

Socioeconomic Impacts of the New Brunswick Private Woodlots Silvicultural Program



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Introduction

New Brunswick has about 1.8 million ha of private woodlots covering 30% of its total productive forest area. These private woodlots have traditionally strengthened the province's forest-based economy—primarily the rural economy—contributing substantially to the wood supply of the forest industry, as well as to other forestry activities, such as providing firewood and recreational opportunities. Over last several decades, the forest industry has been the primary manufacturing industry of the province, contributing substantially to the provincial economy by producing commodities and value-added forest products. In 2004, for example, the value of the wood products and the pulp and paper industries was \$1.6 billion and \$2.34 billion, respectively; most of these products were exported to other countries. Revenue from the forestry and logging sector in the same year was \$1.07 billion with substantial value-added components, and gross output in silviculture and other support activities for the forestry sector was \$84 million. Although contributions from the forestry sector have declined significantly over the past few years, they are expected to rise as market conditions improve and the industry restructuring process concludes.

To encourage better forest management practices and increase the productivity of these forests, over the past five decades, federal and provincial governments have given woodlot owners financial support to carry out various silvicultural activities. Funds from the program are used for approved silvicultural activities that create jobs and contribute to the provincial gross domestic product (GDP), especially in rural communities (MacFarlane and Zundel 1995). The current provincial program, the Private Woodlot Silviculture Assistance Program, is administered by the Department of Natural Resources (DNR) and delivered by the forest products marketing boards. The federal government funds specific silvicultural activities through the Atlantic Canada Opportunities Agency (ACOA). This study evaluates the economic benefits of these programs and explores the importance of private forests and the financial assistance provided by governments to the rural economy of the province.

The study consists of a socioeconomic impact analysis that identifies the direct and indirect effects of the silvicultural expenditures, based on several socioeconomic indicators, including contributions to GDP, personal income, and employment. The study also aims to identify the long-term economic effects of the silvicultural activities, including the increase in the qualitative and quantitative productivity of the forests and the consequent benefits in wood supply to the forest industry.

This report has five sections. Section 1 introduces silviculture and provides brief background information on private woodlot programs and previous research. Section 2 describes the characteristics of the private woodlots of New Brunswick. Section 3 analyzes the short-term economic effects of the Silvicultural Assistance Program on the provincial economy. Section 4 looks at the long-term effects of the program on the productivity of the forests and provides a financial analysis of the investment. Finally, Section 5 discusses the role of program funds in sustaining private woodlots in the future, offers recommendations, and identifies areas needing further research.

1. Background

The functions of silviculture

Silvicultural activities are conducted to reforest harvested areas and other unforested tracts, to improve productivity and other forest stand conditions, to enhance timber quality by encouraging larger-diameter trees, and to reduce the rotation age (the time till harvest).

Reforestation activities, which include site preparation, tree planting, and plantation tending, supplement natural regeneration and reforest abandoned farmland. They can also change the forest stand composition by introducing preferred species or superior varieties that are resistant to pests and diseases or have better stem and fiber characteristics.

Stand improvement activities, primarily precommercial thinning, are generally done 8 to 15 years after harvest or reforestation to create space within the stand and encourage diameter growth of the preferred tree species. The removal of low-quality stems increases the size of the remaining trees and, consequently, the timber yield per unit area. It can also reduce the cost of eventual harvesting operations.

Forests take a long time to grow: harvesting generally occurs 45 years after precommercial thinning and more than 50 years after the initial planting activities.

History of private woodlot programs in New Brunswick

An evaluation of the 1984–1989 Canada–New Brunswick Forest Renewal Agreement (NBFRA) was completed by Gardner Pinfold Consulting Economists Ltd. in 1989. The NBFRA comprised six major programs, one of which was focused on silvicultural activities on private woodlots.

The budget for the Private Land Forest Management program was roughly \$12.6 million, much of which was spent on softwood stand improvement activities. According to the evaluation report, the objective of enhancing the annual sustainable harvests from private woodlots by 200,000 m³ was surpassed by 65,000 m³. Gardner Pinfold (1989) estimated that the private woodlot program created 167 direct person-years of employment, although this estimate is likely understated, as the majority of forestry workers who carry out silvicultural activities work less than 50 weeks per year. Under the agreement, private woodlot owners were required to contribute 10–15% of the cost of completing silvicultural treatments on their land; however, it was reported, this contribution was often not made.

The federal and provincial governments entered into the Cooperative Agreement on Forest Development in 1989. The main objectives of this agreement were to increase the sustainable supply of softwood and high-quality hardwood timber and to develop income and employment opportunities. In 1994, the final year of the agreement, Gardner Pinfold and Agfor Inc. prepared an evaluation of the seven programs under the agreement that were designed to meet its

objectives. The cost of the agreement was shared between the federal government and provincial government on a 55:45 ratio, with Canada contributing \$50 million and New Brunswick \$41 million. The Private Woodlot Resource Development Program (PWRDP) was allocated \$27 million, nearly one-third of the \$91 million total. The objectives of the silviculture assistance component of the PWRDP were to increase the sustainable wood supply and product diversity and quality, and to develop uneven-aged silvicultural alternatives. Gardner Pinfold and Agfor Inc. (1994) show that over the 4 years of the program, softwood reforestation activities were carried out on 4277 ha; stand improvement activities were applied to 9890 ha; and hardwood silvicultural activities were conducted on 1044 ha. Although the program was costly, the report concluded, participation in the program was favourable, and it was expected that little silviculture would be done were the program to be cut. The authors recommended that the program emphasize harvest-based silviculture.

Previous economic impact studies in forestry

The forest industry makes an important contribution to the New Brunswick economy. The economics of forestry activities have been estimated on local, regional, and national scales in many parts of the world. A US study based on data from 29 states estimated that an average eight jobs were created for each 1000 acres of privately owned forests (Anonymous 2009). The same study estimated that each acre of privately owned forest generated an average \$270 in income and \$318 in GDP. MacFarlane (1993) estimated that the 1990–1991 New Brunswick private woodlot silviculture program, which cost \$3,300,384, created 73.8 jobs and generated \$2,023,620 in wages and salaries. Rimmner et al. (2000) used a fixed-price input–output model to estimate the effects of alternative levels of timber cuttings in Finland. The multipliers (type I) derived for the sawmilling industry for gross output, household income, and employment were 1.89, 4.41, and 2.85, respectively. Kulshreshtha (1998) used a regional input–output model to estimate the economic effects of forest operations in northwest Saskatchewan. The output, income, and GDP multipliers for silvicultural activities in the region were estimated to be 1.345, 0.353, and 0.485, respectively.

2. Characteristics of New Brunswick's private woodlots

New Brunswick is a forest-rich province with about 6 million ha of productive forest land, accounting for 80% of its land base. Nearly 1.8 million ha (30%) of these forests are owned by about 40,000 landowners. The average size of woodlot is 45.5 ha (NBFPC Annual Report 2008–09). A report of the Private Woodlots Resources Study done in NB during 1983 called “Private Woodlots: What Does the Future Hold?” suggests that landowners own woodlots for timber and other forest products and also have environmental and social objectives. Only 28% of the landowners reported harvesting commercial timber as one of their top three reasons for owning forest land but were nonetheless interested in active management of their woodlots, including harvesting and silvicultural operations. The province has established seven marketing boards to provide forest management and forest product marketing support to the landowners within their jurisdictions. The average woodlot size is slightly more than 50 ha in the western and southern marketing boards, compared with less than 40 ha in the northern and eastern marketing boards (Figure. 1).

Woodlots' economic importance

Timber from private woodlots plays an important role in creating a competitive market for wood fiber procured within the Atlantic region by providing a consistent wood supply to the forest industry. For example, 17% of wood fiber consumed by the New Brunswick forest industry in 2005–2006 came from private woodlots through the marketing boards compared to 21% during 1998–2000 (Figure 2 &3). Historically, contributions of private woodlots to the provincial wood supply have been proportionate to their land area, with yearly variations depending on market demand and sustainable forest conditions. For instance, harvest of industrial roundwood from private woodlots in 1990 was 2.6 million m³, or 30% of the total harvest in the province; that increased in 2004 to about 3.7 million m³, or 34% of the total harvest, because of an increase in demand from the forest industry. However, with recent changes in global market conditions, the province's forest industry has been passing through a restructuring phase, which has included the closure of many production facilities. As a result, the demand for timber has declined significantly, and the harvest from private woodlots fell in 2009 to 0.9 million m³—a 77% reduction from 2004.

Figure 1. New Brunswick private woodlots: area and ownership for each marketing board

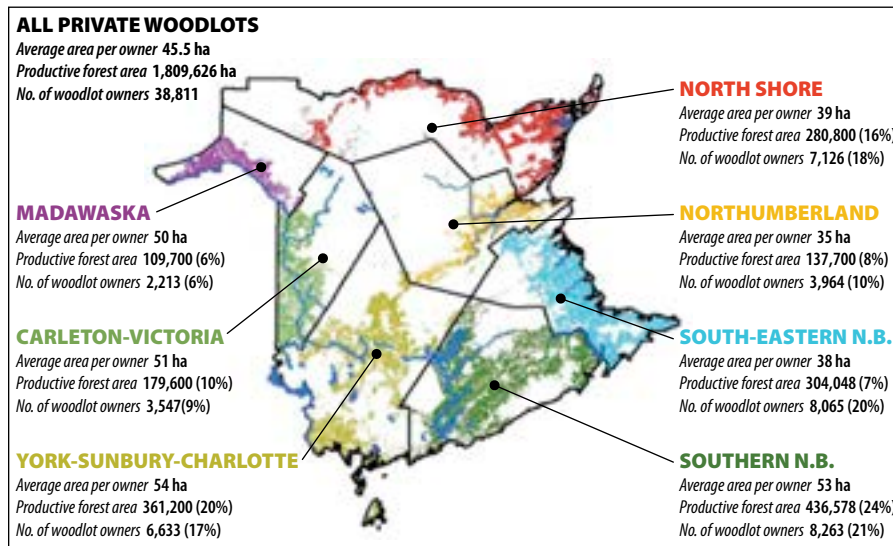


Figure 2. Share of sources of fiber consumed by NB forest industry in 1998–2000

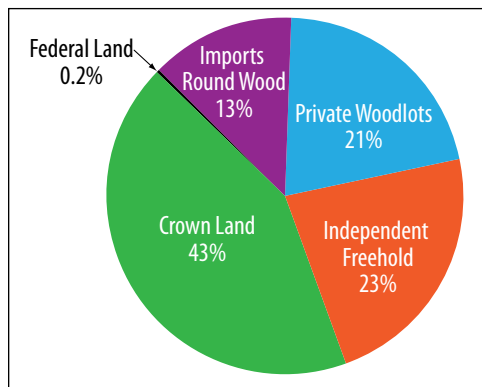
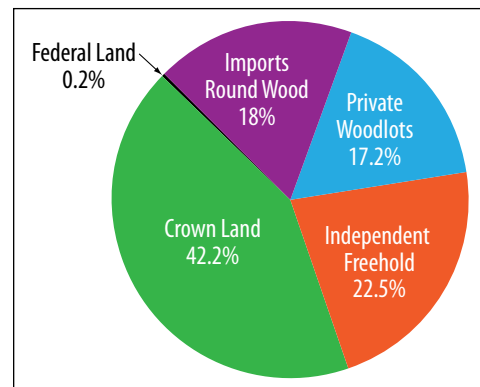


Figure 3. Share of sources of fiber consumed by NB forest industry in 2005–2006



Although harvest levels from private woodlots are not regulated in New Brunswick, the province establishes an annual allowable cut (AAC) as a guideline for the sustainable level of harvesting. The estimated annual sustainable level of total wood supply for 1990–2007 was 3.2 million m³ (28% of the province’s total AAC); the figure was later increased to 3.6 million m³ (31% of the total) (Table 1). With the present market conditions, however, less than a quarter of the wood supply is being used by the forest industry.

Table 1. Estimated private woodlot supply (annual allowable cut) and actual harvests, 000 m³ (percentage of provincial total)

	Estimated Sustainable Harvests (AAC)			Actual Harvests			Harvest Percentage
	Softwood	Hardwood	Total	Softwood	Hardwood	Total	
2004	1 690 (24%)	1,514 (35%)	3,204 (28%)	2,250 (30%)	1,447 (41%)	3,696 (34%)	115%
2009	1,905 (27%)	1,705 (36%)	3,610 (31%)	561 (12%)	287 (9%)	848 (11%)	23%
Change	13%	13%	13%	-75%	-80%	-77%	

Source: National Forestry Database: Table 2.1.1.1 and 5.1.2.0

The management of private woodlots has been complicated by volatility in the demand for various forest products. As harvest volume from private woodlots was declining by 77% from 2004 to 2009, the proportion of pulpwood harvests increased from 32% to 61%. Over the past few decades, the province, with support from the federal government, has offered financial assistance for several silvicultural practices to increase the productivity and quality of sawlogs. As a result, the percentage of the sawlog harvest has increased in forests of all ownerships in New Brunswick: from 47% in 1990 to 73% in 2004 and, over the same period, sawlog harvests in private woodlots alone increased from 24% to 68%. However, because of poor market conditions and mill closures between 2004 and 2009, sawlog harvests from private woodlots declined by 87%, and pulpwood harvests declined by 56% (Table 2).

Table 2. Harvest of industrial roundwood from private woodlots in m³ (all species)

	Year	Logs	%	Pulpwood	%	Total
Private Woodlots	1990	621,213	24%	1,977,191	76%	2,598,404
	2004	2,510,688	68%	1,185,717	32%	3,696,407
	2009	331,056	39%	516,498	61%	847,554
Change (2004-2009)			-87%		56%	-77%
All Ownership	1990	4,063,471	47%	4,660,812	53%	8,724,283
	2004	7,994,929	73%	2,939,844	27%	10,934,773
	2009	3,432,435	44%	4,423,181	56%	7,855,616
Change (2004-2009)			-57%		50%	-28%

Source: National Forestry Database: Table 5.1.2.0

Silviculture program for private woodlots

New Brunswick's Private Woodlot Silviculture Assistance Program provides financial support to help private woodlot owners increase the productivity of their woodlands and, thereby, the wood supply to the forest industry. Over the past few decades, both the provincial and federal government budgets for the program and the cost-sharing arrangement between government and woodlot owners have been modified. The list of silvicultural activities supported by the program has also changed to reflect current market conditions and trends in the forestry industry.

The principal objective of the program is to increase product diversity, wood quality, and sustainable wood supply. It has primarily promoted reforestation and stand improvement activities, but also provided support for forest operating conditions and to encourage owners to develop land management plans. The reforestation activities eligible for compensation are site preparation, planting, and plantation tending. The approved stand improvement activities are commercial and precommercial thinning; however, in recent years, the program has focused mainly on precommercial thinning. These activities have created jobs in the province even in times when other traditional forestry activities have substantially declined.

The Private Woodlot Silviculture Assistance Program is part of a province-wide initiative for implementing forest development activities on all ownerships—Crown forests, industrial forests, and private woodlots. Provincial and federal governments contribute funds through cooperative agreements or as part of a federal or provincial program. The provincial program has continued over several decades with variable levels of funding and cost-sharing by the participating landowners. Table 3 summarizes the sources of funding and the reach of these programs over the years, and Figure 4 shows how the funds were spent in terms of area of forest land. The programs focused on stand improvement activities, primarily precommercial thinning.

The area treated under the silviculture program increased from 5800 ha in 1995 to more than 13,300 ha in 1998, thanks to a \$5 million increase in program funding. The area treated remained above 12,000 ha every year until 2008, when it started to decline following a reduction in program funding. Another reason for the reduction in area treated may be the low demand for timber. Figure 5 presents the area harvested and area treated and shows a sharp decrease in the proportion of harvest area available for silvicultural treatment starting in 2005.

Table 3. Funding for private woodlot silviculture and area treated, 1984–2010

Year	Governments, agency	Funding (million \$)	Area treated (ha)
1984 – 1989	Federal, provincial	10.1	15,500
1990 –1994	Federal, provincial	14.0	16,000
1995 ¹	Provincial	3.0	5,810
1996	Federal, provincial	4.0	7,150
1997	Federal, provincial	4.0	6,850
1998	Federal, provincial	8.0	13,369
1999	Provincial	8.0	14,092
2000	Provincial	8.0	13,212
2001	Provincial	7.9	12,877
2002	Provincial	8.0	12,936
2003	Provincial	8.0	12,946
2004	Provincial	7.2	11,902
2005	Provincial	7.2	11,757
2006	Provincial	8.0	12,532
2007	Provincial	8.0	12,567
2008	Provincial, RDC, federal	6.0	8,534
2009	Provincial, RDC, federal	7.8	9,749
2010	Provincial, RDC, federal	7.8	10,343

RDC = Regional Development Corporation

Sources: New Brunswick Department of Natural Resources & Energy. May 9, 2000. *Private Woodlot Silviculture Program Statistics, Fiscal 1998–1999. Including Summary of 1960–1998 Activities.* Source for years 1995–1998.

National Forestry Database (NFD). *Silviculture – Jurisdictional Tables.* Retrieved: <http://nfdp.cfm.org>. Accessed 23 August 2011.

NB Department of Natural Resources. 1 April 2009. *New Brunswick Private Woodlot Silviculture Manual 2009.* Retrieved: www.gnb.ca. Source for years 2000–2001.

NB Department of Natural Resources. 15 April 2011. *New Brunswick Private Woodlot Silviculture Manual 2011.* Source for years 2002–2006.

Provincial expenditure data provided by Michele MacNeil, *Private Land Silviculture Forester, New Brunswick Department of Natural Resources.* Source for years 2006–2010.

ACOA expenditure data provided by Ken Hardy, *Manager, New Brunswick Federation of Woodlot Owners.* Source for years 2009–2010.

Figure 4. Distribution of area under silvicultural treatments

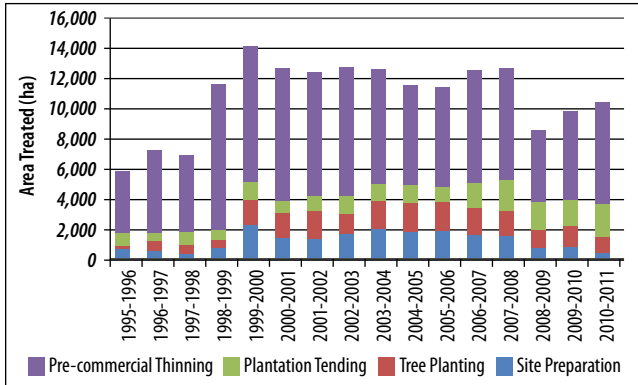
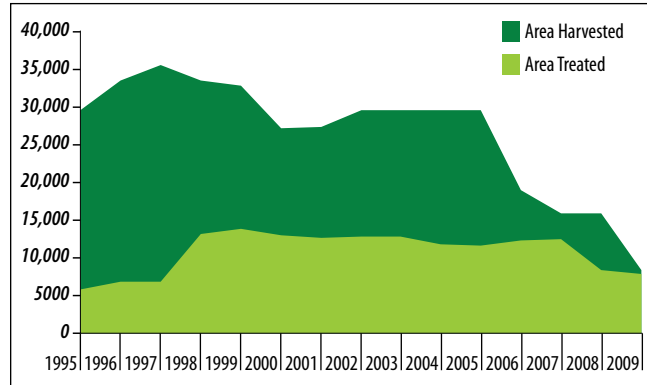


Figure 5. Annual harvest area and area treated with silvicultural activities.



Source: National Forestry Database: Table 6.1.0.0 and NBDNR

The government’s annual commitment to the program before 2008–2009 was \$8 million, with an expectation of 20% cost sharing by the landowners. However, the financial support was lowered to \$6 million for the subsequent 3 years, with an expected cost sharing of 30% by the landowners. Of the \$6 million, the province contributed \$4 million, and the remaining \$2 million came from the Federal Community Development Trust. The area treated under the program decreased from 12,567 ha in 2007 to 8 534 ha in 2008, and some of the funding went unspent. In the subsequent 2 years ACOA provided an additional \$1.75 million dollars per year to support silvicultural activities.

Throughout the program period, most of the silviculture funds were used for precommercial thinning. For example, during 1995–1998, 85% was used for precommercial thinning on 73% of total area treated. However, during 2007–2010, 71% of the funding was used for precommercial thinning on 58% of the total area treated (Figs. 6, 7). The York–Sunbury–Charlotte, South East New Brunswick, and Northumberland marketing boards treated 90 or more of their regions with precommercial thinning; in the other four regions, less than 50% of the total area was treated (Figure 8).

Figure 6. Distribution of silvicultural activities (area)

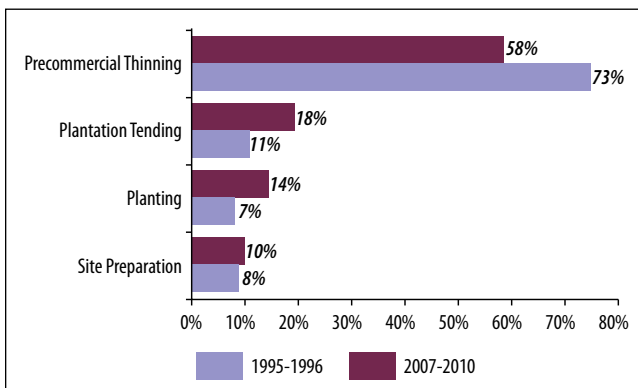


Figure 7. Distribution of silvicultural activities (amount)

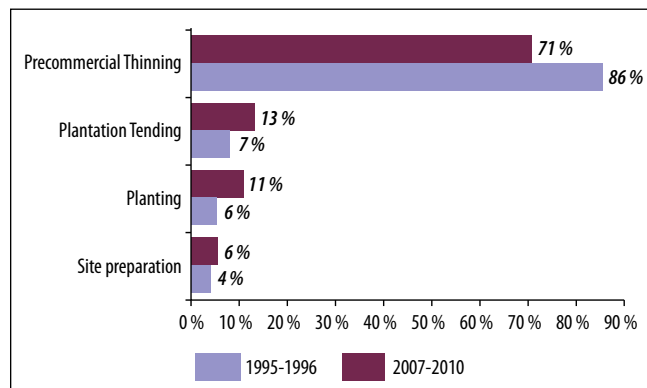
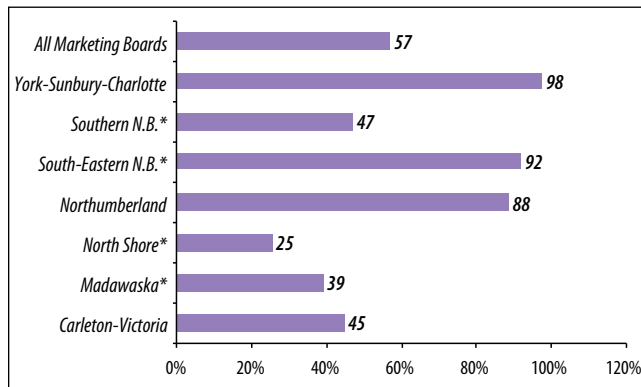


Figure 8. Average percentage of precommercial thinning (2005–2009)

Economic impacts of silvicultural activities

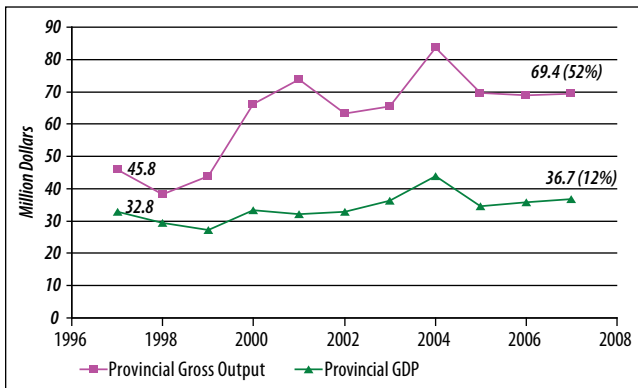
Although the silviculture program aims to provide financial support to private woodlot owners to improve the productivity and wood quality of their forests, it also contributes to provincial GDP by creating jobs and providing raw materials to the province's forest industry.

Provincial gross output and gross domestic product

Historical data on the contribution of silvicultural activities to GDP are collected by Statistics Canada under the North American Industry Classification System (NAICS) Code 1153, Support Activities for Forestry. However, data for some economic indicators are available only for a higher level of industry classification, NAICS Code 115, Support Activities for Agriculture and Forestry. Because the gross output of NAICS 1153 constitutes roughly 90% of NAICS 115 for the province and follows the same trend, some of the socioeconomic indicators are collected and analyzed at this level. At more than \$40 million in the province, annual silviculture expenses by the government and private landowners constitute a majority of the total expenditures under NAICS 1153. Statistics Canada data indicate that total output under this sector increased by 52% in the 1997–2007 decade, from about \$46 million to \$69 million (Figure 9). This increase reflects higher government and private landowner spending on silviculture as well as other forestry-related expenses during the period.

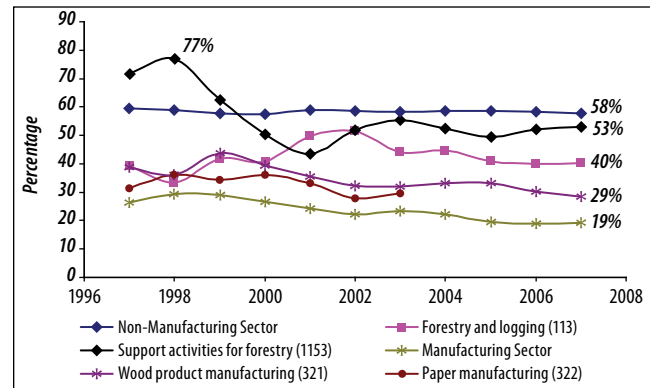
Silvicultural activities contribute a higher proportion of GDP to gross output than forestry and logging and all manufacturing sectors, including the forest products industries. In 1998, the proportion of GDP components, such as salaries and wages, supplementary income, mixed income, and operating surplus, was 77% for NAICS 1153 (Support Activities for Forestry), but had declined to 53% in 2007 (Figure 10).

Figure 9. Provincial gross output and GDP for support activities for forestry (NAICS 1153) (percent change 1997–2007)



Source: Statistics Canada (Table: 381-0015 and 0016)

Figure 10. Provincial GDP as a percentage of gross output (proportion of wages, salaries, and supplementary labor income)



(Source: Statistics Canada Table: 381-0015)

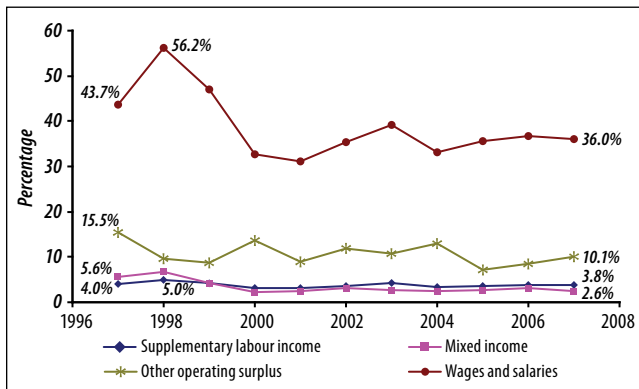
Salaries, wages, and employment

The slower growth of NAICS 115 is reflected in the decline in the proportion of salaries, wages, other compensation, and total number of jobs, which are a major part of GDP. Wages, salaries, and supplementary labor income in the sector were 61.2% of New Brunswick’s gross output in 1998 but declined to about 34% in 2001 before recovering to about 39.8% in 2007 (Figure 11). This sector has the lowest total compensation per job than all other forestry sectors, and it is also lower than the average for all industries (Table 4). Average total compensation was \$22,493 in 1997 and increased to \$36,792 in 2010. Hourly compensation rose from \$10.23 in 1997 to \$18.85 in 2007 but remains the lowest among all major sectors. However, the percentage increases—64% in the level of total compensation and 84% in hourly compensation—were much higher than for other sectors.

The number of New Brunswick jobs in Support Activities for Agriculture and Forestry declined by 39%, from 1210 jobs in 1997 to 740 jobs in 2010; meanwhile, manufacturing jobs increased by 9%, and the total number of jobs in all industries increased by 17%. The forestry and logging, wood products, and pulp-and-paper sectors also saw a substantial decline in the total number of jobs, at a higher rate than the support activities sector (Figure 12).

One measure of the contribution of a sector is its employment multiplier effect (the number of jobs created per million dollars in economic output). The employment multiplier for Support Activities for Agriculture and Forestry was as high as 28 jobs in 1998 before declining to 11 jobs in 2007, following the trend of the GDP contribution. Despite this drop, the employment multiplier has remained higher than all other sectors, including the combined manufacturing and non-manufacturing sectors (Figure 13).

Figure 11: Proportion of GDP components for NAICS 115

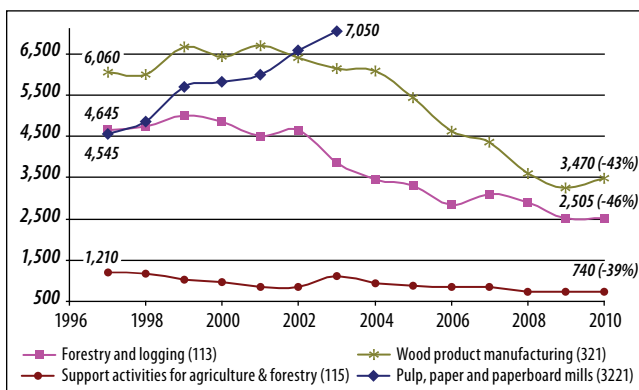


(Source: Statistics Canada Table 381.0013)

Table 4. Total compensation per job and compensation per hour for NAICS 115

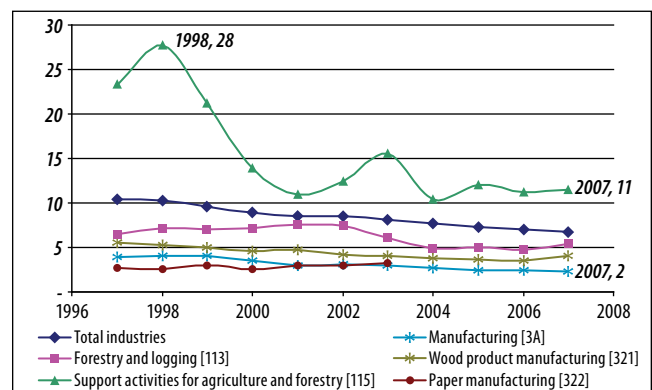
Industry Sector (NAICS Code)	Total Compensation (\$) per job		Compensation (\$) per hour	
	1997	2010	1997	2010
All industries	29,601	44,759	16.19	25.28
Forestry and logging (113)	35,035	47,012	15.77	20.94
Support activities for agriculture and forestry (115)	22,493	36,792	10.23	18.85
Manufacturing (31-33)	38,072	46,295	18.81	23.17
Wood product manufacturing (321)	32,458	43,407	15.25	20.90
Pulp, paper and paperboard mills (3221)	66,713	X	34.06	X

Figure 12. Total number of jobs in forestry sector



(Source: Statistics Canada table 383:0010)

Figure 13. Direct employment multiplier (number of jobs per million \$ output).



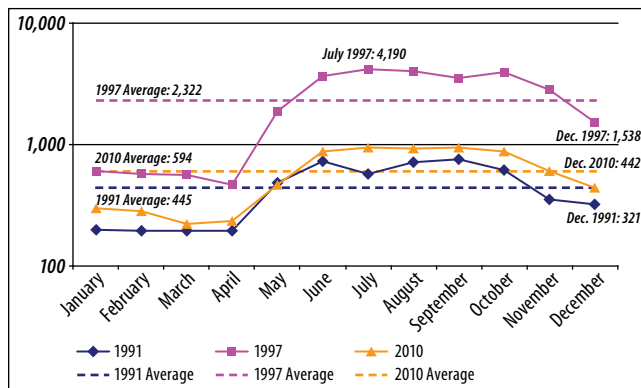
Seasonal variation in employment

Employment in NAICS 1153 is largely seasonal: most activities are carried out from spring through late fall. Figure 14 tracks the employment trend for this sector for three selected years: 1991, 1997 and 2010 as reported by Statistics Canada in the Survey of Employment, Payrolls and Hours (SEPH). Each year, after about 4 months of low employment from January to April, employment starts

rising and stays high from June until October. Thereafter, employment drops gradually to the lowest levels by April.

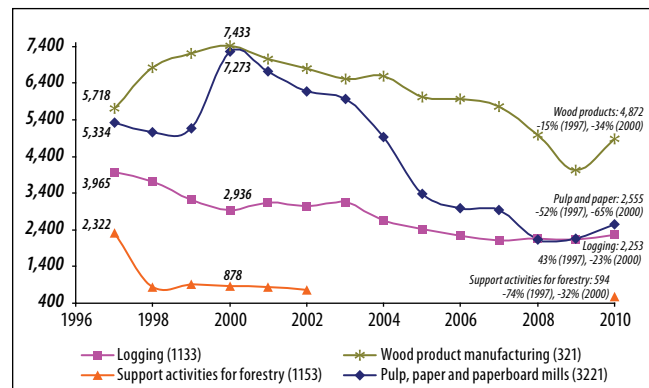
The average annual employment (persons) as reported in the SEPH dropped at different rates for the major forestry sectors (Figure 15). Average employment in the wood products sector and the pulp and paper sector increased to above 7000 by the year 2000 but since then declined to about 4000 and 2100 in 2009 respectively. Employment in the forestry and logging sector has been on a declining trend since 1997, dropping from about 4000 to below 2300. In the support activities for forestry sector, average employment was as high as 2322 which dropped to 852 in 1998 and thereafter slowly decreased to 594 in 2010.

Figure 14. Number of persons employed (seasonally unadjusted)



Source: Statistics Canada table: 281.0023 (SEPH)

Figure 15. Average employment (persons) in forestry sector



Source: Statistics Canada table: 281.0023 (SEPH)

The highs and lows of employment in forestry support activities at different periods over last 20 years are presented for selected years in Table 5. The peaks in employment in this sector ranged from 752 in 1991 to 4190 in 1997; the most recent figure is 948 in 2010. Weekly earnings have remained more steady, rising from \$560 in 1991 to \$757 in 2010 (Table 6).

Table 5. Jobs in NAICS 1153 (Support Activities for Forestry)

	1991	1997	2002	2010
Highest	752	4 190	1 521	948
Lowest	195	470	303	221

Table 6. Average weekly earnings (seasonally unadjusted, in dollars) in forest sectors

Industry	1991	1997	2002	2010
Logging (NAICS 1133)	557	650	673	813
Support activities for forestry (NAICS 1153)	561	558	712	757
Manufacturing (NAICS 31-33)	574	682	723	835
Paper manufacturing (NAICS 321)	940	1,100	1,019	1,115
Wood product manufacturing (NAICS 321)	467	582	677	726

3. Short-term economic impacts of the silviculture program

The silvicultural program contributes to the provincial economy not only in the long term, through enhanced productivity of the forests, but also in the short term, by creating jobs and stimulating the economy through spin-off effects within and outside the province (MacFarlane and Zundel 1995). Because woods work is labor intensive, a significant proportion of the funding pays for wages, salaries, and other labor-related compensation.

The direct and indirect contributions of silviculture (Support Activities for Agriculture and Forestry, NAICS 115) to the economy for fiscal year 2007–2008 can be estimated using Statistics Canada data from input–output tables and related multipliers. Total silviculture spending from the program was \$10,189,870, consisting of \$8,151,896 from the federal and provincial governments plus \$2,037,974 from the landowners, as part of the 20% cost-share agreement. Table 7 lists direct and indirect impacts for four major economic indicators: wages and salaries, GDP, output, and number of jobs.

Table 7. Economic impacts of silviculture program expenses, 2007–2008

	Wages & Salaries	GDP	Output	Number of jobs	Wages per job
<i>Direct within the province</i>	3,668,353	5,777,656	10,189,870	102	35,964
<i>Indirect within the province</i>	305,696	845,759	2,445,569	14	21,898
<i>indirect other provinces</i>	713,290	1,528,480	2,955,062	16	43,478
<i>Indirect all provinces</i>	1,018,987	2,374,239	5,400,631	30	33,557
Total Impact (Direct and Indirect)	4,687,340	8,151,896	15,590,501	132	35,412

Wages, salaries and jobs

Of the \$10.2 million in program spending, \$3.7 million (36%) went toward direct wages and salaries, and another \$1.0 million went toward indirect wages and salaries within and outside the province. Therefore, wages and salaries constituted about 48% of the program funds, and the program created 132 jobs within and outside New Brunswick. Of the total 132 jobs, 102 were direct jobs created within the province, 14 were indirect jobs created within the province, and 16 were indirect jobs created outside the province. The average salary or annual wage was \$35,964 for the direct jobs, \$21,898 for the indirect jobs within the province, and \$43,478 for the indirect jobs outside the province. Compensation for the indirect, within-province jobs may be low because such jobs are likely to be in the service sector, whereas the indirect, out-of-province employment may be in manufacturing.

Gross domestic product

The direct contribution of the program was \$5.78 million, which was 57% of the total expenditure. The indirect contribution to GDP was \$0.85 million, giving a total of \$6.62 million. There was also \$1.53 million of indirect GDP impact outside the province, bringing the total direct and indirect GDP contribution to of the expenses up to \$8.15 million. Finally, \$2 million was spent on direct and indirect international imports.

The indirect GDP contribution came from \$4.4 million spent on factor costs of other inputs. The spin-off effect of this expenditure contributed \$2.34 million worth of GDP and generated an additional \$5.4 million worth of indirect output in other sectors: \$2.45 million within the province and \$2.96 million in other provinces. Thus, the total direct and indirect economic impact of the \$10.2 million silviculture program in 2007–2008 was \$15.6 million in all provinces. The impact within New Brunswick was \$12.64 million, including \$1.63 million worth of international imports. Similarly, the total impact outside the province was \$2.96 million, including \$ 0.41 million in international imports.

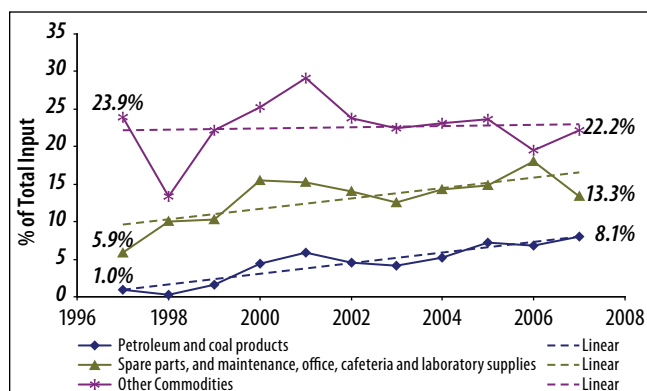
Impact on other industries

Silvicultural activities are highly specialized and require inputs from a limited number of industries. Most of the factor costs are incurred in few commodities. Distribution of the \$4.4 million spent on inputs of commodities from other industries in fiscal year 2007–2008 is presented in Table 8. Most of the factor costs in silviculture were spent on two commodity groups: spare parts and maintenance, office, cafeteria and laboratory supplies; and petroleum and coal products. How these factor costs have changed over time is shown in Figure 16. The share of expenses for these two categories rose from 1997 to 2007, whereas the share of all other commodities remained almost unchanged.

Table 8. *Distribution of expenses among commodities*

Commodity	%	\$
Wages and salaries	36.0	3,670,545
Supplementary labour income	3.2	8,349
Mixed income	2.6	260,225
Other operating surplus	10.1	1,027,205
Subsidies on products and production	-0.3	27,392
Indirect taxes on products and production	4.6	465,666
Total GDP	56.7	5,777,656
Fabricated metal products	2.7	273,921
Machinery	1.3	136,961
Motor vehicles, other transport equipment and parts	0.9	95,872
Petroleum and coal products	8.1	821,764
Transportation and storage	2.3	232,833
Wholesaling margins	3.1	315,009
Finance, insurance and real estate services	1.6	164,353
Professional, scientific, technical, computer, administrative, support and related services	1.6	164,353
Miscellaneous services	5.0	506,754
Spare parts, and maintenance, office, cafeteria and laboratory supplies	13.3	1,355,910
Other commodities	3.4	344,483
Total, coût des facteurs	43.3	4,412,214

Figure 16. Share of factor costs inputs for support activities of agriculture and forestry (NAICS 115) (S level aggregated)



4. Long-term economic impact of silvicultural program

The New Brunswick silviculture program's approved activities are reforestation and precommercial thinning to enhance the volume and/or quality of forest products over 10–20+ years. Program assistance is approved where site or stand conditions, incidence of disease or insects, or landowner objectives are favorable. The actual increment in tree growth is highly dependent on the site condition and the type of treatments done on the stands. Therefore, the rate of return on silvicultural investments depends on the yield of the particular woodlot and the stumpage rate at the time of harvest.

Studies of long-term benefits

Investments in silvicultural activities provide long-term benefits by enhancing forest productivity and improving wood quality. Some of the earlier assistance programs on private woodlots in New Brunswick had specific expectations of increasing the forest productivity and, consequently, the wood supply from private woodlots. For example, the Canada–New Brunswick Forest Renewal Agreement (1984–1989) had two objectives: to improve 1200 ha of hardwood stands to improve product diversity; and to treat 14,300 ha of softwood stands to increase the wood supply by 200,000 m³ annually. The increased wood supply would meet the growing demand of the province's forest industry and also enhance the income potential of small woodlots. Similarly, the Canada–New Brunswick Cooperative Agreement on Forest Development (1989–1994) sought to treat 14,000 ha of softwood and 2000 ha of hardwood stands to increase the sustainable wood supply and increase product diversity and quality. The softwood timber supply was expected to increase by 275,000 m³ of softwood timber from 6000 ha of plantations and 8000 ha of stand improvement activities. A report on the program (Gardner Pinfold 1989) attributed increases in productivity of 65.2 m³/ha to the plantations and 69.7 m³/ha to the stand improvement activities. However, the expected stand improvement may vary because private woodlots have diverse characteristics and are managed by individual owners. Also, approved silvicultural activities vary from time to time, with different specifications and requirements.

Canadian Forest Service researchers have identified similar increases in productivity from precommercial thinning in balsam fir and red spruce stands in northwestern New Brunswick. The increase in gross merchantable volume 43 years after thinning ranged from 21% to 46%, depending on utilization standards and type of treatment (Pitt and Lanteigne 2008).

As that study illustrates, the effects of silvicultural activities are very long term and are realised at the rotation age, which in most cases is more than 60 years after planting and about 45 years or more after a precommercial thinning. In Crown forests, which are generally managed in large units with a long-term planning horizon, the benefits are spread over both time and space. However, on a small private woodlot, the landowner will not realize a return on the investment in silviculture for many years, and his or her investment is tied up in the forest for decades. The financial return from

the investment depends on the quantity and quality of the wood, the price of the forest products in the future, changes in operating costs, and time to harvest. The benefits can be analyzed from the perspective of the society as well as an individual landowner.

Analysis of recent investments

We have analyzed the investment made over 1995–2010 to identify the possible effects on wood supply in terms of both volume and quality of harvested forest products. During the 15-year period, provincial and federal governments invested \$106.7 million in reforestation and precommercial thinning on private woodlots; landowners invested \$25.37 million in the cost-share programs (the cost-share proportions varied from 10% to 30%). Of the total, \$30.5 million was spent on plantation activities (20,254 ha of site preparation, 21,195 ha of planting, and 19,647 ha of tending). The remaining \$101.5 million was spent on precommercial thinning (172,421 ha) (Table 9). The present value of the total \$132 million investment is \$163 million at a 3% interest rate and \$188.4 million at a 5% interest rate. At an average current stumpage rate of \$20/m³, these investments are equivalent to 6.6, 8.15, and 9.42 million m³ of round timber, respectively (Table 10).

Table 9. Government investment in silvicultural activities, 1995–2011

Year	Site Preparation		Tree Planting		Plantation Tending		Precommercial Thinning		Total	
	Area (ha)	Amount (\$)	Area (ha)	Amount (\$)	Area (ha)	Amount (\$)	Area (ha)	Amount (\$)	Area (ha)	Amount (\$)
1995-1996	696	145,600	158	64,200	869	291,100	4,087	2,331,700	5,810	2,832,600
1996-1997	550	111,100	676	220,500	526	111,000	5,398	2,963,300	7,150	3,405,900
1997-1998	385	77,800	542	179,800	854	230,500	5,078	2,788,000	6,859	3,276,100
1998-1999	754	188,300	558	226,300	612	295,000	9,660	6,529,900	11,584	7,239,500
1999-2000	2,212	552,212	1,844	738,816	1,088	537,576	8,933	6,178,975	14,077	8,007,580
2000-2001	1,376	343,541	1,646	656,859	846	425,638	8,764	6,213,595	12,632	7,639,634
2001-2002	1,409	363,052	1,877	773,130	858	446,126	8,261	6,047,246	12,405	7,629,555
2002-2003	1,700	448,233	1,315	554,856	1,157	612,052	8,529	6,353,928	12,701	7,969,070
2003-2004	2,121	579,740	1,861	815,185	985	549,634	7,598	5,957,137	12,566	7,901,695
2004-2005	1,834	501,293	1,861	815,185	1,233	687,832	6,547	5,132,542	11,474	7,136,852
2005-2006	1,927	533,779	1,841	815,706	1,044	593,043	6,555	5,237,531	11,368	7,180,060
2006-2007	1,666	543,949	1,751	877,251	1,700	762,535	7,400	5,912,600	12,517	8,096,335
2007-2008	1,537	501,831	1,683	843,183	2,081	933,433	7,351	5,873,449	12,652	8,151,896
2008-2009	813	232,518	1,120	474,320	1,882	738,873	4,719	3,298,581	8,534	4,744,292
2009-2010	855	310,247	1,390	881,867	1,752	884,059	5,752	5,171,489	9,749	7,247,661
2010-2011	419	154,899	1,072	1,168,198	2,159	913,428	6,693	6,017,331	10,343	8,253,856
Total	20,254	5,588,096	21,195	10,105,356	19,647	9,011,829	111,325	82,007,305	172,421	106,712,587

Table 10. Minimum stumpage rates and required growth for breakeven

Activity	Government	Landowner/MB	Total Present Value			Expected Increase in Volume (m ³)	Cost of Investment / m ³		
			0 %	3 %	5 %		0 %	3 %	5 %
Plantation PCT	\$24,705,282	\$5,835,497	\$30,540,779	\$36,703,294	\$41,680,548	1,377,653	\$22.20	\$26.60	\$30.30
	\$82,007,305	\$19,536,856	\$101,544,161	\$126,305,905	\$146,774,431	7,792,759	\$13.00	\$16.20	\$18.80
Total	\$106,712,586	\$25,372,353	\$132,084,939	\$163,009,199	\$188,454,980	9,170,412	\$14.40	\$17.80	\$20.60
Required increase in timber volume (m ³) at \$20 per m ³			6,604,274	8,150,460	9,422,749	PV = Present value in year 2010–2011			
Required increase in timber volume at \$20 per m ³			Plantation	72	87	98	PCT = Precommercial Thinning		
			Thinning	46	57	66	Expected Increase = Plantation 65 m ³ /ha; PCT 70 m ³ /ha		

Because plantation activities are sequential and all activities are generally done on each hectare planted (though at intensities), for analysis purposes, we assume that all the expenses on plantation activities incurred over this period are for the 21,195 ha of plantation area. Assuming that the increase in productivity will be 65 m³/ha (Gardner Pinfold 1989), these plantation activities will increase the timber volume by 1.38 million m³, yielding an annual increase of 86,000 m³ of wood supply for each of 16 years, beginning 45 years from the treatment. Similarly, the precommercial thinning done over the period can increase timber volume by 7.79 million m³ (assuming 70 m³/ha), yielding an annual increase of 487,000 m³ of wood supply for each of 16 years, about 30 years from the treatment. At interest rates of 0%, 3%, and 5%, the cost of the increased wood supply from plantation activities based on the present value is \$22.20, \$26.60, and \$30.30 per m³, respectively, and that from precommercial thinning is \$13, \$16.20, and \$18.90 per m³, respectively. Thus, the activities will provide positive financial returns at and above these stumpage rates, provided the growth in the volume of timber is at least 65 m³/ha (for plantation activities) and m³/ha (for precommercial thinning).

Conversely, at the preset average stumpage price of \$20/m³, the minimum expected increase in timber volume from plantation activities and precommercial thinning is, at a 0% interest rate, 72 m³/ha and 46 m³/ha, respectively; at 3% interest, 87 m³/ha and 57 m³/ha, respectively; and at a 5% interest rate, 98 m³/ha and 66 m³/ha, respectively (Table 10). Thus, the investment will have a positive return if the increase in the timber volume exceeds these minima and the stumpage rate rises at least as much as interest rates.

The estimated costs are based on landowners' average expenses over the past 16 years but do not include the cost of seedlings, which in most cases is not part of the approved expenses under the program. Returns on investments depend on characteristics, the treatments that landowners are willing to carry out, and the specifics of the program. In general, however, as the program supports more silvicultural activities, landowners whose parcels are suitable can conduct more activities. Plantation activities are expensive for landowners and may not provide adequate returns because the increase in quantity of timber that is required to break even is high (currently about 98 m³ at a 5% real interest rate, assuming a \$20 stumpage). This expectation may increase at the rotation age after about 45 years if the rate of increase in the stumpage price is less than the discount rate of 5%. However, most plantation work targets lands that have lower natural regeneration and, therefore, require reforestation if they are to become economically viable for timber harvest.

Reforestation targeted to supplement natural regeneration can also improve the provision of nonmarket goods and services.

Forecasting the long-term trend in stumpage prices is difficult. The price indexes published by Statistics Canada indicate that prices of sawlogs have been volatile but declining, after a sharp increase during the 1990s. Although the long-term price of pulpwood has increased, albeit at a slow rate, it too has been affected by the current trends in the forest industry and has been declining over the past few years. Those trends suggest it is highly unlikely that stumpage price will increase at a rate greater than the 5% interest rate generally used for the time value of money.

We have examined the returns from the investment on 1 ha of woodlot, taking into account all the costs and the expected increase in the volume of timber. The cost of the major silvicultural activities to enhance the productivity of private woodlots under the current program is about \$2955/ha, which includes silvicultural expenses of \$2814 plus 5%, or \$141, for overhead (Table 11). Landowners and marketing boards pay an additional \$540/ha, which includes the cost of 2000 seedlings and the 10% cost share. The plantation activities (site preparation, planting, and plantation tending) together cost about \$1906/ha, whereas precommercial thinning costs about \$1049/ha.

Table 11. Costs per hectare

Activites	Government	Owner	Total
Site preparation	\$416	\$44	\$460
Planting	\$562	\$43	\$605
Tending	\$423	\$47	\$470
Seedling costs (2000 @ \$0.14 each)		\$280	\$280
Overhead cost (5%)	\$70	\$21	\$91
Total plantation costs	\$1 471	\$435	\$1 906
Precommercial thinning	\$899	\$100	\$999
Overhead costs (5%)	\$45	\$5	\$50
Total thinning costs	\$944	\$105	\$1 049
Total silvicultural expenses	\$2,415	\$540	\$2,955

Table 12 displays the costs per hectare and the associated benefits in increased timber needed to justify the expenses. At a stumpage rate of \$20/m³, the cost of the plantation activities can be recovered with a 40% enhancement in productivity, such that stands yield at least 220 m³/ha. For stands with lower productivity, the costs can be recovered only if the stumpage rate or the stand productivity is higher. Similarly, for precommercial thinning activities, at a \$20 stumpage rate, the cost is recovered with a 40% enhancement in productivity and stands yield at least 140 m³/ha. The table shows the different rate of increase in productivity and the required stumpage to indicate the stands that can recover the costs of the silvicultural expenses. These rates are indicative and are not strictly binding, as the rate of increase in the productivity may not have a linear relationship

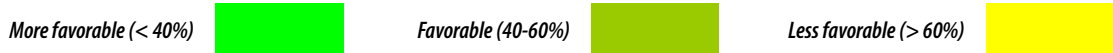
with the yield of the stands. However, it can provide a range of stand productivity for which silvicultural activities are justified at a certain expected stumpage price.

Table 12. Increase in timber volume from silvicultural activities

Total Expenses														
\$	2,955.00	Required Growth (m ³)	Percentage of minimum increase in volume required at different Stand Yield levels per ha											
Stumpage			120	140	160	180	200	220	240	260	280	300	320	340
\$	10	296	246%	211%	185%	164%	148%	134%	123%	114%	106%	99%	92%	87%
\$	15	197	164%	141%	123%	109%	99%	90%	82%	76%	70%	66%	62%	58%
\$	20	148	123%	106%	92%	82%	74%	67%	62%	57%	53%	49%	46%	43%
\$	25	118	99%	84%	74%	66%	59%	54%	49%	45%	42%	39%	37%	35%
\$	30	99	82%	70%	62%	55%	49%	45%	41%	38%	35%	33%	31%	29%
\$	35	84	70%	60%	53%	47%	42%	38%	35%	32%	30%	28%	26%	25%
\$	40	74	62%	53%	46%	41%	37%	34%	31%	28%	26%	25%	23%	22%
\$	45	66	55%	47%	41%	36%	33%	30%	27%	25%	23%	22%	21%	19%
\$	50	59	49%	42%	37%	33%	30%	27%	25%	23%	21%	20%	18%	17%
\$	55	54	45%	38%	34%	30%	27%	24%	23%	21%	19%	18%	17%	16%
\$	60	49	41%	35%	31%	27%	25%	22%	21%	19%	18%	16%	15%	14%

Plantation Activities														
\$	1,906.00	Required Growth (m ³)	Percentage of minimum increase in volume required at different Stand Yield levels per ha											
Stumpage			120	140	160	180	200	220	240	260	280	300	320	340
\$	10	191	159%	136%	119%	106%	95%	87%	79%	73%	68%	64%	60%	56%
\$	15	127	106%	91%	79%	71%	64%	58%	53%	49%	45%	42%	40%	37%
\$	20	95	79%	68%	60%	53%	48%	43%	40%	37%	34%	32%	30%	28%
\$	25	76	64%	54%	48%	42%	38%	35%	32%	29%	27%	25%	24%	22%
\$	30	64	53%	45%	40%	35%	32%	29%	26%	24%	23%	21%	20%	19%
\$	35	54	45%	39%	34%	30%	27%	25%	23%	21%	19%	18%	17%	16%
\$	40	48	40%	34%	30%	26%	24%	22%	20%	18%	17%	16%	15%	14%
\$	45	42	35%	30%	26%	24%	21%	19%	18%	16%	15%	14%	13%	12%
\$	50	38	32%	27%	24%	21%	19%	17%	16%	15%	14%	13%	12%	11%
\$	55	35	29%	25%	22%	19%	17%	16%	14%	14%	12%	12%	11%	10%
\$	60	32	26%	23%	20%	16%	16%	14%	13%	13%	11%	11%	10%	9%

Thinning Activities														
\$	2,955.00	Required Growth (m ³)	Percentage of minimum increase in volume required at different Stand Yield levels per ha											
Stumpage			120	140	160	180	200	220	240	260	280	300	320	340
\$	10	105	87%	75%	66%	58%	52%	48%	44%	40%	37%	35%	33%	31%
\$	15	70	58%	50%	44%	39%	35%	32%	29%	27%	25%	23%	22%	21%
\$	20	52	44%	37%	33%	29%	26%	24%	22%	20%	19%	17%	16%	15%
\$	25	42	35%	30%	26%	23%	21%	19%	17%	16%	15%	14%	13%	12%
\$	30	35	29%	25%	22%	19%	17%	16%	15%	13%	12%	12%	11%	10%
\$	35	30	25%	21%	19%	17%	15%	14%	12%	12%	11%	10%	9%	9%
\$	40	26	22%	19%	16%	15%	13%	12%	11%	10%	9%	9%	8%	8%
\$	45	23	19%	17%	15%	13%	12%	11%	10%	9%	8%	8%	7%	7%
\$	50	21	17%	15%	13%	12%	10%	10%	9%	8%	7%	7%	7%	6%
\$	55	19	16%	14%	12%	11%	10%	9%	8%	7%	7%	7%	7%	6%
\$	60	17	15%	12%	11%	10%	9%	8%	7%	7%	6%	6%	5%	5%



Silvicultural activities will be more cost effective if the stumpage price recovers and matches or exceeds the discount rate. A higher rate of growth in productivity or quality can compensate for any slower rate of increase in the stumpage price.

Precommercial thinning accounts for about 77% of silvicultural investments over the past 16 years. Although these activities appear cost effective, realization of a return on the investment depends on several factors, such as demand for high-quality (high-priced) products and landowners' willingness to wait decades to achieve the expected enhancement in productivity. Research suggests that the range of increase in productivity—21%–46%—is higher in the more productive stands. But the costs are recoverable only at a higher stumpage rate or a higher rate of increase in productivity. Therefore, to recover the cost of the activities, market prices and landowners' management decisions must reflect the enhanced value in terms of both quantity and quality of the timber harvested.

5. Discussion and recommendations

The silvicultural investment program seeks to assist private woodlot owners in conducting forest management practices. Although most woodlot owners have objectives other than timber production, private woodlots supply a substantial amount of wood to the province's forest industry. Landowners have taken advantage of the opportunity the program provides to enhance the productivity of their woodlots and the marketability of their harvested wood. The success of the program is generally monitored in terms of area treated or employment generated. However, it would be helpful to monitor the number of participating landowners and determine the interest of non-participating landowners who want to manage their woodlots better but need financial assistance to do so.

A useful study would compare outcomes for woodlots with silvicultural activities completed using program funds, woodlots with silvicultural activities funded privately, and woodlots with no silvicultural activities; this would help quantify the benefits of the program to the landowners, as well as to the forest industry. The program could be part of a coordinated forest management strategy for all private woodlots with the aim of accommodating value-added outcomes, such as realization of enhanced productivity, rationalization of forest operating expenses, and enhancement of other non-timber values.

The program has helped in institution building by maintaining and, to some extent, strengthening the marketing boards as the primary institution supporting landowners. During the past 5 years, revenue from wood sales has declined considerably, but funds from the program provided a steady flow of revenue for the marketing boards. Silvicultural work on private woodlots has supported contractors and operators in organizing their businesses and coordinating activities with similar activities on Crown forests and industrial forests.

Increasingly, forests are becoming important for their environmental and social values and are being managed to produce a variety of goods and services. Timber, however, is expected to remain a major forest product, along with forest biomass as a source of renewable energy. If more public forests are dedicated to goods and services other than timber, private woodlots will be expected to play a more important role in meeting the demand for fiber.

Because of current market conditions, harvests from private woodlots have declined substantially in recent years. Some observers have suggested that private woodlots managed for timber production will not achieve expected revenue flows and are, therefore, at risk of conversion to other land uses, fragmentation, or degradation. Given the forest products market, funds from the silviculture program may influence the decision making of some landowners and encourage them to actively manage their forests for a range of products and services, including forest productivity.

A mechanism to capture the increased volume and value at harvest would improve the effectiveness of the program. A periodic incentive for landowners might help meet this goal.

Marketing boards need to take some degree of responsibility for ensuring achievement of the targets so that the value of the investments is realised and can fund further investments in the future. Forest industry also needs to play an important role in implementing the program if the activities are intended to enhance the quality and quantity of the fiber supply.

To maximize program effectiveness, administrators should consider refocusing the program in terms of the target audience, approved activities, and participation requirements. To achieve a profitable return, silvicultural activities need to be targeted to woodlots where the expected increase in quantity and quality is high enough to cover the costs incurred. A change in focus might include alternative activities and target production of goods and services other than timber. Broadening the scope of the approved activities might attract more landowners with diverse objectives and result in better sustainable forest management practices.

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