substantiates this claim for some features of the environment (e.g., air quality, water quality, and outdoor recreation), and the positive relation between income and environmental values is probably more broadly applicable as well.[4] At the same time, development of forests for timber production may decrease the supply of these environmental services.

[4] Evidently, the relationship between income and environmental values is not new. Perlin (1991, 120) comments:

> Seneca best articulated the romantic view of forests shared by many of the leisure class of his time: "If you ever have come upon a grove that is full of ancient trees which have grown to unusual height, shutting out the view of the sky by a veil of pleated and intertwining branches, then the loftiness of the forest, the seclusion of the spot and the thick, unbroken shade on the midst of open space will prove to you the presence of God."

One cannot help but note the similarity between this comment, made nearly two millennia ago, and contemporary descriptions of old-growth forests in BC.

Local and global environmental services operate outside formal markets, either because they are true public goods (e.g., aesthetically pleasing landscapes, carbon sinks) or because society has chosen not to allocate them through markets (e.g., clean water flowing from a forested watershed, recreation). It is a simple truism that such goods are systematically undervalued in forest consumption and production decisions. As a consequence, market-based patterns of forest use cannot and do not reflect the social values of these inputs and outputs. This mismatch between the social valuations of natural environments and their value in formal markets will widen over time. Once the gulf is sufficiently large to overcome transaction costs, institutions will emerge to place values on these services. They may actually be traded in formal markets, or they may be protected through direct governmental ownership, through regulation, or through elaborate and costly mechanisms of planning and public involvement in forest decision-making. Whatever the mechanism, productivity as conventionally measured will decline as these previously free environmental inputs come to carry positive costs.

## CHALLENGES FOR A SUSTAINABLE FOREST SECTOR IN BRITISH COLUMBIA

The problems BC faces today are neither more nor less than the local manifestation of the more general phenomena outlined above. In the absence of positive adaptations in public policy, BC faces wrenching structural adjustments in its economy, communities, and regional patterns of development. The well-known "fall down effect" in BC — the planned reduction in timber harvests as old growth is depleted and investment in second growth is inadequate — is but one example of this.

In 1992 the BC government announced a review of long-term timber supply on all Timber Supply Areas (TSAs) and Tree Farm Licences (TFLs) — virtually the entire land base that supports industrial activities related to BC's forest sector. Under the Forest Act, the level of annual allowable cut (AAC) for individual areas is not calculated from any one formula but, rather, is set by the chief forester on the basis of broad biophysical and socio-economic criteria. As a result, it is nearly impossible to predict in advance what future AACs might be. However, the analytical models used by the Ministry of Forests to estimate potential future harvest levels give an indication of the

results of current policy direction. At this writing, the ministry has released analytical reports for 25 of the 36 TSAs, representing some 35.3 mm $m^3$ of AAC (versus about 72 mm cum for TSAs and TFLs province-wide). These reports collectively suggest that current policy regimes will result in a long-term reduction of about 23.5 per cent in provincial total harvest levels, with a significantly greater impact on the Coast than in the Interior (Miller, personal communication).[5]

What are the implications of this level of reduction in timber supply? A recent study (Binkley et al. 1994) examined a variety of economic impact analyses related to harvest reductions. It concluded that a 25 per cent reduction in harvest levels would mean a loss of up to 92,000 jobs and $4.9 billion in provincial gross domestic product (GDP) with more-than-proportional impacts on governmental revenues (i.e., the net loss of taxes on GDP grossed up by increases in social service costs for unemployed workers). Although even Vancouver's economy relies heavily on the forest sector,[6] the impacts would be felt most strongly in the 39 of 55 rural communities in BC where the forest sector is the dominant basic industry (Ministry of Finance and Corporate Relations 1992). These economic effects are likely to produce social effects concomitant with community disruption (e.g., alcoholism, divorce, suicide). These social problems will come just when the province is least able to assist: this study indicates that, with a 25 per cent reduction in harvests, the provincial budget deficit will increase by about $2 billion.

The obviously large negative impacts of current policies suggest that significant benefits might accrue from a change in policy direction. We are indeed at a crossroad in the development of our forest sector. Before turning to desirable policy changes — the path best taken — let us examine some desirable policy outcomes. These include simultaneously maintaining harvest levels, enhancing the productivity of the forest sector at high wage rates within the constraints of available timber, and sustaining the important ecological and environmental characteristics of BC's diverse forest estate.

[5] My own analysis of 22 of the 36 reports suggests a 20-year reduction in AAC in the Interior of 11.8 per cent and on the Coast of 25.1 per cent, for a reduction in the provincial total AAC of 15.9 per cent.

[6] Park (1991) estimated the economic impact of the BC forest industry in the metropolitan area of Vancouver for 1989 to be $6.0 billion of GDP and 115,000 jobs with wages and salaries of $3.0 billion. A more recent study (Chancellor Partners 1994) found that in 1993 133,000 jobs (one in six) and $6.2 billion of regional GDP in metropolitan Vancouver depended on the forest sector.

*Maintaining Harvest Levels*

Current policies are apt to lead to significant reductions in harvest levels. Are these reductions necessary?

Historically, BC's forests have been managed extensively under the implicit assumption that virtually the whole forested land base would, one day, be available for timber production. The BC Forest Service and licencees incorporated non-timber values into timber production plans though a process of "integrated resource management," which attempted to consider wildlife, riparian habitat, recreation, water flows, grazing, and other forest uses on each hectare where logging was to occur. Investments in silviculture were low. While licencees are now required to regenerate all areas logged to a "free-to-grow" stage, and while massive reforestation efforts under the various federal/provincial agreements have virtually eliminated the backlog of "not-satisfactorily-restocked" (NSR) lands, BC's use of silvicultural technology lags behind that of virtually every country with which it competes.

This approach to land management has clearly failed. It does not satisfy those concerned with the non-timber values of the forests. It is a clear prescription for reduced harvest levels and does not respond to the commercial needs of the forest sector, to the economic needs of communities, or to the financial needs of the provincial government. Recent theoretical work (Vincent and Binkley 1994; Swallow et al. 1990) and empirical analysis (Sahajanathan 1994)[7] confirm the old idea that the multiple benefits of forests are best provided by zoning them into a series of special-use areas corresponding to the range of forest values society demands — from wilderness to timber production. The vanguard of the environmental movement understands the wisdom of this approach (e.g., McNeely 1993; Alverson et al. 1994).

BC has moved tentatively in this direction through the process established by the Commission on Resources and the Environment (CORE). In the three areas studied (Vancouver Island, the Cariboo-Chilcotin, and the Kooteneys), CORE defined zones ranging from protected areas to areas for intensive timber production. The details of management in each zone remain to be developed, but if the

[7] This study of the Revelstoke Forest District found that, through moderately increased management intensity, about 40 per cent of the land base would produce the same amount of timber as would 100 per cent of the land base under current rules for intergrated resource management.

management rules actually do permit intensive management on some of the land, then it may be possible to offset much of the planned reduction in harvest levels.

Consider a benchmark. In the late 1970s the Weyerhaeuser Company studied the biochemical efficiency of trees in turning sunlight into wood, and it modelled maximum biologically possible timber yields (Farnum et al. 1983). It applied this model to two sites in the United States — one in the Pacific Northwest (Douglas fir) and a second in the Southeast (loblolly pine) — where they practise the most intensive forestry to be found anywhere in the world. For example, in the Southeast, the study plantations were site-prepared, bedded, fertilized, and planted with genetically improved mycorrhizal-innoculated seedlings that were optimally spaced after planting and repeatedly thinned and fertilized. Yet the production of these stands achieved only 40 to 50 per cent of the theoretical yields. Natural stands in the same locations grow only about 10 to 25 per cent of the theoretical yields.

Forests in BC are managed much less intensively than are those in the aforementioned study sites. As a consequence, there appears to be considerable latitude for increasing the production of economically usable plant parts in this province. With intensive silviculture, yields of from two to five times the levels attainable in natural stands generally appear to be economical.

There is some local empirical evidence that these kinds of increased yields are indeed feasible in BC. Tolnai's (1991) analysis of Weyerhaeuser's TFL 35 near Kamloops found that, with more intensive management, harvest levels on this licence could be sustainably increased by 70.1 per cent. In some stands the increase was even more dramatic, rising from 2.3 $m^3$/ha/yr under the current management regime to 8.3 $m^3$/ha/yr in a more intensive management regime. And, remarkably, these management regimes involved only prompt restocking with desirable species (in this case, lodgepole pine) at an appropriate density. Increased yields from the genetic improvement of planting stock and site emendations could be added to these gains.

The impediments to achieving these gains are primarily institutional. Licencees have no incentive to invest in more intensive silviculture because the gains accrue to the Crown and not to them. From a financial point of view, private investments in silviculture are equivalent to tearing up money and throwing it out the boardroom window: they neither enter the balance sheet nor produce incremental future earnings.

*Enhancing Productivity*

Economists define "productivity" simply as the value of an industry's outputs divided by the costs of its inputs. Increases in productivity are obviously prerequisite to increases in material standards of living. Porter (1990, iii) expresses the situation well: "Productivity is the prime determinant in the long run of a nation's standard of living, for it is the root cause of national per capita income." In his study of Canada, he goes on to say:

> Canada's economy, and especially its export economy, is heavily based on natural resources. Some argue that resource industries are inherently less desirable than manufacturing or "high tech" industries. This logic is flawed. There is nothing inherently undesirable about resource-based industries provided they support high levels of productivity and productivity growth. Such industries can make a country wealthy if its resource position is highly favorable, as has been the case for Canada during most of its history. If resource-based industries continually upgrade their sophistication through improvements in their products and processes, competitive positions can be sustained and productivity growth insured. (Porter 1991, 28)

Productivity in the BC forest sector is squeezed between a rising floor of raw material costs and a fixed ceiling for product prices set by international competitors in the forest products industry and by the cost of substitute products. As a result, the BC forest sector faces enormous challenges in simply maintaining the high levels of productivity that have produced the high standard of living enjoyed by the province,[8] never mind the high levels of productivity growth needed to sustain this standard of living in the face of the predictable negative changes pressing the sector.

Traditional reliance on old-growth timber, which required no human inputs to grow, meant that the value of timber — the rent — was available for distribution to whatever parties found political favour. Historically, some of the rent flowed to licencees as an inducement to establish processing facilities.[9] Some flowed to labour

[8] At present, mills in BC are, on average, mediocre competitors in newsprint and pulp but, at least in the Interior, are international competitors in lumber (NLK 1992; Simons 1992).

[9] Before the April 1994 changes in the stumpage rates, analysts commonly estimated the uncollected rents at about $10/m^3$. The increased stumpage payments announced in April averaged about $11/m^3$, so the amount of uncollected rent, especially for licencees with marginal mills, is probably now small. This is roughly consistent with the estimates of Binkley and Zhang (1995), which found that the change in the stumpage system reduced the capital value of publicly traded firms in BC by about $1.3 billion (or about $2.8 billion if grossed up to the sector as a whole).

in the form of higher wage rates. Figure 1 shows average labour costs for sawmills in the major North American producing regions. Despite an almost 20 per cent devaluation of the Canadian dollar relative to the US dollar over the last four years, BC coastal producers (BCC) still support labour costs that are much higher than those of their competitors across the line in the US Pacific Northwest, westside (PNWW). Devaluation of the Canadian dollar, combined with continued massive investments in labour-saving capital, has worked to keep labour costs in the BC Interior (BCI) in line with the costs of their competitors in the US South (USS).

To counteract the negative competitive effects associated with rising timber costs and high wage rates, BC needs higher-than-average productivity growth. Productivity growth can occur through a reduction in the total costs of inputs or through an increase in the value of outputs. As we have seen, there is endogenous upward pressure on raw material costs, and reductions in our high wage rates are not socially attractive. As a consequence, the only acceptable sustainable answers seem to lie in more efficient production (Binkley 1993).

Increases in productivity result from technology investments that are either earlier or better than those made by competitors. Yet in BC the forest sector spends only about 0.7 per cent of gross receipts on research and development (R&D) where, for example, Sweden spends about 1.8 per cent (Binkley and Watts 1992).

Despite these problems, some elements of the forest sector have been able to adopt technology rapidly. Figure 2 shows the lumber recovery factor for BC interior sawmills between 1986 and 1992. On average, this sector increased technical efficiency by about 1.4 per cent/yr, a remarkable performance by any standard. However, it is not clear that this increase in technical efficiency was adequate to offset higher production costs, competitor responses, and marketplace effects (Binkley 1994). Figure 3 shows that profit margins were no better than constant over the period of these productivity increases.

*Sustaining Environmental Quality*

Assuming that BC devotes some 20 million hectares to zones where timber production is a significant or dominant use, a vast area remains to support other forest uses. Urban and agricultural lands comprise a fairly small portion of the province, so perhaps 65 million ha could be devoted, more or less exclusively, to sustaining the environmental

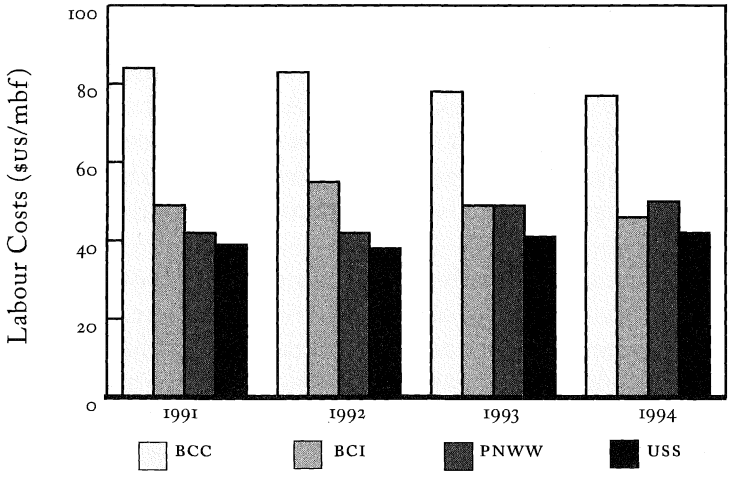


Figure 1: Labour costs in the forest industry (BCC = BC Coast; BCI = BC Interior; PNWW = US Pacific Northwest, westside; USS = US South).

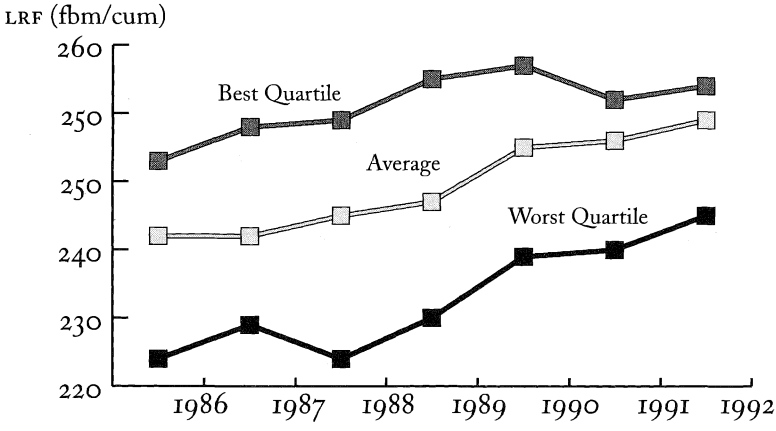


Figure 2: Lumber Recovery Factor (LRF) for Northern Interior Sawmills.

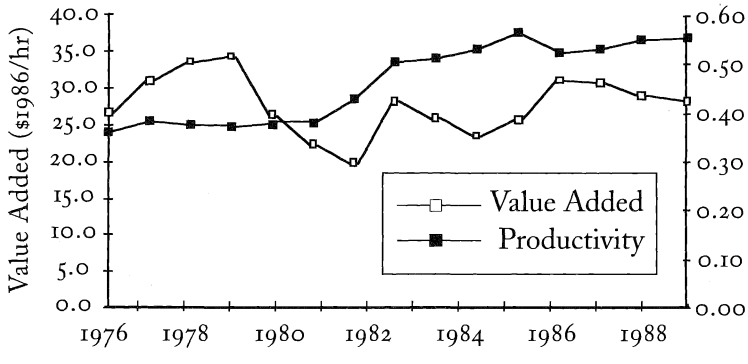


Figure 3: Productivity and value-added in BC sawmills.

values that forests provide. This area would include at least 23 million ha of productive forest, 20 mm ha of savannahs and other vegetated land, and 20 million ha of "rocks and ice." As a point of comparison, the area of France equals about 55 million ha. In other words, through a policy of zoning and intensive dominant-use management, BC could devote an area larger than France to sustaining non-timber values of the forest.

Such a policy might involve three zones: (1) intensive timber production areas as described above, (2) strictly protected areas, and (3) integrated management joint-use areas to form the transition between (1) and (2). For such a strategy to work, two things must happen. First, a core of protected areas must be selected so as to include a reasonable representation of the great variety of BC ecosystems in large enough blocks to sustain landscape-scale processes. The current provincial Protected Areas Strategy is well suited to this task. Second, the joint-use areas must be managed in a way that responds to environmental needs. Nominally, this will occur through the Forest Practice Code, but there may be serious environmental problems associated with the approaches it specifies. The code will reduce the average size of clearcuts and will require that areas logged "green up" (i.e., reach a specified age or cover condition) before adjacent areas may be logged. While sounding innocuous — if not beneficial — the net effect of these two provisions is to scatter the harvest across the landscape. This pattern of harvests will fragment the forest with predictable consequences for biological diversity (Harris 1984). The area of forest edge habitat will increase, and the area of forest interior habitat will decline. These landscape changes will tend to favour early successional species, while much of contemporary public concern focuses on late successional species (e.g., the spotted owl).

The Forest Practice Code will also require more rapid development of the road system and the yearly maintenance of a greater amount of it. The increased length of an active road network will provide more opportunity for illegal hunting. By building the road system faster, BC forecloses any possible future option of deciding that an area should remain roadless. Since the very worst environmental problems associated with timber production in BC come from the failure of roads, it is ironic that new legislation purporting to protect environmental values actually demands more road building.

Finally, the intensive management areas must, indeed, be managed very intensively in order for timber production to make up the

harvests lost through the creation of protected areas and low-intensity management areas. Logically, the Forest Practice Code should contain a very different set of standards for these intensive management areas than the one it has for the other zones. Control of the collateral environmental damage frequently associated with logging should occur through land-use designations and not through management regulations on the intensive management areas. Such policy-driven constraints as minimum rotation ages, green-up/adjacency, and visual quality objectives should be relaxed in the intensive management areas. The tenure system should provide stronger incentives for investment in timber production in these areas. Applied research should be focused in these areas in order to adapt what has been learned about intensive timber management in such locations as Brazil, New Zealand, the United States, and Sweden to the specific circumstances found in BC.

## NEEDED POLICY ADJUSTMENTS

Despite the vast size of the province and its relatively small population, land has become scarce in BC. Each hectare seems to face multiple demands — from local residents, from the province as a whole, and from the international community. The increased scarcity of land logically implies that other productive factors — knowledge, capital, and labour — should be substituted for land in order to produce desired outcomes, whether in the form of environmental values or timber production. Government ownership and control of land in BC means that the price system has not been able to signal the needed changes. Like a fault-line that has accumulated strain over years of tectonic action, the BC forest sector is close to rupturing. Abrupt change appears to be inevitable. Good policy would help ease the transition by providing the flexibility needed for change. What are some appropriate actions?

### *Reform of Forest Institutions*

A thin membrane of institutional arrangements mediates the interactions between humans and forests. In BC, the most significant institution affecting forests is the tenure system. The basic concepts used in the current system of forest tenures derives from the 1945 Royal Commission (the Sloan Commission). At the time, the basic societal need was to use old-growth forests as a wooden magnet to

attract capital investment in the processing sector. Capital investment meant economic development, particularly in the hinterlands of the province. Environmental values of the forest were not of great concern, in part because so vast an area of forests remained undeveloped.

Times have changed. Societal needs now involve attracting capital to invest in the forests themselves; in activities that produce value-added products; and in activities that use such secondary sources of fibre as bark, sawdust, planer shavings, and trim blocks. Standing timber is not a particularly logical or effective inducement for these kinds of investments, so the current tenure system is a blunt tool for crafting the future. As a result both of increases in the timber fees collected by the provincial government and of increasingly restrictive operating rules, forest tenures are no longer the potent plums of political advantage they once were.

The recent creation of Forest Renewal BC (FRBC) nominally provides the capital needed for investments in forest management. Unlike the many previous "permanent" silviculture funds,[10] increased stumpage fees and royalty payments directly fund FRBC without reference to annual appropriations from general revenues. An independent board of directors will direct these funds to five areas: silviculture investments, industry diversification and value-added manufacturing, environmental restoration, strengthening communities, and training workers (with R&D being directed at all these areas). Although there are other similar arrangements elsewhere (e.g., the K-V funds for national forest lands in the US), the magnitude of the FRBC fund is unique. Planning for FRBC assumed that the bellwether grade of lumber (Interior spruce-pine-fir, referred to below by the trade acronym SPF) would trade at $US 350/mbf — at this price, the pool of available funds would be about $400 million/year.

While preferable to the previous situation (where little was invested in growing trees), the FRBC approach to forest management suffers from four potentially serious shortcomings. First, the anticipated revenues may not be realized. SPF traded at around $300/mbf during the end of 1994, and respected industry analysts had forecast even lower prices for 1996. Although historically low North American interest rates and restrictions on Canada/US lumber trade forced prices

[10] Since the original draft of this document was prepared (in early 1995), the recently elected NDP government announced its intention to take $400 million from FRBC's funds to offset its operating defecit.

up well beyond the anticipated levels, these prices probably cannot be sustained in the face of pressure from substitute products. At price levels below $US 300/mbf, the size of the fund is quite sensitive to fluctuations in product prices: each $1 reduction in product price results in a $0.58 product-equivalent reduction in the stumpage rate (Binkley and Zhang 1995). Falling product prices will jeopardize the entire program, and it is not at all clear that investments in the land will be able to secure priority allocation of whatever funds are available. Second, the board is not constrained to invest in the best silvicultural opportunities; indeed, section 6(b) of the BC Forest Renewal Act *requires* the board to "provide advice to Forest Renewal BC as to appropriate *regional goals* for expenditures [emphasis added]." The board is contemplating devolving funding authority to regional bodies. In the absence of clear guidance from the Act, regional allocations are apt to be governed more by politics than by investment efficiency. Third, FRBC has no particular incentive to be frugal in the administration of its funds. For example, an early submission to the board from the Ministry of Forests and the Ministry of Environment, Lands, and Parks requested $33.8 million/yr to add perhaps 400 full-time equivalents to the two bureaucracies (Zak, personal communication). Finally, the efficacy of silvicultural investments depends on an intimate knowledge of the land base, local ecological conditions, and overall landscape management objectives. It is doubtful that a distant third-party funding agency will understand these local circumstance well enough to invest wisely.

In BC, discussions of forest tenures frequently use the analogy of owning a house outright (private land) versus renting it (tree farm licences or forest licences): if you lease a house to people, you hardly expect them to paint it (to invest in silviculture), and if you require them to do so (free-to-grow requirements), they will probably use the cheapest paint possible. To extend this analogy, FRBC offers to buy the paint but provides no incentive to apply it carefully (to implement the most efficient silvicultural investments).

At the same time, there is ample empirical evidence — both from elsewhere in the world and now from BC — that strengthened property rights lead to higher levels of private investment in forest management.[11] In BC, stronger property rights could be achieved

[11] A recent study (Zhang 1994) empirically confirmed this well-known theoretical argument. Zhang examined expenditures on silvicultural activities on different kinds of tenures while holding a variety of factors that might affect such investments (e.g., biogeoclimatic zone, site quality, location) constant. After controlling for all of these factors, silvicultural

either through outright privatization of those lands in the intensive management zones created by CORE or through the sale of long-term leases along the lines of New Zealand's recent policy. Existing tenure holders might retain their current lands or might be satisfied simply to buy logs from others. New kinds of organizations would probably enter the field. For example, pension funds now own timberland in the United States, New Zealand, and Chile worth more than $4 billion. The largest of the timberland management organizations serving pensions funds — the Hancock Timber Resource Group — now owns and manages about 30,000 ha in BC. Stronger private property rights would not only increase the pool of capital available to invest in forest themselves, but they would also provide greater flexibility in responding to BC's rapidly changing circumstances.

Tenure reform should be accompanied by reform of other dysfunctional policies related to the tenure system. Perhaps the most significant of these are the appurtenancy clauses in many coastal tenures, which, on penalty of licence forfeiture, constrain logs from a specific licence to flow to a specific mill. The original objective of these clauses was to use timber to support the development of individual communities. But they have become very expensive subsidies for regional development. In times of tight log markets, efficient mills not associated with the restricted licences must close while less efficient mills that are appurtenant to a particular licence continue to operate. The difference in log values between the efficient and inefficient mills is significant: in one case it amounts to about $60/cum (Binkley, personal observation). In this case, the subsidy for each employee of the appurtenant mill is about $75,000/yr, in addition to wages. I suspect that the employees involved would be pleased to receive a fraction of the capitalized value of this amount in return for granting the company permission to terminate their jobs.

*Strengthening Transition Mechanisms*

The policy changes required to put BC's forest sector onto a path of economic, social, and environmental sustainability will inevitably produce losers as well as winners. In so far as those old policies protect the self-interest of potential losers, it is natural and predictable for

investments are strongly correlated with the strength of property rights. Taking the weakest from of tenure — forest licences — as the base, expenditures/ha on tree farm licences are 27.4 per cent greater, and expenditures/ha on private land are 81.0 per cent greater.

the latter to hold fast to them and to slow the needed adjustments. The magnitude of the adjustments needed in the forest sector demand that explicit attention be paid to the problems of policy transition (Behn 1978).

If policy changes improve economic efficiency (and many in BC would), then — by definition — the winners would be able to compensate the losers and still be better off than they were before the changes. As a practical matter, those who will gain from policy changes should support providing compensation to those who will lose from them.

From a more philosophic vantage point, BC has explicitly chosen *not* to allocate timber resources through market mechanisms but, rather, though a process of governmental control. Timber prices do not properly signal the relative scarcity of timber, and firms' harvesting decisions are virtually dictated by government representing society as a whole. Firms deploy capital and labour moves to specific regions as a result of these socially determined decisions. Therefore, society as a whole logically bears the burden of unanticipated and unannounced adjustments to the system.

Compensation should be paid to those who are economically injured by reductions in timber harvests, changes in tenure policies, or other changes in forest policy that produce both winners and losers. Potentially injured parties include those who own capital or labour made obsolete by policy change. Compensation should cover, for example, the reduced value of homes, the costs of necessary job retraining, the lost value of tenures, and the foregone returns to productive capital (such as sawmills and pulp mills) made redundant by policy change. Compensation for lost tenures might involve granting stronger property rights to a licencee over a smaller portion of a current licence. Compensation is best paid in kind, so timber somewhere else (perhaps created by increased silvicultural investments) compensates for timber lost in one location, while a job of comparable worth compensates for a job lost in logging or sawmilling.

### *Creating a Knowledge-Based Forest Sector*

Rapid adoption of improved technology is key both to the international competitiveness of BC's forest sector and to the responsible stewardship of the environment (Binkley 1993). Forest-sector R&D expenditures in BC are small. There is a significant gap

between us and our competitors with regard to both forest-related R&D and forest-products R&D (Binkley and Watts 1992). Yet rapid development and adoption of leading-edge technology is a fundamental element of the path to a sustainable future.

BC firms face three particularly daunting tasks in effectively deploying R&D (Binkley 1994). First, commodity-grade products (softwood construction lumber, market pulp, newsprint) dominate the BC industry. R&D leverage is less for commodities than it is for higher value-added products. By definition, commodities compete on the basis of production costs. Cost-reducing technology is likely to be available to all producers, so it creates no unique competitive advantage once all producers adopt it. As a consequence, only a strategy of rapid adoption will produce competitive advantage. Such a strategy is extremely difficult to implement. In this context, R&D may be viewed as a powerful means of strategically moving a company out of commodity businesses. MacMillan Bloedel's creation of Parallam® and Space Kraft®, along with its Nexgen-coated paper project, are examples of using R&D to move towards value-added products.

Second, BC's forest sector is a leading international exporter, with a large share of many of the markets it serves. This market position exacerbates the problems of being a commodity producer. In these circumstances, some of the benefits of cost-saving technology are simply passed on to consumers. As long as the consumers are in one's own country, there is a case for government support of R&D; but when they reside elsewhere, such an argument obviously does not apply. In these circumstances, effective technology strategies again involve the rapid adoption and exploitation of features unique to BC (e.g., Western red cedar).

Third, as a result of the tenure system, BC firms cannot exploit synergies between the design of forest management regimes and the design of new products and processes. Through its silvicultural regulations, the BC Ministry of Forests specifies the characteristics of future timber supply for the entire province — species mix, genotype, diameter, clear length — and all producers must adapt to these constraints regardless of their own market information. Under current institutional arrangements, the kind of R&D that led to the clearwood regime for *Pinus radiata* in New Zealand — an approach that permits fast-grown second-growth timber to substitute, in many uses, for BC's old-growth *Pinus ponderosa* — would not be possible.

Similarly, exceedingly low wood costs for Brazil's Aracruz pulp mill came from heavily targeted R&D to produce, plant, and process *Eucalyptus* spp. clones of high cellulose content. Such a strategy is unavailable to BC firms operating on public lands.

A high-technology strategy for the forest sector will create benefits beyond those associated with it alone. This sector has some strong backward linkages with the high-technology sector that could be strengthened and exploited more effectively. Vancouver is the heart of an important international forestry services industry. The Lower Mainland is a hotbed of technology firms providing log- and lumber-scanning equipment and real-time sawmill optimization software. One equipment producer on Vancouver Island is among the world's leaders in the design and manufacture of cable logging equipment. Yet the provincial and federal governments have not, as a matter of policy, worked to build on these strengths.

Finally, a technology-based strategy will pay significant benefits for environmental quality. Better manufacturing efficiency is a powerful lever for environmental improvement. For example, from the perspective of product markets, just one year of the technological improvement depicted in Figure 2 is fully adequate to offset the reductions in timber harvests associated with the decision to set aside the Kitlope — a 320,000 ha drainage on the North Coast thought to be the largest unlogged temperate rainforest watershed in the world. As another example, progressively more sophisticated use of wood wastes has permitted substantial improvements in air quality in towns where sawmills operate. In the mid-1950s all slabs, edgings, planer shavings, and sawdust (which collectively comprise about half of any log) for a typical interior sawmill were burned as wastes. Then pulp mills operating on wood residues were established, leaving only the sawdust and planer shavings to be burned. Now technology has advanced further to permit the production of medium-density fibreboard (MDF - a high-quality panel used in furniture and similar end uses) from these residues. Removing all of the wood fibre from the waste stream will leave only the bark, and mills will burn much of this for process heat used in the manufacture of lumber, MDF, and pulp.

Improved silvicultural technology — from better inventory and yield information to sophisticated techniques of molecular genetics — can sustain harvest levels on a smaller land base, freeing land for allocation to other uses. The power of this technology has not been

extensively used in BC, but it has been in other parts of the world. For example, because of an aggressive high-technology plantation program, forest companies in New Zealand no longer log that country's native forests but, instead, rely entirely on plantation forests. Their agreement to refrain from logging in natural forests — the Tasman Forest Accord — had virtually no economic impact on the country. In contrast, such an agreement in BC would close over 90 per cent of the forest industry, largely because BC has made no similar investments in R&D and forest management.

## CONCLUSIONS

In husbanding its forests, BC faces an ancient challenge. The paths travelled by earlier societies have known but unpleasant destinations. Past policy and development in BC have brought the province to a crossroad in the forest. Only "the one less traveled by" will create a sustainable forest-based economy for the future while maintaining the critical and renowned ecological and environmental features of BC's magnificent forested landscape. Following this path will require a massive redirecting of current policies, both public and private. Many policies that have served well in the past are dysfunctional guides to the future.

Some of the needed changes are now under way. Land-use planning through the CORE process will provide greater long-term political certainty in the forest sector. Increased certainty is prerequisite to the high level of capital investment — in forests and in new sophisticated processing equipment that sustainability (in its broadest sense) requires. The Forest Practice Code will provide a framework for guiding management in the different land-use zones. FRBC may be able to provide the capital required to finance this transition.

But these policy changes must be carefully implemented and strongly reinforced if they are to be successful. Once land-use zones have been established, various interests will no doubt seek to poach across the boundaries. Government must wisely distinguish legitimate needs to revise land-use zones from simple rent-seeking. Economic instruments such as those increasingly used for pollution abatement may be helpful in drawing these distinctions.

The management rules for the various zones must be carefully crafted to support the distinct management objectives of each. Just as industrial intrusion on protected areas should be strictly limited, regulatory intrusion on intensive management areas should be

carefully proscribed. Differences in Forest Practice Code regulations among the various zones provide a useful measure of success in this regard.

Once land-use zones have been defined and zone-specific Forest Practice Code rules have been written, it will be possible to craft a set of institutional arrangements and land tenures that serve the sector more productively than is now the case. Logically, these arrangements involve significant public control in those zones where public values dominate, and significant private control in those zones where private values dominate. In the case of parks and protected areas, institutional reform will require a much strengthened parks agency to handle the capital investment and management activity needed to ensure that the protected areas and very low-intensity zones do, in fact, provide the environmental values anticipated from them. In the case of integrated-resource management zones, institutional reform will require either strengthened direct public management activities or a much more sophisticated set of licence documents than those that are currently used. Economic instruments that bring licencee and public interests into line merit careful attention (e.g., pricing systems for recreation, water flows, or site degradation). In the case of intensive timber management areas, tenure reform will require more powerful inducements to make highly effective investments in timber production. Ample evidence from BC and elsewhere suggests that markets operating through ordinary private property rights provide the needed incentives. The experience of other countries — especially New Zealand, Sweden, and the United States — will provide useful guidance with regard to the advantages both of different kinds of private ownership and of their different mixes (e.g., small and large; institutional, industrial, and individual). However, BC's unique circumstances will no doubt require unique approaches to strengthening private property rights in forest land.

Change is always uncomfortable, and when the stakes are as high as they are in the BC forest sector, discomfort invites paralysis. Sensitive attention to the problems of transition can reduce the discomfort and invite more rapid, creative, and positive responses from the parties involved. Compensation principles should be articulated at the outset. New tenure arrangements should be made sufficiently attractive so that at least some licencees will voluntarily adopt them. Because no one really knows the optimal approach for a sustainable future, experimentation (and its concomitant — failure) should be encouraged. Different approaches might suit different areas.

To make progress down the new road — the one that leads towards a sustainable future — will, most of all, require new ways of thinking about old problems. The forest industry must embrace the righteousness of forest conservation and preservation, and environmentalists must accept the desirability of a robust and efficient forest products industry. Governments must respect the stewardship capacity of the private sector, and the private sector must respect the necessity of governmental regulation of the public goods produced by forests. This revolution of the mind will not be easy, but is the only way down the path "less traveled by."

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