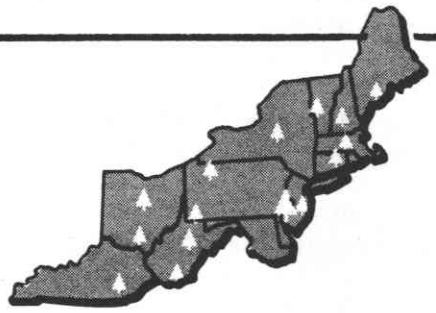
FOREST SERVICE RESEARCH NOTE NE-297

1980

Northeastern Forest Experiment Station



FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE, 370 REED ROAD, BROOMALL, PA. 19008

ODC 331—035 (748)

TRENDS IN TIMBER USE AND PRODUCT RECOVERY IN PENNSYLVANIA, 1966-1977

ERIC H. WHARTON, Forester
and JAMES T. BONES, Research Forester
Northeastern Forest Experiment Station
Broomall, PA

Abstract. Repeated timber utilization studies in Pennsylvania suggest that the recovery of growing-stock timber has improved over the years. Currently 95 percent of the inventory growing stock volume is being recovered from harvested trees. There are many opportunities to recover additional amounts of biomass from nongrowing-stock trees and logging residues. Until recently, these operations were regarded as unprofitable.

INTRODUCTION

High demand for a variety of timber products from Pennsylvania forests has stimulated increased timber utilization and product recovery. Timber growers, harvesters, and processors are finding that the most direct way to stretch the current roundwood timber supply is to use more of each tree that is harvested. In the past, trees of a certain species, size, and straightness were selected in the woods, with a specific product in mind. Often, only a small segment of the tree bole was removed; it was not economical to recover the remainder (Staebler 1979).

Although timber managers have encouraged better harvesting practices for years, it was not until the development of whole-tree harvesting systems and the advent of skyrocketing energy costs that greater product recovery could be achieved at a profit. In addition to increasing wood recovery from harvested trees, there are many opportunities to recover biomass from poorly formed and defective trees. As in the Southern United States, these trees often account for much of the logging residue, especially where hardwood stands are harvested (Chappell and Beltz 1973).

The Resources Evaluation Unit at the Northeastern Forest Experiment Station has inventoried the forest resources of Pennsylvania three times. On each occasion, information concerning timber utilization has been gathered. The most recent utilization work was conducted in 1977. Field measurement data were gathered for more than 1,000 trees that were harvested on 30 widely dispersed logging operations throughout the State. To ensure a representative sample, we selected operations with probability proportional to production. Enough measurements were taken to enable us to compute volume, in cubic feet (ft^3) and board feet, based on both inventory specifications and how the tree was actually harvested. In addition to conventional volume estimation, fresh weight of the above-ground portion of the tree (excluding foliage) was calculated (Fig. 1).

Inventory specifications (as defined in the National Forest Survey Handbook) dictate that cubic volume be measured from a 1-foot stump to a minimum top diameter of 4 inches for growing stock, and that board-foot volume be measured to a top diameter of 7 inches for softwood sawtimber and 9 inches for hardwood sawtimber. Recoverable volume was determined by the timber harvester; it represented his assessment of the usable volume contained in each tree.

TRENDS IN PRODUCT RECOVERY

The volume of timber that is left after the removal of merchantable stemwood represents a considerable untapped resource. Improved recovery can be accomplished through (1) better use of unmerchantable tops and branches that are severed and left at the harvesting site, and (2) recovery of nongrowing-stock trees that are either too small, too rotten, or too poorly formed to be used for conventional wood products. The biomass from these sources could be recovered and used for energy production, channeled into reconstituted board products or small dimension stock, or converted into chemical derivatives and paper products. As shown in Figure 2, the amount of nongrowing stock available for recovery is a function of present levels of timber use.

Conventional methods

Both single product and multiproduct harvesting are common in Pennsylvania. In multiproduct harvesting the operator usually

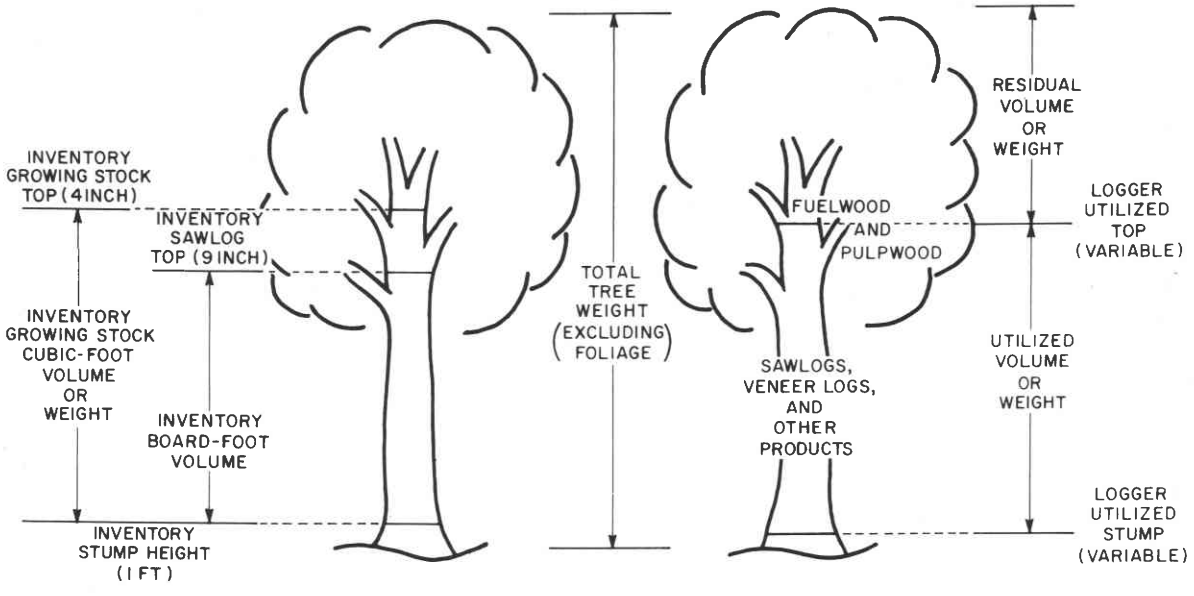


Figure 1.—Product alternatives from different portions of hardwoods upon which volume and weight relationships are based.

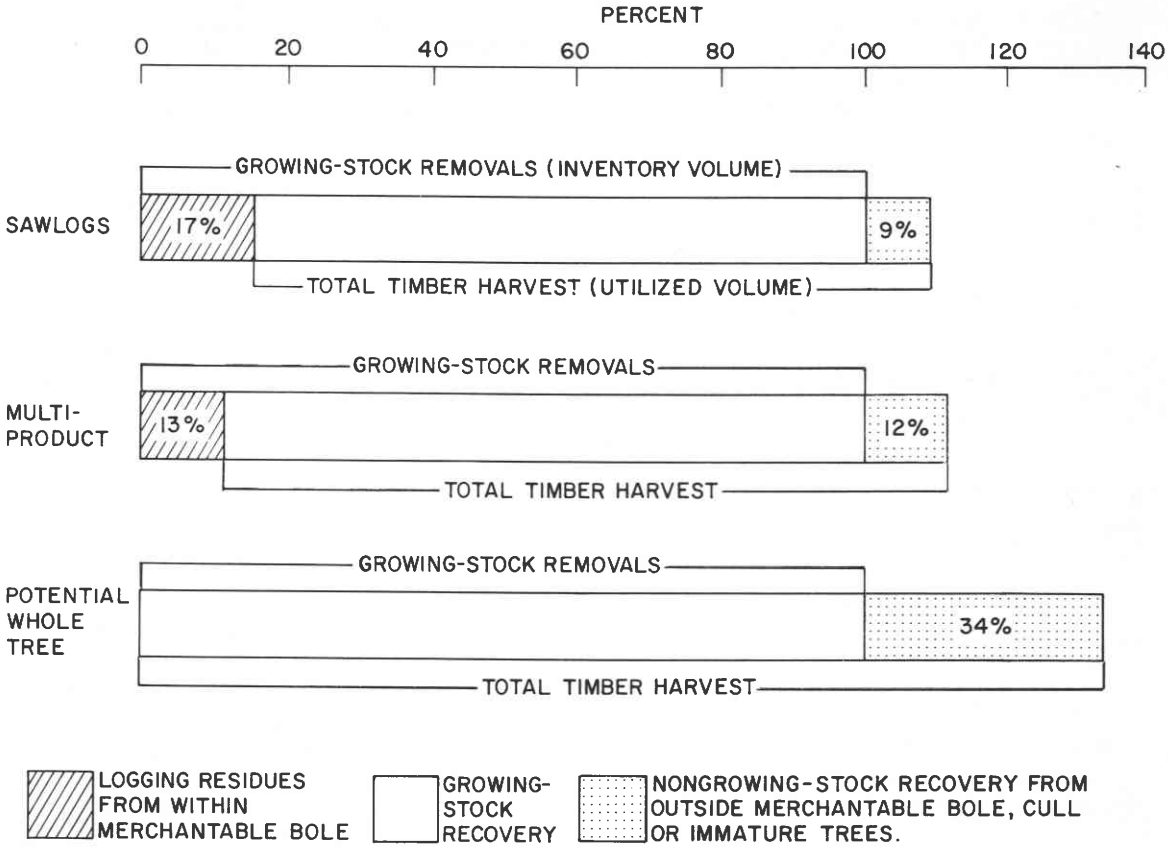


Figure 2.—Relationship of inventory to utilized hardwood volume for three product alternatives in Pennsylvania, 1977.

recovers a greater portion of the tree stem by using the bole to a smaller top diameter in addition to harvesting smaller diameter trees. In 1977 we found that when timber is harvested for a single product, such as hardwood sawlogs, the total merchantable tree bole (by inventory standards) is seldom fully recovered. Our study in Pennsylvania shows that about 17 percent of the volume in the merchantable bole is being left in the woods (Fig. 2). A portion of the loss, however, is offset by wood recovered from nongrowing-stock sources. A volume of wood equal to about 9 percent of the inventory volume total is being salvaged from treetops and from rough, rotten, and immature trees within the areas logged.

When two or more products are being harvested, the volume recovery increases from 83 percent of the inventory volume estimate to 87 percent. In a typical hardwood stand where sawlogs and pulpwood are produced, only 13 percent of the merchantable bole volume is left in the woods (Fig. 2). Much of this loss is offset by product recovery from nongrowing-stock sources equivalent to 12 percent of the inventory volume.

In 1966, only 10 percent of the sample trees were used for more than one product. By 1977, almost 25 percent of the sample trees were used for more than one product. Although the diameter of the average tree harvested has not changed significantly between 1966 and 1977, the volume of wood recovered has increased (Table 1). Sawlog processors have increased average recovery by 13 ft^3 per tree during the period. Cubic-foot recovery rates based on inventory volume estimates have jumped from 79 to 93 percent for sawlog harvesting operations and from 78

Table 1.—Average tree diameter, volume recovery, and rate of recovery, by type of harvesting in Pennsylvania, 1966 and 1977.

Type of harvesting	Diameter of average tree		Recovery from average tree		Recovery rate[a]	
	1966	1977	1966	1977	1966	1977
	inches		ft^3		*percent*	
Sawlogs only	16	17	30	43	79	93
Multiproduct	15	15	30	37	78	102
All types	16	16	30	41	79	95

[a]Volume recovered divided by inventory volume estimate.

to 102 percent for multiproduct operations. Even with these increased recovery rates, a portion of the merchantable material is left after conventional harvesting.

Whole-tree harvesting

Whole-tree harvesting systems are considered the only means of recovering the entire growing-stock inventory volume. In addition, according to our 1977 study, a volume of timber equivalent to 34 percent of the inventory volume total can be recovered from nongrowing-stock sources in a typical Pennsylvania hardwood timber stand (Fig. 2). The use of whole-tree harvesting compared with single product harvesting can increase timber product recovery by as much as 51 percent—17 percent from merchantable tree boles and 34 percent primarily from tops and rough, rotten, dead, and immature trees. In Pennsylvania, the average total tree volume for sawtimber-size trees is 63 ft^3—25 percent of which is not being recovered. Converting logging residue into a usable product depends largely on the availability of local markets for fiber products or fuel, and whether the added value of the material is high enough to pay for its extraction. In an analysis of southern harvesting systems, Porter (1979) found that the recovery of residues can be both economical and energy efficient. The additional machine energy input required to produce 1 Btu of residue output ranged from 0.0067 to 0.0304 Btu.

CONCLUSIONS

Our 1966 and 1977 timber use studies show that more trees are being harvested for more than one product. As a result, the average recovery rate for each tree has increased. Many multiproduct harvesting operations are recovering volumes in excess of the inventory estimate by using more of the tree bole. However, complete recovery can only be accomplished by whole-tree harvesting.

The unmerchantable tops of growing-stock trees are most easily recovered because they are concentrated, accessible, and directly related to timber harvesting levels. In Pennsylvania, the nongrowing-stock trees, while distributed at random throughout the State's timberlands, are of use when harvested with growing-stock trees. The use of whole-tree harvesting systems suggest that current timber recovery rates can be increased as the demand for wood fiber increases.

LITERATURE CITED

Chappell, Thomas W., and Roy C. Beltz.
1973. Southern logging residues: An opportunity. J. For. 71(11):688-691.

Porter, Carl D.
1979. The economic feasibility of modifying six conventional harvesting systems to recover logging residue for fuel and fiber. M.S. thesis. Va. Polytech. and State Univ., Blacksburg, Va.

Staebler, George R.
1979. Rationalization of biomass harvest and use. *In* Proceedings of impact of intensive harvesting on forest nutrient cycling. SUNY Coll. Environ. Sci. and For., Syracuse. p. 2-21.

MANUSCRIPT RECEIVED FOR PUBLICATION 5 MAY 1980

☆U.S. GOVERNMENT PRINTING OFFICE: 1980-603-111/31