OPPORTUNITIES FOR INCREASING TIMBER SUPPLIES IN THE SOUTHEAST

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INTRODUCTION

As wood requirements continue to increase in the United States, efforts to augment future supplies of timber will need to be concentrated in those areas and on those opportunities which promise the greatest returns from the resources which will be available. Particularly at this time, when so many of our priorities and conventional forestry practices are being questioned and reexamined, policy and decision makers need guidelines for identifying opportunities and relating alternative courses of action. Without sound guidelines, there is always the danger of massive misplacement of capital and other resources.

Because of differences in species composition, site capability, land-ownership patterns, forest conditions, and other characteristics, the opportunities for altering prospective timber supplies vary among the major timber-producing regions. The Southeast[1] is one of the Nation's primary timber-producing regions; forests occupy 93 million acres, or almost 63 percent of its land area, and a significant part of its economy depends on the production and utilization of the region's timber. Timber harvested from its forests currently provides about 8 percent of the plywood, 12 percent of the lumber, and 33 percent of the pulpwood produced in the Nation each year.

Using Forest Survey data, we have developed some rather general procedures for identifying and analyzing opportunities for increasing timber supplies in this region.

[1] Florida, Georgia, North Carolina, South Carolina, and Virginia.

PROSPECTIVE TIMBER SUPPLIES

In any assessment of future timber supplies, the first guideline needed is some base measure of the quantity of timber which will likely be available at various points in time under current levels of forest management. This base measure is needed for (1) gauging the intensification and acceleration of timber culture practices required to satisfy projected or assumed levels of demand, and (2) quantifying the response to added efforts aimed at increasing timber yields. The guideline suggested for use in the Southeast is a "recent trends" projection made in conjunction with the 1970 Timber Review (table 1).

Table 1.—Prospectively available removals of growing stock and sawtimber,[1] by softwood and hardwood, by ownership class, 1970-2020

Ownership class	Species group	Removals in 1970	Prospectively available in—		
			1980	2000	2020
		GROWING STOCK (In million cubic feet)			
National Forest	Softwood	35	60	114	162
	Hardwood	26	38	66	79
	Total	61	98	180	241
Other public	Softwood	53	76	106	102
	Hardwood	20	34	53	50
	Total	73	110	159	152
Forest industry	Softwood	359	483	688	713
	Hardwood	161	200	290	301
	Total	520	683	978	1,014
Other private	Softwood	1,343	1,513	1,866	1,811
	Hardwood	850	1,045	1,327	1,289
	Total	2,193	2,558	3,193	3,100
All ownerships	Softwood	1,790	2,132	2,774	2,788
	Hardwood	1,057	1,317	1,736	1,719
	Total	2,847	3,449	4,510	4,507
		SAWTIMBER (In million board feet, International ¼-inch rule)			
National Forest	Softwood	142	252	531	794
	Hardwood	110	132	229	295
	Total	252	384	760	1,089
Other public	Softwood	188	270	405	387
	Hardwood	48	79	116	111
	Total	236	349	521	498
Forest industry	Softwood	1,223	1,620	2,348	2,435
	Hardwood	451	567	617	640
	Total	1,674	2,187	2,965	3,075
Other private	Softwood	4,240	4,847	5,974	5,801
	Hardwood	2,330	2,602	2,467	2,394
	Total	6,570	7,449	8,441	8,195
All ownerships	Softwood	5,793	6,989	9,258	9,417
	Hardwood	2,939	3,380	3,429	3,440
	Total	8,732	10,369	12,687	12,857

[1] That portion of growing stock which is suitable for the production of saw logs.

THE DEDUCTIVE PROCESS

The first step in identifying the opportunities for adding to timber output through more intensive timber culture involved some breakdown of the forest base into meaningful silvicultural or management classes. Some 3.2 million acres classified as noncommercial forest were excluded, whereas an estimated 2.4 million acres of idle cropland were included in the study under the assumption that part of these lands represented an opportunity for increasing future timber supplies. With these adjustments, the study included more than 92.1 million acres, of which 89.8 million acres were classified as commercial forest (table 2).

Table 2.—Area by broad management and ownership class, Southeast, 1970

Management class	All ownerships	Ownership class			
		National Forest	Other public	Forest industry[1]	Other private
	Thousand acres				
Idle cropland	2,353.7	–	–	–	2,353.7
Nonstocked forest	3,960.6	84.6	330.4	692.6	2,853.0
Pine plantations	8,144.5	245.5	393.0	3,841.2	3,664.8
Natural pine stands	28,402.2	1,275.2	1,227.9	6,217.3	19,681.8
Oak-pine stands	13,054.7	634.1	506.0	1,960.8	9,953.8
Upland hardwood stands	22,828.8	2,160.5	580.4	1,929.8	18,158.1
Bottomland hardwood stands	13,406.6	231.4	351.5	3,142.4	9,681.3
Total area	92,151.1	4,631.3	3,389.2	17,784.1	66,346.5

[1] Includes lands under long-term lease.

Initially, a rather detailed breakdown of the commercial forest area by forest type, stand size or stand age, site class, and ownership class was considered. Such a breakdown was recognized as the logical approach to the task and would be required if optimum use was to be made of research data available on silvicultural practices and timber management. Because of the overwhelming number of cells that would be involved in the analyses, however, a decision was made to start from a more general approach that would provide for focusing in on this kind of detail later on in the study after the opportunities had been narrowed through a deductive process.

The second step involved the identification and elimination of areas which obviously had low timber potential because of poor or adverse sites. The logic here was that the limited funds and resources available for the acceleration and intensification of timber culture would not be expended on these marginal lands so long as more promising opportunities were available. The criteria used for screening will vary from region to region and will depend largely upon the data available from the Forest Survey. In the Southeast, all site 5 areas, along with the more adverse physiographic conditions, were eliminated at this stage. Site 5 identified those areas incapable of producing 50 cubic feet of timber per acre annually when fully stocked with trees. The physiographic classes eliminated included the steep, dry mountain

slopes and mountaintops in the Southern Appalachians, deep sands, bays and wet pocosins, and cypress ponds. Altogether, 26.4 million acres were eliminated and reduced the study base to 65.7 million acres (table 3).

Table 3.—Area suitable for intensive timber management, by broad management and ownership classes, Southeast, 1970

Management class	All ownerships	Ownership class			
		National Forest	Other public	Forest industry	Other private
	Thousand acres				
Idle cropland	2,353.7	--	--	--	2,353.7
Nonstocked forest	946.1	21.8	45.8	262.4	616.1
Pine plantations	7,222.9	225.1	277.8	3,478.8	3,241.2
Natural pine stands	21,556.5	779.1	792.8	4,598.9	15,385.7
Oak-pine stands	9,325.9	193.0	292.4	1,477.0	7,363.5
Upland hardwood stands	14,342.3	677.5	338.0	1,376.6	11,950.2
Bottomland hardwood stands	9,960.6	95.7	248.3	2,311.8	7,304.8
Total area	65,708.0	1,992.2	1,995.1	13,505.5	48,215.2
	Percent				
Percentage of totals in table 2	71.3	43.0	58.9	75.9	72.7

At least one significant conclusion which can be drawn from a comparison of tables 2 and 3 at this point is that, with the criteria used, a much higher proportion of the public lands occurs in areas with low or adverse site conditions than occurs in the privately owned lands.

The third step involved another screening of the base Forest Survey information to determine and eliminate those areas already in good condition from the standpoint of timber culture. Here again, the criteria used in this deduction will vary from region to region. In the Southeast, minimum and maximum standards were developed for assessing the level of crop-tree stocking and its competition for each stand represented by a Forest Survey sample with consideration given to such characteristics as forest type, stand size, stand age, volume, and growth. The initial standards were compared with preliminary results of a management prescription study being tested in conjunction with the fourth Forest Survey in Georgia. Several changes and adjustments were made in what might be described as a fine-tuning process and which also drew upon the knowledge and advice of several specialists in timber management. When the final criteria were applied, they indicated that some 19.3 million acres of the land suitable for intensive timber management were in good enough condition to rule out any major opportunity over the next decade for increasing prospective timber yields. This further reduced the study base to 46.4 million acres (table 4).

Table 4.—Area with opportunities for more intensive management, by broad management and ownership classes, Southeast, 1970

Management class	All ownerships	Ownership class			
		National Forest	Other public	Forest industry	Other private
	Thousand acres				
Idle cropland	2,353.7	--	--	--	2,353.7
Nonstocked forest	946.1	21.8	45.8	262.4	616.1
Pine plantations	1,908.9	61.4	67.8	969.4	810.3
Natural pine stands	13,383.4	514.9	494.1	2,664.0	9,710.4
Oak-pine stands	7,373.9	168.5	239.9	1,141.6	5,823.9
Upland hardwood stands	11,497.6	588.7	297.6	1,052.7	9,558.6
Bottomland hardwood stands	8,900.8	89.5	229.2	2,094.9	6,487.2
Total area	46,364.4	1,444.8	1,374.4	8,185.0	35,360.2
	Percent				
Percentage of totals in table 2	50.3	31.2	40.6	46.0	53.3

The conclusion at this point in the study was that the management decisions made and implemented on these 46.4 million acres over the next decade or so would largely determine the extent which prospective timber supplies in the Southeast could be increased through more intensive timber culture during the remainder of this century. The third step also provided an overall picture of the silvicultural status of these areas. Criteria similar to those used to identify the areas in good condition were developed and applied to further break the 46.4 million acres down into treatment opportunity classes before any consideration was given to the economic efficiency of alternative courses of action.

The analysis indicated that 9.2 million acres were occupied by mature stands ready for harvest and regeneration. Younger, immature stands occupied another 10.7 million acres judged to be overstocked to the extent that future timber yields would be adversely affected without intermediate treatment. On the remaining 26.5 million acres there was inadequate stocking of trees which could be featured in management (table 5). For the most part, these were cutover lands where either no provisions were made for adequate regeneration or regeneration efforts failed. Furthermore, substantial quantities of low-quality timber passed over during the cutting along with inadequate, advanced reproduction exist on many of these acres serving only as obstructions to the establishment of any kind of manageable stand. In other words, these acres will contribute very little to the future timber supply until they are converted, planted, or otherwise regenerated.

Although this analysis dwells largely on the more obvious opportunity of converting the pine lands within the condition described to artificial stands through site preparation followed by either planting

Obviously, one of the key cost figures in the Southeast is the average cost of establishing a pine plantation. On some of the idle and open areas where extensive site preparation is not involved, pine plantations can be established at about half the average cost estimated above. Most of these easy planting opportunities have already been exhausted, however, and attention now must be largely focused on those lands that can only be restored through site preparation or type conversion. The 1970 estimate of $44.75 per acre on the average is somewhat higher than the $40.00 per acre estimated by McClay in 1969 and used by Anderson and Guttenberg(2). The difference is probably consistent with the increasing cost of labor and certainly does not detract from the investor's guide to converting oak-pine and low-value, upland hardwood stands prepared by Anderson and Guttenberg. Faced with ever-rising costs, it is probably more important that the potential investor has available guidelines for determining how much he is justified in spending and still receive an acceptable return on his investment.

POTENTIAL PLANTATION YIELDS

The potential yields of pine plantations vary, depending on site, species, density, and age. Loblolly pine and slash pine are the two principal species planted in the Southeast. The yields presented for slash pine (table 7) are based on tables developed by Bennett and Clutter (*4*). The yields presented for loblolly pine (table 7) are based on similar tables developed by Lenhart.[2] In table 7, an initial spacing of 8 by 8 feet, or about 680 trees per acre, is assumed. This spacing assumes a multiple-product objective. Where the objective is to grow only sawtimber, a wider spacing is suggested. Readers of this report are cautioned that the yield tables presented are based on old-field plantations and generally overestimate the yields which can be expected from natural woodland sites. We took this fact into consideration, along with the expected natural losses, in the economic analysis presented later in this report.

An examination of the yield tables emphasizes the importance of site consideration in this kind of analysis. The potential yields from pine plantations at the end of 30 years are from 35 to 40 percent greater for the good sites than for the medium sites. The next logical step, therefore, was to break the area described in table 5 into the two site classes required to enter the yield table presented (table 7).

Table 7.--Yields of unthinned slash and loblolly pine plantations

Age at harvest (years)	Volume harvested per acre		
	All trees as pulpwood	Multiple products	
		Pulpwood	Sawtimber
	Cords	Cords	Bd. ft.
SLASH PINE			
MEDIUM SITE			
20	22.5	22.5	--
25	25.1	15.3	3,627
30	29.8	16.0	5,360
GOOD SITE			
20	32.7	24.7	3,085
25	35.0	17.0	7,297
30	41.3	17.5	9,924
LOBLOLLY PINE			
MEDIUM SITE			
20	29.2	28.8	184
25	39.4	35.2	2,388
30	47.8	38.0	5,126
GOOD SITE			
20	41.0	35.4	2,928
25	54.6	37.5	8,594
30	64.8	37.5	13,293

Site information collected in the Forest Survey was available for separating the commercial forest land, but not idle cropland. Thus, an assumption was made that half of these idle acres occurs on good sites and half on medium sites (table 8).

Table 8.--Estimated area of good and medium sites suitable for intensive timber management but where there is an absence of a manageable stand, by broad management and ownership classes, Southeast, 1970

Management class	All ownerships	Ownership class			
		National Forest	Other public	Forest industry	Other private
	Thousand acres				
GOOD SITES					
Idle cropland	1,176.8	--	--	--	1,176.8
Nonstocked forest	126.2	--	--	70.8	55.4
Pine plantations	111.7	--	--	92.4	19.3
Natural pine stands	1,084.8	44.0	29.2	247.9	763.7
Oak-pine stands	1,125.3	37.1	18.9	184.6	884.7
Upland hardwood stands	1,295.8	83.8	30.0	169.5	1,012.5
Bottomland hardwood stands	1,992.3	3.0	57.8	384.3	1,547.2
Total area	6,912.9	167.9	135.9	1,149.5	5,459.6
MEDIUM SITES					
Idle cropland	1,176.9	--	--	--	1,176.9
Nonstocked forest	819.9	21.8	45.8	191.6	560.7
Pine plantations	815.4	40.9	20.3	451.2	303.0
Natural pine stands	3,625.4	147.4	133.0	637.4	2,707.6
Oak-pine stands	3,040.2	57.9	138.5	452.0	2,391.8
Upland hardwood stands	6,248.2	238.5	157.3	536.7	5,315.7
Bottomland hardwood stands	3,842.6	34.0	79.7	855.5	2,873.4
Total area	19,568.6	540.5	574.6	3,124.4	15,329.1

[2] Lenhart, J. D. Yield of old-field loblolly pine plantations in the Georgia Piedmont. 1968. (Unpublished doctoral dissertation on file at Sch. For. Resour., Univ. Ga., Athens.)

THE ROLE OF THINNING

Bennett has concluded that in the management of slash pine plantations, the role of thinning is changing from the traditional concept associated with this silvicultural tool as developed in natural stands (*3*). In fact, for pulpwood production many owners are selecting spacings that will not require thinning during the rotation. Others insist that thinning must be financially advantageous even in pulpwood rotations, because of the early recovery in establishment costs. Length of rotation is also a question, and early liquidation may be a temptation to those unaware of production rates at various ages.

Based on his study, Bennett concludes that in slash pine plantation management, product objective should determine initial spacing; and, in rotations of short to medium length, thinning should play a secondary role, mostly as a sanitation and salvage measure, and not be viewed as essentially a growth regulator or product developer. On the other hand, in all-purpose management that includes both small and large products, thinning will of necessity play its traditional role in the maintenance of stand vigor and diameter growth.

Of course, in natural stands, thinning is the primary means for controlling density and the fact remains that most southern pine stands are still reproduced naturally. In many instances it is unwise to wait and rely exclusively on commercial thinning to regulate stand density. Particularly in dense young loblolly pine stands, there is a danger of stagnation. Guttenberg has stated the case for precommercial thinning for this species (*7*). He concludes that delaying precommercial thinning can sharply reduce growth response and greatly increase the cost. His study suggests that thinning should be done by mowing seedlings at age 2 or 3, when fire hazard is minimal and costs are low. From an investment of no more than $5.00 per acre, roughly 10 additional cords can be realized.

Of the 10.7 million acres of young, immature stands identified in the Southeast as being overstocked to the extent that future timber yields would be adversely affected without intermediate treatment, a commercial thinning opportunity exists on 7.8 million acres. On the remaining 2.9 million acres, a precommercial thinning or cleaning would be required to correct the overstocking problem. These are probably conservative estimates of the thinning opportunities.

THE ROLE OF PRESCRIBED BURNING

Several major benefits are currently recognized from prescribed burning in the Southeast and include hazard reduction, hardwood and brush control, reduced harvest cost, slash disposal, and site preparation. Cooper points out that prescribed burning has contributed significantly to the reduction in wildfire losses (*6*). For example, in the pine flatwoods of Georgia and Florida, wildfire burn percentages amounted to less than 0.1 percent when sound prescribed burning programs were carried out. Where prescribed burning was not employed, 7 percent of the forest acreage was burned during the same time period.

Cooper further concludes that fire is a preferred treatment because of its low cost, compatibility with other land-use objectives, and because it accomplishes several management objectives at one time. It is not unusual, for example, for a single hazard reduction burn to also improve seedbed conditions, enhance wildlife and range habitats, and control undesirable tree competition. Without this vital tool, foresters would be confronted with unbearable management costs, an intolerable fuel situation that would most assuredly lead to catastrophic wildfires, and a general decline in the productivity of the forest resource.

Although smoke and other products of combustion are integral parts of a fire prescription and are often looked upon as pollutants, the benefits of the practice must be given careful consideration in any regulative policy. Cooper estimates that a suspension of prescribed burning might result in a sixfold increase in the acreage ravaged by wildfire in the South.

IMPROVED PROTECTION OPPORTUNITIES

The potential plantation yield table in this report does not reflect the probable losses to poor survival, fire, disease, and insects. These losses can be substantial and certainly one of the opportunities for increasing future timber supplies is to intensify efforts to hold these losses to a minimum.

Based upon the latest Forest Survey findings, annual mortality losses in the Southeast exceed 500 million cubic feet in merchantable timber each year and reduce gross growth by an estimated 10 to 12 percent. Impact studies are needed for each of the major causes of mortality before guidelines can be established for measuring the relative economic effi-

ciencies of adding to the prospective timber supplies through more intensified protection efforts.

In the Southeast, fusiform rust is one of the major damaging agents for both loblolly pine and slash pine. Many of the plantations have been particularly susceptible to this disease. For example, a study indicates that about 12 percent of all slash pine trees 1.0 inch and larger at d.b.h. in plantations in northern Florida, southern Georgia, and southwestern South Carolina have fusiform cankers on the main stem. In natural slash pine stands, the comparable rate of incidence is below 5 percent. The same study indicates that the percentages are even higher for loblolly pine--about 20 percent in plantations and 10 percent in natural stands. These are statistics on incidence within the existing inventories and do not account for the actual mortality losses. The most promising control measure for fusiforme is the development of more resistant planting stock through genetic improvement.

Reproduction weevils are another serious hazard to pine plantations in the Southeast. When pine is harvested from July to March and the area is planted shortly thereafter, weevils feed on the young trees and can cause their death. According to Speers, weevil-caused mortality of plantations established following harvest during this period ranges from a few to 100 percent but averages about one-third.[3]

For reproduction weevils, two control measures are suggested: (1) allow the planting site to lie fallow for one year or more before planting, or (2) treat the seedlings with an insecticide. Given these two choices, with the estimated cost of treating seedlings shown in an earlier tabulation, the latter measure would seem to be favored. The alternative would involve one year's growth loss.

In 1969, Hodges reported that *Fomes annosus*, or root rot, was present in 59 percent of the loblolly pine plantations and 44 percent of the slash pine plantations surveyed in the Southeast (*8*). The same survey, however, indicated that overall losses to the disease were relatively small. Only 2.8 percent of the trees in loblolly pine plantations, 2.2 percent in slash plantations, and 0.07 percent in natural slash pine stands were dead or dying from the disease. In a few thinned plantations, however, up to 30 percent of the trees were dead or dying. Three control measures for annosus root rot are recommended: (1) chemically treat stump surfaces immediately after felling, (2) confine thinnings to the summer season when high temperatures tend to reduce infection and fewer spores are being released, and (3) inoculate the stumps with the saprophytic wood-decaying fungus *Peniophora gigantea*. The latter measure was originally developed in England and is effective in the Southeast. Methods of application and spore concentrations have been determined. A commercial source of inoculation is now available, and this treatment should compare favorably in cost and effectiveness with borax. Studies are now underway to develop accessories to mechanical tree harvesters for automatically treating stumps.

A host of bark beetles plagues the southern pines with the southern pine beetle generally accepted as the most destructive of all the insects. Southern pine beetles usually attack the mid trunk of a tree first, then "fill in" both upward and downward (*9*). While larger trees are more commonly attacked, trees as small as 2 inches in diameter also may be infested. Salvage is the cheapest and often the most practical form of control. In salvage operations, trees containing beetle broods should be removed first and promptly because the primary objective is to reduce the beetle population to the lowest possible level as rapidly as possible.

Finally, general protection against wildfire is an essential part of forest management. There has been commendable achievement in the reduction of fire losses in the Southeast, but the cost has been high. Over 95 percent of the forest lands in the region are now protected and the percentage of the protected area burned annually has been reduced to below 0.5 percent. According to the report of the Southern Forest Resource Analysis Committee in 1969, cost of fire control in the South averaged about 16 cents per acre protected in 1967. Overall costs for general fire protection ranged up to 50 cents per acre in the Southern Coastal Plain (*10*). Of course, it is unfair to charge off all of this protection cost against timber values alone. Recognition must also be given to the air, water, forage, soil, wildlife, and recreation values.

IMPROVED UTILIZATION OPPORTUNITIES

Another way to increase future timber supplies is through improved and more complete utilization of the prospective supplies. In other words, the objective

[3]Speers, C. F. Impact of weevils on pine reproduction in the South. 1972. (Unpublished progress report on file at Southeast. For. Exp. Stn., USDA For. Serv., Asheville, N. C.)

would be to achieve a higher product output from the available or allowable cut. Giant strides have already been made toward improved timber utilization in many areas; however, the most recent Forest Survey findings estimate that up to 12 percent of the total softwood and 43 percent of the total hardwood removal of growing-stock volume is not used for products. With these percentages, we are talking about over 650 million cubic feet of merchantable timber each year. Land clearing, cultural treatments, and the withdrawal of forest land from the commercial base account for about half of this removal and perhaps there is little opportunity for significantly reducing this type of drain. The other half, however, represents the annual estimate of logging residue and woods waste. Here again, some minimum amount of waste must be tolerated; however, if only half of this wood fiber could be channeled into use, the annual output of timber products could be increased by over 5 percent without increasing timber removals.

In addition to the unused volume in trees cut or destroyed, the volume left standing in rough and rotten trees is a form of residue in the broad sense. Because of high grading, or the removal of only the better trees at time of harvest, an inventory of over 11.5 billion cubic feet of this timber has accumulated. As much as three-fourths of this material is usable for pulpwood and other fiber products; however, once these trees were left as residuals, the opportunity for their utilization was greatly diminished because their low value will not fully compensate for the cost of removal. The most logical long-term solution is to minimize the further accumulation of poor quality timber in the inventory through improved forest management and harvesting practices. In the meantime, attention should also be focused on ways to remove, market, and utilize a greater proportion of the low-value volume already in the inventory. It is estimated that less than 195 million cubic feet of the total output of roundwood products came from this source in 1970.

Another way to improve utilization is to be more selective in the use of the better quality timber for those products which require such input. For example, the Forest Survey findings indicate that over 20 percent of the total volume of sawtimber removed from the inventory in the Southeast each year is used for pulpwood. Of course, the markets available in a particular area largely determine the kind of products for which the timber is used; nevertheless, this heavy use of sawtimber for a fiber product seems somewhat inconsistent with the current concern over the supply of sawtimber for lumber and plywood.

GENETIC IMPROVEMENT AND FERTILIZATION

Faced with a shrinking forest base, timber managers in the Southeast will need to focus greater attention on those opportunities for increasing yields per acre through the development of genetically improved planting stock and the application of fertilizers to enhance soil fertility. The research results on genetic improvement are particularly encouraging. There are already more than 6,000 acres of pine seed orchards in the South and it is estimated that the genetic gains from first-generation stock will average from 15 to 20 percent in terms of volume growth for both slash pine and loblolly pine. An additional 15- to 20-percent gain from second-generation stock is well within expectations.

These seed orchards represent a tremendous investment and their value to the annual regeneration program justifies the most intensive protection. At the Forestry Sciences Laboratories in Athens, Georgia, and Olustee, Florida, scientists are finding ways to reduce seed losses in the orchards. The production potential in seed orchards of loblolly pine is reduced by one-third by cone and seed insects. These insects greatly increase the costs of producing genetically superior trees. Without adequate controls, the size and cost of second-generation orchards will have to be increased by 50 percent to supply the needed quantity of sound seed.

In the case of fertilization, one of the goals is to gain through research a better understanding of the physical and chemical factors that affect soil fertility in the forests. This knowledge will be used to develop practical, effective, and economic schedules for managing the soil organic matter and for applying fertilizers to improve forest growth and vigor. The research also includes studies of the impact of these added nutrients on long-term soil productivity and their effect on streams, lakes, and wildlife habitat (*5*).

POTENTIAL TIMBER-GROWING CAPABILITY

The opportunities to increase prospective timber supplies in any particular region of the Nation are not endless. Superimposed on the total accumulation of opportunities that can be identified is some potential quantity which cannot be exceeded. Although this quantity cannot be precisely determined for the Southeast, the Forest Survey information on site capability provides a reasonable measure which can serve as a guideline.

As the population continues to increase and the competition for land grows more intense, possibilities for expanding the timber-growing base beyond the 92.1 million acres considered in this study are unlikely. In fact, a 5-percent reduction in the commercial forest base over the next 50 years was assumed in the baseline projection presented in table 1. This is perhaps a conservative estimate of the reduction considering the recent trends and mood of the Nation. If we accept these assumptions, then the timber-growing capability of the 92.1 million acres, based on the Forest Survey site classifications, should serve as a potential guideline. This procedure would set the potential net annual growth of timber in the Southeast at just under 6.9 billion cubic feet. This figure does not include the possible gains that can be achieved through genetic improvement and fertilization discussed earlier in this report; however, one might assume that such gains will at least be partially offset by the likely decline in the forest acreage base.

Both the current and prospective estimates of annual timber growth in the Southeast are well below this estimate of potential growth. Based on the 1970 Timber Review, net annual growth of growing stock totaled just over 4.0 billion cubic feet, with annual removals estimated at over 2.8 billion cubic feet. In the prospective or baseline projection, growth and removals just about come into balance at 4.5 billion cubic feet. The conclusion, therefore, is that the potential timber-growing capability of the region is more than 50 percent above the prospective growth that will be achieved with a continuation of recent trends in timber management and is almost 2.5 times greater than the 1970 level of removals.

The estimates established for current, prospective, and potential annual growth are presented by the four broad ownership classes for the major treatment opportunity classes determined in the deductive process (tables 9 - 12). The time frame involved is the 50-year period from 1970 to 2020. Any reduction of the difference between the prospective and potential yields over this period will largely depend upon the degree of acceleration and intensification in timber culture implemented within the next 10 to 20 years.

The results clearly point out that within each ownership class there is a large accumulation of idle, nonstocked, or poorly stocked acres in need of planting, conversion, or regeneration. Collectively, these lands add up to almost 26.5 million acres. It is estimated that current levels of regeneration on such lands will reduce this accumulation by no more than 2 million acres over the next 10 years.

Table 9.—Area by treatment opportunity class with average volume of growing stock per acre and estimates of current, prospective, and potential annual growth, National Forests, Southeast, 1970

Treatment opportunity class	Class acreage	Volume of growing stock	Estimated annual growth		
			Current	Prospective	Potential
	M acres		*Cubic feet per acre*		
Poor or adverse sites	2,639.1	1,014	37	45	57
Stands in good condition	547.4	800	59	77	85
Harvesting	421.4	2,097	76	89	89
Intermediate cutting	315.0	1,628	84	93	96
Conversion or regeneration	708.4	968	37	58	85
All classes	4,631.3	1,122	46	58	70

Table 10.—Area by treatment opportunity class with average volume of growing stock per acre and estimates of current, prospective, and potential annual growth, other public, Southeast, 1970

Treatment opportunity class	Class acreage	Volume of growing stock	Estimated annual growth		
			Current	Prospective	Potential
	M acres		*Cubic feet per acre*		
Poor or adverse sites	1,394.1	615	29	30	45
Stands in good condition	620.7	698	50	65	80
Harvesting	279.0	2,466	79	85	85
Intermediate cutting	384.9	1,696	88	88	88
Conversion or regeneration	710.5	819	30	42	82
All classes	3,389.2	948	44	50	67

Table 11.—Area by treatment opportunity class with average volume of growing stock per acre and estimates of current, prospective, and potential annual growth, forest industry,[1] Southeast, 1970

Treatment opportunity class	Class acreage	Volume of growing stock	Estimated annual growth		
			Current	Prospective	Potential
	M acres		*Cubic feet per acre*		
Poor or adverse sites	4,278.6	614	30	30	50
Stands in good condition	5,320.5	457	43	72	83
Harvesting	1,825.6	2,230	74	89	89
Intermediate cutting	2,085.5	1,233	85	86	86
Conversion or regeneration	4,273.9	660	26	29	84
All classes	17,784.1	817	44	55	76

[1] Includes lands under long-term lease.

Table 12.—Area by treatment opportunity class with average volume of growing stock per acre and estimates of current, prospective, and potential annual growth, other private, Southeast, 1970

Treatment opportunity class	Class acreage	Volume of growing stock	Estimated annual growth		
			Current	Prospective	Potential
	M acres		*Cubic feet per acre*		
Poor or adverse sites	18,131.3	602	29	30	47
Stands in good condition	12,855.0	572	48	74	83
Harvesting	6,621.5	2,006	72	90	90
Intermediate cutting	7,950.0	1,286	77	86	88
Conversion or regeneration	[1]20,788.7	643	29	33	84
All classes	66,346.5	831	43	52	75

[1] Includes 2,353,700 acres of idle cropland.

FOREST OWNERSHIP LIMITATIONS

After guidelines are established for identifying and evaluating the various opportunities available for increasing the timber supplies, the task then will be to initiate and implement those actions and programs deemed most efficient for achieving whatever timber goals are set forth. One of the most perplexing problems which forestry planners and policymakers must cope with in the Southeast is the region's complex pattern of forest ownership. For example, there are over 700,000 private, nonindustrial landowners who collectively possess over 70 percent of the land included in this study. For the most part, these lands are in small tracts and the average owner tenure is short from the standpoint of long-term forestry investments. These people own land for various reasons and it has been concluded that no forestry program has ever really caught on within this owner class. New approaches must be devised if forest management is to be intensified on a majority of these lands, and substantial incentive costs may be required in addition to the costs of the actual forestry practices needed before any real gains can be achieved.

The 17.8 million acres of commercial forest land owned or leased by the forest industries represent the second leading source of timber supply in the Southeast. Most of these lands are in large holdings managed by the pulp and paper companies on short rotations for maximum fiber yields. Unlike the private, nonindustrial owners, these companies have direct control not only over growing the timber, but also of the harvesting and processing of the timber into a wide variety of consumer products. Although the backlog of poorly stocked lands in need of conversion or regeneration is not nearly as large on the industry lands as on the other private lands, it is still large. One might assume that the management deficiencies on the industrial holdings will be corrected over time. Within a particular company, however, there is competition for the available funds. Specific forestry investments are not only compared with other alternative forestry investments, but against all other opportunities, some of which promise a very high payback or return (*1*). Here the forest investment comes down to a matter of economic justification.

Next we come to the publicly owned forest lands--4.6 million acres of which are on the National Forests in the Southeast. These lands are in large tracts and are an important source of timber in the localized areas where they are concentrated. Because of the long rotations practiced in the management of timber on the National Forests, they are particularly important from the standpoint of the sawtimber supply. Conceivably, any timber management deficiency in this particular ownership could be corrected directly through changes in policy, regulation, or funding as required. The primary objective of forest management on these lands, however, is not to maximize either profit or volume of timber, but to grow the maximum amount of timber the land is capable of producing under a multiple use concept where full consideration is given to wildlife, recreation, watershed, and all the other forest values. This multiple use concept often involves modification of some conventional timber management practices. There are also strong public pressures for additional constraints on timber production on the National Forests. These pressures, together with the fact that many of the lands on the National Forests are poor sites, could diminish the opportunities for timber gain.

Finally, there are 3.4 million acres of other publicly owned lands scattered throughout the Southeast which are classified as commercial forest. About half are associated with military or defense installations; however, this ownership class includes a hodgepodge of local, State, and Federal agencies. Some of the most intensive timber management is found within this class but a diversity of land management objectives confronts efforts to accelerate timber culture.

ADDITIONAL OPPORTUNITY ON OTHER PRIVATE LANDS

In spite of the many problems and limitations which confront efforts to increase prospective timber supplies through the acceleration of improved forestry practices on the private, nonindustrial lands, it is logical that attention focuses on this ownership class. The deductive process indicated that 35.4 million acres suitable for intensive timber management in this ownership class presented treatment opportunities. The breakdown of this total showed 6.6 million acres with mature stands ready for harvest; 8.0 million acres with immature, overstocked stands in need of thinning or other stand improvement; 18.2 million acres with poorly stocked stands in need of conversion or regeneration; and 2.6 million acres of open land suitable for planting.

Because this analysis approaches the timber issue from the standpoint of opportunities for acceleration, one pertinent question is, how much of this backlog of treatment opportunity will be reduced over the

next 10 years without any acceleration? For the purpose of illustrating the procedures presented in this paper, a measure of the various forestry practices on other private lands over the past 10 years available for only south and central Georgia was expanded to represent the entire Southeast. This rather optimistic assumption about the accomplishment expected over the next 10 years without any significant acceleration suggests that additional opportunities will remain on more than 19.6 million acres (table 13).

Table 13.—Area of additional opportunity for more intensive timber culture, by management and condition class, other private, Southeast, 1970

Management class	Condition class	Total area available in 1970	Assumed reduction over next 10 years	Additional opportunity
		Thousand acres		
Idle cropland	Open	2,353.7	882.6	1,471.1
Nonstocked forest	Open	201.7	74.9	126.8
	Occupied	414.4	153.8	260.6
Pine plantations	Mature	27.6	27.6	--
	Overstocked	460.4	396.3	64.1
	Poorly stocked	322.3	117.5	204.8
Natural pine stands	Mature	2,180.6	2,180.6	-
	Overstocked	4,058.5	3,493.8	564.7
	Poorly stocked	3,471.3	1,265.9	2,205.4
Oak-pine stands	Mature	999.2	999.2	--
	Overstocked	1,548.2	1,231.2	317.0
	Poorly stocked	3,276.5	164.7	3,111.8
Upland hardwood stands	Mature	1,882.1	1,882.1	--
	Overstocked	1,348.3	1,149.7	198.6
	Poorly stocked	6,328.2	23.6	6,304.6
Bottomland hardwood stands	Mature	1,532.0	1,532.0	--
	Overstocked	534.6	148.0	386.6
	Poorly stocked	4,420.6	--	4,420.6
All classes		35,360.2	15,723.5	19,636.7

The reader must understand that we are attempting to analyze a dynamic rather than a static situation. For example, as existing opportunities are reduced or exhausted, additional opportunities are being created. Nevertheless, the results emphasize that the largest additional opportunity in terms of number of acres will be the conversion and regeneration of poorly stocked stands which require relatively high investments. If the recent trends in the rates of forest treatment in south and central Georgia are expanded to represent the entire region, all of the backlog of available harvest opportunity on other private lands could be exhausted over the next 10 years. The same trends also suggest that up to 80 percent of the existing backlog of thinning and other intermediate treatment opportunities could disappear without any acceleration. In contrast to the progress expected in harvesting and thinning, less than a 15-percent reduction is expected in the backlog of planting and reforestation opportunities.

RANKING THE ADDITIONAL OPPORTUNITIES

These procedures are aimed at going beyond the identification and measurement of additional opportunities to the extent that guidelines might be developed for ranking the additional opportunities in descending order of economic efficiency. Again, the focus is on the other private ownership class and on only those lands suitable for growing pine. These criteria reduce the additional opportunity of 19.6 million acres shown in table 13 to 14.6 million acres. The deliberate elimination of some 5.0 million acres of hardwood from the ranking process should in no way be interpreted as a downgrading of the importance of hardwoods in the Southeast. Although the primary timber issue in the Nation at this particular point in time is a concern over inadequate supplies of softwood sawtimber in light of the increasing demand for lumber and plywood, the main reason for excluding the hardwoods in many parts of this analysis is the lack of data and information.

There are a number of economic indicators available for ranking the additional pine opportunities. One indicator is the estimated cost of treating an average acre within each of the management and condition classes (table 14). The range in cost is from less than $10 to almost $60 per acre. This particular ranking would serve as a guideline if the objective were to increase the prospective pine yields on the maximum number of deficient acres. It does not, however, provide any measure of the relative returns from the investments and therefore is probably the the least useful of all the indicators.

The second indicator examined was the increase in mean annual increment (m.a.i.) of timber per dollar of total cost of treatment (table 15). Here the ranking was by cubic feet of increase per acre treated. This kind of ranking is superior to the cost ranking because it provides a measure of what each dollar will buy; as would be expected, the two rankings differ. Where the concern focuses on the supply of sawtimber rather than the total supply of growing stock, a still better indicator is the increase in mean annual increment expressed in board feet per acre treated (table 16).

Up to this point, all of the rankings have failed

to take into consideration one very important economic factor--the time lag before the returns from the various investments come in. Some of the investments require a longer wait for the returns than others. One widely accepted indicator that takes this factor into consideration is the percent rate of return.

Table 14.--Area of additional opportunity for increasing the prospective supplies of pine ranked by estimated cost of treatment, other private, Southeast, 1970

Management class	Condition class	Treatment	Additional opportunity	Estimated average cost per acre
			M acres	*Dollars*
Pine plantations	Overstocked	Commercial thinning	26.9	9.20
Natural pine stands	Overstocked	Commercial thinning	429.2	10.20
Pine plantations	Overstocked	Precommercial thinning	37.2	11.20
Oak-pine stands	Overstocked	Commercial thinning	178.3	18.20
Idle cropland	Open	Planting	1,471.1	21.20
Oak-pine stands	Overstocked	T.S.I.	138.7	21.20
Natural pine stands	Overstocked	Precommercial thinning	135.5	23.20
Nonstocked forest	Open	Planting	126.8	26.40
Pine plantations	Poorly stocked	Conversion	204.8	26.40
Nonstocked forest	Occupied	Conversion	260.6	51.40
Natural pine stands	Poorly stocked	Conversion	2,205.4	51.60
Oak-pine stands	Poorly stocked	Conversion	3,111.8	54.60
Upland hardwood stands	Poorly stocked	Conversion	6,304.6	59.60
All classes			14,630.9	49.70

Table 15.--Area of additional opportunity for increasing the prospective supplies of pine growing stock ranked by estimated increase in mean annual increment (m.a.i.) per dollar of total cost, other private, Southeast, 1970

Management class	Condition class	Treatment	Additional opportunity	Increase in m.a.i. per dollar of total cost
			M acres	*Cu.ft./acre*
Natural pine stands	Overstocked	Commercial thinning	429.2	4.4
Idle cropland	Open	Planting	1,471.1	3.5
Nonstocked forest	Open	Planting	126.8	3.4
Pine plantations	Poorly stocked	Conversion	204.8	3.0
Pine plantations	Overstocked	Commercial thinning	26.9	2.9
Nonstocked forest	Occupied	Conversion	260.6	1.9
Pine plantations	Overstocked	Precommercial thinning	37.2	1.8
Oak-pine stands	Poorly stocked	Conversion	3,111.8	1.8
Oak-pine stands	Overstocked	T.S.I.	138.7	1.7
Upland hardwood stands	Poorly stocked	Conversion	6,304.6	1.7
Natural pine stands	Poorly stocked	Conversion	2,205.4	1.6
Natural pine stands	Overstocked	Precommercial thinning	135.5	1.5
Oak-pine stands	Overstocked	Commercial thinning	178.3	0.2
All classes			14,630.9	2.0

Table 16.--Area of additional opportunity for increasing the prospective supplies of pine sawtimber ranked by estimated increase in mean annual increment (m.a.i.) per dollar of total cost, other private, Southeast, 1970

Management class	Condition class	Treatment	Additional opportunity	Increase in m.a.i. per dollar of total cost
			M acres	*Bd.ft./acre*
Pine plantations	Overstocked	Commercial thinning	26.9	17.4
Natural pine stands	Overstocked	Commercial thinning	429.2	11.0
Pine plantations	Overstocked	Precommercial thinning	37.2	8.0
Idle cropland	Open	Planting	1,471.1	5.8
Nonstocked forest	Open	Planting	126.8	4.7
Natural pine stands	Overstocked	Precommercial thinning	135.5	4.4
Oak-pine stands	Overstocked	Commercial thinning	178.3	3.6
Nonstocked forest	Occupied	Conversion	260.6	2.4
Oak-pine stands	Overstocked	T.S.I.	138.7	2.2
Upland hardwood stands	Poorly stocked	Conversion	6,304.6	2.0
Natural pine stands	Poorly stocked	Conversion	2,205.4	1.9
Oak-pine stands	Poorly stocked	Conversion	3,111.8	1.6
Pine plantations	Poorly stocked	Conversion	204.8	1.4
All classes			14,630.9	2.7

From the standpoint of economic efficiency, a ranking by this indicator provides the most logical guideline of all (table 17). In this particular analysis, the rates of return on some of the commercial thinning opportunities indicate a disinvestment rather than an investment. The exception for thinning oak-pine stands is explained by the fact that only the increase in pine was considered.

Table 17.--Area of additional opportunity for increasing the prospective supplies of pine ranked by estimated rate of return on investments, other private, Southeast, 1970

Management class	Condition class	Treatment	Additional opportunity	Rate of return[1]
			M acres	*Percent*
Pine plantations	Overstocked	Commercial thinning	26.9	∞[2]
Natural pine stands	Overstocked	Commercial thinning	429.2	∞[2]
Pine plantations	Overstocked	Precommercial thinning	37.2	7.8
Nonstocked forest	Open	Planting	126.8	7.8
Idle cropland	Open	Planting	1,471.1	7.3
Natural pine stands	Poorly stocked	Conversion	2,205.4	7.1
Pine plantations	Poorly stocked	Conversion	204.8	6.9
Oak-pine stands	Overstocked	T.S.I.	138.7	6.7
Natural pine stands	Overstocked	Precommercial thinning	135.5	6.3
Oak-pine stands	Poorly stocked	Conversion	3,111.8	6.3
Nonstocked forest	Occupied	Conversion	260.6	5.7
Upland hardwood stands	Poorly stocked	Conversion	6,304.6	4.0
Oak-pine stands	Overstocked	Commercial thinning	178.3	Negative
All classes			14,630.9	

[1] A 5-percent rate of return was assumed for alternative investment opportunities.
[2] Disinvestments.

PROGRAM IMPLICATIONS

Finally, the full implication of this type of analysis emerges. It can provide planners and policymakers with guidelines for determining the kind and scope of programs required to provide a specified increment in the prospective timber supplies (table 18). For example, if a goal were set to increase the annual growth of pine sawtimber in the Southeast by 500 million board feet by accelerating the treatment of deficient acres in the other private ownership class, the most efficient program according to this analysis would cost an estimated $167 million. This amount of money would cover the estimated cost of treating some 4.8 million acres which are unlikely to be treated without some acceleration but where all of the investment opportunities involved promise a 6-percent rate of return or better with current costs and prices.

If spread over a 10-year period, this particular program, used only as an example, would involve treating an additional 480,000 acres annually at an average annual cost of $16.7 million. One might better comprehend the amount of acceleration involved by reviewing table 6 in this report. There, the number of acres within the other private ownership class planted or treated through intermediate cutting in 1970 was estimated at 1.3 million. The program used here as an example, therefore, would represent a 36-percent acceleration.

Short rotations (30 years) were assumed in the analysis and calculation of rates of returns. In other words, the increased timber which would result from the conversion or establishment of a new stand would be harvested at the end of a 30-year rotation. A 5-percent rate of return was assumed for alternative investment opportunities in bringing the costs and returns to a common point in time. If an "instant growth" concept were assumed, the annual harvest could be stepped up immediately after treatment to the equivalent of the increase in mean annual increment on those additional acres treated. Of course, enough harvesting and thinning opportunities would have to be available at the time of treatment to absorb the step-up in cutting. So long as this condition could be met, the "instant growth" concept would not violate any of the rules of sustained yield. In other words, we could conceivably borrow from today's timber inventory that amount of volume that would be replenished at some point in the future from the response of today's actions. Such a course, however, might invite increases in the price of stumpage.

These same guidelines also indicate that if a goal were set to increase the annual growth of pine sawtimber in the region by 1,500 million board feet instead of the 500 million board feet used in the previous example, the cost of the most efficient program would total almost $700 million. Some 14 million acres would require treatment and opportunities would have to be included which promise less than a 5 percent return on the investment at 1970 prices. Even if spread over a 10-year period, such a program would involve more than doubling the 1970 rate of timber cultural practice within the other pri-

Table 18.--Summary of guidelines for estimating area, cost, and increases over prospective annual supplies of pine growing stock and sawtimber if additional opportunities are exhausted in the order of estimated rate of return on investment, other private, Southeast, 1970

Management class	Treatment	Rate of return	Cumulative area totals	Cumulative cost totals	Cumulative increase in annual volume of pine	
					Growing stock	Sawtimber
		Percent	*M acres*	*Million dollars*	*Million cu.ft.*	*Million bd.ft.*
Pine plantations	Commercial thinning	∞ [1]	26.9	0.2	0.7	4.3
Natural pine stands	Commercial thinning	∞ [1]	456.1	4.6	20.0	52.5
Pine plantations	Precommercial thinning	7.8	493.3	5.0	20.7	55.8
Nonstocked forest	Planting	7.8	629.1	8.4	32.1	71.5
Idle cropland	Planting	7.3	2,091.2	39.6	141.3	252.4
Natural pine stands	Conversion	7.1	4,296.6	153.4	323.3	468.6
Pine plantations	Conversion	6.9	4,501.4	158.8	339.6	476.2
Oak-pine stands	T.S.I.	6.7	4,640.1	161.7	344.6	482.7
Natural pine stands	Precommercial thinning	6.3	4,775.6	164.9	349.3	496.5
Oak-pine stands	Conversion	6.3	7,887.4	334.8	655.1	768.3
Nonstocked forest	Conversion	5.7	8,148.0	348.2	680.6	800.5
Upland hardwood stands	Conversion	4.0	14,452.6	723.9	1,319.3	1,552.0
Oak-pine stands	Commercial thinning	Negative	14,630.9	727.2	1,320.0	1,563.7

[1] Disinvestments.

vate ownership class. The higher the goal the more likely that the available labor, equipment, planting stock, or number of cooperative landowners would become the limiting factor rather than the level of funding.

The implementation of any major program across the other private ownership class would likely require some form of cost-sharing arrangement or other type of incentive to help motivate the landowners involved. If Federal funds were involved, these same guidelines lend themselves to an extension of the analysis to an assessment of various program alternatives from the standpoint of cost-benefits in terms of tax dollars expended.

CONCLUSIONS

This paper represents an effort to illustrate a procedure for identifying and analyzing opportunities for increasing prospective timber supplies. The procedure requires a wide range of input data and involves most forestry disciplines. Essential inputs include a reasonably accurate measure of the extent, condition, productive capability, and the current and prospective treatment of those lands which are to provide the timber and related forest values. Next, the procedure calls for the development of criteria for identifying and ranking those opportunities available for increasing the prospective yields from these lands over time. This step requires the identification of specific treatment opportunities, estimated cost of implementing each treatment, and the likely response in terms of added volume and value.

Although the procedures as presented suggest a ranking of the opportunities on the basis of economic efficiency, planners and policymakers will need to interject social, environmental, and other considerations. In establishing priorities, it is also necessary to measure the possible gains which might be achieved through improved protection and utilization of the existing timber supplies.

Because of obvious deficiencies in many of the inputs used in this particular analysis, this paper is primarily one of procedural presentation. Nevertheless, several conclusions were reached that deserve restatement.

1. The Southeast is one of the Nation's primary timber-producing regions because its forests are currently providing about 8 percent of the plywood, 12 percent of the lumber, and 33 percent of the pulpwood produced in the Nation each year.

2. Prospectively available removals of growing stock each year increase from 2.8 to 4.5 billion cubic feet over the next 30 years without any substantial acceleration in timber culture activities.

3. The potential timber-growing capability of the 92.1 million acres in the region now considered available for timber production is estimated at just under 6.9 billion cubic feet annually, excluding possible gains which can be achieved through genetic improvement and fertilization, or almost 2.5 times greater than the 1970 level of removals.

4. More than 70 percent of the 92.1 million acres analyzed are medium to good sites and are considered suitable for intensive timber management. Of the 65.7 million acres judged suitable for intensive timber management, some 46.4 million acres are in need of treatment.

5. Some 35.4 million of the 46.4 million acres in need of treatment are in the private, nonindustrial ownership class. This class includes an estimated 700,000 landowners whose interests in forestry cover the entire spectrum.

6. At best, this backlog of 35.4 million acres that need treatment will be reduced by less than 45 percent over the next 10 years under current levels of timber cultural activities.

7. The additional treatment opportunities within the other private ownership will include at least 14.6 million acres suitable for growing pine. The cumulative increase in annual volume of pine that could result from the proper treatment of these acres is estimated at 1.3 billion cubic feet and would include almost 1.6 billion board feet of sawtimber.

8. Sufficient cost and yield data are available for concluding that over half the additional treatment opportunities on these pine lands promise a 5-percent return or better on the investment costs which would be involved with current stumpage prices.

9. If spread out over a 10-year period, the cost of treating those acres which promise a 5-percent return or better is rather crudely estimated at $35 million annually.

10. Improved inputs for making this type of analysis would be extremely helpful from the standpoint of long-range planning and forest policy decisions.

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The Forest Service, U. S. Department of Agriculture, is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives—as directed by Congress—to provide increasingly greater service to a growing Nation.