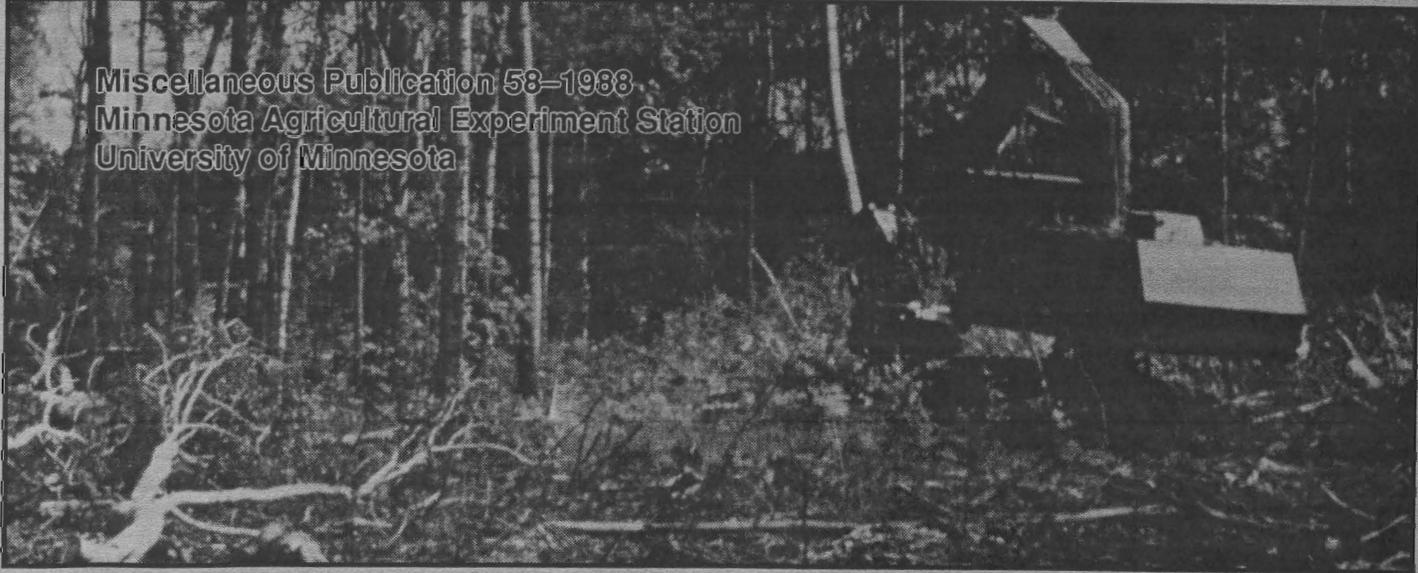


Minnesota's Private Forestry Assistance Program: An Economic Evaluation

Russell K. Henly
Paul V. Ellefson
Melvin J. Baughman



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MINNESOTA'S PRIVATE FORESTRY ASSISTANCE PROGRAM: AN ECONOMIC EVALUATION

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Introduction

A significant portion of Minnesota's forest resource is held by approximately 131,000 nonindustrial private landowners. They own 5.6 million acres, which is 41 percent of the state's commercial timberlands. Though frequently not actively managed for timber production, timber harvest levels on these lands are greater than average harvest levels for all other forest land ownership categories except industrial forest lands.

Despite the high timber production level of the state's nonindustrial private forest lands, it must be remembered that their owners hold them for many reasons. For some, just the thought of timber harvest is anathema. Others actively engage in timber management.

Even more forest land owners would favorably consider timber management if they were aware of the possible returns, and were provided with management assistance.

Cooperative federal-state forest management assistance programs that are directed towards private landowners have been operating in Minnesota, and in other states, for many years. These programs, which are jointly funded by federal and state governments, but administered by the states, provide those nonindustrial private forest landowners with a wide range of technical forestry assistance. That assistance includes timber marking, sale and

management plan preparation, and reforestation guidance.

Minnesota's private forest management program has been operating for many years, but little attempt has been made to systematically assess it. How well has it functioned? What benefits has it provided? This report has sought to provide that documentation and assessment. The ability to document the benefits of government programs has become a crucial need in the budgetary process.

A study of the Georgia piedmont (Cubbage *et al.* 1985) found very positive returns from the state Rural Forestry Assistance programs. It also provided a partial methodological basis for this assessment of the Minnesota Division of Forestry's Private Forest Management Program (PFM). Their methods, modified to suit Minnesota, were useful.

The basic approach compared unassisted timber sales with sales assisted by a state PFM forester. Assisted sales were randomly selected from Division of Forestry district records and paired with similar nearby unassisted sales. Harvests were compared for physical differences, and for differences in financial returns to landowners, future timber production potentials, landowners' personal characteristics and landowner satisfaction. Economic efficiency analyses were also conducted.

Minnesota's Nonindustrial Private Forest Land Resource and its Landowners

THE PHYSICAL RESOURCE AND ITS PRODUCTIVITY

Minnesota is well endowed with forest resources. According to 1977 data, 13.7 million acres (27 percent) of the state's total area, is classified as commercial timberland¹ (Jakes 1980). Of this total, 5.6 million acres (41 percent) are held by nonindustrial private owners (Table 1). This is more than twice the commercial timberland held by any other ownership category.

Nationally, 283 million acres (58 percent) of the nation's 488 million acres of commercial timberland were held by nonindustrial private owners in 1977 (Table 1) (Clawson 1979). State

¹Commercial forest land, under management, is capable of producing greater than 20 cubic feet of wood per acre per year and is not withdrawn from timber utilization through statutory or administrative restriction.

nonindustrial private ownership levels ranged from 97 percent of all commercial timberland in Kansas to 3 percent in Alaska.

Carpenter *et al.* (1986) estimated that in 1982 there were 130,800 nonindustrial private forest landowners, owning 5.1 million acres in Minnesota. These totals excluded owners with 5,000 acres or more, explaining the 500,000 acre difference between his acreage total and that calculated by Jakes (1980).

Carpenter found the average ownership size to be 39 acres. Nationally, there were about 7.8 million nonindustrial private forest landowners in 1977 (Fedkiw 1983), with average ownerships of 36 acres. Thus, Minnesota has been close to the national average for forest land ownership size, though comparison of such aggregate statistics can be misleading.

Productivity (stocking and annual growth rates) is perhaps more crucial than area of

Table 1. Commercial timberland ownership in Minnesota and the United States, by ownership category, 1977.

Ownership Category	Minnesota ¹		United States ²	
	Area (acres)	Percent	Area (Acres)	Percent
Nonindustrial Private	5,594,700	40.9	283,000,000	58.0
Federal	2,336,300	17.1	106,000,000	21.7
State	2,650,500	19.4	24,000,000	4.9
County and Municipal	2,341,600	17.1	7,000,000	1.4
Industry	772,000	5.6	68,000,000	13.9
Total	13,695,100	100.1	488,000,000	99.9

Note: Percentages do not sum to 100.0 due to rounding.
Sources: 1. Jakes 1980; 2. Clawson 1979.

Table 2. Net volume of growing stock on commercial timberland in Minnesota, by ownership category, 1977.

Ownership Category	All Species		
	Volume (1000 ft ³)	Percent	Volume per Acre (ft ³)
Nonindustrial Private	4,483,947	39.1	801
Federal	2,379,590	20.8	1,019
State	1,942,162	17.0	733
County and Municipal	2,012,295	17.6	859
Industry	636,003	5.6	824
Total	11,453,997	100.1	

Note: Percentages do not sum to 100.0 due to rounding.
Source: Jakes (1980).

nonindustrial private forest lands in the state. The percentage of net growing stock volume for each ownership category is fairly close to the percentage of commercial timberland within each category (Table 2).

Federal lands have the highest stocking level (1,019 cubic feet per acre); state lands have the lowest (733 cubic feet per acre). Nonindustrial private lands fall between (801 cubic feet per acre). Stocking levels are a function of several factors, including site quality, management intensity, and rate of timber removal relative to growth.

Net annual growth of growing stock² on commercial timberland in the state is highest for federal lands, with 29.8 cubic feet per acre (Table 3). Nonindustrial private lands are second, at 26.1 cubic feet per acre per year. Industrial lands have the lowest net growth rate, at 20.6 cubic feet per acre per year. Since industry is generally believed to hold the most

productive forest land in the state and to manage it more intensively than other ownership groups, the expectation would be that industrial lands would show the highest annual growth per acre. This apparent discrepancy will be addressed.

Annual levels of timber removal from Minnesota's forest lands are also important to productivity (Table 4). Comparing the percentage of removals with the percentage of forest land in each ownership category shows some substantial imbalances³.

More timber was removed from private nonindustrial forest lands than from all other ownerships combined, though they constitute only 41 percent of the area of the state's commercial timberland base. Removals from nonindustrial private lands and from industrial lands occurred at levels greater than their

²Net annual growth of growing stock is total annual growth less natural losses (Jakes 1980); harvest removals are not reflected in this figure.

³In this comparison and in several of the following, 1976 removals are compared with other variables from 1977. Though concerns of comparability might be raised, the comparisons made seem reasonable, due to the fairly general conclusions being drawn from them.

Table 3. Net annual growth of growing stock on commercial timberland in Minnesota, by ownership category.

Ownership Category	All Species		
	Volume (1000 ft ³)	Percent	Volume per Acre (ft ³)
Nonindustrial Private	146,177	41.9	26.1
Federal	69,589	19.9	29.8
State	63,052	18.1	23.8
County and Municipal	54,203	15.5	23.1
Industry	15,899	4.6	20.6
Total	348,920	100.0	

Source: Jakes (1980).

Table 4. Annual (trend level) removals of growing stock from commercial timberland in Minnesota, by ownership category, 1976.

Ownership Category	All Species		
	Volume (1000 ft ³)	Percent of Removals	Percent of Growth ¹
Nonindustrial Private	104,333	53.9	71.4
Federal	21,625	11.2	31.1
State	34,123	17.6	54.1
County and Municipal	18,354	9.5	33.9
Industry	15,165	7.8	95.4
Total	193,600	100.0	

Source: Jakes (1980).
1. Annual timber removal as a percentage of net annual growth.

respective relative land areas (53.9 percent of removals versus 40.9 percent of land area, 7.8 percent of removals versus 5.6 percent of land area, respectively). The other ownership categories "undercontributed" to timber removals: federal (11.2 percent of removals versus 17.1 percent of land area), state (17.6 versus 19.4 percent), and county and municipal (9.5 versus 17.1 percent).

A more useful comparison is annual removals as a percentage of net annual growth (Table 4). Industrial forest lands experience the highest removal of net annual growth (95.4 percent), followed by nonindustrial private lands at 71.4 percent. The lowest rate of removal of timber occurs on federal lands, where only 31.1 percent of annual growth is removed.

Public lands are clearly contributing a much lower proportion of their production potential to harvests than private lands. Reasons which might be offered for the low timber harvest levels on public lands are poor accessibility, lower timber quality, multiple-use policy constraints, or inadequate budgets for timber sale administration.

Banzhaf (1980) also interpreted the 1977 forest survey data to indicate that per acre volume, growth, and productivity on nonindustrial private lands are about the same as on other ownerships, while removal rates are higher. Banzhaf explained the high cutting levels on nonindustrial private lands as resulting from better accessibility, and from timber harvested during land clearing which occurs almost solely on private lands.

Forest land clearing rates are likely minimal at present, and result primarily from housing and commercial development. Clearing for agricultural expansion is virtually non-existent with current agricultural markets. And, federal and state programs such as the Conservation Reserve Program, Minnesota Forestry Incentives Program, and Reinvest in Minnesota Program are contributing to reforestation of agricultural lands.

Returning to the question of why net annual growth on industrial forest lands appears significantly lower than expected, since 95 percent of the annual growth on these lands is being removed each year, they are likely approaching a regulated forest structure. They may have a larger proportion of young stands than other ownership categories, stands which produce smaller annual volumes of additional wood than more mature, though not

senescent, stands which may dominate other ownerships.

That nonindustrial private forest lands are quite similar to other ownership categories in the state, in terms of stocking and productivity, is indicated by available data. However, they contribute a significantly larger portion of their annual growth to harvests than do the public lands. This runs counter to the concerns of forestry professionals in the 1970s, when aggregate national data showed that nonindustrial private forest lands were significantly underproductive and underutilized for timber, relative to other forest lands.

Clawson (1979) clearly demonstrated that these productivity concerns stemmed largely from data aggregation. When analyzed on a state or regional basis, nonindustrial private lands were clearly pulling their weight in producing timber. Stone and McKeever (1983) also supported this conclusion. Minnesota's nonindustrial private forest lands are more than meeting their "fair share" of state timber production.

CHARACTERISTICS OF LANDOWNERS

Characteristics and ownership motivations of Minnesota's nonindustrial private forest landowners have important implications for timber production expectations. Much has been made of their diversity in income, education, occupation, reasons for ownership (e.g., Birch *et al.* 1982, Clawson 1979). This diversity is widely recognized as a significant challenge to targeting public forest land management assistance.

Data on the characteristics of Minnesota's nonindustrial private forest landowners has been collected recently (Carpenter *et al.* 1986). There are 130,800 owners of less than 5,000 acres (individuals, groups, partnerships, corporations, clubs, estates, and trusts). About 92 percent of the ownerships (120,000) and 91 percent of the land area (4.6 million acres) are held by individuals, including joint party ownerships.

More than 30 percent (39,400) of the ownerships are parts of active farms. These account for 41 percent (2.1 million acres) of Minnesota's privately held forest land. Retired people are 22 percent of the owners, holding 20 percent of the nonindustrial private forest land area. Active farmers hold 16 percent of the units, with 24 percent of the forest land. Professionals, business owners or executives, and white collar

workers own 27 percent of the units, with 30 percent of the area.

Landowners over age 45 account for 62 percent of the owners and 69 percent of the area. Those in the age group 45-65 control almost half the land area.

Holding 49 percent of the nonindustrial private forest land, 43 percent of the landowners have had at least some post high school education. Individuals with fewer than eight years of education represent 19 percent of both the landowners and land area.

Almost one-fourth of the owners, holding one-fifth of the area, have annual incomes of less than \$10,000. This may reflect the large number of retired landowners. A similar portion of owners, 23 percent, earn more than \$30,000 annually and hold collectively hold about a third of the land area.

Carpenter *et al.* (1986) found that individuals own forest lands for a variety of reasons. Primary ownership reasons were: as part of residence or farm (34 percent of owners), for aesthetic enjoyment (16 percent), to produce firewood for own use (15 percent), and for nonmotorized recreation (12 percent). "Major harvesters" who cut substantial amounts of timber in their most recent harvest appeared little different from nonharvesters in their reasons for owning forest land.

In terms of future benefits expected from their lands, even those who said they planned to conduct a harvest in the future, said their sale of forest products was not expected to be an important benefit. Clearly, timber production for income has not been a major impetus for owning nonindustrial private forest land in Minnesota.

Of the individual owners in their study, nearly one-third, owning 17 percent of the individually owned nonindustrial private forest land, said they never planned to harvest. The same percentage (57 percent) said they expected to harvest at some time in the future, as indicated they had harvested some material in the past.

Farmers are especially likely to harvest; 72 percent indicating some future harvest plan. Such farmers own 909 thousand acres of commercial timberland. Farmers have a noted tendency to consider their forest land in economic terms more than do nonfarmers (Barzha 1980).

Retired persons were the only group with both a

high proportion of the state's nonindustrial private forest land and a significant amount of land held by those who never plan to harvest.

Owners with 100 to 500 acres are more likely to harvest in the future than those with larger or smaller holdings. Eighty-one percent of such landowners, holding 1.7 million acres (33 percent) indicated plans to harvest timber at some time in the future.

Combining these age, occupation, education, income, ownership size, and other demographics, suggests profiles for landowners most likely to harvest timber on their own initiative; most likely to harvest if provided information as to how to go about it and/or assistance in doing it and information on wildlife and aesthetic impacts; and least likely to harvest timber under any circumstances.

Farmers and those owning moderately large acreage seem particularly likely to harvest; and they own a significant amount of the state's nonindustrial forest lands. Retirees, a large ownership group holding a large total acreage, are particularly unlikely to harvest timber.

Landowners use professional forestry assistance minimally in managing their timberlands (Carpenter *et al.* 1986). Foresters determine which trees will be harvested only 6 percent of the time. Timber buyers made this decision only 8 percent of the time. The landowner is involved in the majority of the cases (79 percent).

Only 12 percent of forest landowners, holding 21 percent of the state's nonindustrial private commercial timberland, were estimated to have ever requested forestry assistance. Nearly two-thirds of those who requested assistance owned plots smaller than 50 acres. Among owners of more than 500 acres, 60 percent have received assistance, though the number of such owners has been quite small (i.e., 150).

"General management" help was sought by 43 percent of forest land owners requesting assistance. Their needs included management planning, surveying, or insect and disease control. Next most requested was "sales and valuation" assistance (24 percent). This included timber marking, sales assistance, and determination of merchantability. Carpenter *et al.* (1986) concluded that the assisted landowners were generally active timber suppliers.

Many of his surveyed Minnesota nonindustrial private forest landowners did not know where to

get forestry assistance (45 percent of the owners, with 45 percent of the commercial nonindustrial private forest land in the state). Another 29 percent (with 19 percent of the forest land) did not answer the question, perhaps also indicating some further degree of ignorance in this matter. Larger owners were more likely to cite an assistance source than smaller owners.

Of landowners citing an assisting source, 17

percent identified the state forester. Next most frequently identified were the U.S. Forest Service and the Agricultural Stabilization and Conservation Service (each by 3 percent).

Notwithstanding the substantial amount of timber production nonindustrial private forest landowners, for the majority it remains only a small motivation, or no motivation, for their ownership of forest land.

Minnesota Private Forest Management Program: Origins, Policies and Administration

PUBLIC INTEREST IN ASSISTANCE TO PRIVATE FOREST LANDOWNERS

Many concerns lie behind federal and state interest in providing nonindustrial private forest landowners with forest management information and technical assistance. Three of the more basic reasons are to promote efficiency in production of forest land outputs (particularly timber), national security (producing adequate timber and other goods to meet basic national needs), and the welfare of forest landowners (Clawson 1979).

Perfect market conditions would naturally satisfy basic concerns (possibly excepting production of certain "public goods" related to national security and scenic beauty). Several imperfections, however, inhibit the ideal operation of markets for timber in general and for timber from nonindustrial private forest lands in particular. They also inhibit balancing timber production with noncommodity forest land outputs such as wildlife, clean water, and scenic beauty.

A major market imperfection which assisting nonindustrial private forest landowners attempts to correct is the owners' lack of information about timber management opportunities and, closely related, their lack of ability to undertake such management (Worrell 1970). Landowner ignorance is often significant regarding timber prices, costs and possible returns from timber management investments, and methods of timber management and its impacts on wildlife and aesthetic values.

Lacking this information and ability, many nonindustrial private forest landowners underinvest in management for timber and other forest land outputs. This results both in their not capturing the full potential of returns from their forest land, and in a supply of timber and other

outputs which is less than socially optimal in terms of type, quantity, and price.

With or without state assistance, timber prices often present particular market difficulties for landowners. For a given area or stand of timber, there may be very few (or even no) primary timber consumers, leading to limited price competition for both delivered wood and stumpage. With the high bulk-to-value ratio of timber, haul distances from the forest to the primary consumer must be fairly short. And, other factors equal, primary consumers often attempt to locate where there is minimal competition for nearby timber.

Second, timber price information is generally not readily available to the average nonindustrial private forest landowner. Prices mills pay for delivered wood may be available, but these mean little to typical nonindustrial private landowners who sell timber to a logger, who in turn sells to a mill. Forest land owners will not likely have any sense of a logger's operating margin, and will be unable to judge the reasonableness of a logger's price offer.

Third, timber on the stump is not a highly homogenous good. Differences in tree quality, stand density, and site topography and access each affect stumpage prices for a given harvest. They are variables that cannot be easily quantified into a set of dependable price guide factors.

The price information concern is important, since price appears to be an important factor in motivating landowners to harvest timber. Birch and Pywell (1986) note that Pennsylvania landowners holding property for recreation, or as a part of a farm, were likely to harvest if they were offered a "good price" or needed the money. It supports Binkley's (1979) observation that landowners respond to high timber prices

even if they hold their lands primarily for reasons other than timber production.

Even a well informed landowner, with attractive opportunities for investment in forest land management, might not know how to make such investments, nor have the time or ability to go about applying such knowledge. Private forestry consultants could fill this gap, but not all areas are fully served by consultants. And many private ownerships are too small to make hiring a consultant feasible--costs may be too high for the landowner, or possible service fees too low for a consultant⁴. Thus, if smaller landowners and those landowners in areas where there is a shortage of consultants are to receive forest management assistance, state provision of such assistance may be necessary.

Another rationale for having public programs focused on nonindustrial private landowners is to eliminate conflicts between societal and landowner interests in managing a forest tract (Worrell 1970). This disjuncture may occur even when the landowner is fully informed about the returns possible from all management alternatives. The landowner may simply choose to maximize a personal utility function that differs from the social utility function. For example, a landowner may maximize his utility by managing his forest land solely for aesthetic beauty or personal recreation, while society might prefer that he manage it for softwood sawlog production to help reduce the cost of home construction.

In many such instances, no amount of information and assistance will serve to align private and social utility. Cash or tax incentives may be needed to bring private and social interests into congruence.

Analysis of the use of incentives is not part of this study. Minnesota's PFM does, however, play a role in delivering incentives offered through the federal Forestry Incentives Program, Agricultural Conservation Program, and Conservation Reserve Program, and through Minnesota's Forestry Incentives Program and Reinvest in Minnesota program.

⁴The immediate response here should be that, if a landowner does not feel he can afford the cost of engaging a consultant, a positive investment opportunity does not exist. This is an appropriate response from the investment perspective of the landowner; however, from a societal viewpoint, the timber management investment opportunity may be favorable, whether the landowner or society makes the investment in management expertise.

FEDERAL-STATE COOPERATION

Cooperative federal-state forestry programs such as Minnesota's Private Forest Management (PFM) Program have their roots in federal legislation enacted early in the century. Enacted in 1911, the Weeks Law authorized matching federal funds for state fire protection efforts on both private and public lands (Dana 1956). Cooperation expanded with the Clark-McNary Act of 1924, which called for federal-state cooperative funds for distributing seedlings and providing forestry technical assistance and educational programs to farmland owners.

The cooperative federal-state role in providing assistance to private forest landowners has been legislatively expanded over time. Early legislation includes the Soil Conservation and Domestic Allotment Act of 1936, which established the Agricultural Conservation Program (ACP); the 1937 Cooperative Farm Forestry Act; and the 1950 Cooperative Forest Management Act, which greatly expanded the provision of forest management advice to landowners by providing funds and authorizing the Secretary of Agriculture to cooperate with the states to provide technical assistance to forest landowners (Cubbage *et al.* 1985, Weyrick 1968).

More recently, 1973 Public Law 93-86, Section 4, created the Forestry Incentives Program (FIP); and the 1978 Cooperative Forest Management Act brought together and enlarged much of the previously-enacted cooperative forestry legislation.

Most recently, the Conservation Reserve Program initiated by the 1985 Farm Bill constitutes a federal-state effort aimed, in part, at reforesting highly erodible agricultural lands.

In Minnesota, private forestry assistance began at a minimal level in 1925, when the state fielded its first extension forester (Weyrick 1968). In 1946, the Minnesota Timber Producers Association funded two foresters in the Division of Forestry, Department of Conservation, to assist private forest landowners in northeastern Minnesota.

State legislative action providing private forestry assistance dates from 1947, when the legislature authorized the commissioner of conservation to "employ competent foresters" to assist private forest landowners in land management (Minnesota Statutes 88.79) and provided \$10,000 to establishment a Private Forest Management Service (Weyrick 1968).

Another statute directs the commissioner of natural resources to "cooperate with the several departments of the state and federal governments and with counties, towns, corporations, or individuals in the preparation of plans for forest protection, management, replacement of trees, woodlots, and timber tracts, using his influence as time will permit toward the establishment of scientific forestry principles in the management, protection, and promotion of the forest resources of the state," (Minnesota Statutes Section 89.01 subd. 4).

The legislature reaffirmed its commitment to private forest management assistance in the 1982 Forest Resource Management Act, instructing the Commissioner of Natural Resources to add 10 PFM specialists to the 1984-85 biennial budget request (Minnesota Division of Forestry 1983). The positions, formerly funded under an accelerated forest management program supported by the Legislative Commission on Minnesota Resources, were approved and funded by the legislature in 1983.

The 1986 Reinvest in Minnesota legislation has added to the state's role in funding and coordinating reforestation and other natural resource protection efforts.

The major goal of Minnesota's PFM is "to improve multiple-use forest resources management on nonindustrial private forest lands to benefit the landowners, economy, and environment of Minnesota" (Minnesota Division of Forestry 1985b). This is to be done cost effectively to the Division, "consistent with Department policies and complementary of [sic] other governmental and private efforts" (Minnesota Division of Forestry 1987).

Minnesota strives to meet its goal by providing technical forest management assistance to private nonindustrial forest landowners. This assistance is provided directly through assistance from state forestry personnel, and indirectly by encouraging additional private forestry consultants to become active in providing such services (Minnesota Division of Forestry 1983).

ADMINISTRATIVE ORGANIZATION

Minnesota's PFM is integral to the overall activities of the Division of Forestry. It cannot be entirely separated from other Division efforts. Formal authority in the Division flows from the director, through four regional supervisors, to 19

area supervisors, to the 76 forest districts (Figure 1).

The PFM is coordinated primarily by a cooperative forest management specialist located within the Resource Management Section at the Division's St. Paul central office. Despite the oversight and coordination role of this individual, this is a staff, rather than a line, position.

The cooperative forest management specialist position is described as coordinating all aspects of the PFM, identifying problem areas, developing policies and procedures to overcome such problems, and proactively improving the program (Tomlinson 1987a). An important position activity, particularly with the recent Conservation Reserve and Reinvest in Minnesota Programs, is keeping field staff informed of administrative and technical requirements of new federal forestry programs. A team approach, involving Division forestry field staff from across the state, is used to develop policies and procedures.

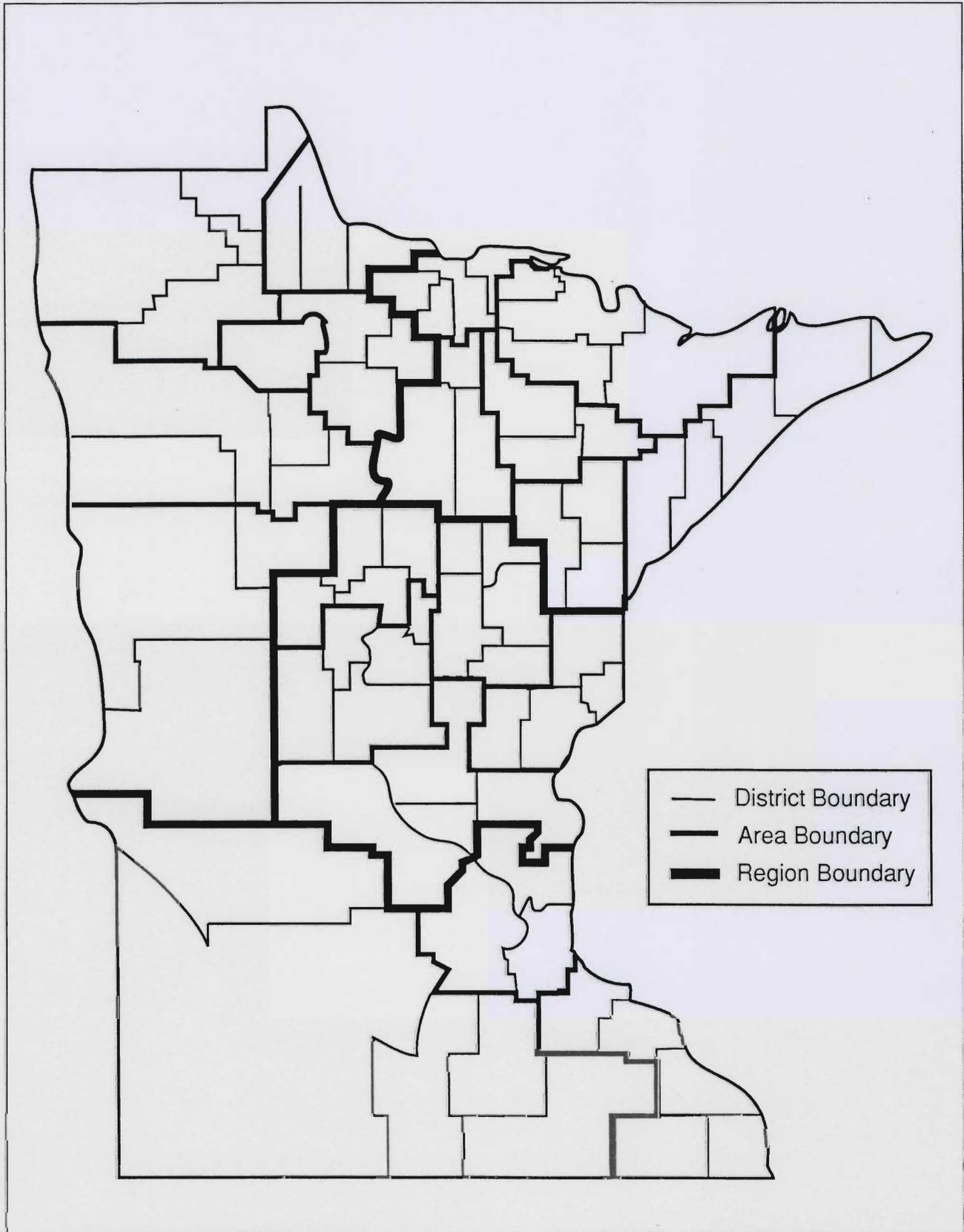
Each region has a PFM contact managing the program at the regional level. Area supervisors have the greatest control over administrative areas, for achieving program targets, prioritizing activities, and balancing PFM work with other area responsibilities. Twelve of the 19 administrative areas have staff foresters coordinating the PFM within their respective areas. In the other areas, a district forester or technician has been delegated this responsibility.

PFM responsibilities are spread widely among Division employees. Even designated PFM foresters usually spend no more than 75 percent of their time on PFM related work (Tomlinson 1987b). Most PFM assistance is provided by area and district foresters and technicians whose other responsibilities include fire prevention/suppression and all phases of managing state-owned forest land.

Relative to other Division of Forestry Programs, such as management of state-owned forest lands and fire suppression, the PFM has somewhat lower budgetary priority. PFM assistance levels have risen and fallen over the years. Peak assistance levels have coincided with the various federal agriculture-forestry programs which have come and gone.

PFM has become an important, integral, and ongoing part of the Division's Mission. It will continue as a major program effort without being as tied to the levels of landowner cost-share and assistance programs as it was formerly. State

Figure 1. Minnesota Division of Forestry administrative regions, areas and districts, 1986.



Source: Minnesota Division of Forestry, 1987.

forest managers, recognizing the better timber and access on *private* forest lands, and responding to public pressure for greater multiple-use emphasis in state forest land management, now look at state-owned forest lands with a more balanced multiple-use, less timber oriented perspective (Tomlinson 1987a).

ASSISTANCE PROVIDED

Minnesota Division of Forestry "service" foresters (those involved in providing forest management assistance to the public) provide private nonindustrial forest landowners with a broad range of assistance. That range runs from simply providing information, to directly performing services. Most of the services offered are free of charge.

Basic assistance provided to nonindustrial private forest landowners include:

- detailed, brief, or revised multiple-use management planning;
- timber sale contract and bid preparation;
- cruising or marking timber, and estimating volume and value;
- scaling of forest products;
- forest product marketing and utilization;
- reforestation and timber stand improvement;
- tree planter rental;
- insect and disease evaluations, damage assessments, and management recommendations;
- technical assistance for and promotion of federal and state cost-sharing programs;
- general advice regarding tax treatment of forest management costs and returns; and
- referral to consulting foresters, forestry service vendors, or tax advisors (Minnesota Division of Forestry 1980).

The most fundamental service provided is the preparation of a comprehensive forest management plan. The first, and perhaps most important step in preparing it is for the forester to become acquainted with the landowner's objectives. The forester next makes a general survey of the owner's forest land, accompanied by the landowner if at all possible. This allows the landowner to learn about his woodland from the forester, and gives the forester a clearer picture of the landowner's management objectives.

The plans entail classifying and mapping the various timber stands on a tract into management units, and then preparing both a general description and basic management recommendations for each of those units. Recommendations are tailored to specific objectives of the landowner, reflecting wildlife, recreation, and other landowner concerns, as well as timber production goals. Comprehensive management plans are usually written to cover a five-year period.

Most of the plans prepared by state service foresters are called "brief" management plans. Despite their name, these plans are not necessarily short and simple. Rather, they provide detailed prescriptions, usually for a single management activity on a particular management unit, such as timber stand improvement or regeneration of a stand after harvest.

Brief plans are sometimes written to follow-up and reinforce verbal management recommendations. As with comprehensive management plans, concerns for non-timber resources are incorporated into brief plans.

Another major category of assistance is timber sale preparation. In helping a landowner set up a timber sale, the service forester will:

- cruise the timber, marking individual trees for selection cuttings or delineating the harvest area boundaries for clear-cuts;
- estimate timber volume and value;
- prepare prescriptions for regeneration and recommendations for timber cutting procedures to be followed by the logger;
- provide the landowner with a list of potential local loggers or timber buyers, a sample timber harvest contract, and recommendations regarding bidding procedures for selling the timber; and
- scale the cut timber, if the landowner wishes.

The state charges most landowners fees for both timber cruising or marking and scaling (Minnesota Division of Forestry 1980). No fees are charged for cruising or marking volumes of less than 10,000 board feet or 30 cords. These represent very small harvests.

Through 1986, with a \$25 minimum charge, basic rates for marking larger sales were:

- \$1.25 per thousand board feet for marked trees usable for lumber, poles, pilings, ties, or veneer;

- \$.50 per cord for marked trees usable for pulpwood, fuelwood, bolts, posts, or other comparable products.

On sales over \$250 appraised value, \$25 was charged for marking the harvest area boundaries of clear-cuts or diameter limit cuts and estimating the harvest volume.

Beginning 1987, the marking and volume estimation fee was changed to five percent of the estimated stumpage value of the timber designated to be sold, to a maximum of \$500 per timber sale. Typical private consultant fees for timber sale assistance have been 15 percent of the sale value, though consultant involvement in the sale process may be much greater (Tomlinson 1987a).

Charges for scaling are \$1 per thousand board feet or \$.25 per cord scaled, with a \$25 minimum charge (raised from \$15 in 1987) each time products are scaled. Fees are also charged for the rental of state owned tree planting equipment to landowners, to pay for equipment wear and tear.

Legislation in 1987 authorized the deposit of management assistance fees directly into the Division of Forestry forest management fund, rather than requiring their deposit into the general fund, as in the past.

The Division stresses that their cruising and marking fees are not charged to pay for the services rendered, but exist primarily to get landowners to make tangible investments in or commitments to their sales. The Division assumes that with such a commitment, the landowner will more likely follow through and complete the actual sale of the timber once the Division has gone to the effort of setting up the harvest.

Some harvests prepared by the Division are not sold. Landowners sometimes fail to follow through. Sometimes no loggers are interested in buying, because of poor markets, small sale size, low quality timber, difficult access, etc.

Service foresters or hired consultants working under Minnesota's PFM also provide hands-on assistance applying the five forestry cost-sharing programs available. They make initial site inspections, write plans for the cost-share treatments, and conduct follow-up inspections of the forest lands once the treatments have been completed.

Cost-share programs include three Federal programs administered by the Agricultural

Stabilization and Conservation Service: Agricultural Conservation Program (ACP), Forestry Incentives Program (FIP), and Conservation Reserve Program (CRP). Minnesota programs, administered by the Soil and Water Conservation Districts, include the Minnesota Forestry Incentives Program (MFIP) and the Re-invest in Minnesota Program (RIM).⁵

A significant amount of the assistance provided to landowners comes as general forest management information or advice via telephone, letters, or in-office contacts. The advice may deal with any facet of forest management: silviculture, forest protection, timber sales, wildlife habitat improvement, basic forest management tax provisions, etc.

State service foresters also promote the PFM and provide private forest management information through group presentations and the media. Group presentation activities include organizing field demonstrations or tours, and staffing county fair booths. The Division encourages their use of mass media to promote PFM, particularly local newspapers and radio stations. And, they are encouraged to facilitate the establishment of woodland owner organizations.

LEGISLATIVE AND ADMINISTRATIVE POLICIES

A number of administrative policies and one statute provide the framework within which the PFM operates. Most fundamental is the 1947 statute (Minnesota Statutes Section 88.79, amended in 1987) which specifically authorizes state assistance to private forest landowners.

LIMITS TO ASSISTANCE

The Minnesota statute both limits assistance to owners of not more than 1,000 acres of forest

⁵ACP and FIP provide cost-sharing for tree planting, site preparation, and timber stand improvement. The two programs have somewhat different participation requirements. MFIP-supported treatments, designed to be complementary to treatments supported by ACP and FIP, include road building and improvement, fencing to protect seedlings from livestock, gopher control in plantations, and firebreak construction and maintenance. CRP and RIM provide funds to farmers for planting trees or grasses on agricultural land. The scope of the cost-sharing programs varies from county to county. ACP is available in all counties; FIP and MFIP are available only in certain counties. CRP and RIM are available statewide but are used mainly where there is farmland subject to high levels of erosion.

land, and authorizes charging reasonable fees for services. Division of Forestry policy (Minnesota Division of Forestry 1980) limits landowner assistance to a maximum of four person-days per year. However, this limit does not include assistance provided in conjunction with the federal ACP, FIP, and CRP programs. And, with the approval of the regional forest supervisor, exceptions may be made in parts of the state where private forestry consultants are not available.

Division policy also recommends that ownerships of greater than 500 acres be referred to private consultants. Such areas are generally too large for state service foresters to adequately assist within the four-day annual time limit.

Division policy specifically prohibits Division foresters from providing a number of services:

- appraising timber for purchase or sale of land;
- estimating value of timber damaged or lost through timber trespass;
- preparing landowner income taxes relating to forest management;
- acting as landowner's agent for timber sales or other purposes; and
- supervising logging or silvicultural operations for the landowner (Minnesota Division of Forestry 1980).

LANDOWNER-CONSULTANT REFERRAL POLICY

A "Landowner-Consultant Referral Policy" (Minnesota Division of Forestry 1984) was prompted by concerns of private Minnesota forestry consultants. They were concerned that the state's free or low-cost assistance to private nonindustrial landowners was taking business from them.

In response, the Division established policies and procedures to provide consultants access to the names and addresses of persons seeking forestry assistance from the PFM.

Under the referral policy, when a landowner requests any PFM assistance which requires a field visit, an Application for Forestry Assistance is filled out and a copy forwarded to the Division of Forestry area office. For 90 days, that copy is open for review by private forestry consultants,

industrial foresters, or forestry service vendors⁶.

The purpose of this review period is to allow private forestry practitioners an opportunity to identify landowners to whom they might offer their services. During this period, the Division may provide the landowner with the service requested, in accordance with standard policies.

Private landowner requests for timber sale assistance require both a review period and a waiting period. When a landowner requests this assistance, an application is again completed, with a review copy forwarded to the Division area office. When the application is filed, the landowner is given a list of consulting and industrial foresters compiled by the Division and urged to consider using their services. The landowner is also told there is a 30 day waiting period after the initial field visit, during which no further sale assistance can be provided.

The waiting period gives consulting and industrial foresters the opportunity to identify and approach potential clients. It also gives landowners the opportunity to contact these foresters to engage their services.

Another provision of the Landowner-Consultant Referral Policy provides a list of consulting and industrial foresters to landowners requesting assistance beyond the scope of PFM permitted services.

These referral policies have helped to allay consultants' concerns that state assistance is taking business from them. But, recently consultants have indicated that the decentralized Division of Forestry's area offices make it difficult for them to efficiently review applications for forestry assistance. Each area office only has the assistance applications for its own jurisdiction (Tomlinson 1987b).

To alleviate this difficulty, the Division is currently developing a centralized computer file for all applications. This file will be accessible to consultants, for a nominal fee, through computer terminals in county extension offices throughout Minnesota.

Discussions with most of the Division's PFM foresters during this study revealed that consultants rarely use the assistance request review files. And, consultants who do, are seldom successful at gaining clients from among the PFM assistance requestors. The files may simply not be useful for identifying clients for such consulting services, or they could just be too difficult to access. Despite limited success in connecting consultants with new clients, the

⁶Forestry vendors provide technical services such as herbicide application, tree planting, or timber stand improvement cuttings.

Division strives to improve the referral system.

Consultant assertions that the state's assistance displaces private enterprise garnered legislative attention and led to a 1983 "white paper" response (Minnesota Division of Forestry 1983). It and the subsequent Landowner-Consultant Referral Policy largely placated the consultants' and legislators' concerns. It perhaps accomplished little in increasing private consultant business, but the cost of maintaining the policy has been very low relative to the political dangers its termination might cause.

A Division of Forestry representative meets about once per year with interested private consultants to discuss their concerns about the PFM, and to seek ways for consultants to better serve the state's private nonindustrial forest landowners.

Division concern for consultants goes beyond trying to minimize the appearance of competing with them. The Division genuinely wants private forest landowners in the state to receive more forest management assistance, and it recognizes that private consultants can expand the assistance available to private forest landowners. They can offer more of the services the state already provides as well as offering ones the state does not (Minnesota Division of Forestry 1983). Also, as Cabbage *et al.* (1985) note, landowners' demand for consultant services may increase as service foresters promote forest management and demonstrate its value.

Consultants presently provide a fairly limited amount of private forest management assistance in Minnesota. There are several reasons. Among them is that timber sales work, the "bread and butter" for many consultants, is not particularly lucrative in Minnesota, since many private timber sales are of fairly low value. Consultants, who are generally paid a percentage (typically 15 percent) of the stumpage sale price for providing harvest assistance, often cannot obtain a large enough fee from a small or low-value sale to make it economically worth their time.

When it comes to other forest management work, such as management planning, and timber stand or wildlife habitat improvement, most land owners are reluctant to invest in consulting forester services, though they may be more than willing to use free assistance provided by state foresters. Kurtz (1986) notes that Missouri nonindustrial private forest landowners have a similar reluctance to pay for consultant services.

Despite the amount of timber harvesting activity

on private nonindustrial forest lands in Minnesota, there would appear to be only a limited role for consultants to play in the management of these lands. This would not change even if free or low-cost state forester assistance were curtailed or eliminated. Information on the level of forestry consultant activity in the state bears this out. Only 23 individuals or firms are on the Division's 1986 list of consultants active in Minnesota. Of these, 5 are based in Wisconsin, two in the Twin Cities offer primarily urban services and not timber sale assistance. Only about half of the remaining 16 work full-time at providing forestry services.

While the Division has had limited success in expanding professional forestry consultant work in Minnesota, it has created many opportunities for forestry vendors providing such services as tree planting, herbicide application, and timber stand improvement cuttings (Tomlinson 1987e). Many of these opportunities stem from the federal and state cost-share programs. The Division has offered a number of training programs for individuals interested in providing such services.

PROGRAM FUNDING AND STAFFING

FUNDING

The Minnesota Division of Forestry's PFM is supported by both federal and state funds (Table 5). Funding levels have generally increased over recent years, though there was a 7.6 percent decline between FY1986 and FY1987, as a result of decreased state funding. Funding levels from a given source may not be directly comparable over all years due to changing accounting methods (Tomlinson 1987d).

Federal-state funding source breakdowns are not entirely accurate. Some federal funds, such as the timber management intensification funds authorized by the 1976 Boundary Waters Canoe Area Wilderness Act (\$2.85 million in FY1986), are melded with the Division's general state appropriation such that particular federal dollars are not directly allocated to any particular Division program. FY1987 PFM funding of \$1.89 million represents 7.3 percent of the Division of Forestry's total budget of \$25.95 million for that year.

STAFFING

Staffing of the PFM has increased 17 percent over the past several years, from 35.8 to 42.0 full time equivalents (FTEs) (Table 6) (Division of

Forestry 1987). The peak level of 42 FTEs in fiscal years 1987 and 1988, was due to additional responsibilities imposed by the Conservation Reserve Program and other agricultural programs (Tomlinson 1986). Staffing levels will have gradually dropped back to about 37 FTEs by 1991, unless those programs do not decline as expected.

Total Division of Forestry regular staffing was 461 FTEs in 1986 (Minnesota Division of Forestry 1987). This means 8.5 percent of the regular Division staff FTEs were used on the PFM in that year, a modest but significant portion of the Division's overall efforts. For comparison, 173 FTEs were dedicated to state forest management in 1986, equal to 37.4 percent of total Division FTEs for that year.

The Division also contracts for some forestry assistance work related to the Agricultural

Conservation, Forestry Incentives, and Conservation Reserve Programs (Tomlinson 1987a). In FY1987 this involved 9 persons on a part-time basis, representing an expenditure of about \$70,000.

Somewhat more use of consultants is expected in the next few years. This will be to meet tree-planting assistance demands spurred by the Conservation Reserve Program. The Division finds it is often more cost-effective to hire consultants to provide these services than to add new staff.

Distribution of PFM FTEs among the various administrative regions largely reflects landowners' demands for assistance. For example, timber harvesting levels and harvest assistance requests are much higher in some areas than others. These variations result not only from the amount of demand for timber in a

Table 5. Minnesota PFM program funding levels by source, FY1984-FY1987.

Source	FY1984	FY1985	FY1986	FY1987
State (State FY)				
Division of Forestry Appropriation	1,480,275	1,672,800	1,702,800	1,531,686
Minnesota Forestry Incentives Program ¹	100,000	150,000	120,000	120,000
Total State	1,580,275	1,822,800	1,822,800	1,651,686
Federal (Federal FY) ²				
Rural Forestry Assistance	69,750	56,800	73,080	87,014 ³
Forestry Incentives Program	7,600	7,300	6,930	6,584
Agricultural Conservation Program	68,360	68,300	64,840	61,598
Public Law 566	18,000	18,000	17,300	22,500
Resource Conservation and Development	27,600	35,000	23,700	0
Conservation Reserve Program	—	—	31,000	65,180
Total Federal	191,310	185,400	216,850	242,876
Total State and Federal	1,771,585	2,008,200	2,039,650	1,894,562

Note: Figures are current year dollars. Funding levels may not be directly comparable across all years due to changing accounting methods.
 1. MFIP funds are cost-share monies paid out directly to landowners; 2. Estimated; 3. Includes "focused funding" grants.
 Sources: Tomlinson 1986, 1987a, 1987d; Minnesota Division of Forestry 1985a.

Table 6. Minnesota PFM program staffing by region, FY1984-FY1987.

Region	Full Time Equivalents			
	FY1984	FY1985	FY1986	FY1987
Bemidji (Region 1)	6.6	6.7	8.5	11.3
Grand Rapids (Region 2)	6.0	6.1	6.7	6.7
Brainerd (Region 3)	11.5	11.9	12.2	12.2
Rochester (Region 5)	9.0	8.1	9.3	9.3
St. Paul	2.7	1.8	2.5	2.5
Total	35.8	34.5	39.2	42.0

Source: Minnesota Division of Forestry 1987, Tomlinson 1987a.

given area, but also from the area's relative portions of public and private forest lands. Obviously, in an area dominated by public lands, there will be few private landowners to request forest management assistance, no matter what the level of harvesting activity.

Present PFM staffing levels appear to be somewhat inadequate, relative to landowners' demands for assistance. However, the Division's cooperative forest management specialist notes that while some of the demand does go unmet, the landowners being assisted are those who are most likely to follow through on management recommendations (Tomlinson 1987a).

Excess demand is dealt with by carefully targeting assistance to committed landowners. For example, PFM foresters emphasize harvesting as only one part of the total management process. Landowners who will follow up harvesting assistance with other appropriate silvicultural treatments receive a high assistance priority. Landowners interested in harvesting timber only for the immediate

financial return are given low priority. And, landowners not following through on management recommendations are given low priority when seeking additional assistance.

PROGRAM ACCOMPLISHMENTS

The Division of Forestry uses a detailed accounting procedure to track PFM accomplishments. Table 7 shows that Minnesota's service foresters are influencing forest management over a significant area. Nevertheless, owners of over 45 percent of the states nonindustrial private commercial timberland have not received forestry management assistance (Carpenter *et al.* 1986).

The total number of acres on which forestry assistance was provided cannot be determined, since more than one type of assistance may have been applied to a given acre (e.g., site preparation for natural regeneration may be provided on a stand which also received timber harvest assistance).

Table 7. Minnesota PFM program accomplishments, FY1985-FY1986. ¹

Accomplishment	FY1985		FY1986	
	Number	Acres	Number	Acres
Total landowners assisted	16,332		14,925	
field assists	5,481		5,061	
incidental assists	10,860		9,849	
Management plans prepared	1,698	65,423	1,677	64,773
comprehensive plans	632	50,105	596	46,310
brief plans	1,071	15,313	1,168	19,288
Site preparation		4,383		5,299
natural		835		2,211
artificial		3,547		3,340
Reforestation completed		7,551		6,648
Total reforestation achieved ²		8,386		8,859
Timber stand improvement		3,200		3,108
Wildlife habitat improvement		6,106		9,007
Recreation improvement		2,459		3,407
Watershed improvement		1,965		3,752
Timber harvests completed	378	8,090	354	7,780
harvest volume (MBF)	5,576		5,252	
harvest volume (cords)	87,406		87,154	
Referrals to consultants	347		268	
Utilization and marketing	577		591	

1. Funding and staffing data in tables 5 and 6 included FY1984 data, but because of a major change in procedures for reporting accomplishments beginning in FY1985, figures from before that year are not comparable with later data and are not presented here; 2. Total reforestation achieved is acres of natural regeneration plus acres of reforestation completed.
Source: Tomlinson 1986, Minnesota Division of Forestry 1985a.

Focusing on 1986, service foresters prepared management plans covering almost 65,000 acres. Timber harvest assistance was provided on 7,800 acres, and reforestation completed on 8,900 acres. Non-timber management improvements (wildlife, recreation, watershed, and overlapping combinations) were aided on about 16,200 acres.

The Division's cooperative forest management specialist noted that timber sale assistance levels have increased greatly in recent years (Tomlinson 1987a). This was not described as resulting from more private timber being sold in the state, but rather from a greater proportion of private timber being sold with PFM assistance. Ideally, this should result in better silvicultural practices on more of Minnesota's nonindustrial private forest lands.

Comparing 1986 PFM accomplishments to the staffing level of 39.2 FTEs (Table 8), 381 total assists, of which 129 were field assists, were accomplished per FTE. Each service forester FTE prepared an average of 43 management plans, covering a total of 1,651 acres. Each service forester FTE also assisted an average of 9 landowners with timber sales on a total of 198 acres of forest land. That assistance yielded 2,223 cords and 134,000 board feet of wood products.

Gansner and Herrick (1980) developed data for service foresters in Northeastern United States,

similar but non-comparable to that shown in Table 8. The lack of comparability has been due to differing data collection methods.

Annual PFM accomplishment target levels are developed at the area level each year. They are based on demand for PFM services and other Division program responsibilities.

An area's initial target plans are moved up through the regions, to the St. Paul office for review. Modifications are made as they are then routed back to the area level. Approved area targets are allocated to the various districts. Each forester and technician providing technical assistance is allotted individual accomplishment targets to achieve, and is evaluated through the year on achievement of accomplishment targets.

Accomplishment targets are seen as guides, however, rather than absolute goals. Unexpected factors such as severe fire seasons can rapidly bring a change in program priorities and output goals. Comparing FY1986 goals (Minnesota Division of Forestry 1985a) with the actual accomplishments (Tomlinson 1986) indicates most were exceeded.

Table 9 presents, for FY1986, the number of service forester hours for four major assistance categories: management plan preparation, harvest assistance, regeneration assistance, and timber stand improvement assistance. They account for two-thirds of total service

Table 8. Minnesota PFM program accomplishments per full time equivalent (FTE), 1986.

Accomplishment	Number per FTE	Acres per FTE
Total landowners assisted	381	
field assists	129	
incidental assists	251	
Management plans prepared	43	1,652
comprehensive plans	15	1,181
brief plans	30	492
Site preparation		135
Reforestation completed		170
Total reforestation achieved		226
Timber stand improvement		79
Wildlife habitat improvement		230
Recreation improvement		87
Watershed improvement		96
Timber harvests completed	9	198
harvest volume (MBF)	134	
harvest volume (cords)	2,223	
Referrals to consultants	7	
Utilization and marketing	15	

Source: Adapted from Minnesota Division of Forestry 1987 and Tomlinson 1986.

forester hours in that year. Also presented in that table are the average number of hours for each assist, the number of hours for each acre assisted on, the average dollars per assist, and the average dollars per acre. The number of hours recorded includes not only the work done in conducting the assistance activity, but also the time spent in promoting such activities to the public.

These figures should not be taken as absolutely accurate, since there is some degree of "looseness" in the manner in which service foresters account for the time they spend on various assistance activities (Tomlinson 1987d). However, they do provide the best available insight on average time and dollar investments in four key assistance areas.

The basic cost of providing PFM assistance is \$21.59 per hour. This figure includes salaries, fringe benefits, and overhead (Tomlinson 1987c). On average, forest management plan preparation costs \$5.25 per acre. Tomlinson (1987b) has estimated the cost of preparing comprehensive plans as \$4.20 per acre and the cost of preparing the more-detailed brief plans at about three times that amount.

Applying this information as formulas, it is possible to break the aggregate cost estimate of \$5.25 per acre into separate estimates for the two plan types.

Where C equals the cost per acre of preparing a comprehensive management plan:

$$C \times (\text{acres of comprehensive plans prepared in 1986}) + 3C \times (\text{acres of brief plans prepared in 1986}) = \$5.25 \times (\text{total number of acres for both types of plans})$$

And, using the appropriate data from Table 7 yields:

$$C \times (46,310) + 3C \times (19,288) = \$5.25 \times (64,773).$$

Solving for C, comprehensive plans cost the Division of Forestry \$3.26 per acre to prepare.

Brief plans cost \$9.79 per acre. These costs are about 22 percent lower than those estimated by Tomlinson (1987b).

Timber harvest assistance averages \$26.00 per acre, or \$571.40 for the average harvest. Regeneration and timber stand improvement assistance average \$38.86 and \$28.15 per acre, respectively. These figures show that while management plan preparation is quite inexpensive, providing more specific management assistance can be fairly costly to the state. The balance between the cost and benefits of this assistance will be examined later.

The average amount of time spent per harvest assist, over 26 hours, indicates that this assistance consumes a large amount of service forester time. On the average harvest, it begins to approach the annual landowner assistance limit of four days. Harvests significantly above the average size, recognizing economies of scale in harvest assistance, could quite easily consume the full four-day allocation.

FUTURE PROGRAM DIRECTIONS

The 1986 Program update document of the Division of Forestry's Minnesota Forest Resource Plan (Minnesota Division of Forestry 1987) sets out future directions for the PFM. The Division plans to maintain PFM assistance at about the same level over the 1987-1991 planning period. But it hopes to produce greater results by more efficiently focusing those efforts.

The Division plans to continue providing private nonindustrial forest landowners with timber sales assistance, while at the same time increasing consultant activity in that area. The Division also intends to improve links with sportsmen and conservation groups, to increase popular support for Division programs and to ensure community input into program administration.

Table 9. Minnesota service forester hours expended on selected assistance activities, FY1986.

Activity	Hours Expended	Hours/ Assist	Hours/ Acre	Cost/ Assist	Cost/ Acre
Management Plan Preparation	15,745	9.39	0.24	\$202.70	\$ 5.25
Timber Harvest Assistance	9,369	26.47	1.20	\$571.40	\$26.00
Regeneration Assistance	15,761		1.78		\$38.86
Timber Stand Improvement	4,053		1.30		\$28.15

Note: Cost calculations based on an annual estimated cost of \$37,350 per FTE of 1730 hours, or \$21.59 per hour of assistance.
Source: Tomlinson 1987c, 1987d.

The Minnesota Forest Resources Plan 1986 Program Update also lists specific strategies and objectives for 1987-1991. Statewide, these include:

- expand public knowledge and awareness of forestry and its importance to Minnesota;
- target assistance to landowners who are committed to managing their lands;
- promote the use of consulting, industrial, and other private foresters in managing private forest lands;
- coordinate PFM services so they complement those provided by other Department divisions, industry, consulting foresters, and forestry vendors;
- develop a system that requires nonindustrial private forest landowners to pay for services for which they receive an immediate financial return (i.e., timber sales assistance);
- identify and promote the use of private consultants for special temporary projects focused on specific products or objectives;
- include other government personnel and private consulting and industrial foresters in PFM related training.

The plan also sets specific targets for the Division's central office in St. Paul:

- establish a statewide policy pertaining to the involvement of the Department of Natural Resources Section of Wildlife in the preparation of private forest management plans and other aspects of the PFM;
- form a closer alliance between the Division and various statewide sportsmen/conservation groups;
- provide information and support to facilitate national and state Conservation Reserve Program rules and regulation changes which will result in increased tree and shrub planting;
- cooperate with the University of Minnesota, Forestry Extension Service to establish a computerized landowner/consultant referral system to replace current referral policy;
- provide information and support for legislative initiatives changing forest property taxation; and
- streamline the paperwork needed to operate an effective PFM.

The 1986 Program update for the Minnesota Forest Resource plan also discusses directions for each of the four Division of Forestry administrative regions:

Region 1 (Bemidji): Continue involvement in private timber sales while encouraging consultants to actively participate. Ensure that wildlife and prairie management is appropriately considered by involving wildlife managers in PFM planning. With the Conservation Reserve Program (CRP) requiring increased time of field personnel, PFM activities and other programs may suffer. PFM accomplishments will likely decrease slightly, depending on CRP and state land timber sales work loads in coming years.

Region 2 (Grand Rapids): With the decrease in budget and staff time for PFM, fewer landowners will be assisted, but quality one-on-one assistance will be maintained. Emphasis will be on timber sales, wildlife habitat and other activities where cost-share dollars are not the chief concern for the landowner. Maintain communication with consultants and refer landowners to them when a consultant can benefit the landowner by providing vendor services.

Region 3 (Brainerd): Maintain the Program at current accomplishment levels except for areas where accelerated emphasis changes, such as CRP increases. These increases will come at the expense of accomplishments in other PFM activities unless increased funding and staffing are provided.

Region 5 (Rochester): Continue assisting private landowners. A special effort will be made to increase public awareness of PFM activities through media, legislators, and farmer and sportsmen organizations.

Specifying targets, strategies, and directions for PFM in the Minnesota Forest Resources Plan Program update is valuable for guiding the Program's focus on activities and on how individual PFM efforts should be prioritized to best meet overall goals. Statewide and regional Plan guidelines are of even greater value if their application and the specific implementation steps are more fully elaborated in the Division's administrative area management plans as they are completed. A review of available area plans indicates this is the case.

The Moose Lake Area Forest Resource Management Plan (Minnesota Division of Forestry 1985c), the only area plan completed to date, briefly discusses PFM general goals, and typical PFM activities carried out in that area.

Present and projected PFM FTE levels are presented for the plan's ten year horizon.

Two key goals are identified for the planning period: increasing timber stand improvement and increasing reforestation, without sacrificing other area assistance targets. Several specific steps toward accomplishing these goals are given in the plan. Additional program priorities for the 1985-1994 planning period are also spelled out. Some of these are quite specific (e.g., increase the number of landowners assisted annually to 415 by 1994). Others are fairly general (e.g., improve the quality of management on nonindustrial private forest lands through educational programs, technical assistance, and other means).

The Moose Lake area plan also provides detailed specification, over the ten year planning period, of planned levels for budgets, staffing, assistance accomplishments, informational and educational programs, staff training sessions, and meetings with other agencies.

A draft of the Park Rapids Area Forest Management Plan provides even more detail, both about past area PFM Program activities and efforts, and future directions. Similar to the Moose Lake area plan, the Park Rapids plan does a very sound job of identifying private forest land management problems and specifying steps to solve them. Future program steps and directions are discussed on both area-wide and sub-unit bases.

Evaluation of the Minnesota Private Forest Management Program

REVIEW OF PREVIOUS EVALUATIONS

RURAL FORESTRY ASSISTANCE IN GEORGIA

Cabbage *et al.* (1985) evaluated Georgia's Rural Forestry Assistance (RFA) Program. They examined 20 pairs of RFA-assisted and RFA-unassisted timber harvests on mixed pine-hardwood stands in the Georgia Piedmont.

They found significantly more pine seedlings on the assisted harvests, though the number of hardwood seedlings and total number of seedlings were not significantly different. They did not find any noticeable difference between harvest groups in slash cover, soil compaction, exposed spoil, and soil erosion.

Differences between assisted and unassisted landowners were usually small. All landowners who received RFA assistance were moderately or highly pleased with their harvests. But, landowners who didn't take advantage of assistance appeared to be slightly less pleased. They did find, however, that assisted landowners received significantly more money for their timber, as much as \$48 per thousand board feet or 87 percent more, depending on the analytical approach taken.

On the basis of the greater harvest returns and better post-harvest stand structure found on RFA assisted sales, Cabbage *et al.* (1985) calculated a series of benefit-cost ratios for RFA

harvest assistance. At a 5 percent real discount rate, the private efficiency benefit-cost ratio was 61:1 and the social efficiency benefit-cost ratio was 24:1.

Even comparing the benefits of RFA harvesting assistance to *total* costs of the entire RFA Program yielded a favorable benefit-cost ratio of 2.2:1 at a 5 percent real discount rate. They therefore concluded that benefits generated by RFA harvest assistance alone justified the expense of the entire RFA Program.

PRIVATE FORESTRY ASSISTANCE IN MONTANA

Jackson (1985) investigated the effects of Montana's Private Forestry Assistance Program (PFA) and concluded:

- landowners who use PFA timber sale assistance can expect to grow more timber in the future than those who do not;
- the incremental present net value of the increased timber growth resulting from PFA advice is quite substantial.

Jackson's report examined 15 pairs of PFA-assisted and PFA-unassisted timber sales in western Montana. He tried to determine whether the PFA assistance influenced the use of timber sale management practices intended to protect non-commodity resources (especially water). He also tried to measure the impacts of PFA

assistance on timber prices received by the landowners.

Jackson found no significant difference in the use of measures to protect either the environment or residual timber between assisted and unassisted timber harvests. Use of such measures, where called for, was quite good. In 78 percent of the instances where called for, adequate or more than adequate management practices were used to protect the threatened resource.

PFA assistance was found to increase the prices paid for timber. Service forester assistance resulted in landowners receiving an extra \$12.85 per thousand board feet, with an average product price of \$220.12 per thousand board feet.

MISSISSIPPI SERVICE FORESTRY PROJECT

Straka *et al.* (1986) examined the benefits and costs of Mississippi's Service Forestry Project. The Project placed an additional service forester in each of two counties.

The objectives of this study were to measure direct and indirect economic impacts of the Project on Mississippi's forest economy. Basic assumptions of the Project were that more service foresters would result in more landowner contacts, which would result in more acres receiving management treatments ultimately leading to a larger timber supply.

There was a social efficiency approach to measuring benefits of the incremental assistance provided by the additional service foresters. At a 7 percent real discount rate, the benefit-cost ratio was 8.2:1. This was assumed to be a conservative measure of the benefits of service forestry assistance since it did not include nonmarket benefits and local economy multiplier effects.

COOPERATIVE FOREST MANAGEMENT IN MISSOURI

Marty and Kurtz (1984) analyzed Missouri's Cooperative Forest Management (CFM) Program. They examined CFM's objectives, and the program structures and activities through which those objectives were sought. They also recommended realigned objectives, and modified structures and activities to better meet these redefined objectives.

This study focused solely on Missouri's private forestry assistance program, but its findings nevertheless raise questions that should be

addressed concerning Minnesota's PFM Program.

Marty and Kurtz noted that CFM's goal to provide forest management advice and services to all state citizens is based on worthy ideals and is politically prudent. But they also noted how difficult it is to implement efficiently. They criticized the Program for simply responding to requests, rather than acting with specific objectives in mind. While that "achieves a degree of public satisfaction at the expense of program efficiency," (p. V), Marty and Kurtz point out that the Program could be improved by carefully prioritizing and targeting assistance.

Specifically, Marty and Kurtz recommended:

- improving understanding of nonindustrial private forest landowners, their objectives, and how they react to alternative forms of assistance;
- determining the role of private forestry consultants in providing technical services in the state;
- considering charging for services;
- focusing assistance to eliminate nonproductive requests and inefficient activities;
- improving data collection for efficiency analysis; and
- refining methods for tracking Program accomplishments and evaluating progress toward objectives.

To identify which assistance activities should receive the most efforts and which should be eliminated, Marty and Kurtz (1984, p. V) suggested that each activity be evaluated "...in light of its contribution toward achieving objectives, the established role of consultants, costs and benefits, and [the] appropriateness of the activity for a State agency."

Marty and Kurtz found that, in Missouri (as was suggested earlier for Minnesota), there are too few private forestry consultants to take over the timber sale assistance role of state service foresters, should the state withdraw this service. They pointed out that the number of consultants was not likely to grow as long as the state was providing free assistance. The authors recommended charging for timber sale assistance in order to solve this dilemma.

Kurtz (1986) later stated that because Missouri's private forest landowners were reluctant to pay for consultant services, it was not likely that the state Department of Conservation could

successfully help more consultants become established. However, Kurtz noted, consultants would continue to play an important role in providing forest management services to large landowners.

EVALUATION PROCEDURES⁷

ANALYSIS FRAMEWORK AND PROJECT SCOPE

Evaluating Minnesota's Private Forest Management Program involved an attempt to replicate procedures used by Cabbage *et al.* (1985) in evaluating Georgia's Rural Forestry Assistance Program. The basic design involved paired-comparison sampling: state service forester assisted timber sales paired with similar, nearby unassisted sales. Data for comparison was collected through on-site measurements and from a questionnaire mailed to the landowners.

The paired comparisons provide the necessary "with and without" framework for assessing the program. The basic experimental hypothesis is that state forester assistance in setting up a timber harvest will lead to better harvest "results" than those achieved on unassisted sales. Such better results might include higher regeneration levels, higher stumpage price, fewer site impacts, and greater landowner satisfaction with the harvest.

The Cabbage study focused on a relatively homogenous forest region in Georgia and dealt primarily with natural mixed pine-hardwood stands. Because Minnesota has a wide range of forest types, it was not feasible to attempt to assess the impact of PFM timber sale assistance across all those types.

Two different timber types were selected for examination: aspen located in the north-central part of the state, and hardwood in southeastern Minnesota. These were selected because both have enjoyed active markets over the past several years and both play dominant roles in the timber economies of their respective regions.

Initial plans also sought to examine jack pine harvests, but this was not followed through with due to funding limitations.

SAMPLE SELECTION

As a first step in sample selection, each Division of Forestry administrative area in the state was asked to identify all Private Forest Management timber harvest assists which met specified criteria:

- Aspen Harvests: minimum five acre size; harvested between 3/1/84 and 2/28/85
- Hardwood Harvests: minimum five acre size; harvested between 9/1/83 and 8/30/84

Criteria dates were selected to allow time for regeneration to have become established on the sites, while also trying to minimize time from harvest to data collection. Suitable harvests down to a five acre minimum were identified, but a 10 acre minimum was used for aspen in actual sample selection. This appropriately balanced using large harvests to minimize the variability of the data collected, with not excluding a large number of harvests below the minimum size. The five acre minimum was used in selecting hardwood sales since these are smaller, on average, than aspen sales in the state.

Once the sample population was identified, random selections of assisted harvests were made from each area, in approximate proportion to the amount of timber harvests assisted by the area, relative to the total number of harvest pairs intended to be sampled.

As work progressed, it became evident that field data collection was slower than anticipated. Thus, seven aspen harvest pairs were completed rather than the anticipated 12 to 15. One assisted aspen harvest was also only eight acres in size, less than the minimum 10 acre size, because less area was actually harvested than planned by the landowner and state service forester.

Only two hardwood harvest pairs were completed rather than the anticipated three.

Once assisted harvests were selected, the landowner was contacted by telephone and asked to participate in the study. No landowner declined to participate.

When the landowner's permission was received to use an assisted harvest in the study, the matching unassisted harvest was sought by surveying the vicinity of the assisted sale for recent unassisted sales, and by asking the assisted landowner, Division of Forestry personnel, and local loggers if they knew of any

⁷For a more detailed discussion of the study's analytical framework, see Henly 1986a. For a more detailed description of data collection procedures, see Henly 1986b.

appropriate unassisted sales. Proximity to the assisted harvest was the main selection criterion. Other criteria were timber type, acreage minimum, and harvest date. Harvest pairs averaged 7.1 miles apart.

Locating the unassisted timber sales sometimes proved frustrating. Harvests were often hard to identify from the road and neither Division personnel nor landowners were always aware of suitable harvests. In some areas, it appeared that service foresters had assisted such a large proportion of harvests, there were few unassisted ones to be found.

Unfortunately, unlike in some other states, in Minnesota there is no way to systematically identify private timber harvests through public records such as hazard reduction agreements, forest practice law notifications, or timber harvest tax filings. Because of the difficulty in locating unassisted harvests, in one aspen pair, a harvest smaller than the 10 acre minimum was used for the comparison.

DATA COLLECTION

Each harvest selected for the study was intensively cruised to collect a range of data. Sample plots were established at the rate of one plot per acre of harvest area for harvests larger than 10 acres. Ten sample plots were taken on harvests smaller than 10 acres in size. All data, except for regeneration, was collected on a one-tenth acre plot size. Regeneration data was collected on plots of one-hundredth acre.

Sample plots were measured for:

- diameter, height, and species of stumps of all harvested trees;
- diameter at breast height (DBH) and species of all trees of one-inch DBH or greater;
- heights, to the nearest 8 feet, to a 4-inch or 8-inch diameter outside bark for all

trees 4 inches DBH or greater;

- individual tree damage, and amount of slash cover, soil compaction, bare soil, and soil erosion;
- volume of merchantable wood left on site as waste;
- number of seedlings, by species, on one-hundredth acre regeneration plots taken on each tenth-acre sample plot.

For each timber sale, the site index and harvest acreage were also determined.

Equations by Raile (1978) and Raile *et al.* (1978) converted stump heights and diameters into estimates of DBH and merchantable volume of harvested trees. This allowed systematic determination of the volume of timber harvested.

It was necessary to reconstruct the harvest volume in this fashion since other measures of timber removed (e.g. logger, mill, or PFM forester tally) would not provide measurement consistency needed to compare harvest volumes across sales. Tables by Gevorkiantz (1955) were used to estimate the merchantable volumes of residual trees.

Equally important to the physical stand measurements, the owners of the sample timber sales were asked to complete a survey (Appendix A) to provide information about their personal characteristics, the timber sale procedures they used, and their reasons for harvesting. Surveys were mailed out with a personalized cover letter and a stamped, addressed return envelope.

If a response was not received within two weeks of the mailing of the questionnaire, a second mailing was sent. It included a personalized letter again asking the landowner to complete the survey, a photocopy of the first cover letter, a copy of the questionnaire, and a stamped, addressed return envelope. Only one landowner failed to complete and return a questionnaire after the second mailing.

Table 10. Harvest area and site index, by assisted and unassisted sales.

Aspen Harvests			Hardwood Harvests		
Assisted	Unassisted	Difference	Assisted	Unassisted	Difference
Harvest Area (acres)					
14.6	12.0	2.6	13.0	9.0	4.0
Site Index (feet at age 50)					
67	63	4	55	57	2

Questionnaire items covered:

- who initiated the timber sale
- who decided what trees would be harvested
- how the timber was sold
- price received for the timber
- reasons for harvesting the timber
- satisfaction with completed harvest
- awareness of the availability of PFM and other forestry assistance
- place of residence
- length of time property was owned
- approximate income
- education level

EVALUATION RESULTS**STATISTICAL CONSIDERATIONS**

Most of the statistical analysis of the physical comparisons uses paired t-tests. That approach is considered appropriate since the assisted and unassisted harvests were purposely paired on the basis of harvest type and proximity of harvest area. It is hoped that the paired harvest approach helped to reduce the high variability inherent in forestry measurement work.

Both one-tailed and two-tailed paired t-tests were used to test for significant differences between assisted and unassisted harvests, depending upon the variables being compared. A two-tailed test implies only that a difference is hypothesized, but with no implication made as to the direction of the difference. A one-tailed test hypothesizes that there is both a difference between the variables being compared and that this difference is of a specific direction.

The difference between the one- and two-tailed t-tests is made clear by examples. There was no prior hypothesis that assisted harvests would have a higher site index than unassisted harvests, though some difference was expected; thus, in this case, a two-tailed paired t-test was used. A prior hypothesis that stumpage prices would be higher for assisted harvests than unassisted, led to applying a one-tailed test.

Since the two harvest pairs completed for the southeastern Minnesota hardwood timber type are a sample too small for statistical analysis, data pertaining to these harvests is treated in a descriptive manner only.

PHYSICAL HARVEST COMPARISONS**Harvest Area**

Average area of assisted aspen harvests was 14.6 acres (Table 10). The average area for unassisted aspen harvests was 12.0 acres. Two-tailed, paired t-test analysis did not show this difference to be statistically significant.

Neither of the above average harvest size figures should be taken to be highly representative of the true population average, however. First, a minimum harvest size of ten acres was used in the study (though it was twice necessary to use smaller aspen harvests). Second, there were several cases where potentially usable unassisted harvests were rejected because of their large size (e.g., 80 acres or more). It was decided not to use such large harvests since they would have required a great amount of the field crew's time and significantly reduced the number of harvest pairs which could be completed.

The assisted hardwood harvests averaged 13.0 acres in size; the unassisted harvests averaged 9.0 acres.

Site Index

Assisted aspen harvests had an average site index (age 50) of 67 feet (Table 10). Unassisted aspen harvests had an average site index of 63 feet. This difference, tested by a two-tailed paired t-test, was significant at $\alpha=0.10$.

Average red oak site index (age 50) for the hardwood was 55 feet for the assisted harvests and 57 feet for the unassisted harvests. These hardwood site index values were somewhat suspect, however, as the field crew had difficulty finding suitable, dominant trees from which to take site index readings.

Harvest Volumes

Initial plans were to determine timber volumes harvested by using measured stump heights and diameters in formulas by Raile (1978) and Raile *et al.* (1982). This would have provided a systematic basis for volume estimation across all harvests, rather than relying on volume estimates from a variety of sources (e.g., PFM forester estimates, logger estimates, consumer scale volumes, etc.)

Unfortunately, results of estimating volume from stumps were very disappointing. Volume estimates based on stump measurements were, in most cases, greatly below those determined

by other sources. Our volume estimates were also significantly less than what would be expected, given the quality of the harvest sites and the yields that would be typically achieved on such sites (Perala 1977).

Discussion with the authors of the formulas did not point to any systematic problems in our application of the formulas that could account for the significant estimation errors.

The results from both of the basic formulas used to estimate volume harvested were carefully examined. The first formula calculated tree breast height diameter from stump height and diameter; the second calculated net merchantable tree volume from the estimated breast height diameter. Comparing estimated breast height diameters and the resulting estimated tree volumes to a number of volume tables, it appeared that the second of the two formulas in the volume estimation chain was sound.

The stump-to-breast-height-diameter link could not be so easily verified. No other comparable formulas or tables were available for comparison. Also, the author expressed a high degree of confidence in this formula.

Several possible stump measurement problems were identified, two of which would lead to the relative "undermeasurement" of stump diameters. Factors of measurement time and technique, they would lead to underestimating

tree breast height diameter, and thus tree volume, using the equations described.

First, the stumps and trees measured to provide raw data in constructing the formula were fresh-cut. Stumps measured in this study were one to two years old and likely had shrunken some in size.

Second, stump diameter measures for the formula construction were made with diameter tapes. In this study, stump diameters were taken as the average of two cross-sections measured with a Biltmore stick. Over the long run, diameter tape measurements would yield a higher diameter than Biltmore stick measurements.

A final contributing factor to underestimating volume could have been missed stumps. Most of the aspen harvests in the study were densely overgrown clear-cuts. Despite the field crew's diligence, stumps could have been missed. On the tenth-acre sample plots, each stump missed would translate into ten missed stumps per acre. This could cause a very large underestimation of volume.

Because of these serious volume underestimation problems, the best available harvest volumes were concluded to be those provided by the landowners or the Division of Forestry. This resulted in an inconsistent volume measurement basis, but it was clearly a better basis than the one initially attempted. There was no readily apparent bias in the use of such data.

Table 11. Average cut, residual, and initial merchantable timber volumes on aspen harvests by assisted and unassisted sales.

Species	Volume (cords per acre)			
	Assisted ¹	Unassisted ²	Unpaired Difference ³	Paired Difference ⁴
	Cut Volume			
aspen	16.7	19.8	-3.1	-4.9
other	5.5	2.5	3.0	2.5
all	22.2	22.3	-0.1	-2.4
	Residual Volume			
aspen	0.1	0.7		-0.6
other	1.3	2.6		-1.3
all	1.4	3.3		-2.0
	Initial Volume			
aspen	16.8	20.9	-4.1	-6.0
other	6.7	3.6	3.1	2.5
all	23.5	24.5	-1.0	-3.4

1. Based on all 7 assisted harvests; 2. For cut and initial volumes, based on 4 of 7 unassisted harvests; 3. Based on difference between average of 7 assisted harvest pairs and average of 4 unassisted harvests; 4. For cut and initial volumes, based on four harvest pairs for which harvest volumes were available for both harvests in the pair.

Since stump derived harvest volume estimates were unusable, and since not all landowners were able to provide harvest volume information, those volumes could not be reconstructed for three of the unassisted aspen harvests.

Using the data available, cut volumes on assisted aspen harvests averaged 16.7 cords aspen per acre, 5.5 cords other species per acre, and 22.2 cords per acre total (Table 11). On unassisted aspen harvests, average cut volumes were 19.8 cords aspen per acre, 2.5 cords other species per acre, and 22.3 cords per acre total. No statistically significant difference was found between harvest volumes on assisted and unassisted sites.

Average hardwood harvest volumes were 5,150 board feet red oak per acre on assisted sales (Table 12). Unassisted sales averaged 2,642 board feet red oak per acre, plus 47 board feet white oak per acre, for a total of 2,688 board feet per acre.

Residual Volumes

Merchantable volume of residual trees was estimated, using standard volume tables (Gevorkiantz 1955), from the diameters and heights of standing trees greater than four inches diameter at breast height, that remained on the timber sale area after the harvest.

On assisted aspen harvests, average residual

volume for all species was 1.4 cords per acre (Table 11). The average total residual tree volume on unassisted aspen sales was 3.3 cords per acre. Residual aspen tree volume on aspen harvests was 0.1 cords per acre on assisted harvests and 0.7 cords per acre on unassisted harvests. Residual noncrop tree volume was 1.3 cords per acre on assisted harvests and 2.6 cords per acre on unassisted harvests. None of these differences was statistically significant.

Silviculturally, a complete clear-cut is highly desirable for optimal aspen regeneration. However, loggers normally have an incentive to only cut trees they intend to remove for sale to a primary wood processor. Intuitively, one might expect residual volumes to be greater on the unassisted aspen sales, since these harvests are not receiving the same level of professional forestry input as assisted sales. As a result, it seems, the logger on an unassisted sale would be less likely to be directed to cut all standing timber than would a logger operating on an assisted sale. The residual timber volumes do point toward this conclusion, but it is not statistically borne out.

Additionally, it would be a mistake to describe either assisted or unassisted landowners as having solely silvicultural objectives. Most also have wildlife and aesthetic interests. They may wish to have some trees left to provide wildlife and scenic benefits, even if they do slightly

Table 12. Average cut, residual, and initial merchantable timber volumes on hardwood harvests, by assisted and unassisted sales.

Species Group ¹	Assisted ²		Unassisted ²		Difference ²	
	sawlogs	cordwood	sawlogs	cordwood	sawlogs	cordwood
	Cut Volume					
desirable	5,150	0.0	2,688	0.0	2,462	0.0
acceptable	0	0.0	0	0.0	0	0.0
undesirable	0	0.0	0	0.0	0	0.0
total ³	5,150	0.0	2,688	0.0	2,462	0.0
	Residual Volume					
desirable	663	2.6	1,997	4.7	-1,334	-2.1
acceptable	11	0.1	18	0.2	-7	-0.1
undesirable	19	0.9	215	1.6	-196	-0.7
total ³	693	3.5	2,230	6.4	-1,537	-2.9
	Initial Volume					
desirable	5,813	2.6	4,685	4.7	1,128	-2.1
acceptable	11	0.1	18	0.2	-7	-0.1
undesirable	19	0.9	215	1.6	-196	-0.7
total ³	5,843	3.5	4,917	6.4	926	-2.9

1. Species groups: desirable—oaks, walnut, butternut, ash; acceptable—sugar maple, basswood, elm, cherry; undesirable—all other species; 2. Sawlog volume in board feet (International 1/4) per acre, cordwood volume in cords per acre; 3. Columns may not sum exactly due to rounding error.

hinder aspen regeneration.

Residual merchantable timber volume on the hardwood sales was determined in terms of both sawlogs (to an eight-inch minimum top diameter) and cordwood (to a four-inch minimum top diameter) (Table 12). Species were combined within three categories: desirable (oaks, walnut, butternut, and ash), acceptable (sugar maple, basswood, elm, and cherry), and undesirable (all other species).

Per acre, assisted hardwood sales averaged 663 board feet desirable, 11 board feet acceptable, 19 board feet undesirable, or 693 total board feet residual merchantable sawlog volume. Per acre residual cordwood volumes on assisted harvests were 2.5 cords desirable, 0.1 cords acceptable, 0.9 cords undesirable (total 3.5 cords).

Unassisted hardwood sales had higher average residual levels. This is not surprising, considering their lower cutting levels. Per acre residual sawlog volume averaged 1,997 board feet desirable, 18 board feet acceptable, 215 board feet undesirable (total 2,230 board feet). Residual averages for per-acre cordwood volumes on the unassisted hardwood sales were 4.7 cords desirable, 0.2 cords acceptable, 1.6 cords undesirable (total 6.4 cords).

Initial Merchantable Volume

Summing cut and residual merchantable volumes yields initial merchantable timber

volumes. On assisted aspen sales, initial aspen volumes averaged 16.8 cords per acre and other species 6.7 cords per acre, for a total of 23.5 cords per acre (Table 11). Unassisted aspen sales averaged 20.9 cords of aspen per acre and 3.6 cords per acre of other species before harvest, for a preharvest merchantable volume total of 24.5 cords per acre. These differences were not statistically significant.

On assisted hardwood sales, initial per acre sawlog volumes averaged 5,813 board feet desirable species, 11 board feet acceptable, and 19 board feet undesirable, for a 5,843 board feet total (Table 12). On unassisted hardwood sales, initial merchantable volume averages per acre were 4,685 board feet for desirable species, 18 board feet acceptable, 215 board feet undesirable (total 4,917 board feet). Initial cordwood volumes were the same as the residual cordwood volumes, since the timber cut volumes reflected only sawlog and tie removals.

Merchantable Waste

Cut wood of merchantable size and quality left on the harvest site was measured for length and end diameters. Volume was calculated using Smalian's formula (Husch *et al.* 1972). It was hypothesized that less merchantable waste would remain on assisted sales, since assisted landowners would be more likely than unassisted landowners to have established utilization standards for their loggers to follow.

On assisted aspen harvests, an average of 64.0

Table 13. Volume of merchantable waste left on harvests, by assisted and unassisted sales.

Species	Assisted Harvests		Unassisted Harvests		Difference	
	cubic feet	cords	cubic feet	cords	cubic feet	cords
	aspen harvests					
aspen	64.0	0.81	40.3	0.52	23.7	0.29
other	42.9	0.54	18.8	0.24	24.1	0.30
all	106.9	1.35	59.1	0.75	47.8	0.60
	hardwood harvests					
oak	94.5	1.19	4.4	0.06	90.1	1.13
other	10.5	0.13	0.0	0.00	10.5	0.13
all	105.0	1.33	4.4	0.06	100.6	1.27

Table 14. Merchantable waste volume ranges on aspen harvests, by assisted and unassisted sales.

Species	Assisted (cords/acre)		Unassisted (cords/acre)	
	low	high	low	high
aspen	9.52	233.18	0.00	91.02
other	15.29	105.68	0.00	57.33
total	34.19	281.19	3.45	93.90

cubic feet (0.81 cords) per acre of merchantable aspen waste remained (Table 13). On unassisted sales, 40.3 cubic feet (0.52 cords) per acre was left. On assisted aspen harvests, 42.9 cubic feet (0.54 cords) per acre of non-aspen merchantable waste remained. On unassisted sales, 18.8 cubic feet (0.24 cords) per acre remained. Total merchantable waste volumes were 106.9 cubic feet (1.35 cords) per acre on assisted aspen harvests and 59.1 cubic feet (0.75 cords) per acre on unassisted aspen harvests. None of these differences were statistically significant by one-tailed paired t-tests, though the differences were quite large in magnitude. This nonsignificance was likely due to the large variability in the range of merchantable waste volumes (Table 14).

On assisted hardwood harvests, average per acre merchantable waste was 94.5 cubic feet (1.19 cords) oak and 10.5 cubic feet (0.13 cords) other species, for a total of 105.0 cubic feet (1.33 cords). On unassisted harvests, merchantable waste consisted solely of red oak at an average of 4.4 cubic feet (0.06 cords) per acre. (Table 14)

Most merchantable waste left, particularly on the hardwood harvests, would be usable only as firewood. Since firewood markets are not especially strong in these rural areas of the state, the material might not be economically merchantable, even though physically usable.

Comparison of these differences is further muddied, since not all the material left by loggers was wasted. In several instances, landowners were gradually removing remaining cut wood for use as firewood.

Clearly, much greater amounts of waste are left on assisted than on unassisted sites. The greater volumes of low value waste on assisted harvests may not represent poor utilization so much as it represents the felling of inferior trees which are not desirable for the residual timber stand.

Residual Stems and Basal Area

Original intentions were to determine initial, cut, and residual stem diameters and basal area. Since stump-to-tree projection methods were not successful, only residual stem and basal area results could be determined.

Residual stem and basal area data provided a more complete picture of the post-harvest stand structure than did the residual merchantable volume information, since the stem and basal area data included all residual trees of one-inch breast height diameter and above. Trees less than one-inch diameter at breast height were treated separately as regeneration.

Aspen Harvests. Operating under silvicultural criteria, one would expect an aspen harvest receiving professional forestry assistance to have fewer residual stems and a lower residual basal area per acre. Using multiple-use criteria, a distinct hypothesis as to basal area differences is not evident.

On the one hand, leaving a few residual standing trees on an otherwise clearcut harvest site provides some wildlife benefits such as nesting and roosting sites for birds, and, in the case of oaks, mast production. On the other hand, the thick aspen regeneration encouraged by a complete clearcut offers excellent cover for deer, grouse, and other wildlife.

Assisted aspen harvests had average residual stem counts of 2.4 aspen stems per acre, and 61.1 other stems per acre, for a total of 63.5 stems per acre (Table 15). Unassisted aspen harvests averaged 12.8 aspen stems per acre, 109.7 other stems per acre, and 122.5 total stems per acre. Figures 2 through 7 show number of stems per acre versus diameter class for aspen, other, and all species.

The only significant difference in number of stems per acre between assisted and unassisted sales is for the number of aspen stems per acre.

Table 15. Residual stems and basal area on aspen harvests, by assisted and unassisted sales.

Species	Assisted	Unassisted	Difference	Significance Level
	stems per acre			
aspen	2.4	12.8	-10.4	0.10
other	61.1	109.7	-48.6	NS
all	63.5	122.5	-59.0	NS
	basal area (square feet per acre)			
aspen	0.5	3.8	-3.3	0.10
other	9.1	20.6	-11.5	0.10
all	9.6	24.4	-14.8	0.10

Figure 2. Aspen harvest residual stems—average for aspen.

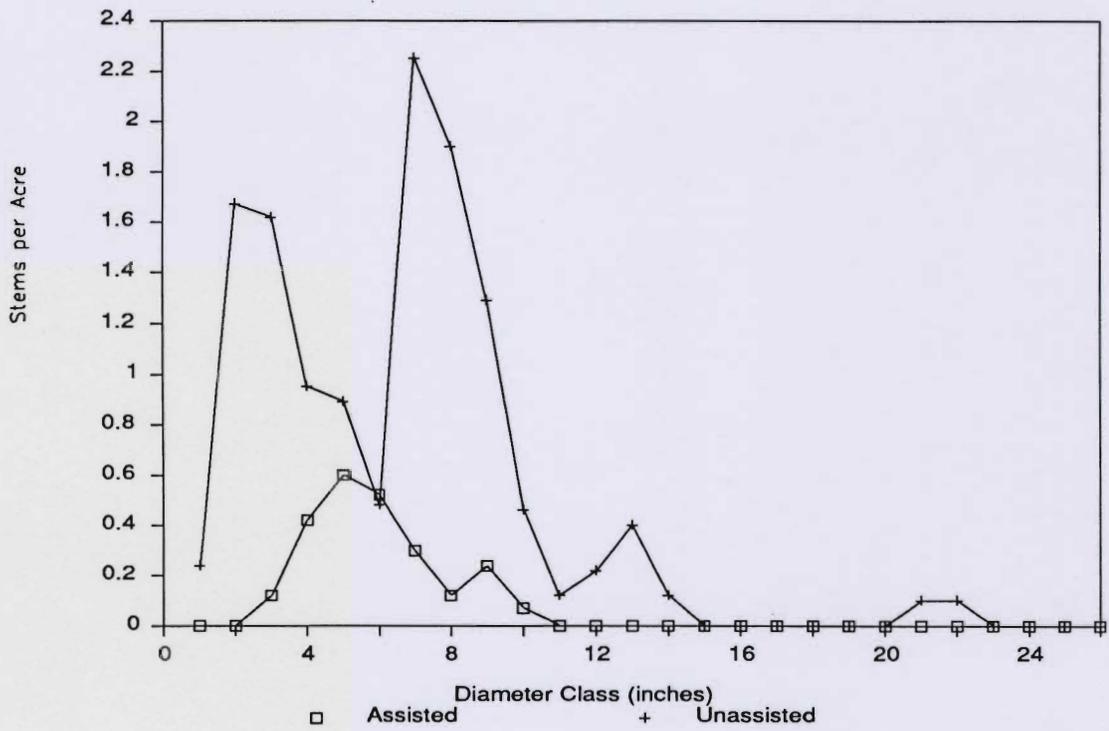


Figure 3. Aspen harvest residual stems—average for other species.

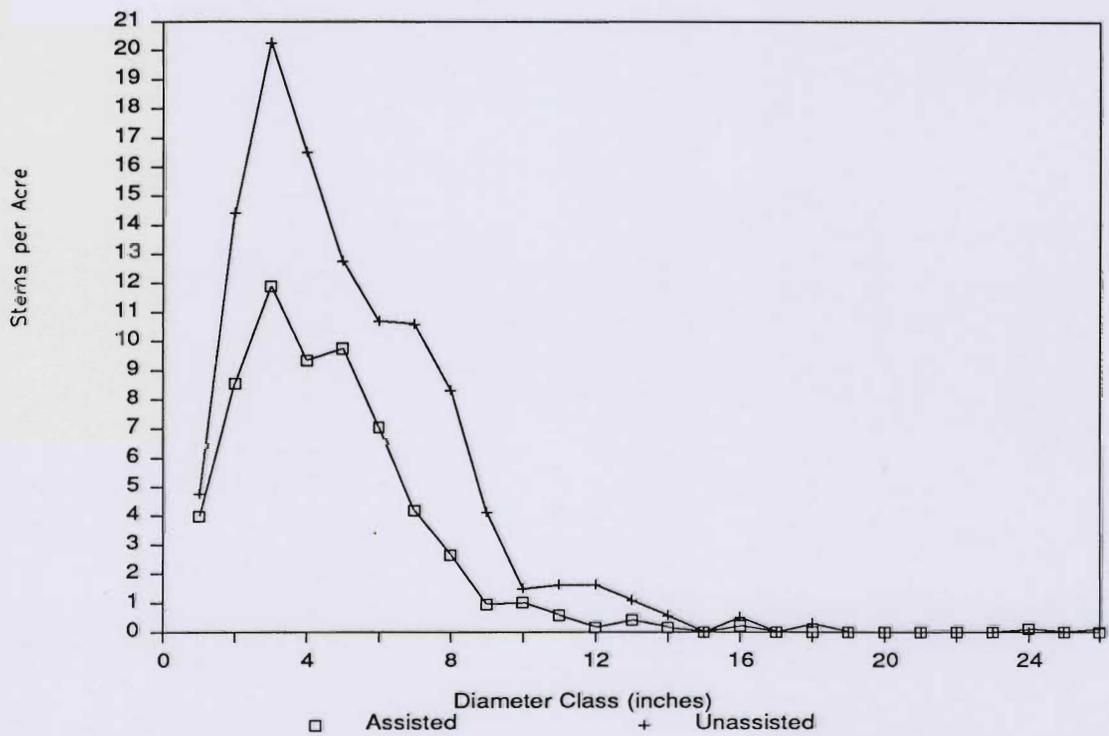


Figure 4. Aspen harvest residual stems—average for all species.

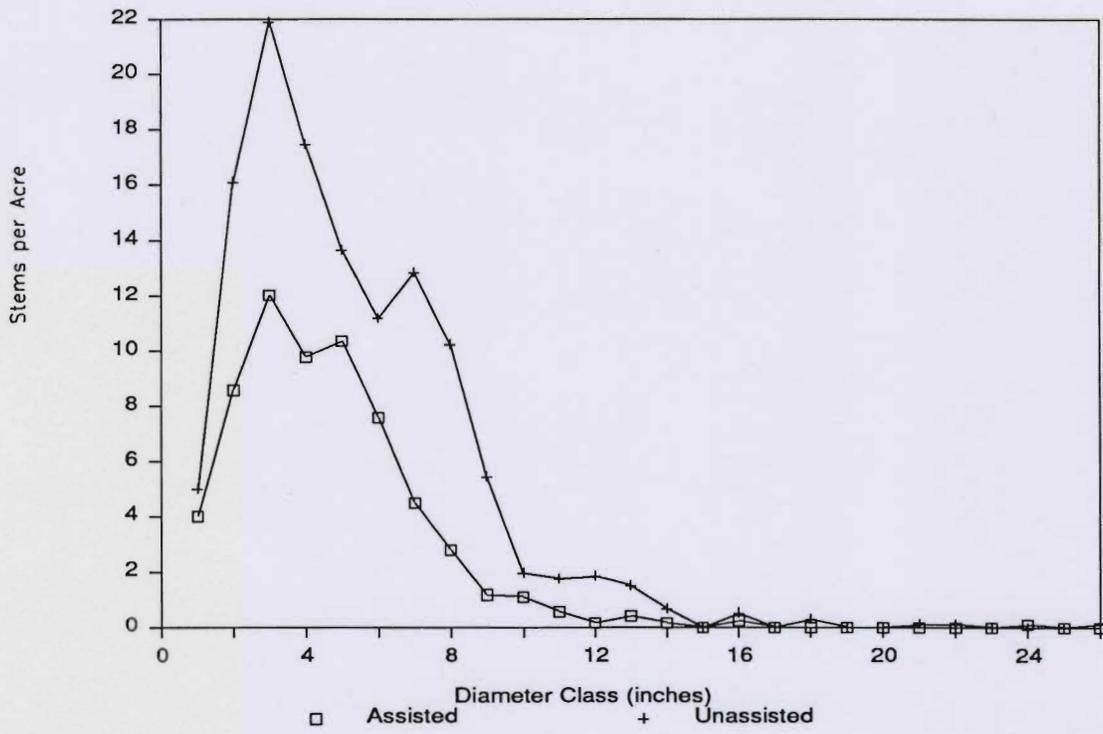


Figure 5. Aspen harvest residual basal area—average for aspen.

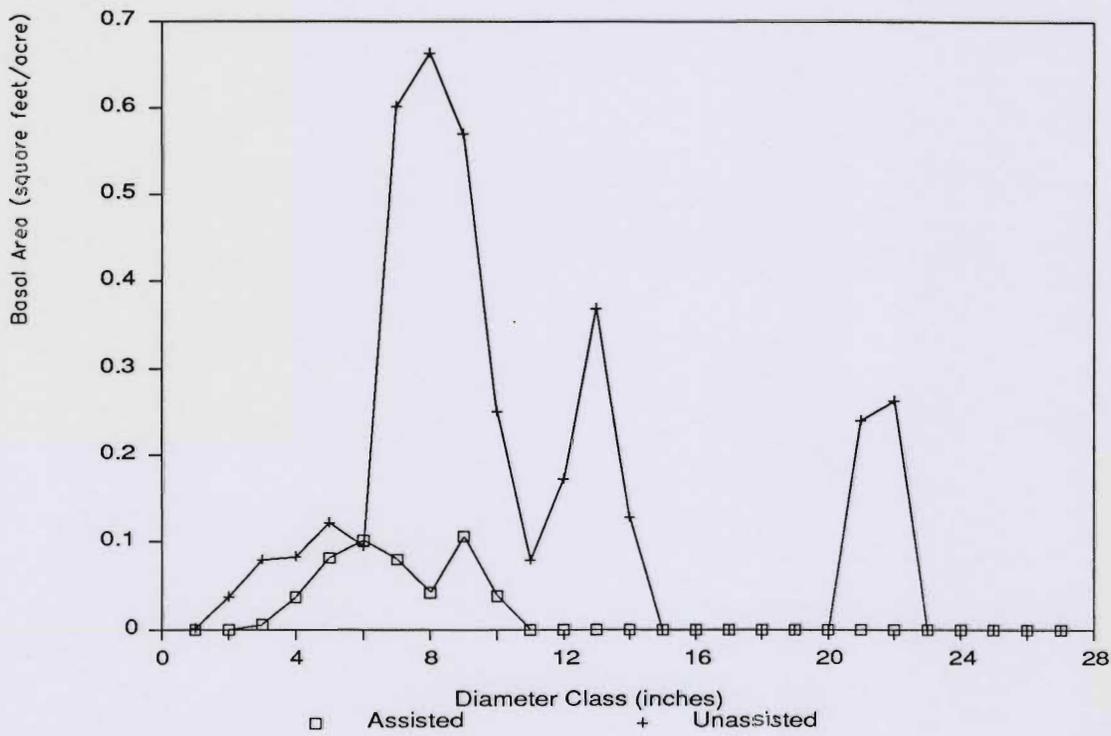


Figure 6. Aspen harvest residual basal area—average for other species.

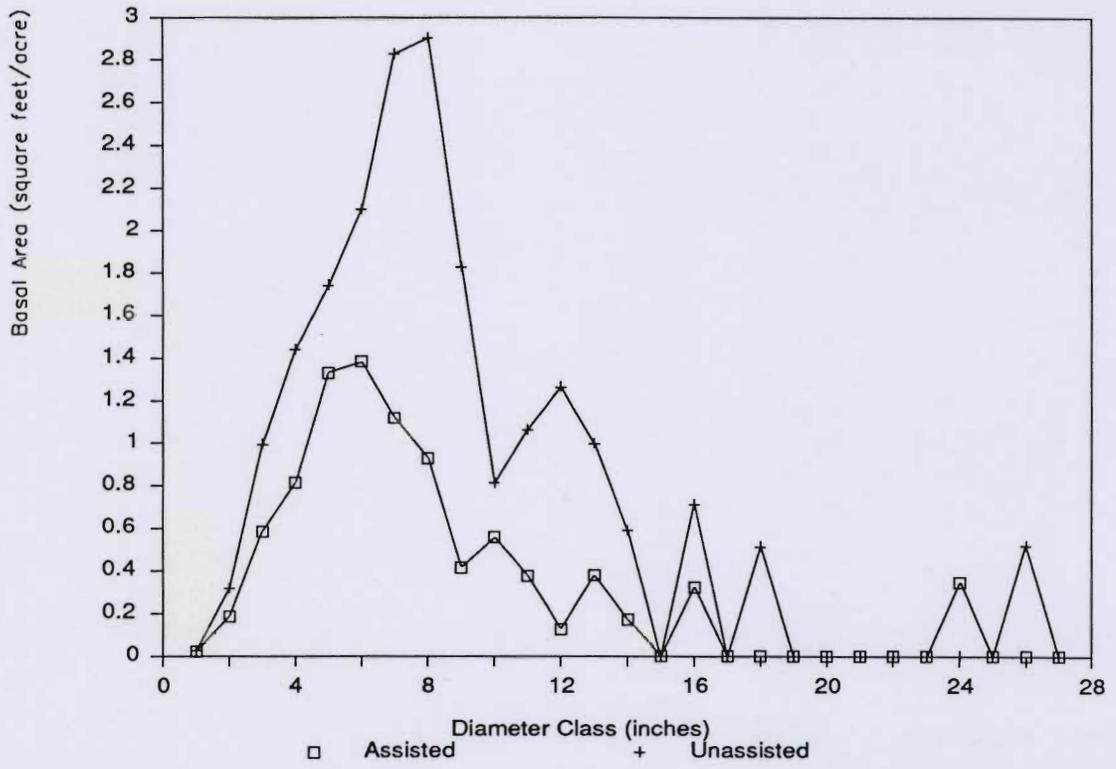
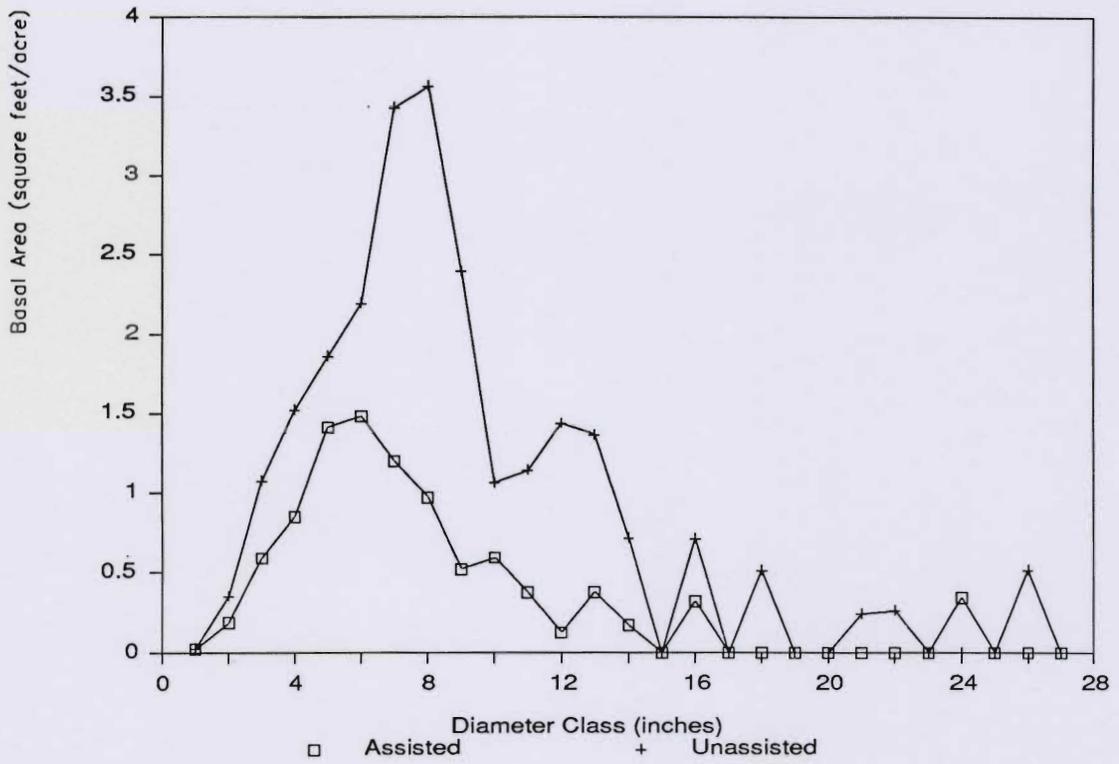


Figure 7. Aspen harvest residual basal area—average for all species.



Operating with the hypothesis that assisted sales will have fewer residual stems per acre, a one-tailed paired t-test is significant ($\alpha=0.10$) for the difference in number of stems per acre for aspen. The test is not significant for other species or all species.

Basal area per acre on assisted aspen sales averaged 0.5 square feet for aspen, 9.1 square feet for other species, and 9.6 square feet total (Table 15). On unassisted sales, basal area per acre averaged 3.8 square feet for aspen, 20.6 square feet for other species, and 24.4 square feet total. Operating with the hypothesis that assisted sales will have less residual basal area per acre, one-tailed paired t-tests show a significant difference ($\alpha=0.10$) between residual basal area levels for aspen, other, and all species.

Perala (1977) notes that an overstory with basal area as low as 10 to 15 square feet per acre will slow aspen sucker growth by 35 to 40 percent. From a silvicultural standpoint, this growth reduction may be of concern on unassisted aspen sales, with their average of 24.4 square feet per acre residual basal area. However, as noted below under "regeneration," this level of residual basal area does not appear to have negatively impacted the number of suckers per acre on the unassisted aspen harvests.

Hardwood Harvests. Assisted hardwood harvests averaged 41.8 desirable, 24.3 acceptable, 61.8 undesirable, and 127.8 total stems per acre (Table 16). On unassisted hardwood sales, there were 124.3 desirable, 50.7 acceptable, 102.7 undesirable, and 277.7 total stems per acre.

Figures 8 through 15 show residual stems and basal area versus diameter class for the four species categories. Residual basal area on

assisted sales was 23.4, 1.7, 5.8, and 31.0 square feet per acre for desirable, acceptable, undesirable, and all species, respectively (Table 16). Residual basal area per acre on unassisted sales was 53.5 square feet for desirable, 3.3 for acceptable, 12.2 for undesirable, and 69.0 for all species. It is not surprising that there is much more residual basal area on unassisted hardwood harvests than on assisted, given the residual volume estimates above.

While assisted hardwood harvests had 40-52 percent fewer stems or less basal area per acre in undesirable species, than unassisted harvests, they also had fewer stems and less basal area per acre in desirable and acceptable species. Thus, consideration of regeneration levels was needed before making conclusions on the quality of the comparative stand structures.

Regeneration

Assuming that assisted harvests receive better professional silvicultural guidance than unassisted harvests, it would be expected that regeneration levels should be higher on assisted harvests. But, that hypothesis is not statistically supported for either aspen regeneration, other species regeneration, or regeneration of all species.

Assisted aspen harvests had average aspen regeneration levels of 9,503 seedlings per acre (Table 17). Unassisted harvests averaged 11,660 aspen seedlings per acre. The 2,157 stems per acre difference, while of some magnitude, was not statistically significant.

Regeneration of species other than aspen showed 957 seedlings per acre on assisted aspen harvests versus a not statistically different 757 on unassisted harvests.

Table 16. Residual stems and basal area on hardwood harvests, by assisted and unassisted sales.

Species	Assisted	Unassisted	Difference
		stems per acre	
desirable	41.8	124.3	-82.5
acceptable	24.3	50.7	-26.4
undesirable	61.8	102.7	-40.9
all	127.8	277.7	-149.9
		basal area per acre (square feet)	
desirable	23.4	53.5	-30.1
acceptable	1.7	3.3	-1.6
undesirable	5.8	12.2	-6.4
all	31.0	69.0	-38.0

Notes: Columns may not sum to totals due to rounding error. See Table 12 for definition of desirable, acceptable, and undesirable species.

Figure 8. Hardwood harvest residual stems —average for desirable species.

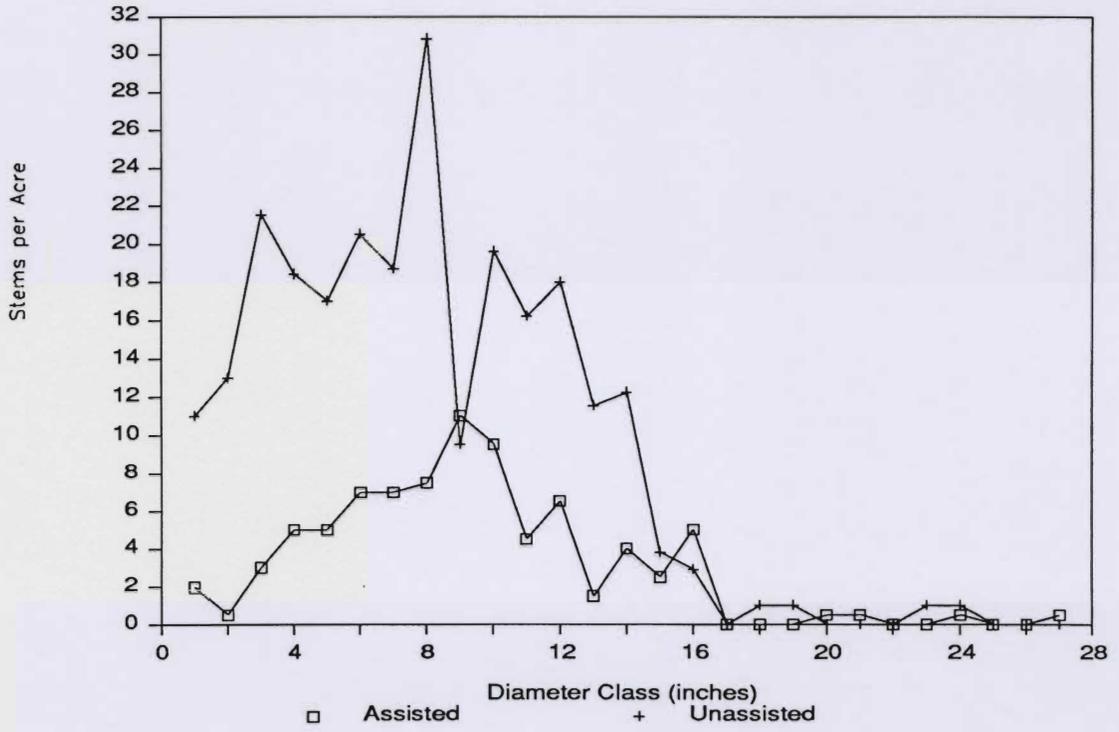


Figure 9. Hardwood harvest residual stems —average for acceptable species.

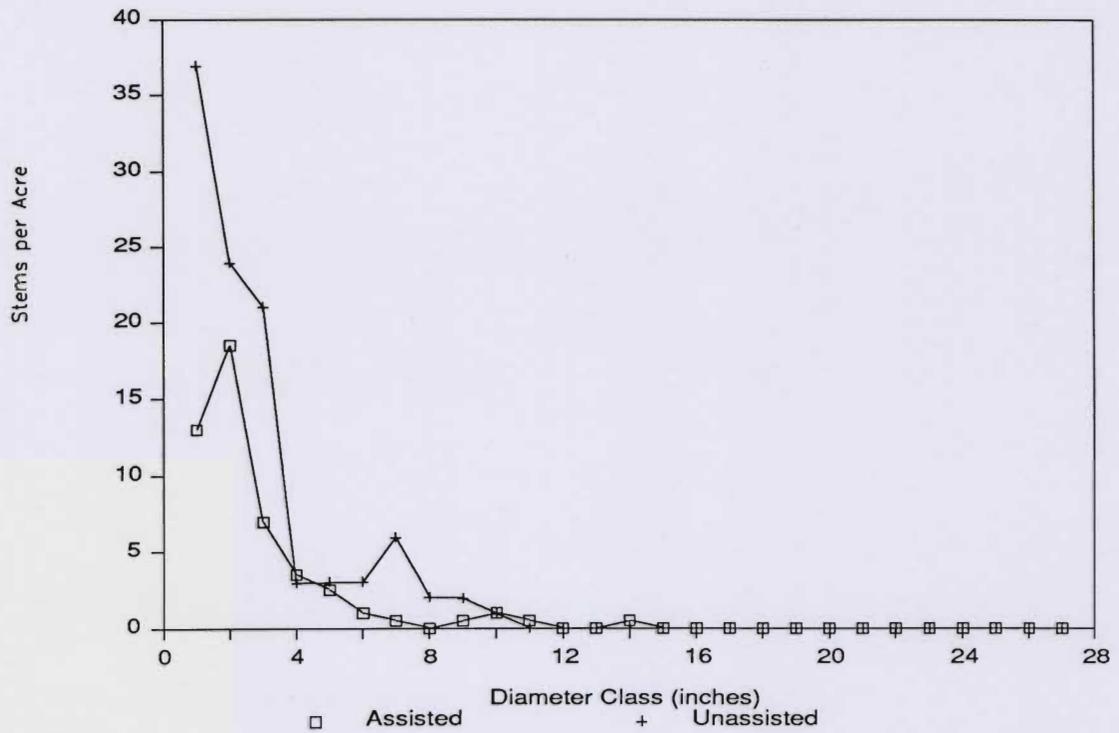


Figure 10. Hardwood harvest residual stems —average for undesirable species.

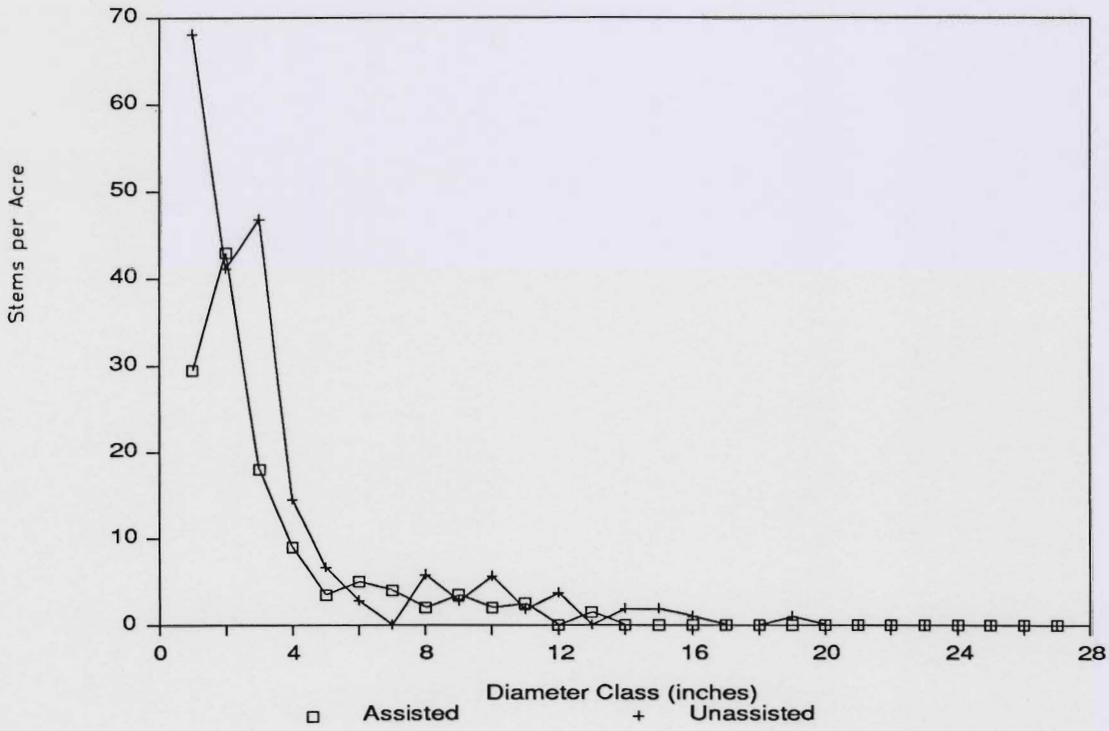


Figure 11. Hardwood harvest residual stems —average for all species.

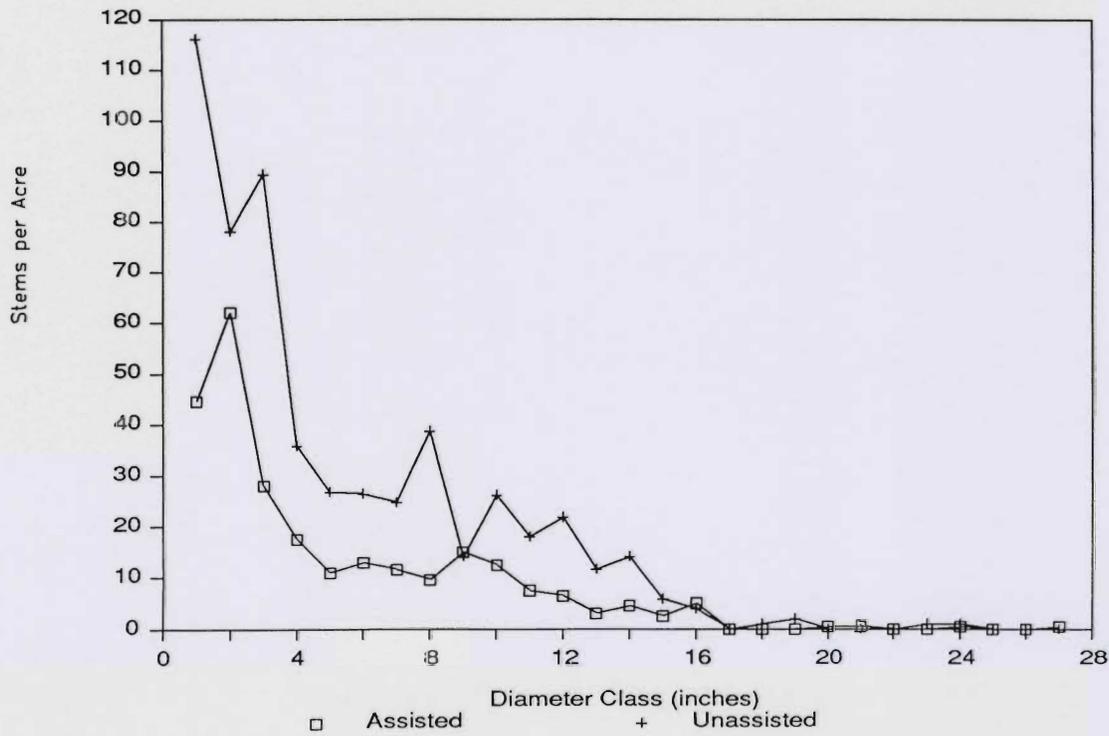


Figure 12. Hardwood harvest residual basal area—average for desirable species.

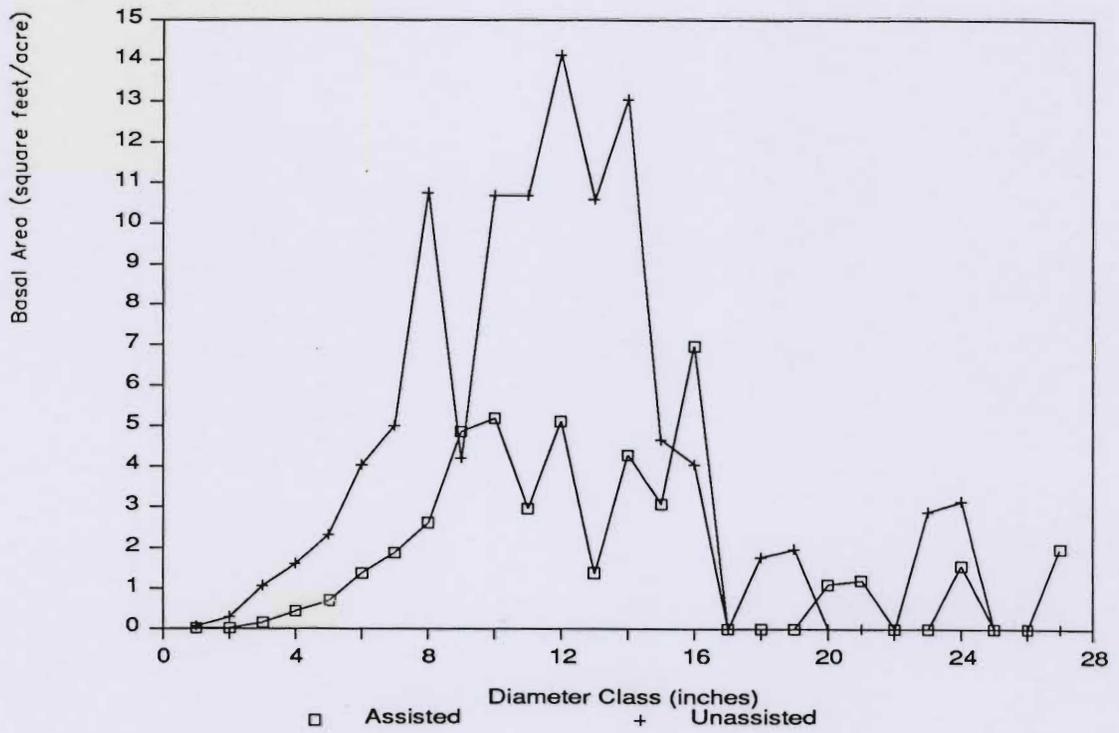


Figure 13. Hardwood harvest residual basal area—average for acceptable species.

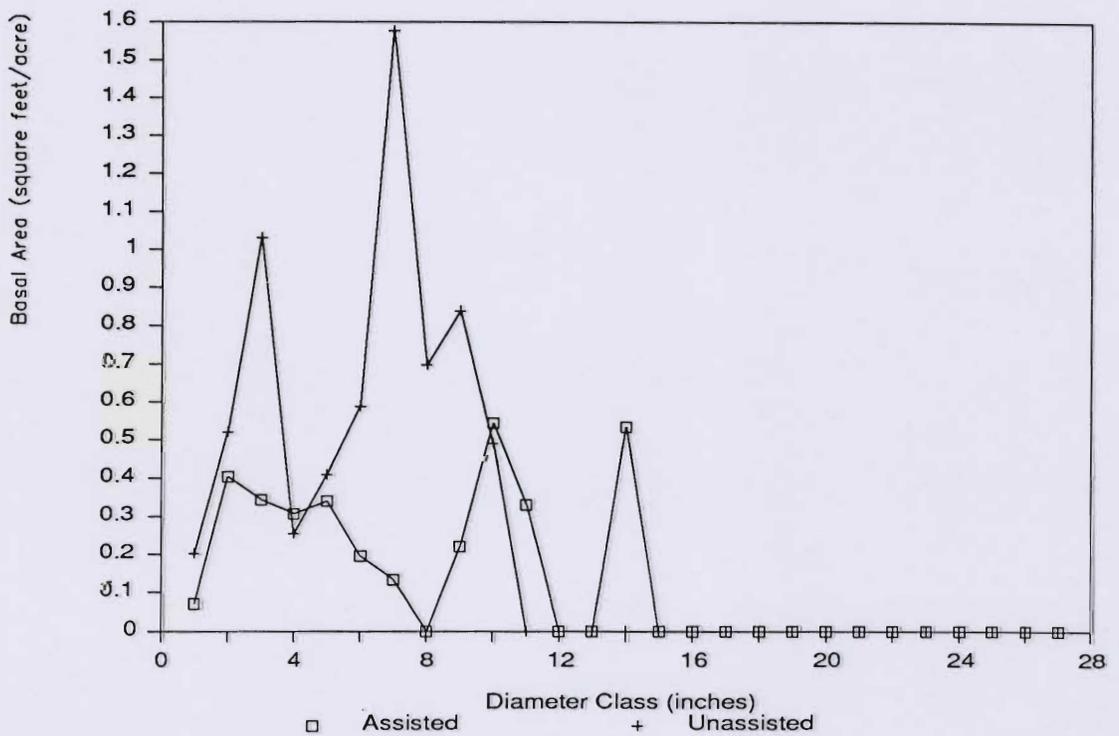


Figure 14. Hardwood harvest residual basal area—average for undesirable species.

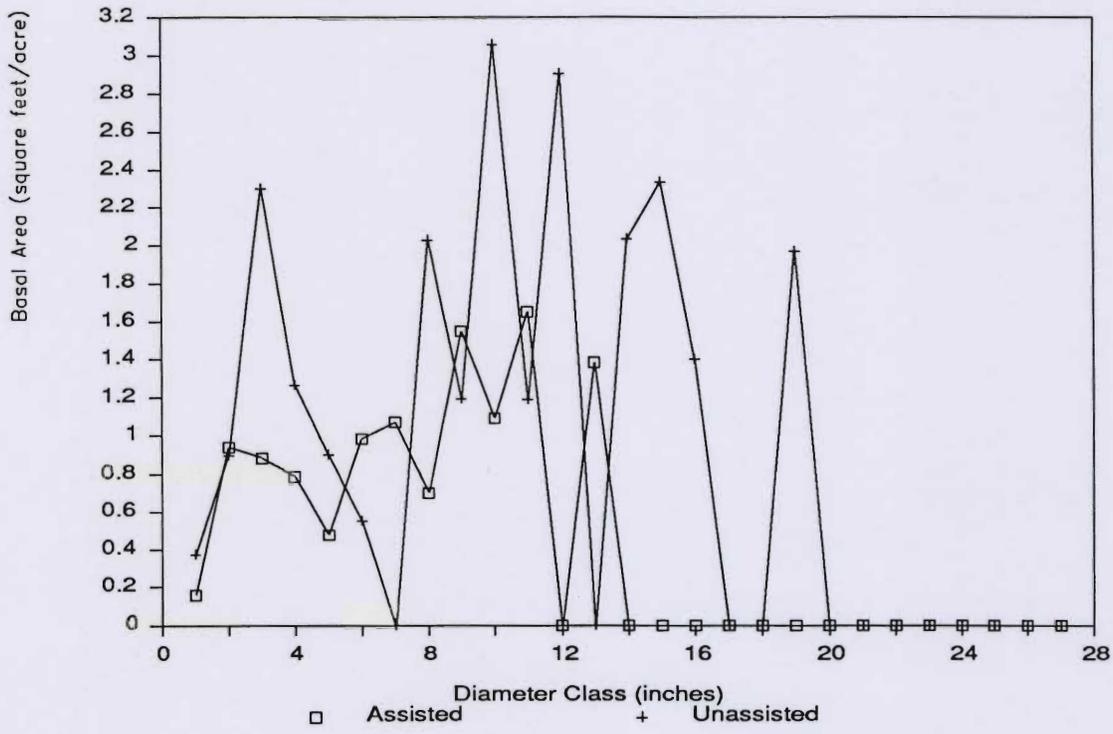
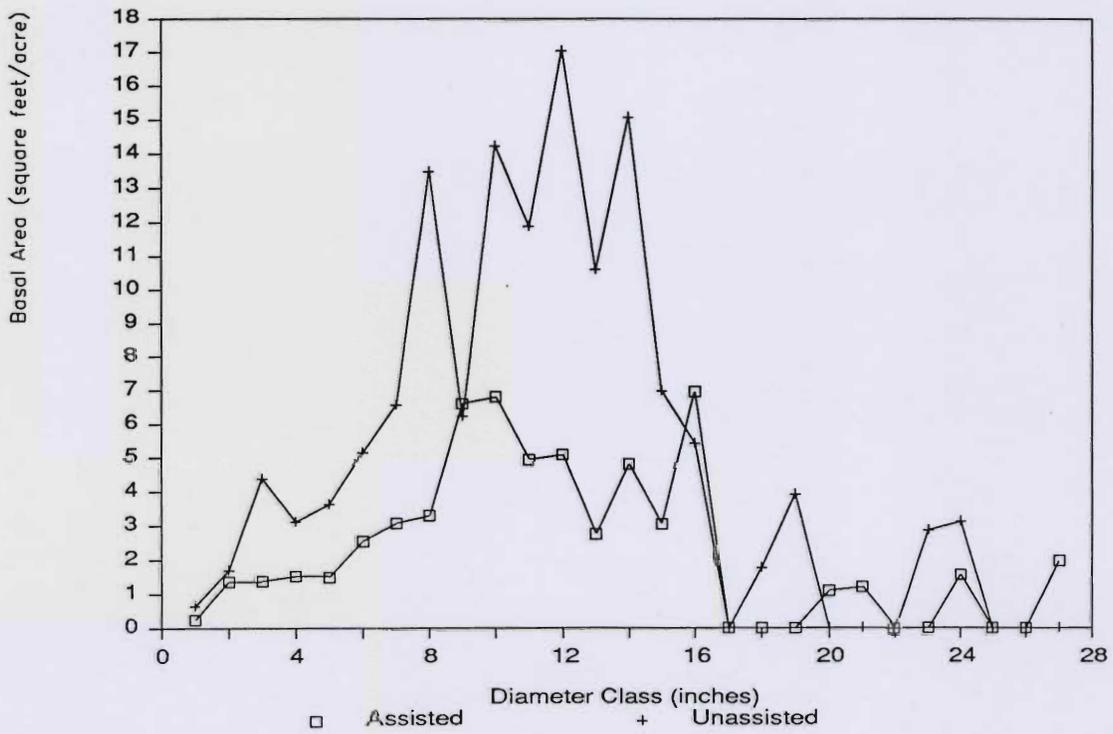


Figure 15. Hardwood harvest residual basal area—average for all species.



Looking at regeneration of all species on aspen harvests, assisted harvests averaged 10,461 seedlings per acre, unassisted harvests 12,417 seedlings per acre. The difference is not statistically significant.

Perala's (1977) concern that residual basal area levels, such as those found on the unassisted aspen harvest, can significantly slow sucker growth do not appear to hold vis-à-vis the number of suckers per acre. It cannot, however, be determined from this study whether their growth rate has been diminished.

Assisted hardwood harvests averaged 525 desirable, 1,188 acceptable and 590 undesirable seedlings per acre (Table 18). Unassisted hardwood harvests averaged 133 desirable, 70 acceptable, and 271 undesirable seedlings per acre. Total number of seedlings per acre was 2,303 on the assisted sales and 473 on the unassisted.

Contributing to the low average regeneration on unassisted sales is that one of the two harvest areas was in use for cattle grazing, a silviculturally disastrous practice. The higher residual basal area levels on the unassisted hardwood harvests would have also led to expectations of lower regeneration levels, since the competition level would be higher.

The greatly higher regeneration levels on assisted hardwood harvests appear to promise better stocked future stands than might be expected for unassisted harvests. However, the higher residual basal area levels on unassisted harvests also point to less need for regeneration in the development of the post harvest stand.

Adverse Site Impacts

Measurements were taken to estimate four types of adverse site impacts: slash cover, soil compaction, bare soil, and soil erosion. Since these factors were comparable across all harvests, regardless of timber type, aspen and hardwood harvests were combined in the assisted versus unassisted harvest comparison for these factors.

For bare soil and soil erosion measures, all sample plots on all harvests were in the lowest measurement category: zero to ten percent of the ground area affected. Clearly, the bare soil and erosion impacts on all harvests, assisted and unassisted, were minimal. Some differences between assisted and unassisted harvests, though not large, were found for slash cover and soil compaction (Table 19).

The site impact measurements taken did not detect any significant differences between assisted and unassisted harvests for the four categories measured. And, worrisome or unacceptable levels of impacts were not found for any of them. Thus, although PFM assistance did not apparently lead to less site impact than on unassisted sales, in neither case can the level of impacts be expected to significantly affect future timber production or multiple use potentials.

LANDOWNER CHARACTERISTICS AND HARVEST RETURN COMPARISONS

Aspen and hardwood harvests were combined in analyzing data gathered from the questionnaires returned by landowners. This aggregation is reasonable since the comparison factors of concern are simply assisted versus unassisted landowners. All but one unassisted landowner returned completed questionnaires. But since some of the appropriate questionnaire responses were known for this landowner from personal conversations and visiting the harvest site, where so known, these responses were tallied. Unknown responses for this landowner were tallied as "no response."

Sample size was too small to allow chi-square tests for response differences between assisted and unassisted landowners. Thus, most results in this section are presented in a descriptive fashion only and the reader is cautioned against drawing overly conclusive inferences.

Landowner Characteristics

Most landowners in the study live on farms or in rural areas: 67 percent of the assisted and 78

Table 17. Average seedlings per acre on aspen harvests, by assisted and unassisted sales.

Species	Assisted	Unassisted	Difference	Significance Level
aspen	9,503	11,660	-2,157	NS
other	957	757	201	NS
all	10,461	12,417	-1,957	NS

Note: Columns may not add up to totals due to rounding error.

percent of the unassisted (Table 20). The remainder in both groups live in a town or city.

Fifty-six percent of the assisted landowners and 22 percent of the unassisted landowners have had at least some college education. This difference appears to bear out findings by other researchers that persons who use forestry assistance programs are better educated than those who do not.

Regarding Minnesota private nonindustrial forest landowners, Carpenter *et al.* (1986) found a clear relationship between landowner education level and use of assistance. Only four percent of landowners with eight or fewer years of education had used some form of public forestry assistance. Among those with nine to 12 years of education, 11 percent had used assistance.

Seventeen percent of those with one to four years of college and 24 percent of those with more than four years of college had made use of public forestry assistance.

Returning to our PFM study data, in 1985 only 11 percent of the assisted, but 44 percent of the unassisted landowners had annual incomes of less than \$10,000. These low income levels in part reflect the retired status of a number of landowners in the study. Thirty-three percent of the assisted and 11 percent of the unassisted landowners were in the middle income range of \$20,000 to \$39,999. Thirty-three percent of each group were in the \$40,000 and above income range.

From the limited income data collected, it appears that assisted owners had a somewhat

Table 18. Average seedlings per acre on hardwood harvests, by assisted and unassisted sales.

Species Category	Assisted	Unassisted	Difference
desirable or acceptable	1,713	203	1,410
desirable	525	133	392
acceptable	1,188	70	1,118
undesirable	590	271	319
Total	2,303	473	1,830

Note: Columns may not sum to totals due to rounding error.

Table 19. Slash cover and soil compaction site, by assisted and unassisted sales.

Impact Class	Slash Cover		Soil Compaction	
	Assisted	Unassisted	Assisted	Unassisted
	average percent of plots in impact class			
1	78.7	78.8	71.8	67.3
2	17.0	19.4	24.2	30.4
3	4.2	1.7	3.4	2.2
4	0.0	0.0	0.6	0.0
5	0.0	0.0	0.0	0.0
Total	99.9	99.9	100.0	99.9

Slash Cover Impact Class Definitions:
 1 = 0-10 % of ground area of plot affected
 2 = 11-25 % of ground area of plot affected
 3 = 26-50 % of ground area of plot affected
 4 = 51-75 % of ground area of plot affected
 5 = 76-100% of ground area of plot affected

Soil Compaction Impact Class Definitions:
 1 = few signs of traffic on plot
 2 = some signs of traffic on plot, no significant ruts
 3 = moderate signs of traffic, ruts less than 3" deep
 4 = large amount of traffic, ruts greater than 3" deep
 5 = heavy traffic on almost all of plot, ruts often greater than 6" deep

Notes: Percentages may not total 100.0 due to rounding error.

higher income level than unassisted landowners. Others have noticed a similar pattern to the use of public forestry assistance programs. However, in their study of Minnesota forest landowners, Carpenter *et al.* (1986) did not find a clear relationship between income and use of forestry assistance, even though owners in the \$20-25,000 and \$40,000 and above income categories had the highest incidence of assistance usage.

Landowners were asked to identify the most important reason for undertaking recent timber harvest activities (Table 20). The vast majority of assisted landowners, 89 percent, harvested because they either felt the timber was mature or that harvest would improve the stand. Only one assisted landowner (11 percent) cited the need for income as the most important decision factor.

Looking at unassisted owners, 44 percent harvested because they thought the timber was mature or that the harvest would improve the remaining stand, 22 percent harvested because they needed the income, and 11 percent because they were offered a good price.

Timber Sales Methods

Landowners were asked a series of questions to determine how they sold their timber (Table 21). How each went about selling timber could have had a significant impact on the results of the sale.

Carefully selecting reputable loggers, using bidding procedures for setting stumpage prices, and having a written contract between the landowner and timber buyer or logger are important steps towards avoiding the problems

Table 20. Characteristics of forest landowners participating in PFM program evaluation.

Questions and Responses	Assisted		Unassisted		Row Total	
	Number	Percent	Number	Percent	Number	Percent
Where do you now live?						
City with population 100,000 or more	0	0.0	1	11.1	1	5.6
City with population 10,000 to 99,999	2	22.2	0	0.0	2	11.1
City/town with population under 10,000	1	11.1	1	11.1	2	11.1
On a farm	3	33.3	5	55.6	8	44.4
Rural area, but not on a farm	3	33.3	2	22.2	5	27.8
No response	0	0.0	0	0.0	0	0.0
Column Total	9	99.9	9	100.0	18	100.0
What is the highest level of education you have completed?						
Did not complete high school	1	11.1	1	11.1	2	11.1
High school graduate	3	33.3	5	55.6	8	44.4
Some college	2	22.2	0	0.0	2	11.1
College graduate or above	3	33.3	2	22.2	5	27.8
No response	0	0.0	1	11.1	1	5.6
Column Total	9	99.9	9	100.0	18	100.0
In which category would you place your total 1985 household income (before taxes)?						
Under \$10,000	1	11.1	4	44.4	5	27.8
\$10,000 to \$19,999	1	11.1	0	0.0	1	5.6
\$20,000 to \$29,999	1	11.1	0	0.0	1	5.6
\$30,000 to \$39,999	2	22.2	1	11.1	3	16.7
\$40,000 to \$49,999	0	0.0	1	11.1	1	5.6
\$49,999 and above	3	33.3	2	22.2	5	27.8
No response	1	11.1	1	11.1	2	11.1
Column Total	9	99.9	9	100.0	18	100.2
What was the most important reason for harvesting timber at the time that you did?						
Felt timber was mature or harvest would improve remaining stand	8	88.8	4	44.4	12	66.7
Wanted to clear land	0	0.0	0	0.0	0	0.0
Was offered a good price	0	0.0	1	11.1	1	5.6
Needed the income	1	11.1	2	22.2	3	16.7
Other	0	0.0	1	11.1	1	5.6
No response	0	0.0	1	11.1	1	5.6
Column Total	9	99.9	9	99.9	18	100.2

Note: Percentages may not total to 100.0 due to rounding error.

Table 21. Timber sales methods employed by forest landowners participants in PFM program evaluation.

Questions and Responses	Assisted		Unassisted		Row Total	
	Number	Percent	Number	Percent	Number	Percent
Who initiated the timber sale?						
Landowner	6	66.6	5	55.6	11	61.6
State service forester suggested it	3	33.3	0	0.0	3	16.7
Consulting forester suggested it	0	0.0	0	0.0	0	0.0
Timber buyer or logger suggested it	0	0.0	2	22.2	2	11.1
Other	0	0.0	1	11.1	1	5.6
No response	0	0.0	1	11.1	1	5.6
Column Total	9	99.9	9	100.0	18	100.1
How did you select a timber buyer?						
Accepted first buyer's offer.	0	0.0	4	44.4	4	22.2
Contacted several buyers independently and negotiated a price	4	44.4	0	0.0	4	22.2
Sold at oral auction to highest bidder	0	0.0	0	0.0	0	0.0
Solicited sealed bids from several buyers	5	55.5	0	0.0	5	27.8
Other	0	0.0	5	55.5	5	27.8
No response	0	0.0	0	0.0	0	0.0
Column Total	9	99.9	9	100.0	18	100.0
Did you have a written timber sale contract with the buyer?						
Yes	8	88.8	3	33.3	11	61.1
No	1	11.1	5	55.6	6	33.3
No response	0	0.0	1	11.1	1	5.6
Column Total	9	99.9	9	100.0	19	100.0
Who mainly determined which tree would be harvested?						
Landowner	1	11.1	6	66.7	7	38.9
State service forester	8	88.8	0	0.0	8	44.4
Industry forester	0	0.0	0	0.0	0	0.0
Consulting forester	0	0.0	0	0.0	0	0.0
Timber buyer or logger	0	0.0	3	33.3	3	16.7
Other	0	0.0	0	0.0	0	0.0
No response	0	0.0	0	0.0	0	0.0
Column Total	9	99.9	9	100.0	18	100.0
What unit(s) of measure was (were) used to determine the volume of wood sold?						
Board feet	2	18.2	2	18.2	4	18.2
Ties	2	18.2	2	18.2	4	18.2
Cords	6	54.5	5	45.5	11	50.0
Weight	1	9.1	2	18.2	3	13.6
All timber within a designated area	0	0.0	0	0.0	0	0.0
No response	0	0.0	0	0.0	0	0.0
Column Total	11	100.0	11	100.1	22	100.0
Who determined the volume of wood in the sale?						
Landowner	0	0.0	0	0.0	0	0.0
State service forester	8	88.8	0	0.0	8	44.4
Industry forester	0	0.0	0	0.0	0	0.0
Consulting forester	0	0.0	0	0.0	0	0.0
Timber buyer or logger	1	11.1	7	77.8	8	44.4
Other	0	0.0	2	22.2	2	11.1
No response	0	0.0	0	0.0	0	0.0
Column Total	9	99.9	9	100.0	18	99.9
Which of the following best describes how you reforested or plan to reforest the tract?						
Planted seedlings, tubelings, potted trees, or seeds	2	22.2	0	0.0	2	11.1
Natural regeneration from seed or seedlings already on the tract before harvest	3	33.3	2	22.2	5	27.8
Natural regeneration from root suckers, stump sprouts, or seed produced by trees left on the tract or nearby	4	44.4	6	66.7	10	55.6
Performed a partial cut, so no reforestation needed	0	0.0	1	11.1	1	5.6
None planned; land to be converted	0	0.0	0	0.0	0	0.0
No response	0	0.0	0	0.0	0	0.0
Column Total	9	99.9	9	100.0	18	100.1

Note: Percentages may not total 100.0 due to rounding error.

that often plague nonindustrial private timber harvests (Kelley 1987).

In the majority of both assisted and unassisted sales, harvests were initiated by the landowner. Landowners initiated 67 percent of assisted sales and 56 percent of the unassisted sales. Service foresters suggested 33 percent of the assisted sales. Unassisted harvests were suggested by loggers or timber buyers 22 percent of the time.

Assisted and unassisted landowners differed greatly in how they selected a timber buyer or logger and set the stumpage price. Assisted landowners selected a buyer or logger by contacting several and negotiating a price in 44 percent of the cases. The other 56 percent of assisted sales selected buyers by soliciting sealed bids.

Of unassisted landowners, 44 percent simply accepted the first buyer's stumpage price offer. The remaining 56 percent used "other" selection methods, such as using a known, honest logger; a friend (two cases); or the same logger as had recently harvested a relative's land.

Considering the difficulty a landowner who only occasionally harvests timber has, in keeping informed of current market stumpage prices, the use of some form of a bidding or negotiating process for selling timber should be highly encouraged.

Assisted landowners had a written contract with their timber buyer or logger in 89 percent of the cases. Only 33 percent of unassisted landowners had written contracts.

Written timber sale contracts are important documents for the specification of stumpage payments and harvest procedures. However, a signed harvest contract is no guarantee of logger performance. This is well illustrated by two landowners in this study who did not receive full stumpage payments from their loggers, despite written contracts. The relatively low value of many Minnesota timber harvests, high legal and court costs, and the highly leveraged financial position of most loggers make it very difficult for landowners to collect unpaid stumpage fees, whether they have a written contract or not.

Selection of trees to be harvested being an important step in the silvicultural management of a timber stand, professional forestry input at that point has been important, especially on hardwood sales. Trees to be harvested were determined by a state PFM forester on 89

percent of the assisted sales, with the landowner making the determination for the rest. On unassisted sales, trees to be harvested were determined by the landowner 67 percent of the time, and by the logger or timber buyer in the remaining 33 percent of cases.

Measurement of the quantity of wood harvested on aspen sales was made in cords for 86 percent of the assisted and 71 percent of the unassisted sales. The remaining quantity determinations, 14 percent assisted and 29 percent unassisted, were made by weight. For all hardwood sales, volume determinations were based both on board feet and number of tie cuts. A tie cut is roughly equivalent to 40 board feet.

In 89 percent of assisted harvests, volume of timber sold was determined by the state service forester based either on a cruise estimate or scaling measurement. One assisted case (11 percent) had the timber volume determined by the logger or timber buyer.

Seventy-eight percent of the unassisted sale volume determinations were made by the buyer or logger. The consumer (e.g., the mill that purchased the cut and delivered timber) determined the volume in 22 percent of the unassisted sales.

Landowners were asked to describe how they planned to reforest the harvested tract (Table 21). Most said they were depending on natural regeneration of one form or another. This is not surprising, given the prolific suckering regeneration behavior of aspen, which harvests comprised the bulk of sales examined in the study.

Harvest Returns

Harvest return comparisons are based on the price landowners were offered for their timber, where known. Analysis problems arise since three landowners (two assisted and one unassisted) were paid only partially or not at all for their timber. Both of the assisted landowners had written contracts with their loggers. The unassisted owner did not.

Among these three landowners, the aspen bid price was provided by only one, an assisted owner who received only partial payment for his timber. This is taken to be a "good faith" bid price, despite the logger's failure to pay in full, since a contract was signed and an advance payment of one-third of the sale price received by the landowner. Thus, the aspen bid price from this latter sale was used in making harvest return comparisons.

Average stumpage prices were calculated for aspen only. An attempt was made to calculate a weighted average price for the combined "other" (nonaspen) species harvested, but available price information was considered too weak and species mixes too variable for this figure to be meaningful.

Complete bid price information was available for four of the seven aspen harvest pairs. One-tailed t-tests were made with the hypothesis that assisted sales, because of their more frequent use of a competitive sale procedure (i.e., sealed bids or price negotiation) as a result of service forestry advice, would likely receive higher stumpage prices than unassisted sales.

Both paired and unpaired t-tests were used, a paired test to compare the difference between the four pairs for which complete sale price information was available, and an unpaired test to compare the difference between the means for all harvests for which the aspen bid price was available.

The average aspen bid price on assisted sales was \$4.66 per cord, with the range between \$3.00 and \$6.11 per cord. The average bid on unassisted aspen sales was \$3.32; the range \$2.50 to \$4.00.

The paired, one-tailed t-test difference of \$1.35 per cord was significant at $\alpha=0.10$. The unpaired, one-tailed t-test difference of \$1.35 per cord was significant at $\alpha=0.05$. The conclusion,

then, was that service forester assistance does result in higher stumpage prices for the landowner selling aspen.

On the hardwood harvests, the primary species cut was red oak. Red oak veneer prices on assisted sales averaged \$405 per thousand board feet. Red oak tie cuts averaged \$2.95 per tie or about \$74 per thousand board feet. On unassisted sales, red oak veneer prices averaged \$325 per thousand board feet, and tie cuts averaged \$3.75 per tie or about \$94 per thousand board feet.

Satisfaction with Harvest

Landowners were asked several questions about their satisfaction with their timber harvests (Table 22). Among assisted landowners, 78 percent were moderately satisfied with the price received, versus 22 percent who expressed a low degree of satisfaction. Among unassisted owners, 22 percent expressed high satisfaction with the price received, 33 percent moderate satisfaction, and 22 percent low satisfaction. Despite having received less money for their timber, on average, than assisted landowners, unassisted landowners did not appear to be less satisfied with their timber receipts.

Assisted landowners appear to be less satisfied than unassisted owners with the condition of their timber stand after harvest. Assisted landowners were moderately satisfied 78 percent of the time and had a low level of

Table 22. Timber harvest satisfaction of forest landowners participating in PFM program evaluation.

Questions and Responses	Assisted		Unassisted		Row Total	
	Number	Percent	Number	Percent	Number	Percent
What was your level of satisfaction with the price received?						
High	0	0.0	2	22.2	2	11.1
Moderate	7	77.7	3	33.3	10	55.6
Low	2	22.2	2	22.2	4	22.2
No response	0	0.0	2	22.2	2	11.1
Column Total	9	99.9	9	99.9	18	100.0
What was your level of satisfaction with the condition of your timber stand after harvest?						
High	0	0.0	2	22.2	2	11.1
Moderate	7	77.7	5	55.6	12	66.7
Low	2	22.2	1	11.1	3	16.7
No response	0	0.0	1	11.1	1	5.6
Column Total	9	99.9	9	100.0	18	100.0
What problems, if any, did you have with your timber sale?						
Some problems	5	55.5	4	44.4	9	50.0
No problems	4	44.4	4	44.4	8	44.4
No response	0	0.0	1	11.1	1	5.6
Column Total	9	99.9	9	99.9	18	100.0

Note: Percentages may not total 100.0 due to rounding error.

satisfaction 22 percent of the time. Unassisted landowners were highly satisfied 22 percent of the time, moderately satisfied 56 percent of the time, and had a low degree of satisfaction 11 percent of the time.

Landowners were asked whether any problems arose during their timber sale. Fifty-six percent of assisted landowners and 44 percent of unassisted landowners reported having some sort of problem with their timber sale.

Problems described for assisted sales included:

- Did not get full payment from logger.
- Logger hauled logs across field after told to use woods road.
- Logger knocked out fence.
- Logger did not pay for timber harvested.
- Had to rely on logger's honesty in scaling logs at landing.
- Logging road was not usable by normal vehicles after sale.

Problems described for unassisted sales included:

- Logger never cleaned and leveled property as he had agreed (note: no written contract). Trails were filled with deep ruts.
- Did not get paid for timber harvested.
- Standing trees were left. Logger was called back to fell them (and he did so).
- Logger became ill and left several walnut trees unharvested. Farm was sold with trees still on property.

While the unassisted landowners may have been somewhat more satisfied overall with their timber harvests, both they and assisted landowners encountered problems in their sales. The listing of landowner complaints clearly put blame for the problems on the loggers.

Landowner complaints about such problems are certainly not new and, in some cases, have led states to regulate loggers (Banzhaf 1980).

Public Forestry Program Awareness

Similar to what Carpenter *et al.* (1986) found, landowners had only limited awareness of the availability of forestry assistance (Table 23). As would be expected, all of the assisted owners were aware of it. And among unassisted landowners, 56 percent said they were aware of the availability of state assistance.

Limited forest management assistance from the forest industry has been available only in certain areas of the state. Not surprisingly, landowner awareness of this assistance was fairly low. Only 22 percent of assisted and 44 percent of unassisted landowners were aware that it was available. The levels of awareness of private forestry consultant assistance were similar.

Low awareness of private consultant services among assisted landowners (22 percent) is surprising, considering the Division of Forestry's consultant referral policy. As described earlier, this policy requires both that state service foresters inform landowners of the availability of consultant timber sale services and that timber sale assistance be delayed 30 days, during which time consultants have the opportunity to contact landowners and offer their services. Either Minnesota's PFM foresters are not clearly getting the message across to landowners, vis-à-vis the availability of private consultant services, or the respondents did not understand the question.

The latter is possible. A third of the assisted landowners did not respond to this particular question. Among those responding, twice as many stated they were not aware of consultant services as expressed awareness.

Landowners who were aware of the availability of the several forms of forestry assistance, but did not make use of them, were asked why they didn't. Unassisted landowners primarily responded to this section. Various reasons given for not using assistance.

State assistance (unassisted landowners):

- Do not like their attitudes or methods. I wish to control my own forest and get paid for every cord cut and preserve food and cover for wildlife. The price is low because the state offers vast amounts of timber at give away prices.
- Do not need it.
- Small amount of timber harvested and did not think help necessary.
- State cannot totally supervise sale and harvest of timber.
- Farm had been scanned by state forester when previous owner had farm.

Forest industry assistance (unassisted landowner):

- Satisfied with state forester. (Note: same unassisted landowner that stated farm

Table 23. Awareness and use of public forestry programs by forest landowners participating in PFM program evaluation.

Questions and Responses	Assisted		Unassisted		Row Total	
	Number	Percent	Number	Percent	Number	Percent
Where you aware that it was possible to receive harvest assistance from:						
a. The state						
Yes	9	100.0	5	55.6	14	77.8
No	0	0.0	3	33.3	3	16.7
No response	0	0.0	1	11.1	1	5.6
Column Total	9	100.0	9	99.9	18	100.1
b. Forest industry						
Yes	2	22.2	4	44.4	6	33.3
No	4	44.4	4	44.4	8	44.4
No response	3	33.3	1	11.1	4	22.2
Column Total	9	99.9	9	99.9	18	99.9
c. Private forestry consultants						
Yes	2	22.2	4	44.4	6	33.3
No	4	44.4	4	44.4	8	44.4
No response	3	33.3	1	11.1	4	22.2
Column Total	9	99.9	9	99.9	18	99.9
Which of the following forestry tax, incentive, and educational programs have you used?						
a. Capital gains tax treatment of timber sale income						
Yes	4	44.4	2	22.2	6	33.3
No	4	44.4	6	66.7	10	55.6
No response	1	11.1	1	11.1	2	11.1
Column Total	9	99.9	9	100.0	18	100.0
b. Deduct original cost of buying timber from timber sale income, for tax purposes						
Yes	1	11.1	1	11.1	2	11.1
No	4	44.4	7	77.8	11	61.1
No response	4	44.4	1	11.1	5	27.8
Column Total	9	99.9	9	100.0	18	100.0
c. Deduct woodland maintenance costs from income, for tax purposes						
Yes	2	22.2	1	11.1	3	16.7
No	3	33.3	7	77.8	10	55.6
No response	4	44.4	1	11.1	5	27.8
Column Total	9	99.9	9	100.0	18	100.1
d. Amortize tree planting costs, for tax purposes						
Yes	1	11.1	0	0.0	1	5.6
No	3	33.3	8	89.9	11	61.1
No response	5	55.5	1	11.1	6	33.3
Column Total	9	99.9	9	100.0	18	100.0
e. Tax treatment of timber sale income, acquisition costs, or management practice costs (combines questions a through d, immediately above)						
Yes	5	55.6	3	33.3	8	44.4
No	2	22.2	5	55.6	7	38.9
No response	2	22.2	1	11.1	3	16.7
Column Total	9	100.0	9	100.0	18	100.0
f. Cost-sharing for tree planting or timber stand improvement						
Yes	2	22.2	0	0.0	2	11.1
No	3	33.3	8	88.9	11	61.1
No response	4	44.4	1	11.1	5	27.8
Column Total	9	99.9	9	100.0	18	100.0
g. Publications, tours, workshops, or conferences sponsored by the Minnesota Extension Service or Minnesota Department of Natural Resources						
Yes	1	11.1	0	0.0	1	5.6
No	4	44.4	8	89.9	12	66.7
No response	4	44.4	1	11.1	5	27.8
Column total	9	99.9	9	100.0	18	100.1

Note: Percentages may not total to 100.0 due to rounding error.

had been scanned by state forester when previous owner held it.)

Private consultant assistance (assisted landowner):

- Poor experience in the past.

Private consultant assistance (unassisted landowner):

- Lack of trust.
- Cost.

Questions about landowners' use of the various federal tax provisions related to forest management income and expenses seemed to confuse a number of the study participants, perhaps indicating that their knowledge and understanding of such provisions is quite limited. The large number of nonresponses indicates either unfamiliarity with the information or confusion with the questions.

Capital gains treatment of timber sales income was the most used tax provision. It was used by 44 percent of assisted landowners and 22 percent of unassisted owners. Forty-four percent of assisted owners and 67 percent of unassisted owners said they did not take advantage of this tax break.

Of course, use of capital gains treatment assumes that timber sale income was declared by the landowner when filing his or her taxes.

Some landowners may leave such income undeclared, and thus not make use of any timber management tax provisions.

Landowner use of tax provisions such as amortizing tree planting costs or deducting the original timber purchase and management costs from timber sale income is quite limited. Combining responses to all four questions on use of forest management tax provisions indicates that 56 percent of assisted landowners and 33 percent of unassisted landowners make use of at least one of the provisions. That equals only 44 percent of all landowners in the study. Apparently, there is a great need for educating forest landowners about tax provisions and the record keeping necessary when using them.

Among assisted landowners, only 22 percent had ever received any cost-sharing incentives for tree planting or timber stand improvement. No unassisted landowner had received cost-sharing assistance. Forest landowners in the study also made little use (only 11 percent) of forestry education publications, tours, workshops, or conferences sponsored by the Division of Forestry or the Minnesota Extension Service.

Caution is again advised against drawing hard and fast conclusions from this section's data. Due to the small size of the sample, response percentages presented should be viewed more as qualitative indicators than as precise quantitative measures.

Minnesota's Private Forest Management Program: Assessment and Recommendations

The goal of the PFM is "...to improve multiple-use forest resource management on non-industrial private forest lands to benefit the landowners, economy, and environment of Minnesota," (Minnesota Division of Forestry 1985b) in a manner that is "...cost effective to the Division, consistent with Department policies and complementary of [sic] other governmental and private efforts," (Minnesota Division of Forestry 1987).

Though the Division of Forestry stresses the multiple-use nature of the goals of the PFM, this evaluation focuses on timber production concerns. This is partly a result of the difficulty of identifying and evaluating non-timber forest land outputs. Further, despite the PFM's multiple-use goal statement, an interest in timber production

(or at least immediate returns from the harvest of an already-mature stand of timber) is in many cases the factor triggering landowner requests for PFM assistance.

PHYSICAL RESOURCE AND SILVICULTURAL CONSIDERATIONS

ASPEN HARVESTS

Summarized in Table 24 are the key physical comparisons made for the aspen harvests. Most of the factors showed no significant difference between assisted and unassisted sales, indicating that service forester assistance, or lack of same, had little effect on a number of

important harvest outcomes. Several of these factors were largely or totally independent of harvesting operations: harvest size, site index, and initial aspen volume.

Considering the simplicity of aspen silviculture--in a word, clearcut the site and leave it to regenerate via root suckering--the lack of differences among many of the other factors (e.g., aspen harvest and residual volumes and aspen regeneration levels) is not surprising. Where forester involvement is more likely to make a difference (e.g., minimizing residual basal area to maximize root suckering) significant differences are observed.

Service forester assistance made a difference in residual basal area level, but it apparently did not make enough of a difference to produce significantly better root sucker regeneration on the assisted harvests. Thus, study results indicate that service forester assistance made no significant difference in the silvicultural outcomes of the aspen harvests sampled.

HARDWOOD HARVESTS

Silvicultural outcomes on assisted hardwood harvests appear somewhat more positive than those on unassisted hardwood harvests. However, no firm conclusions should be drawn from these appearances, given the limited sample size.

The recommended silvicultural practice for producing high quality oak sawtimber and veneer trees in southeastern Minnesota, where adequate advanced regeneration is established, is even-aged management (Sander 1977). Clear-cutting is recommended, with the removal of all trees greater than two-inches in diameter at breast height.

One of the assisted hardwood harvests was a clear-cut. The other hardwood harvests were partial cuts.

Average residual basal area on assisted hardwood harvests is less than a third of that on unassisted harvests. Also, average regeneration levels of desirable and acceptable species are almost eight times higher on the assisted harvests. These figures may indicate that the assisted harvests have the potential to develop into better timber stands in the future than do unassisted harvests. However, all of the harvests, with the exception of the assisted clearcut hardwood harvest, are in need of further timber stand improvement cuttings.

Results from the small sample of hardwood harvests indicate that service forester assistance may lead to silviculturally more desirable post-harvest stand conditions. Certainly, with the silviculturally more difficult management of hardwoods (vis-à-vis aspen), there is much more potential for professional forester assistance to make a difference in the timber production potentials of the post-harvest timber stand. This is particularly so where, for whatever reason (e.g., landowner preference), a partial cut is favored over a clearcut.

SITE IMPACTS

The site impact measurements for slash cover, soil compaction, bare soil, and soil erosion did not detect any significant differences between assisted and unassisted harvests (both aspen and hardwood) for these factors. Nor were site impacts found to be at worrisome or unacceptable levels. Thus, service forester assistance was found to make no difference in these site impact factors.

ECONOMIC CONSIDERATIONS

LANDOWNER BENEFITS OF ASSISTANCE

The major leverage point in analyzing economic benefits of aspen harvest assistance would be

Table 24. Summary of key physical comparisons for assisted and unassisted aspen harvests.

Factor Compared	Average Assisted	Average Unassisted	Unit	Significance
harvest size	14.6	12.0	acres	NS
site index	67.0	63.0	feet ₅₀	0.10
aspen harvest volume	16.7	19.8	cords/acre	NS
residual aspen volume	0.1	0.7	cords/acre	NS
initial aspen volume	16.8	20.9	cords/acre	NS
merchantable aspen waste	0.8	0.5	cords/acre	NS
residual aspen stems	2.4	12.8	stems/acre	0.10
residual aspen basal area	0.5	3.8	feet ² /acre	0.10
other residual basal area	9.1	20.6	feet ² /acre	0.10
aspen regeneration	9,503.0	11,660.0	suckers/acre	NS

the significant difference found between aspen stumpage prices received by assisted and unassisted landowners. Unfortunately, the study could not determine price differences for other species harvested, due to the lack of available information and the variability of those species. But, generally, only small volumes of these species were involved in the harvests and their stumpage prices were lower than those for aspen. Thus, any differences would likely have been quite small.

Economic analysis of multiple use benefits provided by service forester assistance were outside the scope of this study. While such benefits are difficult both to quantify and place a value on, no difference in such benefits (e.g., wildlife habitat, aesthetic appearance, watershed impacts) was noted between assisted and unassisted aspen harvests.

An average difference of \$1.35 per cord was found at mean aspen stumpage prices of \$4.66 per cord on assisted harvests and \$3.32 per acre on unassisted harvests. Thus, on the average 16.7-cord-per-acre assisted aspen harvest, service forester assistance provided landowners a value of \$22.55 per acre.

Total gross value provided to landowners by service forester assistance on the average 14.6-

acre assisted aspen harvest was \$329.16. Subtracting the \$25.00⁸ cruising fee all assisted landowners paid to the Division of Forestry, the net pretax value of assistance to the average assisted aspen harvester was \$304.16, or \$20.83 per acre (Table 25).

The median income bracket for assisted landowners was \$30,000 to \$40,000 per year. Given this income level, and recognizing that not all assisted landowners made use of capital gains income treatment and subtraction of woodland management costs from receipts, landowners (who actually declared their timber income on their tax returns) on average paid taxes on harvest income at estimated marginal rates of 15 percent to the federal government and 7 percent to the state (Bureau of the Census 1987). Thus, tax returns to the federal treasury averaged \$45.62 per aspen harvest or \$3.12 per acre. Tax returns to the state treasury averaged \$21.29 per aspen harvest or \$1.46 per acre.

⁸The analysis here was done on the basis of the timber sale assistance fees in effect at the time these sales were conducted. Had the current five percent of gross stumpage value fee been in effect, the average assisted landowner would have paid the state a total of \$56.81, or \$31.81 more than under the previous fee schedule.

Table 25. Landowner, state, public, and federal costs and returns from PFM assistance on the average assisted aspen sale.

	Total	Per Acre
Landowner		
Gross incremental landowner returns	\$329.16	\$22.55
less \$25 state timber cruising fee	(25.00)	(1.72)
Pretax landowner returns	304.16	20.83
less federal income tax (15%)	(45.62)	(3.12)
less state income tax (7%)	(21.29)	(1.46)
Net incremental landowner returns	237.25	16.25
State and Public		
Gross cost of harvest providing assistance	\$379.60	\$26.00
less \$25 state timber cruising fee	(25.00)	(1.72)
less state income tax receipts	(21.29)	(1.46)
less federal program funding	(15.64)	(1.07)
Net state costs	317.67	21.75
Federal Government		
Federal portion of harvest assistance costs	\$ 15.64	\$ 1.07
less federal income tax receipts	(45.62)	(3.12)
Net federal receipts	29.98	2.05
State and Federal Governments		
Gross cost of providing harvest assistance	379.60	26.00
less state revenues — timber cruising fee (\$25.00)	(25.00)	(1.72)
— state income tax receipts	(21.29)	(1.46)
less federal revenues — federal income tax receipts	(45.62)	(3.12)
Net state and federal costs	287.69	19.70

Net after-tax incremental returns to assisted landowners harvesting aspen thus averaged \$237.25 per harvest, or \$16.25 per acre. These values essentially represent a transfer payment from the public to the landowner.

Based on study results, the above is the only benefit to assisted landowners for which a monetary value can be determined. Since no significant differences were found between assisted and unassisted aspen harvests in factors likely to influence future timber outputs from these lands, no future incremental timber production benefits can be assigned.

A benefit of assistance which is real, but difficult to value, is the security offered to the landowner by the sample harvesting contract and cutting regulations the Division of Forestry strongly recommends landowners institute with their loggers. This may, however, be more of a sense of false security than of genuine protection.

Two of the assisted landowners with sales contracts received less than full payment for the timber harvested. Because of the high costs of legal action and the weak financial position of many loggers, remedy for contract violations may often be impractical.

STATE, PUBLIC, AND FEDERAL NET BENEFITS OF ASSISTANCE

The average timber harvest assist provided by the PFM is estimated to cost the Division of Forestry \$26.00 per acre, based on FY1986 data (Table 9). Based on these costs, assistance on the study's average 14.6 acre aspen harvest cost the Minnesota Division of Forestry \$379.60 (Table 25). From this should be subtracted the \$25.00 timber cruising fee⁹ paid by the assisted landowners (which, at the time these harvests were conducted, was deposited in the state general fund, rather than remaining in Division of Forestry control, as under the new fees system).

Also to be subtracted are the state income tax revenues paid by the harvesting landowners, an average of \$21.29 per harvest. This yields a net cost to the state of \$333.31 per harvest, or \$22.83 per acre. Adding in federal income tax receipts gives a total net public cost of \$287.69, or \$19.70 per acre on the average aspen harvest assist.

⁹Again, this fee would have been \$56.81 under the present fee structure, but state costs would still remain much higher than state returns.

Looking only at funds directly designated for PFM activities such as harvesting assistance [the state Division of Forestry appropriation (\$1,702,800) and federal Rural Forestry Assistance monies (\$73,080)], only 4.1 percent of these funds are of federal origin (Table 5). Assume that a similar percentage of the total cost of providing harvest assistance is paid by the federal government. This represents a cost of \$15.64 per average aspen harvest, or \$1.07 per acre. Comparing this to the federal taxes paid on the average aspen harvest, a total of \$45.62 per harvest or \$3.12 per acre, the federal government benefits by \$29.98 per harvest or \$2.05 per acre.

Comparing net landowner assistance benefits (\$237.25 per harvest or \$16.25 per acre) to net state assistance costs (\$317.67 per harvest or \$21.75 per acre) on aspen harvests indicates that service forestry assistance on the average aspen sale costs the state a total of \$80.42 or \$5.50 per acre more than the landowner benefits.

At the societal level, including both state and federal costs (\$287.69 per harvest or \$19.70 per acre) and landowner returns (\$237.25 per harvest or \$16.25 per acre), service forestry assistance costs society a total of \$50.44 per harvest or \$3.45 per acre on the average aspen harvest assist. Thus, not only does timber harvest assistance on aspen harvests appear to accomplish only a transfer of income from the state or society to the assisted private landowner, but such assistance appears to be an inefficient transfer of income as well.

In addition to the high costs of providing harvest assistance, PFM's high costs for assisting timber stand improvement (\$38.86 per acre) and regeneration (\$28.15 per acre) also deserve attention. Detailed analysis of these costs, however, are beyond the scope of this study.

One caution about the above analysis: FY1986 figures used for the cost of service forester timber sale assistance average all timber sale assistance the Division of Forestry provided in that year, whether for aspen, hardwood, or softwood harvests. It may be that the cost of assistance on silviculturally simple aspen harvests is less than for assistance on silviculturally more complex hardwood sales. Thus, the cost of providing aspen sale assistance may be somewhat overpriced in this comparison.

On the other hand, the average size of timber harvest assists in FY1986 was 22 acres, or 50 percent larger than the average aspen harvest

assist in this study. Thus, assuming economies of scale, the cost of aspen harvest assistance may have been underestimated.

Further, under the new timber sales assistance fee structure, the Division will collect more money from most landowners, particularly on sales involving higher value timber such as jack pine or hardwoods. This increase will go further toward offsetting the Division's cost of providing such services, though, as the Division stresses, it is not charging timber sale assistance fees for the purpose of directly offsetting the cost of providing that assistance.

At any rate, the estimate of Division costs of providing aspen harvesting assistance appears to indicate a net transfer of income from the state to assisted landowners (whether it be efficient or not), a small transfer from landowners to the federal government, and no net economic benefit to society at large.

THE LOGGER'S ECONOMIC ROLE

The research carried out on this project and the discussion so far presented largely ignores the economic role of the logger in producing timber from nonindustrial private forest. The exception is the price paid for landowners' timber.

Since loggers are usually price-takers at the mill gate, their profit margins are determined by the price they negotiate with landowners, less operating costs. Thus, when the logger negotiates a below-market (above-market) stumpage price from the landowner, the logger's benefit (loss) is exactly equal to the landowner's loss (benefit).

Assuming that the logger and landowner pay comparable marginal income tax rates, higher or lower stumpage prices negotiated between the logger and landowner have no net societal impact. The exception to this is that the landowner might offer less timber for sale at a lower price.

Having concluded that assisted landowners receive higher prices for their timber, a direct implication is created of lower profits for loggers who purchase such sales. However, the logger is purchasing a different product when buying an assisted sale than when buying an unassisted sale.

Additional value added inheres to the assisted sale through the efforts of the service forester to mark harvest boundaries and develop volume estimates. The logger may be willing to pay a higher price for such timber since the work of the

service forester replaces work he would otherwise have to do. Thus, service forester efforts may lower the logger's costs of operation on an assisted harvest.

Clearly, assisted landowners have the first opportunity to capture the added value of the service forester's activities. However, some of this value likely slips through to the logger (e.g., through lack of marketing effort on the part of the landowner).

Finally, a word may be in order for small loggers operating near the margin of profitability. Without occasionally purchasing stumpage at bargain below-market prices, they might go out of business. The social costs of this (i.e., the operator and employees being unemployed, leaving creditors unpaid, etc.) are likely greater than the inefficiency of the logging operation.

HARDWOOD HARVEST ASSISTANCE

Were enough data available, higher values of service forester assistance could likely be shown for hardwood harvests than for aspen harvests. This is because of the much higher value of hardwoods and the greater degree of silvicultural expertise required in their harvest and regeneration.

The minimal data collected here does point toward some positive stumpage price and silvicultural benefits from state service forester assistance on these harvests.

PROGRAM CONSIDERATIONS

ASSISTED SALE STUMPAGE PRICES

Assisted aspen sale landowners did receive significantly higher stumpage prices than unassisted landowners. What factors might account for this difference? Two come readily to mind. First, assisted landowners were much more likely to use bidding or negotiation procedures to sell their timber.

Looking at aspen and hardwood harvests combined, questionnaire responses showed that all the assisted landowners sold timber using either sealed bids (56 percent) or by contacting several timber buyers and negotiating a price (44 percent). Among unassisted landowners, all used either a known or trusted logger (56 percent) or accepted the first buyer's offer (44 percent). It seems highly likely that using more competitive timber sale procedures, as recommended by the state service foresters,

contributed to the higher stumpage prices received by assisted landowners.

A second likely contributor to the higher stumpage prices received by assisted landowners is the timber cruise data and harvest area map prepared by the service foresters. This information gives prospective timber buyers important insight into the type and volume of timber being offered and the accessibility of the harvest stand. Such information may be of enough value to timber buyers or loggers to allow them to more carefully calculate their operating margin on a prospective harvest, and offer a price closer to their minimum return objectives.

LANDOWNER SATISFACTION AND PUBLIC FORESTRY PROGRAM AWARENESS

Despite their higher stumpage prices, assisted landowners were not more satisfied (as indicated by questionnaire responses) than unassisted landowners with their receipts. Also, unassisted landowners were more satisfied with the post-harvest condition of their timber stand than were assisted owners.

The difference in satisfaction with post-harvest condition may be a result of the higher residual basal area on the unassisted sales, which leave less of a barren clearcut appearance. It might also be due to assisted landowners having higher expectations than the unassisted landowners.

When used, the recommended harvesting contract and cutting regulations provided to assisted landowners may have provided them some added sense of security, but with little practical recourse against problems with their loggers.

Sizable proportions of both assisted (56 percent) and unassisted landowners (44 percent), whether or not they had harvesting contracts with their loggers, encountered logger-related problems on their harvests. This indicates a need for landowners to select and supervise loggers with more care. It also indicates a need for loggers to improve their operating methods, including making full payment on stumpage cut and minimizing impacts on landowners' roads and trails.

Landowners' low awareness of the availability of state forestry assistance, as indicated both by Carpenter *et al.* (1986) and this study's questionnaire responses of unassisted landowners, raises the question of whether the Minnesota Division of Forestry should do more

to market PFM. However, since service foresters already seem to be working near the limits of their capacity, it may be counterproductive for the Division to stimulate demands for assistance it cannot meet.

Landowners' lack of awareness of and apparent confusion over many of the tax provisions relating to timber management costs and returns indicates a significant need for better education in these areas. And, with changing tax laws, this need is becoming even greater. Both the Division of Forestry and the Minnesota Extension Service can play an important role in satisfying this need.

PROGRAM ADMINISTRATION

The Division of Forestry does an excellent job administering PFM. Program goals and objectives are well defined, in both the broad, long term and the closely focused short term. Specific annual accomplishment targets are established and generally achieved. Assistance efforts are, to some degree, targeted towards landowners most likely to follow through on PFM forest management recommendations.

PFM and the forest resource production role of the state's nonindustrial private forest lands are fully integrated and thoroughly addressed in the Division's forest resources planning efforts, from the state-wide to the administrative area level. The Division's staff time accounting procedures allow for fairly detailed evaluation of both PFM accomplishments and the costs of providing assistance. And, the present staffing level for PFM appears reasonably adequate to meet current demands for assistance.

By aggressively pursuing tree planting opportunities created by the recent federal Conservation Reserve Program and the state Reinvest in Minnesota Program, the Division of Forestry is also helping to further conservation and timber production in the state. Such Division of Forestry actions as this, as well as maintenance of a sizable service forestry program, help to communicate a positive state forestry picture to forest product companies considering new operations in Minnesota, as well as to Minnesota's present forest product firms.

RECOMMENDATIONS

A number of recommendations for the Division of Forestry PFM Program may be drawn from this discussion. Aspen harvest assistance, as currently provided by the Division, appears to generate economic benefits solely for the assisted landowner. No net economic benefits

accrue to society as a whole. Thus, the Division may want to reconsider the scope of the assistance currently provided on aspen harvests.

For example, the benefits landowners reap from service forester assistance on aspen harvests appear to stem primarily from the use of the competitive sale procedures recommended by the service foresters. Timber cruise information developed by service foresters may also contribute to the higher stumpage prices received by assisted landowners.

No significant silvicultural benefits of aspen harvesting assistance were found. Thus, for aspen harvests, the Division may want to play more of an advising role (i.e., providing landowners with marketing information, competitive sale process information, sample harvesting contracts with recommended cutting regulations, general silvicultural recommendations) and less of a technical assistance role (i.e., less on-site harvest planning).

Concomitantly, fees for timber cruising assistance should perhaps be increased to levels closer to their actual costs. The Division's plans to increase these fees to five percent of stumpage value will help. The Division could conceivably attempt to recover from landowners all of its timber cruising costs, or any other assistance costs, since it is legislatively authorized to charge reasonable fees for services provided (Minnesota Statutes Section 88.79).

Due to service forestry budget cuts, a number of states have been forced to initiate or increase assistance fees charged to landowners (Fedkiw 1983). New York has reported a more effective forestry assistance program as a result of initiating fees for several services (Wiedemann

1984). However, there are legitimate concerns that landowners will not likely be willing to pay for services not linked in some way to income generation.

Reducing the scope of aspen assistance will reduce costs to the Division. Increasing fees for timber cruising will help reimburse the Division and at least partially internalize the cost of assistance within landowner production functions.

Of course, landowners with predominantly aspen forest lands should not be closed out of the general forest management planning assistance provided by the Division. Aspen stands should be "guided" into harvest at the appropriate time by the Division's comprehensive and brief management plans.

These recommendations represent a fairly significant departure from present PFM services, at least as far as aspen harvest assistance is concerned. The Division of Forestry may want to test-implement them in a limited area to determine whether they yield satisfactory results. Concerns may be raised over landowners' possible negative reactions to curtailment of services in general, as well as possible negative reactions to curtailment of aspen harvest assistance while maintaining harvest assistance on other timber types at the same level.

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APPENDIX:
Landowner Questionnaire and Cover Letter

July , 1986

Dear :

Thank you for participating in our study of the effectiveness of forestry assistance for timber sales on private lands. You are one of a very small number of landowners being asked to describe how you recently sold timber. The information you provide will enable us to help other woodland owners like yourself market timber more efficiently and effectively.

Please complete and return the enclosed questionnaire within two weeks. A stamped, addressed return envelope is provided. You may be assured of complete confidentiality of your answers. The questionnaire has an identification number for mailing purposes only. This is so that we may check your name off the mailing list when your questionnaire is returned. Your name will never be placed on the questionnaire.

Results of this research will be made available mainly to foresters, woodland owners, legislators, and interested citizens in Minnesota. You may receive a copy of the results by writing "copy of results requested" on the back of the return envelope and printing your name and address on it. Please do not put this information on the questionnaire itself.

This research is sponsored by the University of Minnesota, the Minnesota Department of Natural Resources, and the U.S. Forest Service. I would be happy to answer any questions you might have. Please write or call. The phone number is (612) 624-0702.

Thank you very much for your assistance.

Sincerely,

Russell Henly
Research Specialist

RH/bjz

Enc.

UNIVERSITY OF MINNESOTA
COLLEGE OF FORESTRY

Minnesota Private Landowner Forest Management Study

Completion Instructions: Please fill in the blanks with the information asked for or circle the number of the appropriate response.

All the information you provide will be kept confidential; study results will be published in a manner such that the individual landowners who have participated in the study will not be identifiable. The code number in the upper right hand corner of this page is used only to keep track of which questionnaires have been returned.

Please return the questionnaire in the provided stamped, addressed envelope. Or, return to:

Russell Henly
Research Specialist
College of Forestry
110 Green Hall
1530 North Cleveland Avenue
St. Paul, MN 55108

Phone: (612) 624-0702 or 624-3400

1. When did the timber harvest on your property start and end?

Started: _____ (month and year)

Ended: _____ (month and year)

2. Who initiated the timber sale?

1. Landowner
2. State service forester suggested it.
3. Industry forester suggested it.
4. Consulting forester suggested it.
5. Timber buyer or logger suggested it.
6. Other (specify) _____

3. Who mainly determined which trees would be harvested?

1. Landowner
2. State service forester
3. Industry forester
4. Consulting forester
5. Timber buyer or logger
6. Other (specify) _____

4. What unit(s) of measure was (were) used to determine the volume of wood sold? (Circle as many as apply)

1. Board feet
2. Cords
3. Weight
4. All timber within a designated area
5. Other (specify) _____

5. Who determined the volume of wood in the sale?

1. Landowner
2. State Forester
3. Industry Forester
4. Consulting Forester
5. Timber Buyer or Logger
6. Other (specify) _____

6. How did you select a timber buyer?

1. Accepted first buyer's offer.
2. Contacted several buyers independently and negotiated a price.
3. Sold at an oral auction to the highest bidder.
4. Solicited sealed bids from several buyers.
5. Other (specify) _____

7. Did you have a written timber sale contract with the buyer?

1. Yes
2. No

8. What was the most important reason for harvesting timber at the time that you did?

1. Felt timber was mature or harvest would improve remaining stand.
2. Wanted to clear land.
3. Was offered a good price.
4. Needed the income.
5. Other (specify) _____

9. What price(s) did you receive and what volume was harvested for each species cut?

a. species _____
vener: \$/thousand board feet _____ volume harvested _____
and/or
ties: \$/tie _____ number of ties cut _____
and/or
sawlogs: \$/thousand board feet _____ volume harvested _____
and/or
pulpwood: \$/cord _____ volume harvested _____
and/or
firewood: \$/cord _____ volume harvested _____
or
\$/tract _____

b. species _____
vener: \$/thousand board feet _____ volume harvested _____
and/or
ties: \$/tie _____ number of ties cut _____
and/or
sawlogs: \$/thousand board feet _____ volume harvested _____
and/or
pulpwood: \$/cord _____ volume harvested _____
and/or
firewood: \$/cord _____ volume harvested _____
or
\$/tract _____

c. species _____
vener: \$/thousand board feet _____ volume harvested _____
and/or
ties: \$/tie _____ number of ties cut _____
and/or
sawlogs: \$/thousand board feet _____ volume harvested _____
and/or

9. c. continued

pulpwood: \$/cord _____ volume harvested _____
and/or

firewood: \$/cord _____ volume harvested _____
or

\$/tract _____

10. What was your level of satisfaction with the price received?

1. High 2. Moderate 3. Low

11. What was your level of satisfaction with the condition of your timber stand after harvest?

1. High 2. Moderate 3. Low

12. What problems, if any, did you have with your timber sale?

13. Which of the following best describes how you reforested or plan to reforest the tract?

1. Planted tree seedlings, tubelings, potted trees, or seeds.
2. Depended on natural regeneration from seed or seedlings already on the tract before harvest.
3. Depended on natural regeneration from root suckers, stump sprouts, or seed produced by trees left on the tract after harvest or nearby.
4. Performed a partial cut, so no reforestation needed yet.
5. No regeneration planned; land to be converted to non-forest uses.

14. Were you aware that it was possible to receive harvest assistance from:

- | | | |
|---------------------------------|--------|-------|
| a. The state | 1. Yes | 2. No |
| b. Forest industry | 1. Yes | 2. No |
| c. Private forestry consultants | 1. Yes | 2. No |

15. If you were aware of the availability of assistance but did not make use of it, why didn't you?

a. State assistance:

b. Forest industry assistance:

c. Private forestry consultants:

16. The federal government offers several tax and other incentives to woodland owners to encourage woodland management. Which of the following have you used?

a. Capital gains treatment of timber income, for tax purposes

1. Yes 2. No

b. Deduct original cost of buying timber from timber sale income, for tax purposes

1. Yes 2. No

c. Deduct woodland maintenance costs from income, for tax purposes

1. Yes 2. No

d. Amortization of tree planting costs, for tax purposes

1. Yes 2. No

e. Cost-sharing for tree planting or timber stand improvement

1. Yes 2. No

f. Publications, tours, workshops, or conferences sponsored by the Minnesota Extension Service or Minnesota Department of Natural Resources

1. Yes 2. No

17. Where do you now live?

1. City with population 100,000 or more
2. City with population 10,000 to 99,999
3. City or town with population less than 10,000
4. On a farm
5. In a rural area, but not on a farm

18. What is the highest level of education you have completed?

1. Did not complete high school
2. High school graduate
3. Some college
4. College graduate or above

19. In which category would you place your total 1985 household income (before taxes)?

1. under \$10,000
2. \$10,000 to 19,999
3. \$20,000 to 29,999
4. \$30,000 to 39,999
5. \$40,000 to 49,999
6. \$50,000 and above