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AN ECONOMIC ASSESSMENT OF PINE REGENERATION IN MISSISSIPPI AND ALABAMA

By

Robert Andrew Daniels

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ABSTRACT

AN ECONOMIC ASSESSMENT OF PINE REGENERATION IN MISSISSIPPI AND ALABAMA

by

Robert Andrew Daniels

Lack of pine regeneration after harvest on private, nonindustrial forestlands in Mississippi and Alabama is a major cause of decline in net annual growth. Most pine reforestation in these states is accomplished with public cost-share assistance. Net present value analysis was used to evaluate the economic profitability of Loblolly pine plantations using cost-share assistance in Mississippi and Alabama. Pine plantation investments were analyzed for marginal cropland and cutover timberland situations with site quality, stumpage price region and unimproved or genetically improved seedlings as variables. These investments were evaluated at the 4, 6 and 8 percent real discount rates.

Marginal cropland pine plantations were profitable on all sites evaluated in Alabama and Mississippi, except those on the poor quality site using unimproved seedlings in north and central Mississippi. The profitability of cutover timberland pine plantations was dependent on the combination of site quality, stumpage price region, discount rate and type of seedlings used.

Cutover timberland plantations were unprofitable on the poor site using unimproved seedling stock in both states at the 4 percent discount rates, even in the best stumpage markets. These plantations were profitable at the 8 percent discount rate on the excellent and good sites using either seedling type in both states except for north Mississippi and central Mississippi using unimproved seedlings. Cutover timberland plantations were profitable on the excellent, good and average sites in all price regions using either improved or unimproved seedlings at 6 percent discount rate. Tables are provided that show the net present value for marginal cropland and cutover timberland plantation investments on all sites, and stumpage price regions within Mississippi and Alabama using improved or unimproved seedlings at 4, 6, or 8 percent real rates.

These results show private, nonindustrial forest landowners the profitability of their cost-share plantations for specific sites and market conditions in Mississippi and Alabama.

An assessment of genetically improved pine seed, seedlings, nursery capacity and site preparation/tree planting services available in Mississippi and Alabama is presented. The availability of these plantation inputs appears ample.

DEDICATION

This paper is dedicated to the memory of my parents Joseph A. and Susan M. Daniels who would have been especially pleased with this accomplishment. Their love and encouragement remains with me always.

I also dedicate this paper to my wife, Diane, in appreciation for her love, patience and encouragement throughout my studies. Without her this would not have been possible.

ACKNOWLEDGEMENTS

I would like to thank Dr. Daniel Chappelle for his helpful guidance and advice in the conclusion of my studies. I also appreciate the help of Dr. Robert Marty, Dr. Daniel Keathley, Dr. James Hanover, and Dr. Lee James.

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CHAPTER ONE: INTRODUCTION

The forests of the Southern United States are a major source of timber products for the United States and the world. The southern states include Alabama, Mississippi, Georgia, Tennessee, Louisiana, Arkansas, Florida, North Carolina, South Carolina, Virginia, Oklahoma and Texas. This region has been an important producer of timber products for many years. In 1987, 32.8% of the U.S. softwood lumber production, 45.3% of U.S. hardwood lumber production and 65.1% of the nation's pulpwood production originated in the southern U.S. (Ulrich 1989). By comparison, fifteen years earlier, in 1972, the southern states produced 25.8% of the nation's softwood lumber, 48.5% of its hardwood lumber and 62.2% of its pulpwood (Ulrich 1989).

The southern softwood resource occupies a significant portion of he southern forest. In 1985, southern pines were a major forest cover ype component on 88.7 million acres, including pine plantations, natural stands, and mixed pine-hardwood stands. These stands represented oftwood timber volume of 106.7 billion cubic feet or about 40 percent of ne standing volume in 1987 (Waddell 1989).

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The southern softwood resource is comprised almost exclusively of southern pines. There are 10 pine species (genus Pinus) that are native to the south, but four principal species; Loblolly (P. taeda), Slash P. elliottii), Longleaf (P. palustris) and Shortleaf (P. echinata) accounted or 84.8 percent of the softwood sawtimber volume in 1987 (Waddell 989).

The southern hard pine species cannot be separated on the basis wood structure (Panshin and De Zeeuw 1970). Therefore, these pecies are commonly known as "southern pines" in the industry and are sed interchangeably in manufacturing processes, since their physical nd chemical properties are very similar. Throughout this paper the term uthern pine will refer to this group of species.

The southern pine resource is the basis for a large, diverse and gionally important industry. Southern pine is used to produce a variety products including dimension lumber, plywood, poles, piling, chips, per, veneer, furniture, composite products and many others.

e southern forest industry occupies a very important position in the gional economy. In 1982, forest industries in the South employed one every nine workers, paid $1 out of every $10 in wages and salaries d produced $1 out of every $11 of value-added to the economy by nufacturing. Nearly one of every five southern manufacturing ablishments was a forest industry in 1982, totaling nearly 17,000, ithwide. Forest industries employed 557,000 workers and paid $8.5

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oillion annually in wages and salaries. The products shipped by southern forest industries in 1982 were valued at more than $49 billion (USDA Forest Service 1988). Several reports have described the mportance of the forest products industry to the southern region in detail USDA Forest Service 1980, Flick et al. 1980, USDA Forest Service 988, Flick and Teater 1988).

Alabama Forestry

Forests and forest industry are very important to Alabama. Forests ccupy 21.6 million acres or 65% of Alabama's total land area (Rudis, et l. 1984). Southern pine forest types occupy 7.3 million acres and the ak-pine type occupies another 4.5 million acres. The remaining mberland supports hardwood forest types including oak-hickory which the state's predominant type on 7.3 million acres. The latest forest urvey of Alabama (1982) showed that 54 percent of the growing stock nd 62 percent of the sawtimber volume were softwood (USDA 1985b). orest ownership in Alabama is primarily private, nonindustrial (PNIF). hile forest industry owns 21 percent of the state's forestland and 5 ercent is publicly owned, 74 percent is controlled by PNIF owners. A 982 Alabama Forestry Commission study estimated that there were pproximately 223,500 PNIF owners in Alabama.

The Alabama Forestry Commission (AFC) is the forestry service ganization in Alabama. Primary responsibilities of the AFC are fire otection, timber management and the production and distribution of

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tree seedlings. The AFC is headquartered in Montgomery. Each of Alabama's 67 counties has an AFC county ranger supervisor or a county forestry supervisor.

AFC county supervisors provide forest management services to private landowners free or at moderate cost. Timber management prescriptions, prescribed burning, fire lane construction and reforestation equipment rental are among the services offered.

Forest industry in Alabama is large and well distributed throughout the state. Forest industry is Alabama's largest manufacturing industry and among the largest employers (Flick 1983). In 1985, forest products firms employed approximately 64,300 workers or one of every six manufacturing workers in the state (Alabama Forest Resource Center 1987). Forest products are the most important agricultural crop produced in Alabama with a production value of $757 million in 1989 (Alabama Forestry Commission 1990). Table 1 shows the value of Alabama's timber harvest since 1982.

Forestry is fundamentally important to the Alabama economy. An input-output model of the state's economy using 1977 data for Alabama showed that the forest industry occupies a significant economic position (Flick 1980). The forest industry multipliers were consistently larger than those of other manufacturing sectors. The study showed that Alabama's economy would experience larger increases in business activity, household income and employment from expansions in forest industries

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TABLE 1. Annual Timber Harvest Value, Alabama 1/

Year	Value (Millions $) 2/
1989	758
1988	702
1987	802
1986	566
1985	718
1984	638
1983	635
1982	498

1/ Sources: Forestry Cash Receipt Reports, Alabama Cooperative Extension Service and Alabama Forestry Commission.

2/ Value delivered to the first point of processing such as pulpwood yard or sawmill, rounded to nearest million in current dollars.

than from comparable expansions of more traditional Alabama manufacturing industries such as primary metals and textiles.

A more recent input-output study of the Alabama economy reaffirmed the economic importance of forest industry sectors. Holmes (1988) developed an input-output model of the Alabama economy based on output multipliers and associated coefficients adapted to Alabama from updated (1984) national model coefficients by the Bureau of Economic Analysis (B.E.A.) of the U.S. Department of Commerce. His model also includes adjustments to the B.E.A. coefficients and estimates of sector outputs, taxes and government expenditures. The resulting multipliers developed from this model place forest products firms above the weighted state average multiplier in output, income and employment. Table 2 shows output, income and employment multipliers for the two forest industry sectors from Holmes' model compared with other selected

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TABLE 2. Alabama Output, Income and Employment Multipliers (Type II) For Selected Economic Sectors

Sector	Output	Income	Employment
Textile Mill Products	3.30	2.56	2.56
Wood/Furniture Products	2.95	2.37	2.31
Paper/Allied Products	2.57	2.56	4.11
Food and Tobacco Products	2.75	3.38	4.25
Chemicals/Refined Petroleum	2.08	2.85	4.27
Weighted Average	2.45	1.97	2.05

Source: Holmes 1988

sectors and the weighted average for that multiplier. Forest industry output, income and employment multipliers are larger than the weighted average multipliers for all sectors. In particular, both wood/furniture products and paper/allied products sectors have high income multipliers, wood/furniture products has a high output multiplier and paper/allied products has a high employment multiplier. All multipliers reported by Holmes are Type II, that is they include direct, indirect, and induced changes in output, income or employment due to an increase in economic activity in the various sectors.

Mississippi Forestry

Forestry is the single largest land use in Mississippi and occupies 16.9 million acres. Softwood forest types occupy 4.8 million acres or 28 percent of all commercial forest land, while the oak-pine type occupies 3.5 million acres. When these types are grouped together pine timber is a majo

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a major component of the forest type on 8.3 million acres which accounts for nearly 49 percent of the state's forest land (Donner and Hines 1987). Commercial forest land is well distributed throughout the state with the exception of the Delta region in northwest Mississippi which is primarily agricultural land.

Mississippi's forest resources are almost equally divided between softwood and hardwood. The total volume of growing stock in 1987 was 19.4 billion cubic feet. Of this total 56 percent (9.1 billion cubic feet) is softwood and 53 percent (10.3 billion cubic feet) is hardwood. Similarly, in 1987, the total sawtimber volume on Mississippi's timberland was 73.2 billion board feet, of which 54 percent (39.5 billion board feet) was softwood and 46 percent (33.6 billion board feet) was hardwood.

The ownership of Mississippi's commercial forest land is predominantly PNIF. Approximately 130,000 PNIF owners control 69 percent of Mississippi's forests, representing 11.7 million acres. Forest industry owns slightly less than 20 percent and public agencies own 11 percent of the state's forests.

The Mississippi Forestry Commission (MFC) is the state agency charged by the Mississippi Legislature with fire protection, management of public forest lands, tree seedling production and providing forestry assistance to PNIF owners, upon their request. The commission is headquartered in Jackson and has a network of county foresters in nearly every county of the state. In some cases, such as the Mississippi

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Delta, a county forester may service several counties, but in most cases there is one graduate forester per county. The MFC county forester manages a small crew of technicians and others who provide fire protection, prescribed burning, fire lane construction, tree planting, timber management and other services to county forest landowners.

As in Alabama, forest industry is very important to the economy in Mississippi. Timber has been among the three most valuable agricultural crops in Mississippi for over 10 years. The production value of forest products in 1989 was $717 million (Daniels 1990). Table 3 shows the value of Mississippi's timber harvest since 1982.

In 1982, Mississippi had 1094 forest industry establishments employing 37,200 workers that produced shipments valued at $2.9 billion. These establishments accounted for 35 percent of all

TABLE 3. Annual Timber Harvest Value, Mississippi 1/

Year	Value (Millions $) 2/
1989	717
1988	611
1987	600
1986	478
1985	488
1984	527
1983	484
1982	406

1/ Source: Harvest of Forest Products, Mississippi Cooperative Extension Service, Forest Resources Market Note Series.

2/ Value delivered to the first point of processing such as pulpwood yard or sawmill, rounded to nearest million.

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manufacturing facilities, paid $532.6 million in wages and salaries and produced $1.13 billion in value-added by manufacturing (USDA Forest Service 1988).

In 1986, there were 52,299 workers employed at 1352 forest industry establishments including the lumber/wood products, furniture/fixtures and paper/allied products sectors (Rush 1988).

Porterfield described an input-output study of the Mississippi economy focusing on the forest products sector, based on 1974 and 1975 data (Porterfield, R.L., T.R. Terfehr and J.E. Moak 1978). The study described the forest resources, ownership patterns, forest industry and the importance of PNIF management to future productivity. The analysis also showed that forestry was an important part of the state economy. Output, income and employment multipliers all illustrated forestry's strong influence. Table 4 shows the comparison of the "average" forest industry multiplier with the "average" Mississippi economy multiplier.

TABLE 4. Comparison of Total Forest Industry Multipliers with Mississippi Economy Multipliers

		Multipliers 1/	
	Output	Income	Employment
Total Forest Industry2/	3.56	3.94	4.67
Mississippi Economy	3.74	3.24	3.86

1/ Multipliers shown are an average of Type I and Type II Multipliers

2/ Total Forest Industry Multipliers are the Average of Multipliers From 11Forest Products Manufacturing Sectors

Source: Porterfield et. al. 1978

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The Mississippi Research and Development Center has developed an input-output model for the state economy that contains 92 sectors and utilized both published data and survey data (Lee 1986). In this analysis three forest industry sectors are defined, lumber/wood products, furniture/fixtures and paper/allied products. Lee comments (p. 31) that "Food, furniture, lumber and apparel sectors have high output multipliers. Since food, furniture and lumber are strongly linked to Mississippi's agricultural and forestry sector these sectors' multipliers are larger than other sectors." In a later discussion Lee concludes "the sectors such as food processing, lumber and mining which are strongly connected to the state's agricultural resources or natural resources have comparative advantages in economic development strategies".

Table 5 shows Type II multipliers for forest industry manufacturing sectors compared with the state's weighted average Type II multipliers from Lee (1986).

TABLE 5. Forest Industry Sector Type II Multipliers Compared with Weighted Average Type II Multipliers for all Sectors.

	Type II Multipliers		
	Output	Income	Employment
All Manufacturing	1.910	2.157	2.423
Lumber/Wood Products	2.017	2.089	2.230
Furniture/Fixtures	2.267	1.730	1.786
Paper/Allied Products	1.973	1.964	2.604
Weighted Average	2.045	1.970	2.149

Source: Lee 1986

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The Question of Pine Reforestation

The southern forest industry was built largely on southern yellow pine. It should not be surprising therefore, that interest in pine reforestation has been keen for many years. Several reports have established increased pine reforestation as a necessary goal in southern forestry, particularly pine reforestation on PNIF lands (Southern Forest Resource Analysis Committee 1969, USDA Forest Service 1978).

Concern about the levels of pine regeneration on PNIF lands of Mississippi and Alabama began to rise in the late 1970's and early 1980's (Murphy 1973, Van Hooser 1973, Murphy 1978, Alabama Committee on Forest Productivity 1978, Mississippi Forestry Association 1979, Rudis, et al. 1984). A major concern was the increasing rate of pine timber harvests and the apparent failure of some forest landowners to regenerate pine stands after harvest (Weaver and Bullard 1982, Bullard et al. 1981).

In the early 1980's Mississippi and Alabama both launched formal forest planning efforts. In Alabama, a special legislative forestry study committee was formed and in Mississippi the governor convened a conference on the "Pathways For Forestry". A common conclusion drawn by each of these forest planning efforts was the need for increased pine reforestation on harvested PNIF lands. In Mississippi, a specific reforestation target to reforest 200,000 PNIF acres annually by the year 1990 was established. In Alabama, county forest planning committ

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committees were organized and local teams began working on the reforestation problem.

While emphasis had been placed on pine regeneration on PNIF lands in the planning process, researchers began to study the reforestation situation on PNIF lands to quantify the problem and identify measures that could be useful to stimulate additional reforestation and management. In addition, with an increase in pine plantings anticipated, the availability of genetically improved seedlings also became a concern.

Brissette (1982) was concerned that too little nursery capacity existed to achieve the PNIF reforestation goals and that because of land and other constraints state nurseries were producing at or near capacity.

In the early 1980's, researchers began to focus attention on the PNIF lands of the South. It was becoming clear that PNIF lands had economic investment potential for growing softwood timber, (Adams et al., 1982, USDA Office of Budget and Program Analysis 1983) but PNIF owners largely were not reforesting their harvested pine lands. At the same time, southern softwood timber supply and demand projections (USDA Forest Service 1982 b, Adams et al., 1982) showed increasing demands for southern pine timber and forecast rising real stumpage prices. Subsequently, a more detailed assessment of southern timber supply and demand (USDA Forest Service 1988) predicts softwood timber removals above net annual growth until after the year 2000. This dec

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decline in southern softwood sawtimber availability is projected to increase real sawtimber stumpage prices at an annual rate of 3.2 percent in the South Central region. A detailed review of the southern softwood timber supply and demand literature is given in Appendix A.

A study of 759 southern PNIF owners who had harvested timber between 1971 and 1981 by Royer and Kaiser (1983) revealed many interesting facets of southern PNIF owner's behavior regarding harvesting and reforestation. Partial harvesting (defined as the removal of "only some mature trees....with many larger or mature trees regardless of type remaining on the parcel") was the most widely used harvest method and was used on 46 percent of the acres harvested. Clearcutting or seed tree harvests were used on 32 percent. The most common reasons for harvesting timber were that the owner perceived the timber as mature and was offered a good price. Another important reason expressed for cutting timber (particularly for partial cutting) was the motivation to improve the growth of remaining trees. The dominance of partial harvesting as a preferred cutting method is consistent with PNIF owners' multiple ownership objectives and may imply that this groups' guiding rate of return is different from owners who prefer other harvest methods.

Closer examination of reforestation behavior showed that reforestation activities were most common on clearcut sites, but that site preparation was actually conducted on only 38 percent of these acres.

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The result was that 62 percent of clearcuts were not purposefully reforested. A similar situation occurred on partially cut parcels with no reforestation action taken on nearly 75 percent of these acres.

The major motives for reforesting were the belief that the land should be kept in timber, anticipated profits, and the advice of a forester. The primary reason for not reforesting was a belief that pine would come back naturally. Cost-sharing was a modest incentive to reforest, but it was most common among owners reforesting clearcuts.

The conclusions of this study pointed to the fact that pine reforestation on PNIF lands needed more emphasis if the full potential of the South's pine resource was to be realized. The authors cited a need for increased education among PNIF owners in the South regarding silvicultural choices. In addition, a majority of landowners apparently did not recognize the need for pine regeneration.

In another article, Kaiser and Royer (1983) identified the most important barriers to southern pine reforestation. To identify why southern landowners were not investing in pine reforestation, interviews were conducted with owners of harvested forestland from 13 southern states. Their survey of harvested southern ownerships showed that 64 percent of the acres were left to reforest themselves. On 4 of 5 acres in the South that were not actively reforested the lack of pine reforestation can be attributed to the owner's belief that the site would naturally reforest itself. Other important reasons for not reforesting were "high costs

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costs" (51 percent of acres), "returns too far in the future" (43 percent of acres), "other uses for harvest income" (40 percent of acres) and "returns from forestry being too low" (34 percent of acres). These reasons were considered important by the authors, reflect economic perceptions and imply differences in time preference (reflected in their guiding rate of return) among southern landowners. They are economic and financial constraints on forest management even after the need to reforest is established in the minds of these landowners. This study showed that a combination of high costs and low or delayed returns is a significant obstacle to pine reforestation.

A group of factors of less importance to reforestation decisions also included: poor productivity of the land, fire, insect and disease risks, poor condition of the site following harvest, too much difficulty getting assistance, lack of cost-sharing and indecision about future land use. It is interesting to note that 27 percent of the acres harvested was owned by individuals who consider the "red tape" associated with getting assistance on forest management as being too cumbersome. The authors concluded that (p. 10) "reshaping the perceptions of the owners of 80 percent of the harvested lands in the South is central to the question of pine reforestation." From a policy viewpoint, it appears that institutional changes in cost-sharing program administration and increased educational initiatives for forest landowners in combination with the usual tax incentives and cost-share funding are needed to stimu

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stimulate reforestation among a major segment of southern PNIF owners. Though this segment of southern owners has been identified, public policy changes have essentially been confined to tax changes and cost-share funding.

Dutrow and Kaiser (1984) outlined the potential economic opportunities for southern PNIF forestry investments considering the U.S. Forest Service RPA Assessment projections (USDA Forest Service 1981a) that timber demand will rise faster than supply. The broad groups of forestry investments described included: stocking control (such as prescribed burning, precommercial and commercial thinnings and release), stand conversions, regeneration of non-stocked acres, regeneration of hardwoods and regenerating mature or overmature softwoods. Expected financial returns in real terms were provided. Stocking control in existing stands ranked highest with an 18 percent real rate of return on investment while regenerating hardwood stands was ranked lowest (though still profitable) at 8 percent real rate of return. Analysis of data for the South indicated that over 88 million acres of nonindustrial ownerships promise returns of 4 percent or more above the level of inflation with 50 percent of these acres offering returns of 10 percent or more. In Alabama, about 13.6 million acres would return at least 4 percent and 9.3 million acres would yield at least 10 percent above inflation. For Mississippi, these figures are cited as 9.1 million acres at 4 percent and 5.5 million acres at 10 percent or less.

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The conclusion drawn by the authors is that investments in growing timber can be profitable, particularly in the South, though large initial capital commitments, long time periods and lack of firsthand knowledge seem to be limiting factors on PNIF lands. The authors urged governments to continue efforts to provide information and assistance to all timberland owners and do what is necessary to improve the investment climate for the private sector.

Recognizing these opportunities and considering the problems of conventional agriculture (overcapacity, soil erosion, low prices, poor market outlook) Congress established the Conservation Reserve Program (CRP) as part of the Food Security Act of 1985 (Public Law 99-198). This law authorized the Secretary of Agriculture to retire land from crop production to conserve and improve the soil and water resources of farms and ranches. The law was authorized for crop years 1986 to 1990 and cumulative reserve lands are intended to equal not less than 40 million and not more 45 million acres in the U.S. (Cubbage and Gunter 1987). A major goal under the CRP is the reduction of soil erosion. To accomplish this objective, the plan proposed to convert highly erodible cropland, previously devoted to agricultural crops to a less-intensive use such as permanent grass or trees. The measure provides for annual rental payments to enrolled landowners for a ten year period. The amount of annual payments is determined through a competitive bidding procedure conducted at the state level. In addition, cost-sharing funds were

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were made available to assist enrolled landowners establishing trees or other permanent cover.

Through the first four sign up periods (March, 1986 - February 1987) about 1,136,000 acres (5.8% of the total CRP enrollment) had been accepted for tree planting, nationwide. Of this total, approximately 1,020,000 acres (89%) were located in the southern states from Arkansas and Louisiana east to South Carolina and Florida (Moulton and Dicks, 1987). Table 6 shows the CRP acres devoted to tree planting in the Southern states through the first nine signup periods, ending in August, 1989. Alabama and Mississippi are among the top three tree planting states under the CRP.

TABLE 6. Conservation Reserve Program Tree Planting Acres Accepted (August, 1989)

State	Total
Alabama	278,475
Arkansas	125,696
Florida	112,065
Georgia	608,047
Louisiana	71,447
Mississippi	428,115
North Carolina	81,411
South Carolina	208,730
Tennessee	27,107
Texas	18,322
Virginia	28,055
Total	1,987,470

Source: Agricultural Stabilization and Conservation Service

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The CRP tree planting effort should be a significant boost to southern softwood timber supplies if the experience of the Soil Bank Program (1956-1960) is predictive of the way today's forest landowners will behave. These forests tend to remain after the annual payments cease (Alig et al. 1980). A study of soil bank tree planting in South Carolina reported a real social internal rate of return of 6.3 percent. (Marsinko and Nodine, 1981) However, though CRP is a major reforestation effort and will add approximately 706,590 acres of new forest in Mississippi and Alabama, the problem of PNIF reforestation after harvest remains. Though hundreds of thousands of southern acres have been planted to trees under the CRP reforestation on cutover lands has continued to lag behind.

A number of researchers have followed the work of Royer and Kaiser (1983) by examining those factors that were shown to influence PNIF owner reforestation behavior. Royer and Kaiser (1985) found that where a professional forester is consulted, regeneration and harvesting decisions tend to improve, but that this guidance has had only limited effects because too few landowners were receiving such assistance. The authors concluded that the public forester's role in the South should shift from one of giving technical assistance to one of promoting forest management and regeneration among more landowners.

Cubbage, et al. (1985) evaluated the impact of state assistance foresters in the Georgia Piedmont and showed that tracts that assistance fores

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foresters marked selectively had significantly more residual volume after harvest than tracts where no professional foresters were involved. Assisted landowners also received nearly twice the stumpage price per unit for their timber than did unassisted landowners.

A study in Mississippi (Straka, et al. 1986) concluded that significant economic benefits can be attributed to forest management promotion activities by state service foresters among PNIF owners. Benefit/cost ratios were reported from 3:1 up to 20:1 using real discount rates between 4 and 10 percent. Among other accomplishments a Mississippi Forestry Commission service forester annually stimulated site preparation on 1,238 acres and reforestation on 1,152 acres.

A survey of forestry assistance in Georgia also found foresters to be effective in assisting PNIF owners (Cubbage and Hodges 1986). Industry foresters tended to work fewer, but larger ownerships, (average tract size between 636 and 1,533 acres) while state foresters worked smaller ownerships (average tract size 131 acres) and consultants dealt with ownerships between these extremes (average tract size 376 acres). The study notes that one-quarter of PNIF lands in Georgia received some forestry assistance in 1983. However, though a large acreage was under management, less than 15 percent of the annual volume harvested came from forester-associated cases. In addition, planned reforestation represented only one third of the total harvested PNIF acreage each year.

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A study by Fesco, et al. (1987) reinforces the importance of private, nonindustrial forest land owners in the South and the need for reforestation. Based on a survey of PNIF owners from 12 Southern states who harvested pine timber between 1971 and 1981, nearly 90 percent of the forestland harvested was held as a family operation. Four of five of these harvested acres were owned by those who hope to pass their holdings on to their heirs. In addition, the survey showed that 80 percent of the clearcut or partially cut acres, ("thinned" acres were assumed not to need reforestation) were not actively reforested. The authors reported that approximately 75 percent of the harvested acres were not actively reforested because the owners largely felt that the site would reforest itself. The authors commented that (p. 79) "Southern pine reforestation depends on reshaping the perceptions of those who own some three-quarters of the clear and partial cut lands that are not actively reforested." They concluded that (p. 80) "assuring an adequate supply of Southern pines in the future will require not simply a change in public policy but a change in attitude [of these owners] as well." The principal public policy changes reported that landowners said would stimulate investment in pine reforestation were lower property taxes and increased cost-sharing. Nearly 80 percent of harvested timberland was owned by an individual who said lower property taxes would have a high or moderate effect on their decision to reforest. Reforestation decisions on 60 percent of the harvested acres would be highly or moderately affected

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by the increased availability of cost-share funds. Tax issues and cost-sharing were the only public programs rated highly or moderately effective by the surveyed landowners of more than half the harvested acres. However, public program options such as increased educational funding were not considered even though the need for an attitude change was identified as a major problem.

Rosen and Doolittle (1987) characterized PNIF owners in the Mid South (including Mississippi and Alabama) and commented on the well documented failure of these owners to regenerate pine stands. They describe Mid South PNIF tracts as poorly stocked with low timber volumes per acre. The authors offer these characteristics combined with relatively small areas in pine reforestation and disproportionately large areas of upland hardwoods as further evidence of PNIF reforestation failure.

After increasing concern about PNIF pine reforestation and much research, precise estimates of reforestation after harvest vary. Fesco, et al. (1987) concluded that 46 percent of southern PNIF owners that had harvested pine stands actually implemented reforestation practices such as planting, seeding, or leaving seed trees. The South's Fourth Forest Report (USDA 1988) estimates that about half of all clearcuts on PNIF pinelands are followed by adequate reforestation practices. A recent study of timberland harvested in Mississippi between 1977 and 1987 (McWilliams 1988) concluded that 83 percent of the harvested pine and mixed

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mixed pine hardwood stands that had poor regeneration were held by PNIF owners. In another study of residual pine stocking after harvest on private land in six southern states including Mississippi and Alabama (McWilliams 1989) the estimated success rate for pine regeneration ranged between 31 and 57 percent on PNIF land. The study indicated that the pine regeneration situation was improving and that 48 percent of harvested pine stands on PNIF lands had high pine stocking (a stand was classified as high stocking if it was greater than 60% pine).

The condition of southern forestlands and trends in softwood inventory have caused pine reforestation on private, nonindustrial land to be a major concern (McWilliams 1990). Though Conservation Reserve Program (CRP) tree planting has been significant, reforesting harvested acres will continue to be an essential priority in the South.

In Mississippi and Alabama CRP tree plantings have been among the highest of any state in the nation. However, a comparison of tree planting acres in the CRP with non-CRP acres suggests that PNIF reforestation rates for other lands such as cutover stands may be unsatisfactory. Tables 7 and 8 show CRP tree planting as a portion of PNIF tree planting in Mississippi and Alabama between 1985 and 1989. Since CRP acres are former cropland, non-CRP acres should reflect reforestation of lands recently harvested. In Mississippi and Alabama, non-CRP acres have fallen below planting levels seen prior to CRP.

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TABLE 7. Private Nonindustrial Forest Plantings and Conservation Reserve Plantings - Mississippi (acres)

Year	PNIF	CRP[1]	Non CRP	%CRP	Total
1985	101,743	0	101,743	0	231,260
1986	114,947	0	114,947	0	218,292
1987	151,600	81,781	69,819	53.9	260,615
1988	250,882	152,013	98,869	60.6	356,175
1989	148,916	67,632	81,284	45.4	266,021
1990	——	102,389	——	——	——

[1] Conservation Reserve Planting estimates from ASCS. Accepted tree planting contracts in a particular year were assumed to be planted in the following year.

Source: USFS Planting Reports and Mississippi Forestry Commission.

TABLE 8. Private Nonindustrial Forest Plantings and Conservation Reserve Plantings - Alabama (acres)

Year	PNIF	CRP[1]	Non CRP	%CRP	Total
1985	65,200	0	65,200	0	223,608
1986	122,600	0	122,600	0	307,600
1987	179,200	83,066	96,134	46.3	376,200
1988	142,720	97,741	44,979	66.1	301,135
1989	94,273	63,939	30,334	67.8	255,872
1990	——	33,729	——	——	——

[1] Conservation Reserve Planting estimates from ASCS. Accepted tree planting contracts in a particular year were assumed to be planted in the following year.

Source: USFS Planting Reports and Alabama Forestry Commission.

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Assessments of southern softwood timber supply and demand have shown rising harvest levels and declining softwood inventories. Reforestation rates after harvest on Mississippi and Alabama PNIF lands have apparently declined recently. The lack of pine reforestation after harvest on southern PNIF lands has been cited as a major factor in regional declines of southern pine net annual growth and inventory and pine type acreage changes. Increased pine reforestation and management on PNIF lands will provide economic benefits to Alabama and Mississippi. However, many private, nonindustrial owners perceive that returns on forestry investments (even cost-share investments) are low and that getting cost-share or other forestry assistance is too difficult. State-specific economic analysis is needed to demonstrate the economic attractiveness of cost-share pine reforestation investments and to guide landowners in selection of the most profitable sites for their investments.

PNIF owners also need detailed information about the availability of pine seed, seedlings and reforestation services. This information will help landowners efficiently access goods and services needed to reforest harvested forestlands and assist state forestry agencies in planning for the future.

Research Objectives

The objectives of this study are:

1) To analyze pine seed availability, nursery capacity, pine seedling production and site preparation/tree planting services in Alabama

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and Mississippi as potential limiting factors on PNIF pine reforestation.

2) To analyze the economic profitability of cost-shared pine plantation investments in Mississippi and Alabama using improved or unimproved seedlings on four site quality classes in six stumpage price regions.

3) To analyze the sensitivity of the analysis to changes in the discount rate.

4) To identify the most profitable sites for pine plantation investments in Mississippi and Alabama.

Research Methods

Information available from public forestry agencies, private industry and the literature was used to construct descriptions of pine seed availability, tree nursery capacity, pine seedling production and site preparation/tree planting services availability in Alabama and Mississippi. The availability of these "plantation inputs" is examined to assess their potential as limiting factors in PNIF pine reforestation in Alabama and Mississippi.

Net Present Value (NPV) analysis was used to determine the economic profitability of pine plantations in Alabama and Mississippi. A series of pine plantation budgets was prepared for each state using YIELD plus, a timber yield and financial analysis microcomputer program

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(Hepp 1982). The budgets were calculated for marginal cropland and harvested forestland situations on four site quality classes, six stumpage price regions (three per state) and for improved or unimproved seedlings. These budgets were constructed using a 4 percent real discount then the plantations were evaluated at 6 and 8 percent real discount rates to compare the sensitivity of the results to discount rate. A detailed description of these budgets follows in a later chapter.

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CHAPTER TWO: PLANTATION PRODUCTION INPUTS

Reforestation, particularly on PNIF lands is important to Alabama and Mississippi forestry. Lack of adequate pine regeneration on harvested PNIF land has been identified as a major cause of the regional decline in softwood growth. Many variables are important in the reforestation decision, on the human side and the economic side. These decisions have a significant effect on the southern forest.

Equally important, however, are the delivery systems that must be available to perform the regeneration tasks once an owner decides to reforest. Site preparation contractors and tree planters must be easily available at reasonable cost. In addition, for the tree improvement potential to be realized efficient nurseries must produce high quality improved seedlings that are available to PNIF owners. It is essential that the mechanism for tree planting be completely functional and efficient because pine reforestation is accomplished almost exclusively by tree planting. For example in 1984, 97 percent of all reforested acres in the South were accomplished by tree planting. In 1987, in Alabama and Mississippi, the tree planting percentage of reforested acres was 99 and 98 percent, respectively.

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The purpose of this chapter is to examine the major components of the delivery system for artificial pine reforestation in Alabama and Mississippi. Are the tree planting system components adequate? These components include seed, seedlings, nursery capacity, site preparation contractors and tree planting contractors. If PNIF owners are stimulated to increase reforestation on harvested lands, individual states must have efficient nurseries to deliver high quality, improved seedlings, and contractors must be available to do the work. If any of these is lacking or in limited supply the production of plantations will be constrained. Therefore, it is useful to examine the status of each component within Mississippi and Alabama to identify potential "bottlenecks" in the plantation production process.

Pine Seed Availability

Before genetically improved seedlings can be grown, reliable supplies of genetically improved seed must be available. The following questions then arise: what improved seed is available (especially for production of trees available to PNIF owners); at what cost; and who has access to it?

Forest industry firms were the first to invest heavily in tree improvement programs through the industry cooperatives formed at universities such as North Carolina State and Texas A & M. Hence, industry has the greatest amount of improved seed available from company seed orchards. Table 9 shows the ownership of southern pine

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TABLE 9. Ownership of Southern Pine[1] seed orchards in southern states.[2]

State	Ownership Category (Acres)				
	State	Federal	Forest Industry	Private	Total
Alabama	357[3]	0	565	0	922
Arkansas	78	283	171	0	532
Florida	739	0	1,382	0	2,121
Georgia	645	0	762	0	1,407
Louisiana	335	210	491	0	1,036
Mississippi	284[4]	330	185	0	799
North Carolina	85	78	453	0	616
Oklahoma	41	0	176	0	217
South Carolina	188	136	420	0	744
Tennessee	168	8	88	5	269
Texas	210	0	438	0	648
Virginia	359	0	199	0	558
Total	3,489	1,045	5,330	5	9,869
Percentage	35	10	55	0	100

[1] Southern pine includes Loblolly, slash, shortleaf and longleaf pines only.
[2] Source: USDA Forest Service 1982a.
[3] Alabama Forestry Commission as of September 1987.
[4] Mississippi Forestry Commission as of September 1987.

seed orchards in the southern states. This seed, however, is company property and is used exclusively to produce trees to be planted on company lands. Weyerhaeuser seedlings planted in Mississippi, for example, are grown at nurseries outside Mississippi from improved seed harvested in company seed orchards. Some improved seedlings are made available to private landowners each year by forest industry, but the seed is not generally available. Therefore, the most advanced source of genetica

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TABLE 10.

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of genetically improved seed is privately owned and not for public use. It is also interesting to note that in 1981, 70 percent of all seed orchards in the U.S. were southern pine and of southern pine orchards, 88 percent were either Loblolly or slash pine.

Most state forestry agencies in the South have been engaged in active tree improvement programs for many years. The Mississippi Forestry Commission tree improvement program has lagged behind some of the leading states, such as Florida and Georgia. Table 10 shows the distribution of seed orchard ownership in Mississippi. Currently, MFC

TABLE 10. Mississippi southern pine seed orchard ownership.

	Ownership Category (Acres)				
Species	State[1/]	Federal	Forest Industry	Private	Total
Loblolly pine	209	107	113	0	429
Slash pine	75	102	72	0	249
Shortleaf pine	0	11	0	0	11
Longleaf pine	0	110	0	0	110
Total	284	330	185	0	799
Percentage	35	41	24	0	100

[1] Mississippi Forestry Commission as of September 1987.
Source: USDA Forest Service 1982.

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has 284 acres of grafted southern pine seed orchards. MFC began producing improved Loblolly pine seedlings from its own orchard seed in 1986 but it will be several years before the reliance on "woods run" seed is eliminated. The U.S. Forest Service has a large seed orchard in south Mississippi but that seed is used primarily to produce seedlings for the national forests. Also, there is a small acreage of forestry industry orchards in Mississippi.

Improved pine seed is available on the open market in limited quantities (Bell 1985). International Forest Seed Company (IFS) of Odenville, Alabama fills orders for improved seed of Loblolly, Slash, and Virginia pines. The source of IFS Company improved seed is forest industry surplus. IFS Company contracts with forest industry firms to clean orchard seed and acts as broker to sell excess seed when a particular firm has more than they need. Most improved seed is sold to other forest industry firms but some is sold to state nurseries. Availability of improved pine seed depends on seed orchard cone crops and seed yield in any particular year, seed source required and amount needed. Also, improved seed is much more costly than "woods run" seed. IFS Company offers first generation improved Loblolly pine seed (clonal orchard origin) for about $40 per pound, depending on availability and quantity ordered. These costs are twice that of "woods run" seed which the company sells for about $18 to $20 per pound.

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State forestry agencies purchase some improved pine seed from seed dealers, but budget constraints can limit the quantities. Typically, the state nursery superintendent has need for a definite amount of seed and only a limited amount of money to spend. Since he can get twice the amount of seed if he purchases "woods run" as opposed to improved, there is incentive to buy "woods run" seed. In addition, some agency foresters are hesitant to buy "improved" seed from a dealer because they do not know exactly what improvement they can expect. In Mississippi's case, improved seed costs are prohibitive. So, MFC procures their pine seed by purchasing cones from individual collectors across the state through county forestry offices. Seed yield and costs vary from year to year but MFC reports that seed acquired by this method costs about $14 per pound. MFC intends to use this procurement process until their seed orchards produce enough improved seed to supply their nursery needs.

The Alabama Forestry Commission's tree improvement program was begun earlier and has progressed further than Mississippi's. The AFC has 357 acres of seed orchards under management with a major goal of the program to produce genetically improved seed for AFC nurseries. Table 11 shows the seed orchard capacity by ownership class in Alabama. It is interesting to note the much larger industry seed orchard acreage in Alabama than in Mississippi. Since 1981, AFC nurseries have been producing a minimum of approximately 20 percent improved pine seedlings from their own orchard seed. The balance of

TABLE 11. Alabama sc

Species
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TABLE 11. Alabama southern pine seed orchard ownership.

Species	Ownership Category (Acres) State[1]	Federal	Forest Industry	Private	Total
Loblolly pine	210	0	481	0	691
Slash pine	95	0	56	0	151
Shortleaf pine	7	0	10	0	17
Longleaf pine	45	0	18	0	63
Total	357	0	565	0	922
Percentage	39	0	61	0	100

[1] Alabama Forestry Commission as of September 1987.
Source: USDA Forest Service 1982a.

improved seedlings are produced from improved seed purchased on the open market. AFC's goal is to produce enough improved seed in its own orchards to completely supply Commission nurseries with improved seed by 1990 (Alabama Forestry Commission, 1983).

Unlike Mississippi, the Alabama Forestry Commission has elected to purchase improved seed on the open market to supplement its own improved seed production. Contracts for improved seed purchases are announced and interested firms submit bids on those contracts. The low bid firm that meets the seed contract specifications is awarded the contract. Contract specifications require that all seed be first generation improved seed of specified germination capacity, but they need not be certified as to degree of improvement. Some improved seed purchases are made from tree

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are made from tree seed companies while others may be purchased from forest industry firms directly depending upon who submits the winning bid. The only seed collection AFC does from the wild is for a small amount of hardwood tree seed and occasionally a few longleaf pine cones

In summary, the supply of genetically improved pine seed to PNIF ownerships in Mississippi and Alabama is constrained by cost barriers and ownership of improved seed orchards. Both states have active seed production programs that should provide sufficient quantities of improved pine seed within 10 years. While Alabama has chosen to supplement its improved seed supply by open market purchases from industry, Mississippi has not because of budget constraints and concerns about the quality of improvement that can be obtained when purchased seed are not certified.

Nursery Capacity

The number of acres committed to tree seedling production in a state is not a complete measure of that state's tree seedling supply because seedlings for planting can be easily shipped from outside state borders. Interstate shipment of seedlings is routinely done by forest industry nurseries but much less among state-owned nurseries. It is useful, therefore, to examine state nursery capacity within the context of regional nursery capacity since in-state seedling production does form the bulk of the supply of trees available to PNIF owners.

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Forest tree nurseries fall into four categories: federal, state, forest industry, and other private. The only federal nursery in the South is Ashe Nursery in south Mississippi. It's production is used for reforestation needs on National Forest lands although on occasion surplus seedlings may be sold to others in need of seedlings. The federal contribution to seedling production is small and to PNIF supply is virtually nil.

State nurseries are owned and operated by the various state forestry agencies and produce a major portion of seedlings used for reforestation within their state, both on forest industry lands and PNIF lands. In fiscal year 1980 (1979-80 planting season), state nurseries produced 45 percent of all seedlings grown in the South. In fiscal year 1981, of the seedlings produced by state nurseries (602 million pine) 55 percent were available to PNIF owners and 45 percent were grown on a contract basis primarily for forest industry (Brissette, 1982). In the past, forest industry had many of their seedlings contract-grown by state nurseries but in the last 15 years many forest industry firms have established their own nurseries and have relied much less on the states to produce seedlings for them.

Forest industry nurseries now form the major part of the South's nursery capacity accounting for about 45 percent of existing nursery acres, concentrated most heavily in Georgia, South Carolina, Florida, Texas, and Alabama. The forest industry nursery system now has 2,571 acres in the South compared to 2,566 acres in state nurseries (Figure 1).

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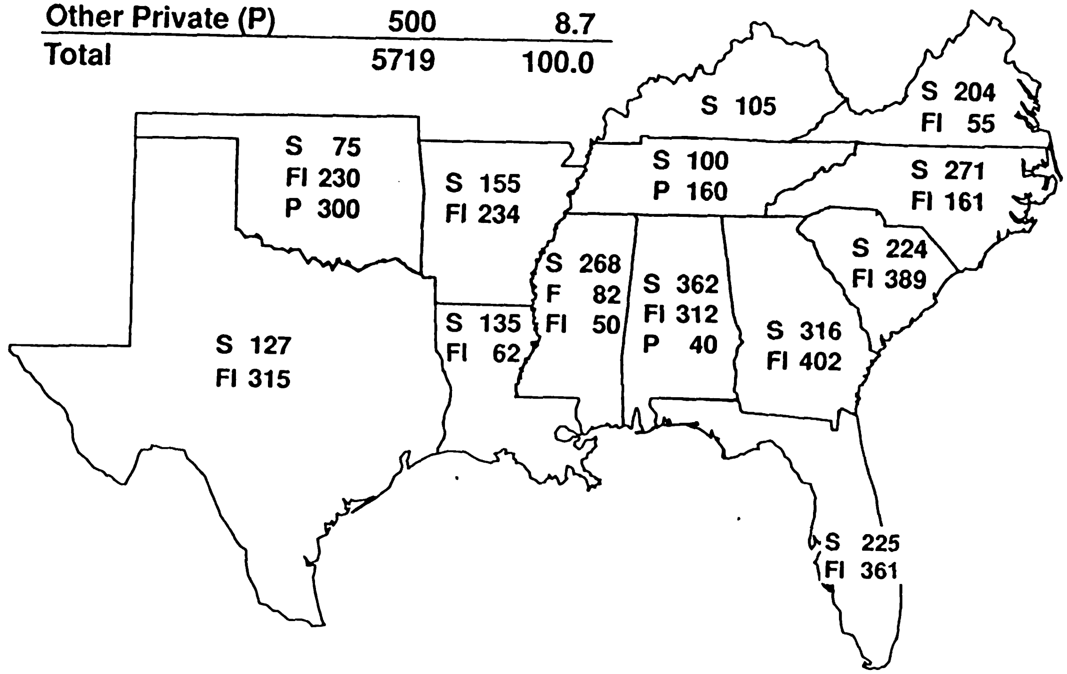
Other private nurseries form another small portion of production capacity (8.7%) and primarily produce hardwood tree seedlings for the ornamental and landscaping industry. Appropriately then, the discussion of nursery capacity centers on state and forest industry nurseries since they form about 90 percent of all pine seedling production capacity in the South.

The State of Mississippi has relatively few nurseries. The Mississippi Forestry Commission operates tree nurseries at Mount Olive, Waynesboro and Winona. Pine seedling production predominates, accounting for 99 percent of seedling production but the Winona nursery does produce some hardwood seedlings each year. The pine seedlings produced at the MFC nurseries are sold at or near cost to forest landowners through the county forester's office. The expressed purpose of state tree nurseries is to provide seedlings for reforesting private forestlands.

The MFC nurseries occupy a total of 268 acres and produced 68.4 million seedlings in 1985. The nurseries are operated on two years of seedling production then one year fallow to maintain soil organic matter and fertility. Seeding production of MFC nurseries has approached the maximum annually, for the past three years but under this management regime the annual production limit of MFC nurseries is 70 million seedlings.

	Acres	Percent
State (S)	2566	44.4
Forest Industry (FI)	2571	44.9
Federal (F)	82	2.0
Other Private (P)	500	8.7

	Acres	Percent
State (S)	2566	44.4
Forest Industry (FI)	2571	44.9
Federal (F)	82	2.0
Other Private (P)	500	8.7
Total	5719	100.0



Source: USDA Forest Service 1982a, American Association of Nurserymen, 1981

Figure 1. Regional Tree Seedling Production Capacity

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A more intensive management regime would require a more intensive soil management program to maintain fertility. If the Mississippi reforestation goals established in the Pathways for Forestry in Mississippi report (Mississippi Forestry Commission 1985) are to be met, other seedling sources must be available. New production from state nurseries would require funds to establish another nursery or to further intensify the management of existing nurseries. Neither seems likely given the shrinkage of state agency budgets in recent years (Table 12). In 1984, MFC spent nearly $1.5 million to upgrade facilities such as packing sheds and storage facilities at its nurseries, but these improvements have not increased the number of seedlings available.

TABLE 12. Mississippi Forestry Commission Nursery Funding.[1] (Dollars)

Fiscal Year*	Total Budget	New Capital Improvement
1982	1,023,900	0
1983	1,983,873	0
1984	2,629,376	1,464,555
1985	1,290,236	4,526

* MFC fiscal year is from July 1 to June 30.

[1] Source: Mississippi Forestry Commission, 1987

Forest industry nursery capacity in Mississippi is virtually nil. Two small forest industry nurseries are currently operating. The 20-acre International Paper Company nursery at Natchez is a research facility. The former Leaf River Forest Products nursery in Wayne County is the only forest industry

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only forest industry nursery in Mississippi producing pine seedlings. Total annual production on 20 acres is about 11 million seedlings for planting on company lands. Essentially, all industry-grown pine seedlings planted on company lands or on private land are shipped in from other states such as Alabama, Arkansas, Texas, and the Carolinas.

The State of Alabama has nearly twice the forest nursery capacity of Mississippi. In all, about 714 acres are devoted to tree seedling production in Alabama. The Alabama Forestry Commission operates three forest nurseries totaling 362 acres. The nurseries are located at Atmore, Opelika and Autaugaville and produced about 64 million seedlings in fiscal year 1984.

AFC expanded the Hauss Nursery at Atmore, Alabama in 1986. This expansion added 230 acres of seedling production capacity and increased seedling production by 25 million trees beginning in 1988. In addition, AFC recently located a fourth nursery site in North Alabama to produce an additional 35 to 50 million seedlings. These increases in capacity have been planned in anticipation of future seedling shortages.

Like Mississippi, Alabama's public nurseries were established to provide seedlings for planting on private forestland though about 10 percent is contract production for forest industry. In Alabama, each AFC nursery generates operating funds from seedling sales but the AFC state office provides funding for capital improvements. Stronger funding in the past few years (Table 13), has allowed AFC to commit funds for nursery improvement and e

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improvement and expansion as well as improving nursery equipment and purchase of improved seed on the open market for seedling production.

TABLE 13. Alabama Forestry Commission Nursery Funding.[1] (Dollars)

Fiscal Year*	Total Budget	New Capital Improvement
1981	1,023,679	0
1982	1,189,045	0
1983	1,296,766	0
1984	1,250,466	0
1985	1,567,803	0
1986	1,714,000	750,000
1987	1,868,480	500,000

* MFC fiscal year is from October 1, to September 30.

[1]Source: Alabama Forestry Commission, 1988

AFC expects to be self sufficient in improved seed by about 1990. Currently, all Virginia, Loblolly and Slash pine seedlings produced in AFC nurseries are improved seedlings. Of these, all the improved Virginia and Slash pine seed come from AFC seed orchards while only half the Loblolly seed is from AFC sources. The other improved Loblolly seed is from open market purchases.

In an effort to provide as many improved seedlings to Alabama landowners as soon as possible AFC has been using all "in house" improved seed tha

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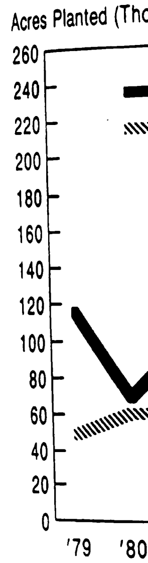
improved seed that is available. Consequently, unlike Mississippi, no seed is currently in storage. AFC does, however, intend to build a 3-year supply as seed supplies increase.

Forest industry nurseries are plentiful in Alabama. Five forest industry firms operate nurseries totaling 312 acres. These nurseries produce pine seedlings for operations on company land primarily, but a certain percentage of these seedlings eventually get planted on PNIF lands.

Usage of Southern Pine Seed and Seedlings

In Mississippi, the total number of acres planted has risen steadily since 1980-81 from 150,442 acres to 266,021 acres in 1988-89. That is a 76 percent increase in 9 years. In Alabama, there has also been a marked increase in acres planted since 1980, though the total faltered slightly in 1984. Total acres planted has increased from a low of 133,849 acres in 1979-80 to a peak of 376,200 acres in 1986-87 with 255,872 acres planted in 1989. As in Mississippi, this represents a large increase in 8 years. Much of these increases in planting is due to an increase in PNIF planting (Figure 2). In Mississippi, forest industry planting declined from 1982 until 1987 when it rebounded somewhat. Mississippi PNIF planting has been increasing since 1983 and has actually surpassed industry planting totals since 1985. In Alabama, both industrial and PNIF planting have continued to increase since 1980 and in 1986-87 PNIF and industry planting totals were nearly the same.

Alabama



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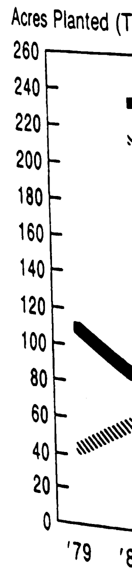

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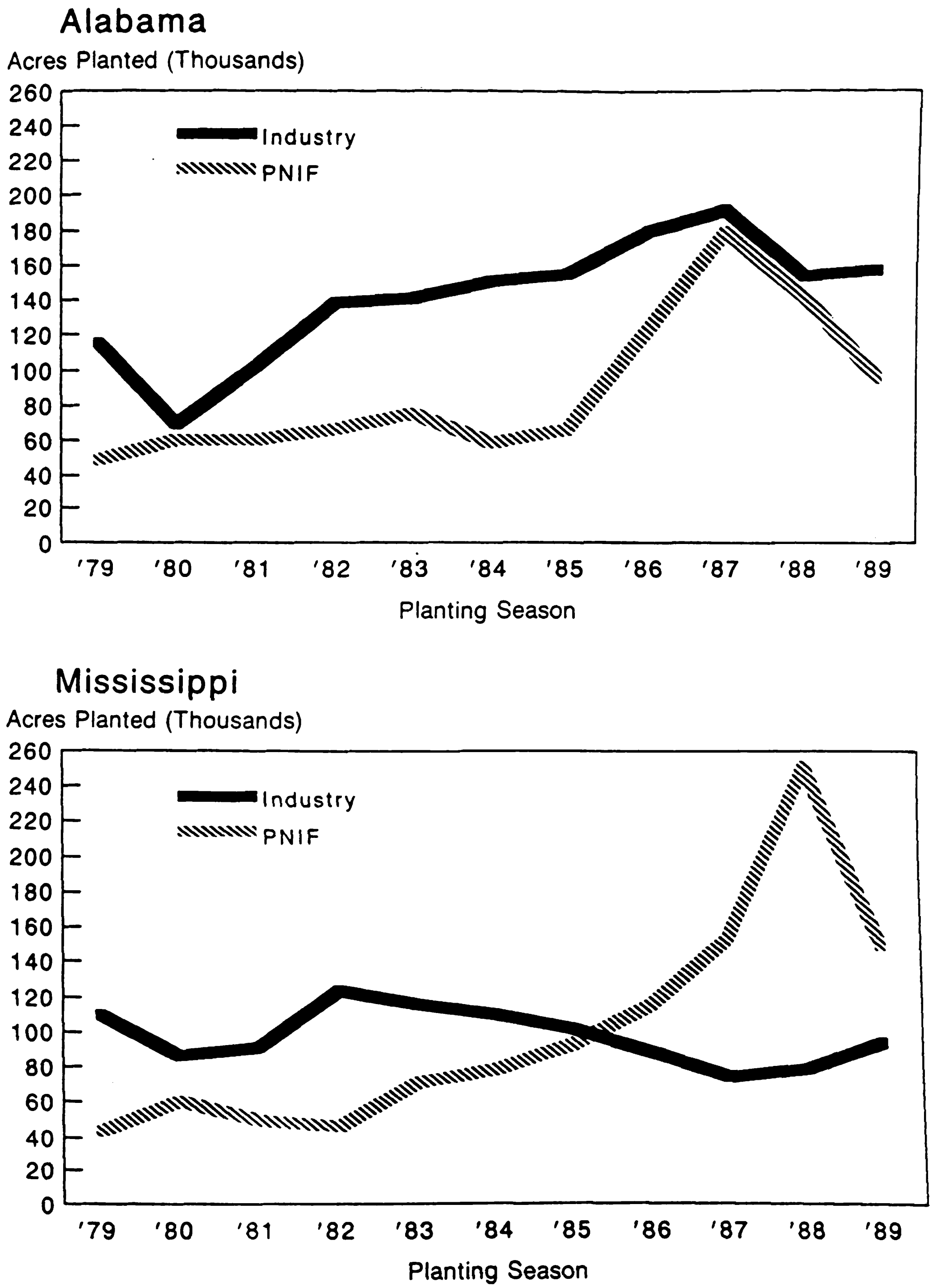

Figure 2. Reforested acres in Mississippi and Alabama 1979 – 1989

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We can estimate the number of seedlings required to plant these acres by using the fact that all PNIF and public acres were planted with 726 seedlings per acre in those years. (Recently, the minimum number of seedlings planted per acre has been lowered to 700.) Industry acres usually plant fewer trees per acre, say 700 on average.

Table 14 shows the number of seedlings used to plant the total acres for Mississippi and Alabama for the years 1980 through 1989. These figures are conservative since they do not account for seedlings lost due to mishandling or wasted in any other way or replanting done because of plantation failure.

Table 14 shows the steady increase of total seedlings used in pine regeneration in Mississippi and Alabama from 1980 to 1989. Though usage has slowed recently, seedling usage remains well above early 1980's levels.

A more detailed breakdown of seedling usage, however, in Mississippi and Alabama shows differences between industry and PNIF seedling usage since 1980. Grouping PNIF, Federal and Other Public tree planting into one group and comparing it with forest industry planting reveals seedling use trends for forest industry and private landowners.

TABLE 14. Seedlings

Year	Acres thousan
1980	155.0
1981	150.4
1982	181.2
1983	196.9
1984	203.8
1985	211.8
1986[2]	218.2
1987[2]	260.6
1988[2]	356.1
1989[2]	266.0

[1] Assumes 800 trees
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TABLE 14. Seedlings planted in Mississippi and Alabama, 1980-1989

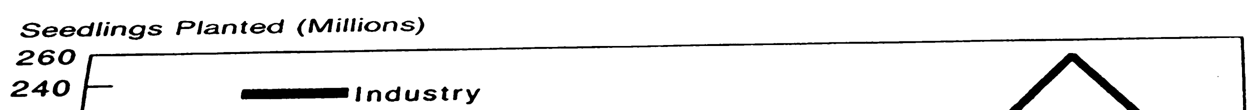
Year	Mississippi		Alabama	
	Acres thousands	Seedlings[1] billions	Acres thousands	Seedlings[1] billions
1980	155.0	155.3	133.8	100.1
1981	150.4	111.3	163.6	120.8
1982	181.2	132.7	207.0	151.8
1983	196.9	146.1	220.0	162.0
1984	203.8	152.1	212.2	154.8
1985	211.8	159.3	223.6	163.3
1986[2]	218.2	152.8	307.6	215.3
1987[2]	260.6	182.4	376.2	263.3
1988[2]	356.1	249.3	301.1	210.7
1989[2]	266.0	186.2	255.8	179.1

[1] Assumes 800 trees per acre for PNIF and Public ownerships and 700 trees per acre for industry ownership.

[2] Seedling totals calculated assuming 700 trees per acre for all ownership to reflect regulation change by state forestry agencies to allow fewer seedlings per acre.

Figure 3 shows the forest industry and PNIF/Public seedling usage trends in Mississippi as part of total Mississippi seedling usage. This graph clearly shows the upward trend in PNIF/Public seedling needs from 1982 to 1988 with the fall in 1989.

Similarly, Figure 4 shows seedling usage trends for the forest industry and PNIF/Public groups in Alabama. These Alabama trends are similar to Mississippi. The PNIF/Public seedling need rose significantly from 1985 to 1987 in response to the CRP and a new state cost-share program but PNIF plantings fell between 1987 and 1989. Forest industry


Seedlings Planted (Millions)
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Industry

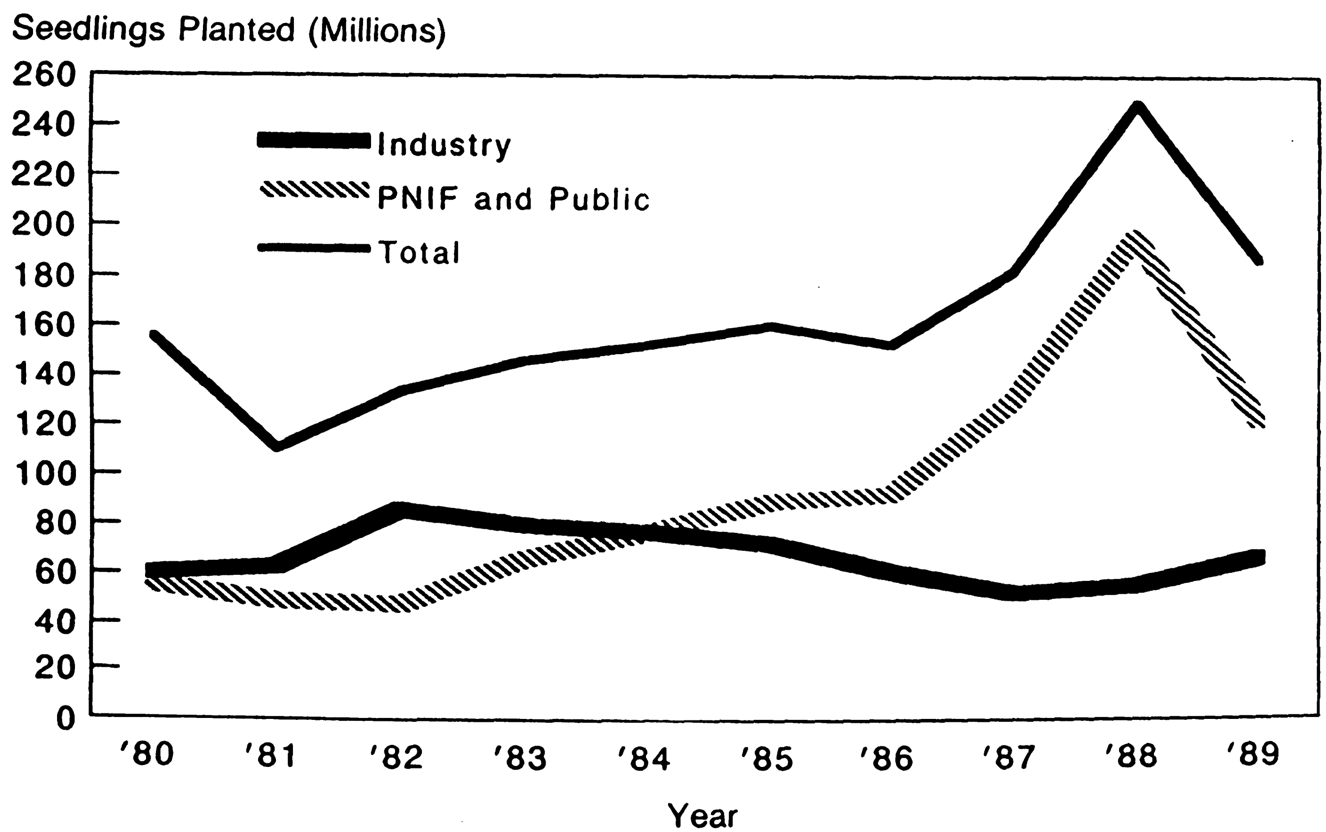
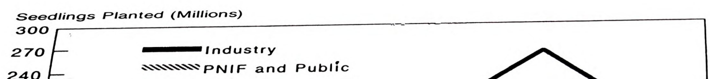


Figure 3. Seedling Usage 1980-1989, Mississippi



Seedlings Planted (Millions)
300
270
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Industry
PNIF and Public

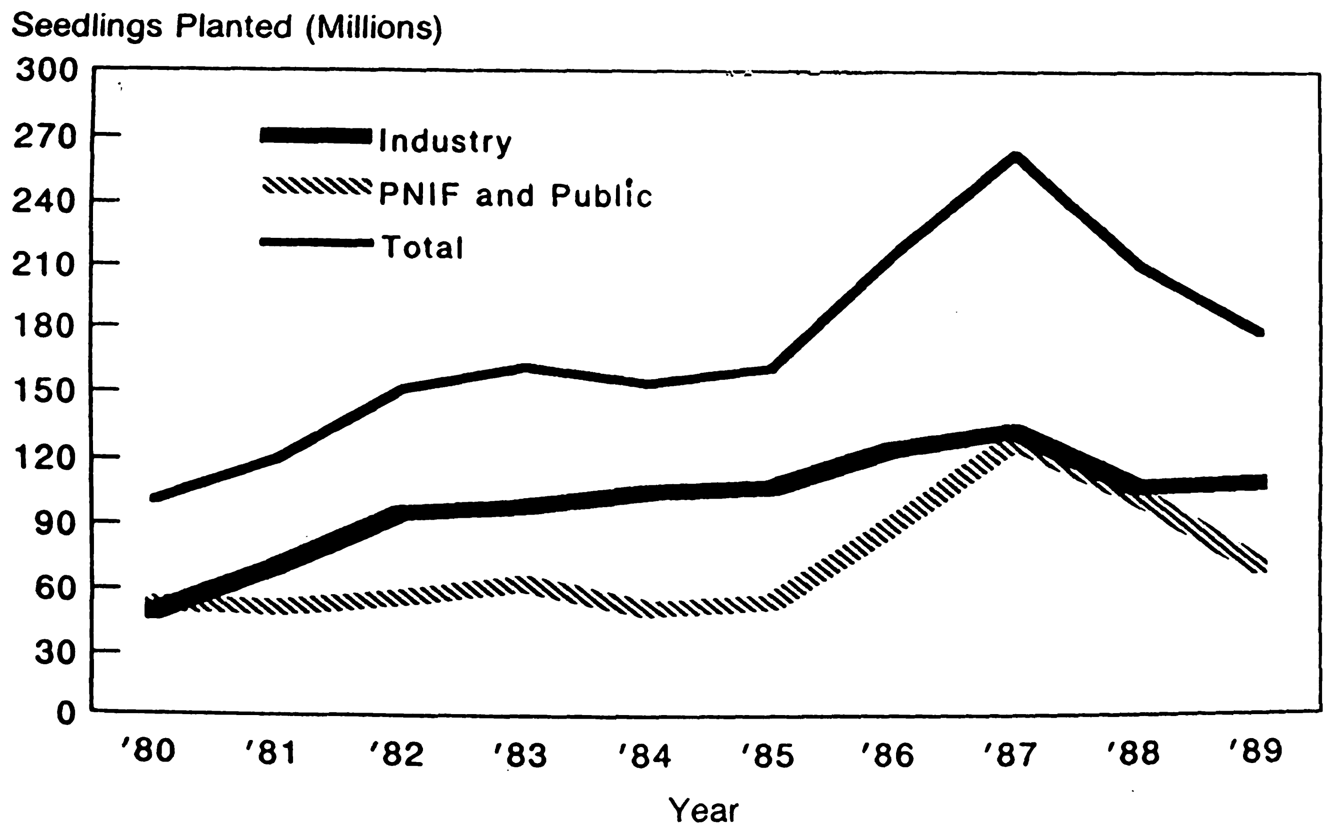

Figure 4. Seedling Usage 1980-1989, Alabama

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Loblolly pine is by far the most widely planted species of southern pine followed by Slash pine, which is planted mostly in the southern lower coastal plain. Of southern pine seed orchards listed in the latest directory (USDA Forest Service, 1982a) 56 percent were Loblolly pine and 32 percent were Slash pine. Shortleaf and Longleaf pine combined to make up the remaining 10 percent. If we assume that 75 percent of all seedlings planted are Loblolly pine, another 20 percent are Slash pine and the remaining 5 percent are Shortleaf and Longleaf pines, we can then use average numbers of seed per pound to estimate the pounds of seed needed to produce seedlings for planting.

The trends will obviously follow the trends shown for planted acres and seedlings so only the pounds of seed needed are shown in Table 15. These figures were calculated using an average number of seeds per pound for each species (USDA Forest Service 1974) and assuming that 75 percent of the seeds planted grow to become plantable seedlings. One recent study, however, reported that seed efficiency (number of plantable seedlings divided by the number of pure live seeds sown) ranges from 40 to 90 percent (South, 1986). The data in Table 15 show that the seed required to produce needed seedlings for Mississippi

Table 15. Estimated Loblolly and Slash Pine Seed Requirements for Mississippi and Alabama, 1980-1987.

Table 15. Estimated Loblolly and Slash Pine Seed Requirements for Mississippi and Alabama, 1980-1987.

	Mississippi				Alabama			
Year	Total seedlings planted millions	Loblolly seed (1) (lb.)	Slash seed (1) (lb.)	Estimated used (1) (lb.)	Total seedlings planted millions	Loblolly seed (1) (lb.)	Slash seed (1) (lb.)	Estimated used (1) (lb.)
1980	115.3	5,646.6	1,670.6	7,316.2	100.1	4,902.2	1,450.7	6,352.9
1981	111.3	5,450.6	1,612.8	7,063.4	120.8	5,912.5	1,749.8	7,662.3
1982	132.7	6,497.3	1,922.8	8,420.1	151.8	7,430.6	2,199.1	9,629.7
1983	146.1	7,149.6	2,115.9	9,265.5	162.0	7,927.5	2,346.1	10,273.6
1984	152.1	7,445.7	2,203.6	9,649.3	154.8	7,576.0	2,242.1	9,818.1
1985	159.3	7,798.8	2,308.1	10,106.9	163.3	7,995.3	2,366.2	10,361.5
1986	152.8	7,477.4	2,212.9	9,690.3	215.3	10,536.7	3,118.3	13,655.0
1987	182.4	8,927.2	2,642.1	11,569.3	263.3	12,886.6	3,813.8	16,700.4

(1) See example calculations in Appendix B.

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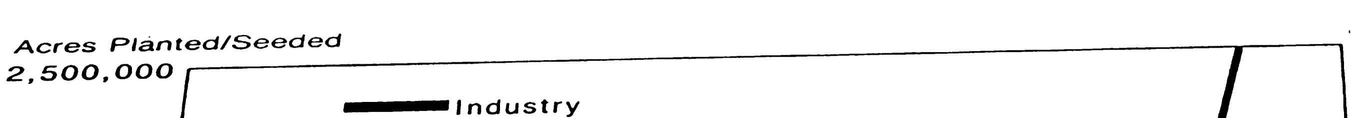
and Alabama have increased steadily through 1987. In Mississippi, seed needs rose 58 percent from 7,316.2 pounds in 1980 to 11,569.3 pounds in 1987. In Alabama, seed needs have increased even more dramatically. Seed usage in 1980 was 6,352.9 pounds but it increased 162 percent to 16,700.4 pounds in 1987. This is not to say that inside each state that many pounds of seed were used, but that the seedlings produced for a particular state consumed a given amount of pine seed. As PNIF reforestation increases even more seed will be required annually to produce the needed seedlings. But where will the needed seed come from? If Alabama and Mississippi wish to offer greater numbers of improved seedlings to landowners they will be forced to purchase forest industry surplus seed until state orchards produce needed quantities of seed. A problem with purchasing seed is that state forestry agency budgets have been shrinking in recent years. The alternative is to use "woods run" seed and produce an "average" seedling that is becoming less desirable to landowners.

Seedling needs in Mississippi and Alabama have risen in recent years, particularly among PNIF owners. This trend is also true for the entire region. Figure 5 shows the tree planting record for the southern states since about 1950. For the last 15 years there has been a steady increase in tree planting except for a short dip in 1980 and 1981. The South has experienced increases in both PNIF and forest industry planting. These two have combined to push reforestation acres to their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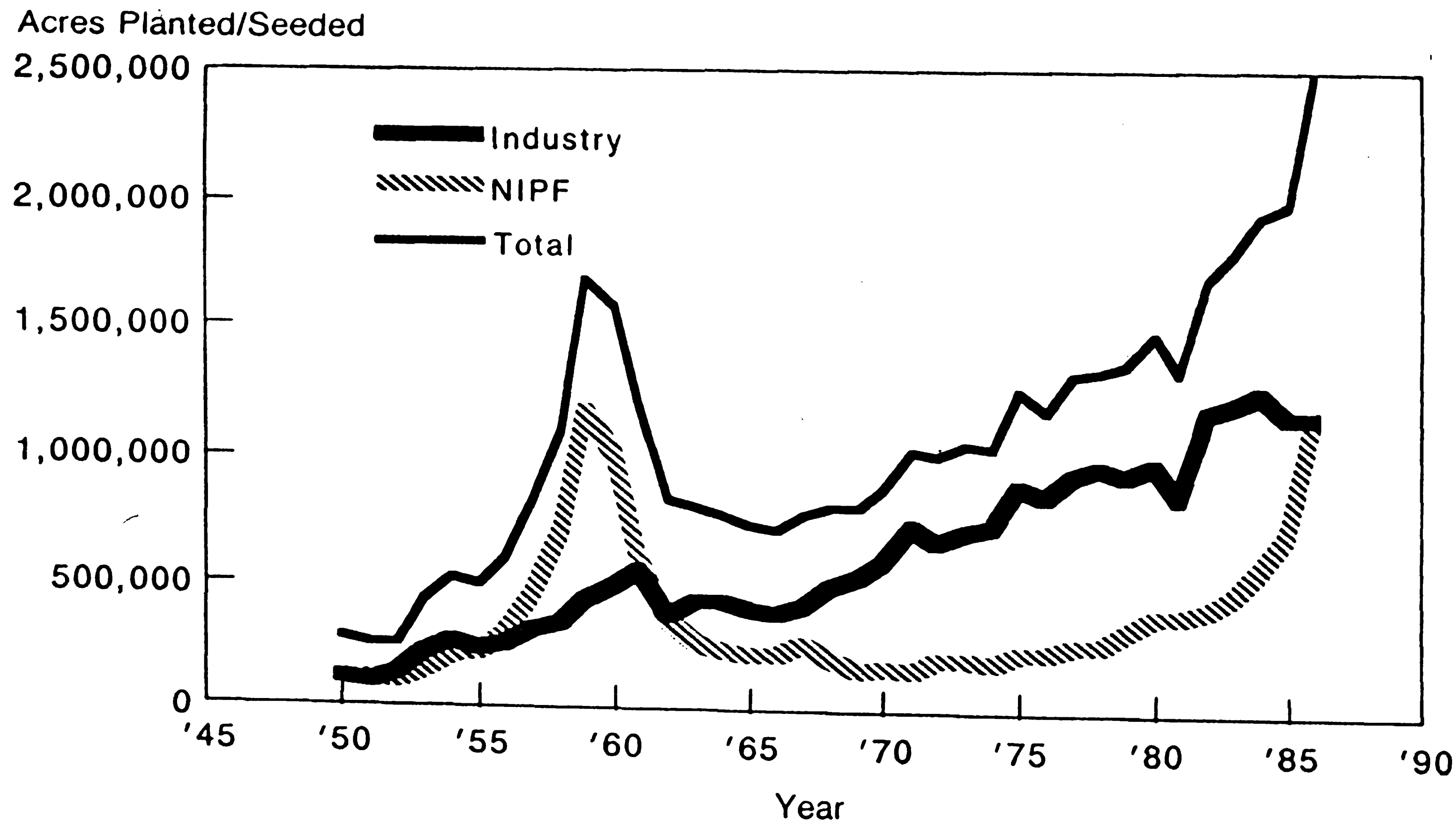

Figure 5. Forest Tree Planting/Seeding in the South 1949-1987

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Planting Services

It is difficult to completely describe the supply of planting services available in Mississippi and Alabama because of the variety of services involved and the nature of the forestry contracting business. Based on the most current directories of forestry contractors available from the respective state forestry agencies, Mississippi has about 170 tree planting or site preparation vendors and Alabama has an estimated 166. The most common planting services offered are mechanical site preparation, tree planting (both by hand and machine), and prescribed burning but other services offered include: tree injection, herbicide applications and direct seeding by helicopter. Many contractors that offer planting services are also in other businesses and do forestry work seasonally in a limited locality. They also may be "in the business" a few years and then cease to operate when other opportunities calling for heavy equipment arise. For these and other reasons state forestry agencies have difficulty maintaining an up-to-date list of forestry vendors. This may change in the future as vendors become more organized and serious about the business rather than treating it as a seasonal sideline. The information presented, therefore, is the best information available from state forestry

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Accomplishing site preparation and planting work in Mississippi and Alabama follows one of two paths depending upon whether the work will be done on forest industry land or PNIF lands. Often, on forest industry lands company crews use company-owned heavy equipment, such as crawler tractors, to clear logging slash and other debris. Then company foresters use prescribed burning to leave a clean site ready for planting. (Increasingly in recent years, however, forest industry has been contracting out their site preparation, even burning, where possible, to independent vendors. Also, increasing mechanical site preparation costs have created a great interest in herbicides for site preparation and planting.) Soon after site preparation is complete, company crews or more often, contracted vendors, replant the tract with improved seedlings grown in forest industry nurseries. Tree planting vendors contract with individual companies to plant trees on company lands. Trees are provided by company nurseries and these planting operations are supervised and checked by company foresters. Industry foresters estimate that more than 80 percent of tree planting on forest industry lands in Mississippi and Alabama is done by independent contractors. Reforestation operations on forest industry lands then are closely monitored by company foresters to ensure efficiency and success. Use of company site prep crews and/or a relatively small group of experienced tree p

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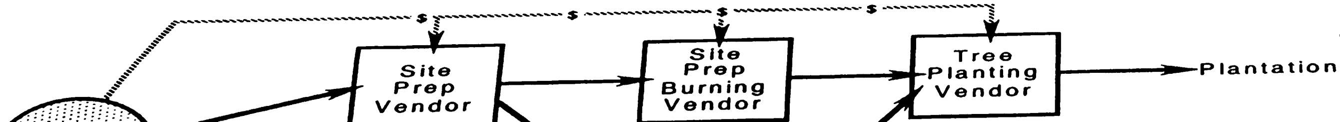
On PNIF land, however, the reforestation procedure is more complicated. Few forest landowners have sufficient equipment or inclination to attempt their own site preparation or planting. In fact, since most PNIF planting is done with public cost-sharing assistance, a state forestry commission forester is usually involved to help arrange and monitor the operations. The normal procedure on PNIF land is to contact the county forester or ranger to get a recommendation on what site preparation treatments are needed.

After a site preparation recommendation is given, the forester furnishes the owner with a list of vendors available and it's the owner's choice as to how (or if) to proceed and with whom. The public forester is prohibited by law from recommending specific vendors over others. From this point, the landowner chooses a site preparation vendor, contracts with him to perform the work and orders seedlings. Before planting season arrives the landowner must arrange with a tree planting vendor to do his tree planting. When tree planting season arrives the chosen vendor performs the tree planting services and a state forestry agency forester checks the work. If all is done properly, the forester certifies the planting job and the cost-sharing funds are reimbursed to the landowner or are paid to the vendor. Figure 6 gives a flowchart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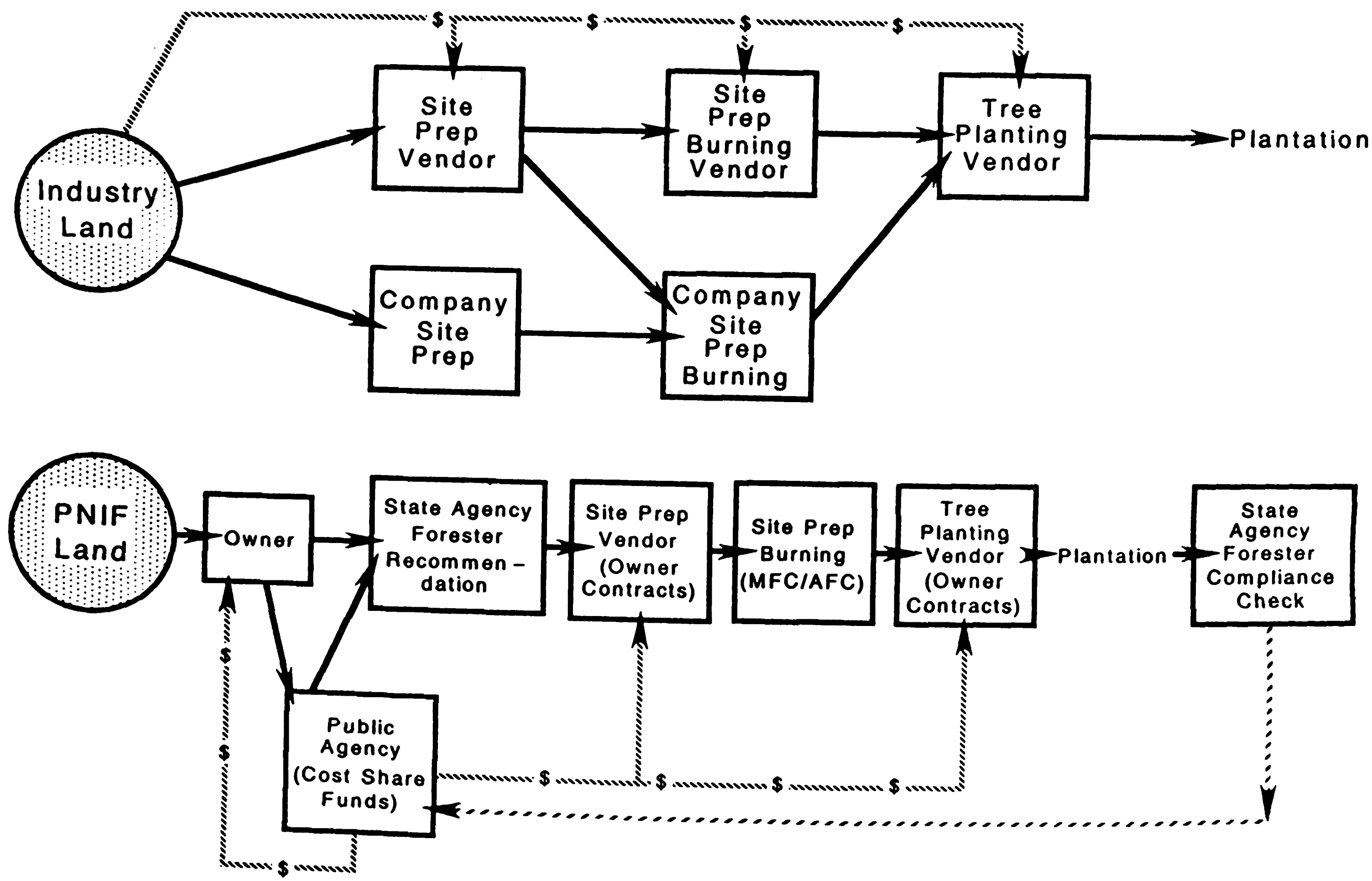

Figure 6. Reforestation Flowchart For Industry And PNIF Land

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representation comparing the reforestation sequence on forest industry land and PNIF land. Reforestation on forest industry land can proceed smoothly and efficiently because the various operations are performed or supervised by company personnel without delay and payment for services is direct from buyer to seller. When forest industry land is being planted by contract tree planters, company foresters usually check planting while the operation is still in progress and compliance is assured when the job is complete. The contractor complies with the planting specifications and is paid promptly for services rendered. On PNIF land reforestation delays occur because additional players such as contractors and agency foresters must become involved. This is particularly true when public cost-sharing funds are used to finance the operation and this is usually the case in Mississippi and Alabama. In 1986-87, 97 percent of all Mississippi PNIF tree planting was accomplished using either state or federal cost-share funding while in Alabama the percent of cost-share funded PNIF planting was 59 percent. Reforestation delays develop for reasons such as coordination and scheduling difficulties, limited manpower, compliance checking delays, landowner apathy, cost-share funding availability and vendor availability. In a study of why PNIF owners do not invest in pine reforestation (Kaiser and Royer 1983) 27 percent of harvested acres were owned by individuals who consider the "red tape" associated with getting assistance with forest management as being too cumbersome. These delays become ve

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delays become very significant when we realize that PNIF owners are very dependent on cost-sharing monies to get plantations established. Therefore, streamlining the PNIF reforestation sequence has the potential to lower landowner apathy, reduce information and transactions costs and stimulate more PNIF acres to be reforested. Policy changes in this system could be very useful ways to increase PNIF reforestation.

In Mississippi, there are two sources of tree planting and site preparation vendors. The Mississippi Forestry Commission maintains a master list of reforestation vendors and lists of vendors are furnished to landowners upon request. This list dates from 1981, is periodically updated, and lists 148 vendors, 141 of which offer tree planting or site preparation services. Other services offered include tree injection, fire lane construction, prescribed burning, helicopter services and others. Table 16 shows a breakdown of services offered by these vendors.

Another source of reforestation vendors is the Directory of Consulting Foresters Operating in Mississippi published by the Mississippi Forestry Commission in March 1984. This publication lists consulting foresters who are available for various forestry services in Mississippi. In total the publication lists 69 firms and individuals offering a wide mix of services from marketing and environmental impact studies to timber sales and regeneration services. Several vendors who are listed on the MFC vendor list also appear in this directory but when these are eliminated, 29 additional tree planting or site preparation vendors

TABLE 16. Miss

Services Offered
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Machine Planting 4
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TABLE 16. Mississippi forestry vendors, 1981

Services Offered	No. Vendors	Percent of All Vendors
Hand Planting [1, 4]	66	44.6
Machine Planting [4]	16	10.0
Mechanical Site Preparation[2]	64	43.0
Tree Injection [4]	37	25.0
Firelanes and Prescribed Burning[4]	4	2.7
Others [3]	13	8.8

Source: Mississippi Forestry Commission.

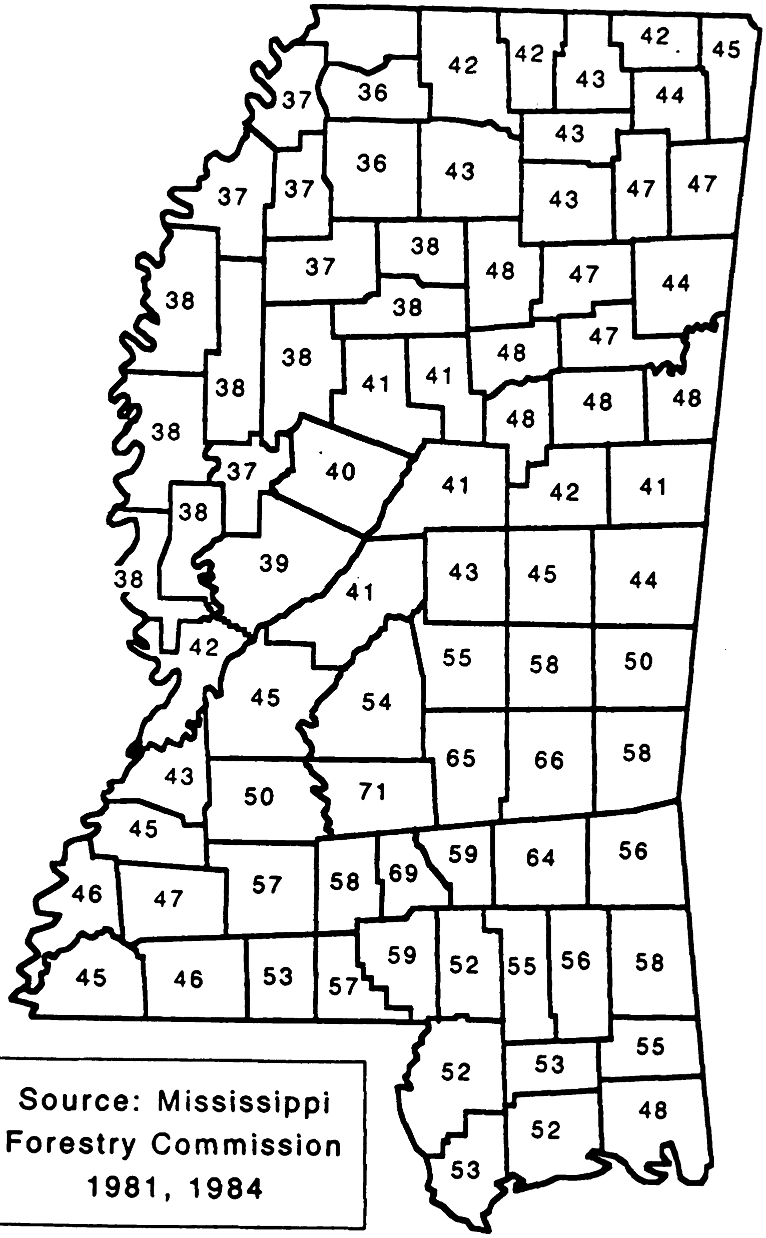
1 "Planting" or "tree planting" was counted as hand planting.

2 Mechanical Site Preparation includes shearing, raking, chopping, K-G blade work, bedding and bush hogging. All firms do not offer all services.

3 Others include LAP programs, aerial spraying and seeding, boundary line maintenance and woods road construction.

4 This service also offered by Mississippi Forestry Commission.

remain. When these names are added to those listed on the MFC list and plotted according to Mississippi counties they service, we see the number of vendors available to each county to do reforestation work. Figure 7 shows the number of tree planting and site preparation vendors available to Mississippi forest landowners by county and reveals that forest landowners have between 36 and 71 vendors willing to do reforestation work in their county. In all, about 170 tree planting and site preparation vendors are operating in Mississippi. Among these vendors, 33 are willing to service all counties in Mississippi. These figures do not include the Mississippi Forestry Commission that does offer tree planting services to private landowners, though the Mississippi Forestry



Source: Mississippi
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Figure 7. Available Tree Planting and Site Preparation Vendors by County in Mississippi

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Commission reports that 90 percent of all work done on PNIF land in Mississippi is performed by private vendors.

In Alabama, the Alabama Forestry Commission publishes a formal directory of tree planting vendors (Alabama Forestry Commission 1984). The latest edition of the directory lists individuals and companies, by county, who are willing to do mechanical site preparation and tree planting for private landowners in Alabama. The purpose of the directory is to help landowners efficiently find a vendor to fill their tree planting needs. The directory is a compilation of information provided by vendors who expressed a willingness to do site preparation or tree planting work and lists about 100 individuals and firms.

The Alabama Forestry Commission estimates that only about 60 percent of all Alabama's tree planting and site preparation vendors were listed in the 1984 directory so that an estimated 160 to 170 vendors are currently available to private forest landowners in Alabama. Currently, vendors are listed by the county they are willing to service, so a landowner in any particular county can turn to the list for his county and choose one of the vendors available. According to the 1984 directory every county has at least 19 vendors available and some have as many as 35 tree planting or site preparation vendors.

Figure 8 shows the number of tree planting and site preparation vendors available to Alabama forest landowners by county. The Alabama Forestry Commission feels satisfied that there are enough tree

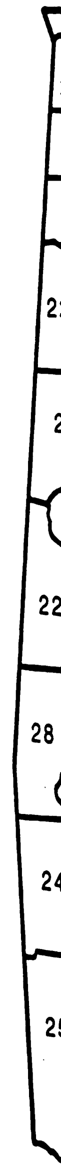

Figure 8

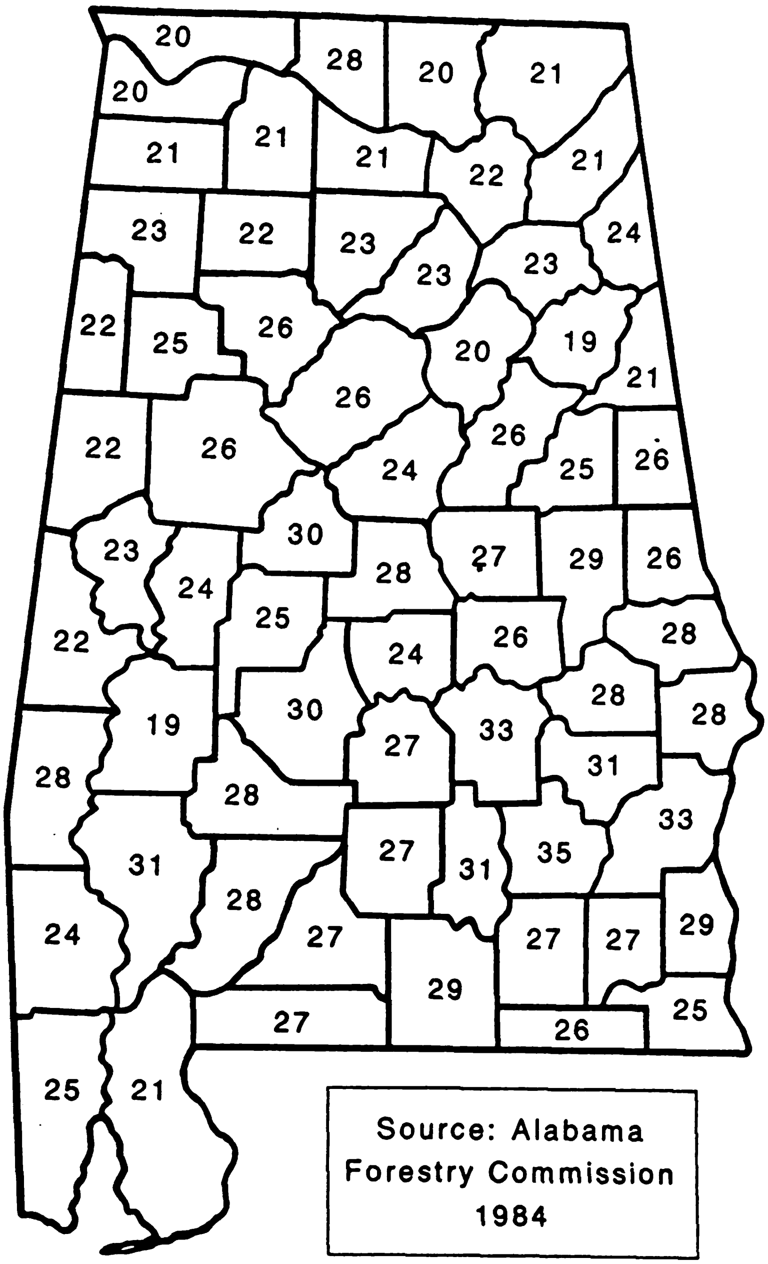

Figure 8. Available Tree Planting and Site Preparation Vendors by County in Alabama

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planting and site preparation vendors available to Alabama forest landowners and the vendor directory makes it easy to locate them by including telephone numbers. An important difference between Alabama and Mississippi is that AFC does no tree planting at all while MFC does about 10 percent of the planting done on PNIF land in Mississippi each year. However, in both Mississippi and Alabama the forestry commission does more than 90 percent of all site preparation burning on PNIF lands. This is principally due to the potential liability exposure for consultants and equipment availability.

Based on discussions with reforestation vendors, agency foresters and industrial foresters it appears that in both Mississippi and Alabama there is a stratification in the reforestation services market between forest industry lands and PNIF lands. Forest industry in Mississippi and Alabama contract out between 80 and 100 percent of all their company land tree planting. Forest industry tracts are large and attract competition for tree planting contracts by highly organized, production-type reforestation companies. These reforestation companies operate similarly to contract grain harvesters in the Great Plains. They begin in the South in December or January and work their way north planting trees until May or June when they finish in the Great Lakes region. These tree planters plant with hodads and easily out-bid local dibble-type tree planting venders on a cost-per-planted acre basis. For example, hodad planting crews typically average 6,000 trees planted per

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man per day while a good dibble bar tree planter may plant 4,000 trees or less per day. This difference in production allows hodad crews to plant trees for $29 to $31 per acre compared to $40 or more per acre done by dibble bar crews. Most of the "hodad" vendors are from out of state and are based in Arkansas, Tennessee, Idaho, Montana or the Southwest. These reforestation companies offer low prices and good survival to forest industry and tend to get contracts year after year.

A good example of such a reforestation company is Evergreen Tree Planting Service of Sand Point, Idaho. This firm has been planting for forest industry in Mississippi and Alabama for about eight years . In a typical year they will plant about 15,000 acres in Mississippi and 9,000 in Alabama for such clients as International Paper Company, James River Corporation, Champion International, and others. Evergreen does 95 percent of their planting on forest industry land with about 5 percent planted on PNIF land coordinated by the state forestry agency or an industry client. They prefer not to work with PNIF owners directly because there are problems trying to plant smaller tracts and they also do not like the difficulties of delayed payment.

Forest industry tree planting contracts are attractive because the tracts are large and payment is direct. Since virtually all industry contracts are awarded after a bid process these high production, low-cost reforestation firms capture most of the contract hand planting done on forest industry land in Mississippi and Alabama because of their low per acre rates, m

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per acre rates, mentioned earlier. At least one firm, however, Weyerhaeuser, which manages land in both states, uses dibble planters only. Their experience with hodad planters has been poor and company managers feel that tree planters who plant 6,000 trees per day are too fast to do a high quality planting job. While the trees survive a few seasons Weyerhaeuser feels too many are leaning or "j-rooted" and will not make a quality crop tree over the stand rotation. Another reason mentioned is that the hodad planting tool was not designed for the flat terrain found in the South. Basically, the Weyerhaeuser approach is to do a high quality planting job on fewer trees per acre (600 trees per acre vs 700 per acre planted by many companies) and hodad planting does not measure up to their expectations.

Forest industry firms tend to contract their tree planting to the same few reliable vendors each year. Hence, because of the attractiveness of forest industry contracts the best tree planting vendors (either hodad or dibble bar planters) work for forest industry and the higher cost, less efficient vendors are crowded out of the competition for industry contracts.

Since the larger industrial clients tend to be served by the out-of-state reforestation companies or the better in-state vendors most hand planting on PNIF land (much of which is paid for by cost-share funds) is left to local, less efficient contractors. The local tree planting vendors vary greatly in quality and reliability. In fact, one industry manager felt that many local t

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that many local tree planters set their prices in order to get the maximum per acre amount allowed by cost-sharing program policies rather than trying to be more cost competitive. Also, these vendors often do not understand insurance and workmen's compensation required of vendors by forest industry so that they cannot compete with well organized out-of-state competition. State forestry agencies have desired to certify tree planting vendors so landowners would have some measure of reliability but this requires a statewide effort and the certification programs have not been established. In the final analysis there tends to be a relatively small group of efficient, well organized reforestation vendors that service forest industry's reforestation needs and another larger, less efficient and less organized group of vendors that are available to service PNIF lands. This market stratification causes hand planting costs for forest industry tracts to be about $10 per acre less than typical costs on PNIF lands. It would appear to be feasible to direct an appropriate amount of public effort to establish a vendor certification program and consolidate small tracts to stimulate competition for PNIF tree planting contracts thereby reducing tree planting costs on PNIF lands which are planted using public funds.

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CHAPTER THREE: PINE PLANTATION BUDGETS

Budget analysis is a technique used to compare the value of present and future costs with the value of future incomes from an investment opportunity. In the case of pine plantation investments, revenues are many years in the future as are some costs of management. The construction of budgets for such long term investments requires assumptions and estimates of future values of known variables in the analysis. The assumptions used in this analysis are presented throughout the chapter as the budget construction is described.

This chapter describes the construction of budgets used to analyze the economic attractiveness of cost-share pine plantation investments in Mississippi and Alabama. These budgets model pine plantation investments in two different situations: marginal cropland and cutover (harvested) timberland. Additional variables include site quality, regional stumpage prices, improved or unimproved seedling stock and discount rate.

The budgets presented were developed using the Tennessee Valley Authority YIELD plus microcomputer program (Hepp 1987a).

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YIELD plus is a yield forecasting and planning tool that performs growth, yield and financial analysis. YIELD plus was chosen because it combines growth and yield prediction and financial analysis capabilities in a single microcomputer program. It is the current version of YIELD 1.1 which was the first microcomputer-based growth and yield program introduced in the U.S. (Hepp 1987b). The comprehensive set of growth and yield simulators incorporates current research findings and the financial analysis package reflects current tax laws such as the Reforestation Tax Incentives, Public Law 96-451. Other programs are available that perform southern pine growth and yield projections for old fields or harvested sites, or financial analysis separately but YIELD plus provides all these features in one program at a reasonable cost. It is widely used in the South with over 500 registered copies in distribution. The program is most useful for even aged forest types in the southeastern U.S. and contains 13 individual growth simulators. The growth simulators used for this analysis were "Old Field Loblolly Pine" for the marginal cropland budgets and "Cutover Site Loblolly Pine Plantation" for the cutover stand budgets. The research data used to construct the YIELD plus growth simulators used for this analysis are complete and current. The YIELD plus manual cites 10 studies used to construct the "Old Field" simulator and 8 studies for the "Cutover Site Loblolly Pine Plantation" simulator.

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The purpose of these budgets is to estimate the economic attractiveness of pine plantation investments on various sites in Mississippi and Alabama. The primary indicator of economic attractiveness used in this study is net present value (NPV). NPV is the most commonly used measure of economic effectiveness (Fortson 1986) and is the present value of all incomes from an investment minus the present value of all costs. NPV is calculated using the following formula:

$$NPV = \sum_{j=0}^{n} I_j/(1+i)^j - \sum_{j=0}^{n} C_j/(1+i)^j$$

Where:
C = Cost
I = Income
n = length of investment
i = discount rate
j = year cost or income incurred

If the NPV is positive (that is, the present value of incomes is greater than present value of costs) then the investment project is a better use of funds than an alternative represented by the discount rate used to calculate NPV.

Two other measures of effectiveness are also given in this analysis: Internal Rate of Return (IRR) and Equivalent Annual Income (EAI) . The IRR is the interest rate at which NPV is equal to zero. To put it another way, IRR is the rate at which discounted revenues equal discounted costs. The internal rate of return assumes that all intermediate investment incomes are reinvested in the project and is calculated using the following formula:

$$NPV = \sum_{t=0}^{r} C_t (1 + i)^{r-t} = \sum_{t=0}^{r} I_t (1 + i)^{r-t}$$

Where:
C = Cost
I = Income
i = Internal Rate of Return
r = rotation length in years
t = year cost or income incurred

A project is considered profitable if the IRR is greater than the discount rate.

Equivalent Annual Income (EAI) is NPV expressed as an annuity over the length of the investment computed at the discount rate. This measure can be useful for comparing investments of unequal length such as comparing agricultural and forestry investments.

EAI can be computed using the following formula.

$$EAI = NPV \frac{(P(1 + P)^n)}{(1 + P)^{n-1}}$$

Where: NPV = net present value
P = discount rate
n = investment length in years

The attractiveness of investing in pine plantations varies according to the productivity of the land and the previous use. In this case, land that had previously been in crops is relatively inexpensive to establish in pine, whereas timberland recently harvested generally requires greater expenses. Two different types of plantation investments were analyzed. The first plantation investment is that of reforesting harvested forestland. These budgets were titled "Cutover Timberland" and are the type of investments analysts report should be increased on southern PNIF land to ensure adequate pine supplies for the future (USDA Forest Service 1988, Knight 1987, Sheffield and Cost 1987). The second plantation investment is planting retired agricultural land. These budgets are titled "Marginal Cropland".

These two plantation investment scenarios were simulated on four different types of land designated as "Poor", "Average", "Good", and "Excellent" site quality. The U.S. Forest Service has categorized forestland in Mississippi and Alabama in one of six categories based on productivity. For this analysis, the six Forest Service productivity categories (site classes) were consolidated to the four site quality classes above and converted to site index base year 25 because the YIELD plus program requires a base 25 site index. The Forest Service site classes are defined by productivity expressed in cubic feet of wood produced per acre per year. These categories have equivalence in site index base year 50. For this study, the lowest two categories and the highest two categories were combined to yield a total of four site quality classes with associated representative site index (age 50) values. These site categories were consolidated because it seemed clear that the lowest site class would be marginal for timber production and the highest would be profitable. In addition, four site quality classes would help streamline the study. These site quality classes were labeled Poor, Average, Good and Excellent. The representative site index values were then converted to site index 25 values using height-growth curves for second growth Loblolly pine (USDA Forest Service 1982c). These site index 25 values were then used as input to the YIELD plus model. Table 17 shows the definitions of site quality for this analysis and how they correspond to the Forest Service site classes and site index, base year 25. Tables showing the number of acres by county in each site quality class are given in Appendix C.

Another variable studied in this analysis is price region. Within each state are three distinct timber market areas designated "North", "Central", and "South". In Alabama these regions correspond with the Timber Mart South price reporting districts (Timber Mart South) and in Mississippi they correspond with the MCES Timber Price Report (Martin and Daniels, 1988) districts. Figures 9 and 10 show the price reporting regions used in this analysis for Alabama and Mississippi, respectively. Timber Mart South is a regional price reporting service based in North

TABLE 17. Site Quality Definitions for Plantation Budgets

Site Productivity

Forest Service Site Class 1/	Loblolly Pine Site Index (50)		Representative Site Index 50	Site Index 25 2/
20-49	51-59	Poor	70	45
50-84	60-79			
85-119	80-94	Average	88	57
120-164	95-109	Good	95	60
165-224	110+	Excellent	110	70
225+	110+			

1/ Site class is growth in cu. ft./acre/year at culmination of mean annual growth for fully stocked natural stands.

2/ Taken from height-growth relationships in USDA 1982 C.

Carolina and is the only published source of private timber prices for Alabama. Timber Mart South is widely used in the Southern United States as a source of timber prices information. The MCES Timber Price Report figures are used because the figures are specific for Mississippi and widely used in the state.

Prices used in this analysis are 12 month averages for pine sawtimber, chip-n-saw and pulpwood between September 1987 and September 1988. They are taken from Timber Mart South for Alabama and the MCES Timber Price Report for Mississippi. By using these price

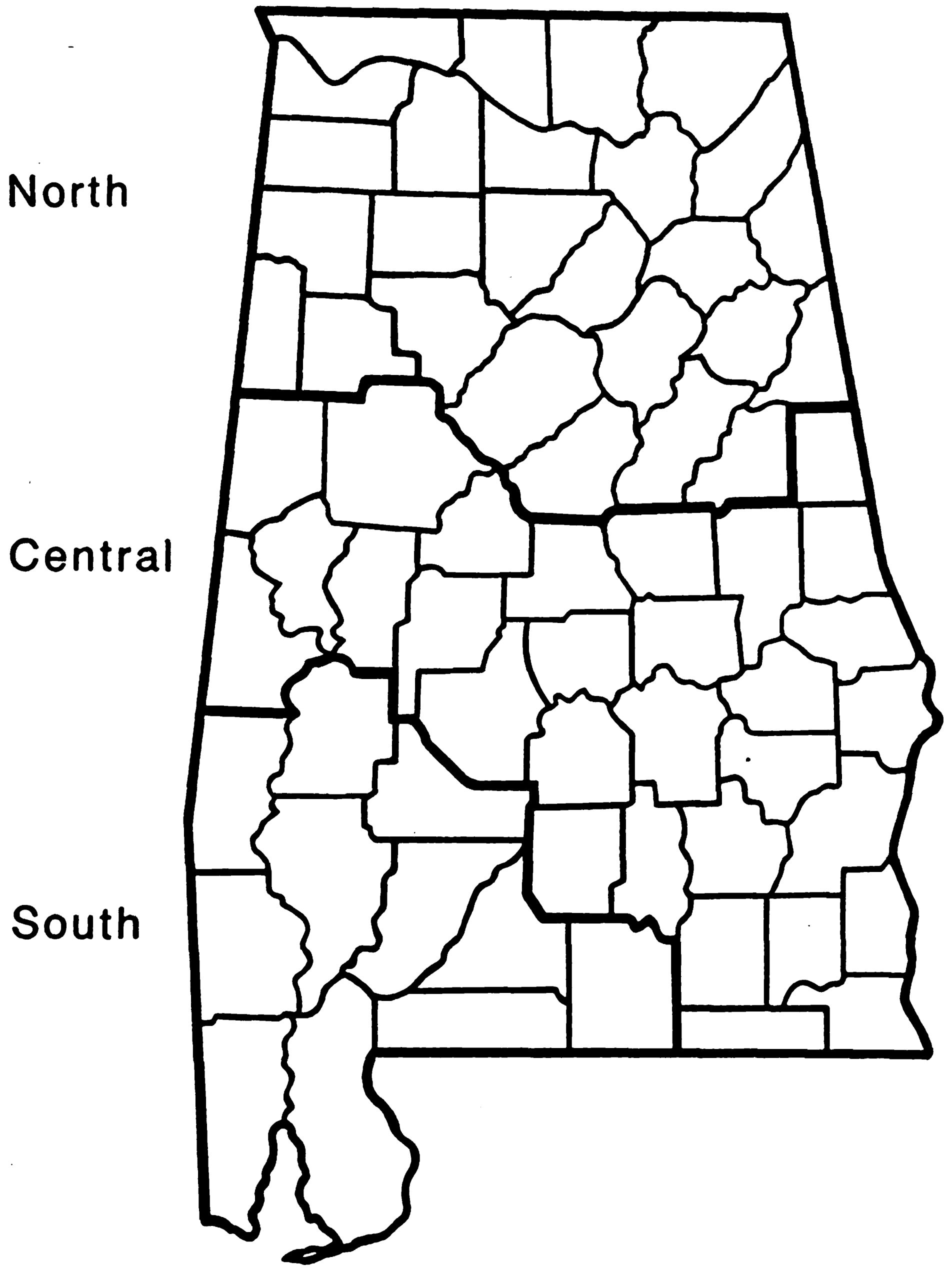

Figure 9. Alabama Price Reporting Regions

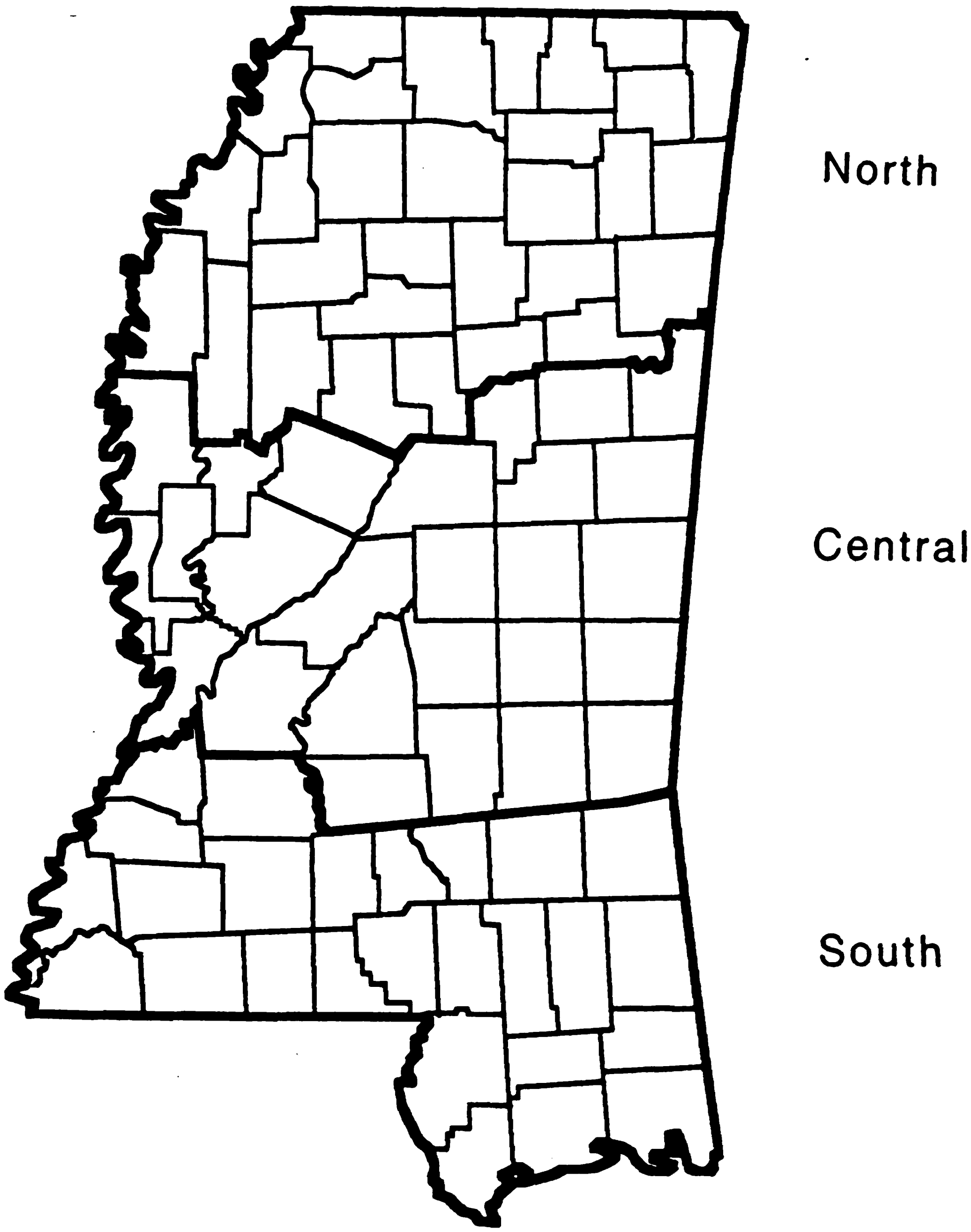

Figure 10. Mississippi Price Reporting Regions

averages in the analysis an implicit assumption is made that these products will remain the major pine product categories and that their relative prices will be consistent over the rotation. Through the 1960's and 1970's pine pulpwood and sawtimber were the two major categories of southern pine products. During the late 1970's chip-n-saw technology began to influence the market since it could produce dimension lumber from smaller trees. Since that time, chip-n-saw pine has entered the Alabama and Mississippi timber markets as a product category between pulpwood and sawtimber. At this time, and for the foreseeable future, these prices are expected to maintain their relative positions. The South's Fourth Forest report (USDA 1988) projects substantial increases in softwood lumber and pine pulpwood production in the South Central Region. These increases are expected to cause real price increases for both pine pulpwood and sawtimber stumpage. Such increased lumber demand should also maintain active markets for chip-n-saw size trees.

The question of consistency of the relative price differences between price regions in each state is also worthy of mention. Traditionally, pine timber prices have been highest and most competitive in south Alabama and Mississippi with prices lower as you travel north in each state. Stumpage prices have also traditionally been higher in Alabama than Mississippi . Competition for stumpage has been the reason for this east-west difference. The three distinct price regions reflect this market segmentation. This delineation of distinct market areas is expected to persist but as competition continues to spread from south to north prices in the northern price regions should begin to approach price parity with the other regions in the future. Such a development, should it take place, however, would improve the economic climate for regeneration investments in the region.

Though the South's Fourth Forest study projects increasing use of hardwood pulpwood in the pulp and paper industry, no major changes are currently anticipated that would change the relative prices of the softwood products used in this analysis.

Table 18 shows the product prices used for this study. Markets for pine products are assumed to be active, which is the case throughout Mississippi and Alabama.

TABLE 18. Stumpage Price Averages for Mississippi and Alabama, 1988.

	Mississippi			Alabama		
Price Region	Sawtimber	C-N-S	Pulpwood	Sawtimber	C-N-S	Pulpwood
	dollars					
North	132	107	9	148	107	14
Central	166	107	9	186	119	16
South	178	131	12	201	158	19

Sawtimber and C-N-S prices in $/MBF, Doyle, Pulpwood prices in $/cord

Sources: MCES Timber Price Report and Timber Mart South.

YIELD plus simulators generate product volumes in pulpwood, chip-n-saw, and sawtimber. In this analysis trees from 4 to 7 inches DBH are considered pulpwood, 8 to 11 inches DBH chip-n-saw and 12 inches DBH and larger are sawtimber. Trees below 4 inches DBH are unmerchantable.

A final variable in the analysis is type of seedling stock. Two alternatives were considered, unimproved or improved seedlings. This alternative is relevant because in the past ten years improved seedlings have become more available to private landowners and many ask if they should spend the additional funds to plant them.

A key question arises when constructing an analysis such as this: What growth advantage should be assigned for improved seedlings? Loblolly pine progeny tests indicate first generation volume gains ranging from 10 to 20 percent compared with unimproved stock (Lantz and Kraus 1987, Talbert et al. 1985). Currently, there are no growth and yield models available for genetically improved stock (Sullivan 1984) but research has demonstrated that improved and unimproved trees have significantly different heights and yields at equal ages similar to those due to site-index changes (Hollowell and Porterfield 1986). Accordingly, it is common practice among biometricians in the absence of growth and yield models, to estimate gains due to genetically improved planting stock by increasing the site index. A ten percent increase in growth is widely accepted among forest biometricians to model gains from genetically superior stock (Matney 1988, Hepp 1988). The authors of the South's Fourth Forest study used a 10 percent increase over base yields when estimating growth and yield increases for pine plantations established with genetically superior planting stock (USDA Forest Service 1988 p. 129). A series of technical sessions were held among regional contributors to the South's Fourth Forest study and the 10 percent yield increase for improved seedlings was adopted as a concensus among technical experts. Therefore, for this study the gains from using improved planting stock were modeled by increasing the site index 10 percent. For example, when improved seedling plantations were being analyzed, the site index (base age 25) for the "Excellent" site class was adjusted from 70 to 77 to simulate the gain from improved seedlings. Future analysis might include a range of yield improvements associated with improved planting stock. This simulation technique implies a linear relationship between site index and volume increase which is not strictly true. Site index is a measure of tree height at a given age and we know that the relationship between tree height and volume is nonlinear. However, within a small range of change such as the 10 percent assumption used in this analysis the degree of nonlinearity is not anticipated to be relevant to the simulation outcome (Belli 1990, Land 1990).

Assumptions and Fixed Variables

In this analysis rotation length was set at 35 years at which time all trees were harvested. Throughout the rotation a standard thinning schedule was applied to all stands. The plantations were thinned from

below taking the smallest diameter trees first to leave the highest value crop trees. Plantations were thinned at age 15, 22, 29 and then final harvest was performed at age 35. The thinning prescription was to reduce basal area at ages 15, 22 and 29 to the numerical equivalent of the 50 year site index. Using the 50 year site index as a target basal area for thinning southern pine stands is a common practice among southern foresters (Ezell 1988) and falls within the range of basal area identified by Smith (1962) but it is recognized that other thinning prescriptions could be successfully employed. The thinning prescription used here has been used in other studies as a standard management schedule (Ballard, et al. 1981).

During the analysis this management schedule was applied uniformly to all stands with the exception of the "cutover timberland" budgets on the "Poor site". On those sites growth was insufficient to support a thinning at age 15 so a modified management schedule of thinnings in years 25, 30, and final cutting at 35 was substituted. Prescribed burning was also used as a standard management practice during the rotation. Stands were burned every 5 years for competition control and wildlife habitat beginning in year 15 until rotation end. Plantation establishment was accomplished in one of two ways. Stands on marginal cropland only required prescribed burning for site preparation and were machine planted with 726 seedlings per acre as recommended by the state forestry agencies. Machine planting was used because this method is appropriate for old field reforestation and the cost is less than hand planting. Stands on cutover timberland normally require more extensive site preparation to remove logging slash and residual stems.

Though it is recognized that site preparation requirements can vary considerably from one site to another a standard site preparation scenario was used for this study. Cutover timberland stands were established by single-pass, roll chopping to remove competing and residual vegetation, prescribed burning to clear the site and finally hand planted by crews using dibble bars at 726 seedlings per acre. On these sites hand planting is required because logging slash will not permit machine planting.

The owners of these plantations are assumed to be private, nonindustrial landowners in the 15 percent marginal tax bracket. Current tax laws are considered in this analysis. There is no capital gains exclusion for timber sale income but the reforestation tax incentives (P.L. 96-451) are used. It is assumed that no costs such as consultant's fees are incurred when timber is sold, however, a $2 per acre annual cost is assumed to pay for management and taxes. Most tree planting on PNIF lands in Mississippi and Alabama is accomplished with the assistance of a public cost-share program, either state or federal. It is assumed, therefore, in this analysis that these plantations are established using cost-share funding. Current programs such as the Forestry Incentives

Program and similar state cost-share programs in Mississippi and Alabama will pay up to 65 percent of site preparation and planting costs up to a maximum amount per acre for each practice. In this analysis it is assumed that the landowners secure state or federal (FIP) cost-share funding to assist them in reforestation and that they take advantage of the reforestation tax incentives. Public funding agencies will pay up to 65% of reforestation costs on various reforestation practices up to a maximum amount per acre. For example, the Mississippi Forestry Commission will pay 65% of seedling and tree planting costs up to $37 per acre. The costs paid by landowners to established plantations in this study were calculated according to the maximums allowed for each practice by the respective state forestry agency. Baseline costs for the required management practices are regional averages taken from Straka et al. (1989). Table 19 shows base costs used in the analysis. These costs were then adjusted by cost-share assistance to get landowner expenses used for the analysis.

This study utilized a real analysis approach, that is, results represent returns without regard to inflation. Analysis on a real basis is often used so that alternate investment opportunities can be compared (Risbrudt and Ellefson 1983) and does not make any assumptions concerning the future rate of inflation. Results are presented independent of inflation in current (1988) dollars so users can make their own assumptions about inflation rates and adjust the results accordingly.

TABLE 19. Average Costs for Selected Forest Practices and Tree Seedlings[1]

Item		Cost $/Acre	
Improved Seedlings[2]	Alabama	19.96	
	Mississippi	22.50	
Unimproved Seedlings[2]	Alabama	16.69	
	Mississippi	16.69	
Machine Planting; old fields[3]			34.45
Hand planting following intensive site preparation[4]			38.69
Roll chopping, single pass[4]			65.47
Site preparation burning, chopped areas[4]			9.70
Silvicultural burning, ground drip torch[3]			5.43

1 Source: Straka et al. 1989
2 State Forestry Commission Prices
3 Used for Marginal Cropland Site Prep
4 Used for Cutover Timberland Site Prep

Land costs are not considered, since land is normally viewed as a separate investment from the forest investment.

In discounted cash flow analysis of forestry investments the choice of discount rate is very important and has been the source of debate among economists for years. The debate has focused most intensely on the appropriate rate to use when evaluating public forestry programs. Basically, two schools of thought have developed concerning the proper discount rate for evaluating forestry investments. The first contends that since forestry investments compete for limited funds with other government projects the current nominal market interest rate (opportunity cost of capital) should be used. A second school of thought has argued that the use of current market rates overemphasizes the short run and is inappropriate for long-term investments, such as forestry. They contend that discounting at current market rates undervalues or ignores the interests of future generations and have proposed the use of lower discount rates which reflect the "social time preference" (Lorrain-Smith 1982, Helliwell 1974). Harou (1985) provides a thorough, concise review of the discount rate literature in forestry. Several authors have offered theoretical approaches aimed at reconciling these two opposing views of the discount rate problem (Manning 1977, Foster 1979, Foster 1985).

Klemperer (1976) reported historical real rates of return on long term financial investments such as Aaa corporate bonds during the 1960's (3 percent), bank loans (2 percent) and stocks before taxes between 1871 and 1973 (5 percent). He documented that real returns to capital have historically been fairly stable and not as high as commonly thought. Row, et al. (1981) similarly present estimates of long-term private opportunity costs for capital (real market rates of return) in the range of 2 to 6 percent as part of their rationale in recommending a 4 percent discount rate for use in Forest Service long-term land and resource planning. Foster (1982) cited similar real rates of return. Randall (1981) suggests a six percent social discount rate to evaluate public investments.

A significant body of literature has developed over the past 30 years on the discount rate for evaluating public forestry investments. Recently, several authors have utilized corporate finance techniques to focus on a method to determine the appropriate discount rate for long-term corporate forestry projects (Fortson 1986, Zinkhan 1988a, Zinkhan 1988b). These researchers have utilized techniques that adjust the firm's marginal weighted average cost of capital, commonly used as the firm's discount rate, for risk and the ability of the project to support long term debt. The general conclusion of this research has been that corporate discount rates for evaluating forestry projects should be lower than have previously been used. Zinkhan (1988a) arrived at an approximate real discount rate of 4.3 percent for corporate southern timberland-related projects in 1987.

Though the use of modern corporate finance techniques to determine an appropriate discount rate may be appropriate for individual PNIF owners with diversified portfolios (Zinkhan 1988a) methods that apply generally to PNIF owners are not available. Typically, if PNIF owners employ discounted cash flow analysis at all, they utilize the "current market rate" as expressed by money market funds or certificates of deposit as their alternate rate. Few attempts have been made to estimate the discount rate for PNIF owners, but one would expect to observe a wide range of discount rates among the population for several reasons.

Private, nonindustrial forestland owners comprise a very diverse group, including farmers, professionals, retirees, factory workers, and many others (Birch et al. 1982). Research has shown that these owners have multiple ownership goals for their property which often include timber production but also include many other objectives such as recreation, grazing, residence, and others (Porterfield et al 1978, Marlin, C.B. 1978). Such a diversity of ownership objectives suggest that time preferences, investment strategies and expected returns on forest investments should also be diverse. Royer and Moulton (1987) in a study that used regression analysis to examine the effects of cost-share programs and tax incentives on the likelihood of reforestation noted (p. 46) that the regression analysis "clearly indicated that the probabilities of reforestation are not the same among landowners who are familiar with public financial incentives and those who are not, other factors being equal." This diversity seems intuitively clear but no research is available that assigns interest rate preferences to specific groups of forest landowners.

Some authors have attempted to categorize and describe landowner objectives and attitudes regarding reforestation investments. Fedkiw (1983) described a classification of PNIF owners by investment strategy after Yoho. He classified five groups of PNIF investors: custodial investors, sideline forest investors, speculators, hobby investors, and "true investors". Fedkiw described characteristics of each category's investment strategy and objectives for owning the land. Given the description of these groups of PNIF investors it is unlikely that the same rate of return will be acceptable to all.

Davis (1980) examined PNIF reforestation behavior in central Mississippi and used discriminant analysis to describe attitudes of "reforesters" and "non-reforesters". Most "non-reforesters" required one of two types of motivation to agree to reforestation. Some merely required that a forester personally present their options and opportunities while others required that someone else pay all costs and oversee the planting. Such diverse opinions on reforestation as compared with landowners who did reforest implies that the rate of return expected by these owner groups is also diverse.

Kronrad and DeSteiguer (1983) described attitudes among PNIF landowners regarding discount rates and investment lengths. They tried to determine if the present alternative rate of return for short-term, liquid investments adequately reflects the rate of return desired for long-term illiquid investments. Results of a survey of 123 PNIF landowners who attended Extension forestry educational meetings in North Carolina, indicated that those landowners wanted a higher rate of return on their investment as the investment length increases. The present average nominal alternative rate of return of the landowners surveyed was 11.5 percent with a range from 5 to 18 percent. For a five year investment the average rate of return desired was 13.2 percent and for a 25 year investment it was 15.1 percent.

These results suggest that forest landowners may require a nominal discount rate 3.6 percent higher than the current alternative nominal rate for a risk-free, liquid investment to invest in reforestation. These estimates were gathered in 1982 when inflation was 6.2 (Economic Report of the President, January 1989) percent. The nominal rate of interest is related to the real rate by the following formula (Fortson, 1986):

$$(1 + k) = (1 + i)\ (1 + g)$$

Where: k = the nominal rate
i = the real rate
g = the inflation rate

If we use this equation to solve for the real rates expressed by the North Carolina landowners surveyed by Kronrad and DeSteiguer it yields the following:

Investment Time Period	Survey Average Nominal Discount Rate	Associated Real Discount Rate
Present	11.5	4.9
5 years	13.2	6.5
25 years	15.1	8.3

These rates offer interesting insight into PNIF discount rate preference but it is only a glimpse. The reported averages represented ranges in landowner rate preferences and that of a biased sample of

landowners, namely those that attended Extension forest management meetings. In addition, these estimates were for risk-free investments of the specified periods and would need to be adjusted (up or down) for risk. Nevertheless, these rates suggest that real discount rates of some southern PNIF owners are in the range of 4 to 8 percent.

The Forest Service uses a 4 percent discount rate in long term land and resource planning (Row et al. 1981) and real discount rates from 4 to 10 percent were used by Forest Service in the South's Fourth Forest study (USDA Forest Service 1988). Randall (1981) notes that in the long run, it appears, the real rate of interest, r, in the United States as reflected by the prime lending rate is about 2.5 to 3 percent. In a long term forest investment model used by Adams et al. (1982) as part of a U.S. timber supply model a discount rate of 4 percent was used. On the strength of current evidence and practice by other researchers real discount rates of 4, 6 and 8 percent were used in this analysis to evaluate pine regeneration investments.

It is appropriate to describe the output of the YIELD plus package. The YIELD plus program has the capability to perform sophisticated investment analysis. The user builds a cash flow stream by specifying the level and timing of harvests in the forest that is being "grown" by the growth and yield simulator. All current federal income tax regulations (Tax Reform Act of 1986) including credits, deductions, depletion allowances, depreciation and tax liabilities are included in the package.

However, calculation of alternative minimum tax is not included. The YIELD plus package generates a summary of forest growth over the rotation with a summary of each harvest during the rotation including age the cutting occurred, average tree height, thinning method, and summaries of the residual stand and harvested component. The next report is a "Detailed Wood Flow Report" which is a profile of each harvest by diameter class. It shows how many trees were in each DBH class at the time of harvest, how many of each were cut and how many remained. It also gives the value of harvested products.

Based on the growth and yield simulation and financial parameters imputed to the model, the YIELD plus program will generate a Financial Profitability report. This report summarizes the costs and revenues that occurred during the rotation and lists before and after tax Net Present Value and other measures of economic efficiency. Finally, a cash flow report is produced. This report shows revenues and expenses for each year of the investment throughout the rotation. Examples of YIELD plus output for the "marginal cropland" and "cutover timberland" regeneration investments are given in Appendix D.

CHAPTER FOUR: RESULTS AND DISCUSSION

A series of 204 enterprise budgets was constructed to analyze the economic attractiveness of cost-share pine regeneration investments in Alabama and Mississippi. These budgets examine pine reforestation investments in two situations: marginal cropland plantings and reforestation following harvest using moderately intensive site preparation. In these scenarios, site quality, stumpage price region and seedling type were variables. A real discount rate of 4 percent was used for the base analysis, then 6 and 8 percent rates were used to evaluate changes in the results due to a change in the discount rate. Cost-sharing assistance such as in FIP or similar state cost-sharing programs was assumed with all analyses. The case of the Conservation Reserve Program which combines annual payments to the landowner and cost-share funds for plantation establishment was not considered.

The analyses were performed using the YIELD plus computer package from the Tennessee Valley Authority. These budgets examine the timber investment only. Potential incomes from other sources such as hunting leases or non-market values are not considered. Incomes such as stumpage, and expenses such as site preparation, planting, taxes, controlled burning etc. are in 1988 dollars. The guiding rate was 4 percent. The analysis was conducted on a real basis and is independent of inflation effects. Net present value (NPV) was used as the primary indicator of economic efficiency however, internal rate of return (IRR) and equivalent annual income (EAI) are also presented

The marginal cropland case was a consistently profitable investment in both Alabama and Mississippi. Net present value for Alabama marginal cropland plantings ranged from a high of $952.95 in the south, using improved seedlings to a low of $138.80 in the north using unimproved or "woods run" seedlings. NPV using improved stock ranged from $952.95 on the Excellent site in the south market region to $194.28 on the Poor site in the northern market region. The use of improved seedlings increased NPV an average of 25 percent on the Excellent sites, over 40 percent on the Good and Average sites and 37 percent on the Poor sites. The use of improved seedling stock increased NPV an average of $166.17, $166, $150.70 and $67.14 on the Excellent, Good, Average and Poor sites, respectively. As expected, NPV was highest in the southern market region for all sites because prices are higher in the south. Table 20 shows a summary of results for Alabama marginal cropland plantation investments.

The results of the Mississippi marginal cropland budgets were similar to Alabama. The NPV was positive for all sites, in all regions indicating a profitable investment. NPV ranged from $747.43 for the

Table 20. Alabama Marginal Cropland Budget Summary, 4 Percent Discount Rate

	Excellent Site (SI=70)*						Good Site (SI=60)*					
Price Region	North		Central		South		North		Central		South	
Seedling Type	I	U	I	U	I	U	I	U	I	U	I	U
IRR**	15.9	14.4	16.8	15.4	17.8	16.3	13.9	12.3	14.9	13.1	15.9	14.0
EAI Δ	36.08	28.62	44.57	35.63	51.06	40.74	25.15	17.76	31.35	22.05	36.06	26.07
NPVΔΔ	673.35	534.16	831.84	665.04	952.95	760.41	469.42	331.50	585.19	411.52	673.02	486.57

	Average Site (SI=57)*						Poor Site (SI=45)*					
Price Region	North		Central		South		North		Central		South	
Seedling Type	I	U	I	U	I	U	I	U	I	U	I	U+
IRR**	13.4	11.8	14.4	12.6	15.3	13.5	9.9	8.7	10.8	9.6	11.6	10.3
EAI Δ	22.17	15.46	27.71	19.15	31.99	23.4	10.41	7.44	13.52	9.82	15.87	11.75
NPVΔΔ	413.72	288.59	517.27	357.35	597.12	430.03	194.28	138.80	252.35	183.34	296.17	219.23

* Site Index Base Year 25
** IRR = Internal Rate of Return
Δ EAI = Equivalent Annual Income
ΔΔ NPV = Net Present Value
All measures of economic efficiency are before taxes.

I = Improved seedlings
U = Unimproved seedlings

southern market region, using improved seedlings to $88.66 in the northern market region using unimproved stock. NPV using improved stock ranged from $747.43 on the Excellent site in the south to $134.40 on the Poor site in the north. Improved seedlings increased NPV of the reforestation investment an average of $138.53 or 27 percent on Excellent sites, $133.17 or 43 percent on Good sites, $119.47 or 45 percent on Average sites and $54.94 or 47 percent on Poor sites. Table 21 shows a summary of results for Mississippi marginal cropland plantation investments.

There is no doubt that planting marginal croplands or pasture with pine seedlings using cost-share assistance in Alabama and Mississippi is a profitable investment. In addition, using improved seedlings will increase the investment's net present value (from $45 to $192 depending on state and site quality) more than the small additional costs (about $3 - $15) of the improved seedlings.

The analysis of reforestation on cutover forestland is of central focus given the lack of PNIF reforestation after harvest noted previously. The situation examined in these budgets is that of harvested forestland that requires moderately intensive site preparation. The site preparation method analyzed is the use of a single pass of a roll-chopper drawn behind a bulldozer, followed by site preparation burning and hand planting. Typically, the chopper will crush residual trees and brush concentrating the material near the ground. After a few months the slash

Table 21. Mississippi Marginal Cropland Budget Summary, 4 Percent Discount Rate

	Excellent Site (SI=70)*						Good Site (SI=60)*					
Price Region	North		Central		South		North		Central		South	
Seedling Type	I	U	I	U	I	U	I	U	I	U	I	U
IRR**	13.8	12.6	14.2	13.1	15.5	14.2	12.0	10.7	12.5	11.1	13.5	12.2
EAI$^{\Delta}$	28.94	22.49	34.50	27.14	40.05	31.59	19.39	13.58	23.40	15.92	27.49	19.37
NPV$^{\Delta\Delta}$	540.21	419.80	643.99	506.65	747.43	589.57	361.83	253.41	436.72	297.19	513.17	361.59

	Average Site (SI=57)*						Poor Site (SI=45)*					
Price Region	North		Central		South		North		Central		South	
Seedling Type	I	U	I	U	I	U	I	U	I	U	I	U+
IRR**	11.5	10.2	12.0	10.6	13.0	11.7	8.3	7.4	8.9	7.9	9.8	8.7
EAI$^{\Delta}$	16.88	11.73	20.33	13.56	24.11	16.83	7.20	4.75	9.11	6.09	11.25	7.89
NPV$^{\Delta\Delta}$	314.98	218.97	379.50	253.02	449.97	314.05	134.40	88.66	170.09	113.70	209.98	147.27

* Site Index Base Year 25
Δ EAI = Equivalent Annual Income
$\Delta\Delta$ NPV = Net Present Value
All measures of economic efficiency are before taxes.

I = Improved seedlings
U = Unimproved seedlings

is dry enough for burning. This is usually done in the fall months. If all is successful the tract will be ready to plant during the December-February planting season. The total cost of this treatment and planting is estimated at $ 136.36 or $130.55 (1988 dollars) depending on whether improved or unimproved seedlings are used. This cost is average for mechanical site preparation and planting but can be as high as $200.00 per acre or more for other site preparation techniques. Using cost-share assistance the landowner's costs are between $50 and $60 per acre in this analysis.

The cutover timberland analysis for Alabama showed pine plantation investments profitable on all sites, except "Poor" sites. On the "Poor" cutover sites using unimproved seedlings, growth was not sufficient to support the harvest schedule established for the study and simulation runs were infeasible. The management schedule could not be followed on these sites because not enough wood was produced to allow 4 harvests beginning at age 15 as previously described. Therefore, the cutting schedule was modified as noted previously to make the simulation feasible. Hence, the results shown for "Poor" sites using unimproved seedlings in both states reflect a different management schedule than all other budgets. This difference is noted in the summary tables. These budgets are not useful for comparison but is noteworthy that these investments yield positive NPV.

It is interesting to note that using improved seedlings caused these sites to be economical for plantation establishment though they are marginal. It also illustrates that different management prescriptions must be followed based on productivity.

On Alabama cutover timberland, NPV ranged from a high of $906.07 on "Excellent" sites in the southern region using improved seedlings to being infeasible on the "Poor" site in the northern region using unimproved seedlings. NPV using improved seedlings ranged from $906.07 on the "Excellent" site in the southern market region to $86.42 on the "Poor" site in the northern region. Improved seedlings increased NPV of plantation investments an average of $196.97 or 33 percent on "Excellent" sites, $127.03 or 36 percent on "Good" sites, and $134.57 or 48 percent on "Average" sites. On "Poor" sites the use of improved stock increased yields sufficiently to allow the plantations to produce enough wood so that the original harvest schedule could be met. NPV on "Poor" sites with improved seedlings ranged from $86.42 in the north to $175.63 in the south. Table 22 shows a summary of results for Alabama cutover timberland pine plantation investments.

The results of budget analysis of Mississippi cutover timberland are similar to those for Alabama. Pine plantation investments were profitable on all sites, except "Poor" sites using unimproved seedlings. As in Alabama, the original harvest schedule could not be met with unimproved stock so a modified harvest schedule was substituted. Therefore, NPV under the original schedule is infeasible. NPV shown

Table 22. Alabama Cutover Timberland Budget Summary, 4 Percent Discount Rate

	Excellent Site (SI=70)*						Good Site (SI=60)*					
Price Region	North		Central		South		North		Central		South	
Seedling Type	I	U	I	U	I	U	I	U	I	U	I	U
IRR**	10.50	9.60	11.30	10.30	11.80	10.90	8.90	8.00	9.70	8.80	10.20	9.20
EAIΔ	33.37	25.20	42.55	32.51	48.54	37.24	20.06	14.45	26.18	19.26	30.38	22.49
NPVΔΔ	622.82	470.38	794.24	606.83	906.07	695.00	374.45	269.67	488.60	359.54	567.02	419.77

	Average Site (SI=57)*						Poor Site (SI=45)*					
Price Region	North		Central		South		North		Central		South	
Seedling Type	I	U	I	U	I	U	I	U+	I	U+	I	U+
IRR**	8.5	7.5	9.3	8.2	9.8	8.7	5.8	3.9	6.4	4.5	7.0	5.2
EAIΔ	17.37	11.41	22.87	15.45	26.66	18.41	4.63	-.15	7.02	1.00	9.41	2.85
NPVΔΔ	324.14	213.04	426.94	288.35	497.60	343.58	86.42	-2.76	131.07	18.74	175.63	53.13

\+ This combination of site index and seedling quality made a harvest at year 15 infeasible. Cutting schedule was modified as follows: Harvests to the same residual basal areas were made in year 25, 30, and 35.

* Site Index Base Year 25

** IRR = Internal Rate of Return, ΔEAI = Equivalent Annual Income, ΔΔ NPV = Net Present Value.
All measures of economic efficiency are before taxes.
I = Improved seedlings U = Unimproved seedlings

on Table 23 are for the modified cutting schedule. Otherwise, NPV ranged from $712.81 on "Excellent sites" in the southern region to being infeasible on "Poor" sites of all regions using unimproved seedlings. NPV using improved seedlings ranged from $712.81 on the "Excellent" site in the southern region to $31.84 on the "Poor" site in the north region. Improved seedlings increased NPV on average by $147.47 or 31 percent on "Excellent" sites, $105.36 or 41 percent on "Good" sites, $109.47 or 57 percent on "Average" sites and caused infeasible plantations on "Poor" sites to be feasible and economical (positive N.P.V). Table 23 shows a summary of results for Mississippi cutover timberland pine plantation investments.

If we combine our understanding of the economic attractiveness (NPV) of pine plantation investments with the number of acres in a particular site quality class, we can develop profitability curves that show the quantity of acres with the highest investment potential. NPV estimates for the various sites are shown graphically with estimates of the number of acres in each site classification. The acreage figures come from the U.S. Forest Service and are presented in Appendix C. Those tables show the number of acres in each of the four site quality classes analyzed for every county in Alabama and Mississippi. Profitability curves for marginal cropland and cutover timberland in each price report region in Alabama and Mississippi are presented in Appendix E. On the vertical axis is net present value (NPV) at 4

Table 23. Mississippi Cutover Timberland Budget Summary, 4 Percent Discount Rate

	Excellent Site (SI=70)*						Good Site (SI=60)*					
Price Region	North		Central		South		North		Central		South	
Seedling Type	I	U	I	U	I	U	I	U	I	U	I	U
IRR**	9.5	8.8	10.1	9.4	10.6	9.9	7.9	7.2	8.5	7.8	9.1	8.3
EAIΔ	26.44	19.80	33.15	25.13	38.19	29.14	15.00	10.28	19.30	13.60	22.98	16.46
NPVΔΔ	493.52	369.60	618.71	469.10	712.81	543.92	279.89	191.89	360.22	253.87	428.93	307.20

	Average Site (SI=57)*						Poor Site (SI=45)*					
Price Region	North		Central		South		North		Central		South	
Seedling Type	I	U	I	U	I	U	I	U+	I	U+	I	U+
IRR**	7.5	6.6	8.1	7.2	8.6	7.7	4.7	2.9	5.1	3.1	5.8	3.9
EAIΔ	12.57	7.71	16.39	10.35	19.66	12.96	1.71	-1.92	2.94	-1.69	4.99	-.15
NPVΔΔ	234.53	143.89	305.88	193.20	366.96	241.80	31.84	-35.80	54.85	-31.47	93.09	-2.81

\+ This combination of site index and seedling quality made a harvest at year 15 infeasible. Cutting schedule was modified as follows: Harvests to the same residual basal areas were made in year 25, 30, and 35.

* Site Index Base Year 25

** IRR = Internal Rate of Return, Δ EAI = Equivalent Annual Income, ΔΔ NPV = Net Present Value. All measures of economic efficiency are before taxes.

I = Improved seedlings U = Unimproved seedlings percent discount rate and on the horizontal axis is cumulative acres in that price region. Each curve is separated into four steps that represent a site quality class within the price region. The height of the step is determined by the NPV of the pine plantation investment for that site quality class. The width of the step is determined by the number of acres within the region in that site quality class as given by the Forest Service. Each figure has two curves one representing the pine plantation investment using improved seedlings and the other for unimproved seedlings. As long as the curve is above the horizontal axis the NPV is positive and the investment is profitable, below the horizontal axis the investment does not exceed the alternative rate. Twelve curves are presented, one for each of 6 price report regions in two states under two different plantation establishment regimes: marginal cropland and cutover timberland.

Sensitivity Analysis

Forest investments are sensitive to interest rates because they are long term investments. Since expenses such as site preparation and planting are incurred early in the investment and are not recovered until timber is sold years later, the interest rate used to calculate costs and returns is very important. The plantation budgets developed in this analysis for pine plantations on marginal cropland and cutover timberland were recalculated using alternative real discount rates of 6 and 8 percent to test the sensitivity of the results to interest rates.

Knowledge of how investment profitability changes as the interest rate changes is important, given the range of real interest rates that PNIF owners are likely to prefer. A range of interest rates is reasonable since PNIF owners have many ownership objectives. This sensitivity analysis will assist landowners that require different interest rates to evaluate their most profitable forest management investment opportunities by identifying the combinations of site quality, stumpage prices and management costs that make investments profitable at different discount rates.

In the base analysis which used a 4 percent discount rate, all combinations of plantation type, site quality, price region, and seedling type were simulated. In this sensitivity analysis, all combinations were not run at 6 and 8 percent discount rates. Budgets were run with the 6 and 8 percent rates for the Excellent and Poor sites for each plantation type in Mississippi and Alabama with the intention of finding the combinations where the plantation investment became unprofitable (NPV negative). Since it is the Poor sites that are on the margin, those plantations on the Poor sites were the first to become unprofitable. However, as necessary, additional budgets were run for various combinations among the average sites to identify those situations where the investment became unprofitable. Sensitivity analysis was also run on the Excellent sites and as expected they remained profitable. Table 24 shows a summary of the sensitivity analysis for marginal cropland

Table 24 Marginal Cropland Sensitivity Analysis Summary 1/

Marginal Cropland

State	Mississippi						Alabama					
Seedling Type	Improved			Unimproved			Improved			Unimproved		
Site \ Price Region	North	Central	South	North	Central	South	North	Central	South	North	Central	South
Excellent	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8
Good	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8
Average	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8
Poor	4,6,8	4,6,8	4,6,8	4,6	4,6	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8

1/ A 4,6, or 8 in each cell indicates that the plantation investment with that particular combination of variables has positive NPV at that Discount Rate.

plantation investments in Mississippi and Alabama. Marginal cropland pine plantation investments were profitable at all interest rates in Mississippi and Alabama with the exception of the Poor site using unimproved seedlings in the north and central Mississippi price regions. These two situations were unprofitable at 8 percent but were profitable at 4 and 6 percent discount rates.

The cutover timberland plantation investment showed more sensitivity to the discount rate. This is not surprising since yields on cutover sites are lower than on agricultural fields and establishment costs are higher than for marginal cropland plantations. Table 25 shows a summary of the sensitivity analysis for cutover timberland plantation investments in Mississippi and Alabama. In Alabama, reforesting cutover timberland on Excellent, Good and Average sites using improved or unimproved seedlings was profitable at 4, 6, or 8 percent discount rates except those investments using unimproved seedlings on the Average site in the northern region. The plantation using unimproved seedlings in north Alabama on Average sites was profitable only at the 4 and 6 percent rates. Cutover site plantation investments on Poor sites were profitable at the 4 and 6 percent rates using improved seedlings in central and south Alabama but only at 4 percent in north Alabama. Unimproved seedlings on Poor cutover sites required a modified management schedule so could not be compared.

Table 25 Cutover Timberland Sensitivity Analysis Summary 1/

Cutover Timberland

State	Mississippi						Alabama					
Seedling Type	Improved			Unimproved			Improved			Unimproved		
Site \ Price Region	North	Central	South	North	Central	South	North	Central	South	North	Central	South
Excellent	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8
Good	4,6	4,6,8	4,6,8	4,6	4,6	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8	4,6,8
Average	4,6	4,6,8	4,6,8	4,6	4,6	4,6	4,6,8	4,6,8	4,6,8	4,6	4,6,8	4,6,8
Poor	4	4	4				4	4,6	4,6			

1/ A 4,6, or 8 in each cell indicates that the plantation investment with that particular combination of variables has positive NPV at that Discount Rate.

In Mississippi, fewer sites were profitable at the 8 percent discount rate than in Alabama. Cutover timberland plantations were profitable in all price regions using improved and unimproved seedlings on Excellent sites at the 4, 6, and 8 percent discount rates. Investments on Good and Average sites using improved seedlings in the central and south price regions were also profitable at all discount rates tested. Plantations on Good sites in south Mississippi using unimproved seedlings were also profitable at all rates tested. In north Mississippi cutover plantations on Good and Average sites using improved seedlings were profitable at only the 4 and 6 percent rates. Plantations using unimproved seedlings on Good sites in north and central Mississippi and those on Average sites in all price regions were profitable at the 4 and 6 percent discount rates, but not at 8 percent. On Poor sites cutover plantations using improved seedlings were profitable at the 4 percent discount rate only in all price regions. Poor site plantations using unimproved seedlings required a modified management schedule and could not be compared. Tables 26 through 29 show the results of the sensitivity analysis for marginal cropland and cutover timberland plantation investments in Alabama and Mississippi.

Based on the profitability levels shown by these analyses and Forest Service estimates of timberland acreage in each site quality classification we can estimate the maximum number of acres in each state where reforestation investments of this type are profitable under the

Table 26. Alabama Marginal Cropland Sensitivity Analysis Budget Summary

	Excellent Site (SI = 70)*						Poor Site (SI = 45)*					
Price Region	North		Central		South		North		Central		South	
Seedling Type	I	U	I	U	I	U	I	U	I	U	I	U
6% Discount Rate												
IRR	15.90	14.40	16.80	15.40	17.80	16.30	9.90	8.70	10.80	9.60	11.60	10.30
EAI	25.65	19.8	31.86	24.89	37.01	28.91	6.14	3.84	8.41	5.57	10.27	7.06
NPV	371.87	287.13	461.89	360.91	536.64	419.16	88.99	55.65	121.98	80.79	148.85	102.32
8% Discount Rate												
IRR	15.90	14.40	16.80	15.40	17.80	16.30	9.90	8.70	10.80	9.60	11.60	10.30
EAI	17.55	12.98	22.08	16.66	26.17	19.81	2.69	.93	4.35	2.18	5.81	3.32
NPV	204.59	151.28	257.37	194.14	305.06	230.91	31.38	10.79	50.68	25.37	67.68	38.66

*Site Index Base Year 25
IRR = Internal Rate of Return
EAI = Equivalent Annual Income
NPV = Net Present Value
I = Improved seedlings
U = Unimproved seedlings

Table 27. Mississippi Marginal Cropland Sensitivity Analysis Budget Summary

	Excellent Site (SI = 70)*						Poor Site (SI = 45)*					
Price Region	North		Central		South		North		Central		South	
Seedling Type	I	U	I	U	I	U	I	U	I	U	I	U
6% Discount Rate												
IRR	13.80	12.60	14.20	13.10	15.50	14.20	8.30	7.40	8.90	7.90	9.80	8.70
EAI	19.71	14.81	23.46	17.95	27.94	21.49	3.49	1.71	4.78	2.62	6.49	4.02
NPV	285.79	214.75	340.10	260.19	405.04	311.63	50.60	24.83	69.28	37.93	94.05	58.25
8% Discount Rate												
IRR	13.80	12.60	14.20	13.10	15.50	14.20	8.30	7.40	8.90	7.90	9.80	8.70
EAI	12.59	8.91	15.06	10.98	18.68	13.81	.50	-.74	1.35	-.15	2.71	.94
NPV	146.78	103.88	175.54	127.95	217.69	160.93	5.84	-8.68	15.73	-1.74	31.59	10.91

*Site Index Base Year 25
IRR = Internal Rate of Return
EAI = Equivalent Annual Income
NPV = Net Present Value
I = Improved seedlings
U = Unimproved seedlings

Table 28. Alabama Cutover Timberland Sensitivity Analysis Budget Summary

6% Discount Rate

	Excellent Site (SI = 70)*						Average Site (SI = 57)*					
Price Region	North		Central		South		North		Central		South	
Seedling Type	I	U	I	U	I	U	I	U	I	U	I	U
IRR	10.50	9.60	11.30	10.30	11.80	10.90	8.50	7.50	9.30	8.20	9.80	8.70
EAI	19.98	14.08	26.40	19.16	30.83	22.60	8.60	4.36	12.47	7.17	15.27	9.31
NPV	289.63	204.16	382.77	277.78	447.05	327.67	124.73	63.16	180.78	103.96	221.44	134.93

6% Discount Rate

Poor Site (SI = 45)*

Price Region	North		Central		South	
Seedling Type	I	U	I	U	I	U
IRR	5.80	-	6.40	-	7.00	-
EAI	-.54	-	1.15	-	2.87	-
NPV	-7.84	-	16.66	-	41.68	-

Table 28. (cont'd)

8% Discount Rate

	Excellent Site (SI = 70)*						Average Site (SI = 57)*					
Price Region	North		Central		South		North		Central		South	
Seedling Type	I	U	I	U	I	U	I	U	I	U	I	U
IRR	10.50	9.60	11.30	10.30	11.80	10.90	8.50	7.50	9.30	8.20	9.80	8.70
EAI	9.63	5.46	14.06	8.93	17.32	11.41	1.62	-1.32	4.30	.61	6.35	2.14
NPV	112.22	63.62	163.90	104.09	201.81	132.95	18.86	-15.36	50.07	7.14	74.05	24.89

8% Discount Rate

Poor Site (SI = 45)*

Price Region	North		Central		South	
Seedling Type	I	U	I	U	I	U
IRR	5.80	-	6.40	-	7.00	-
EAI	-4.89	-	-3.72	-	-2.49	-
NPV	-57.04	-	-43.34	-	-28.98	-

*Site Index Base Year 25
IRR = Internal Rate of Return
EAI = Equivalent Annual Income
NPV = Net Present Value
I = Improved seedlings
U = Unimproved seedlings

Table 29. Mississippi Cutover Timberland Sensitivity Analysis Budget Summary

6% Discount Rate

	Excellent Site (SI = 70)*						Good Site (SI = 60)*					
Price Region	North		Central		South		North		Central		South	
Seedling Type	I	U	I	U	I	U	I	U	I	U	I	U
IRR	9.50	8.80	10.10	9.40	10.60	9.90	-	-	-	-	-	-
EAI	14.61	10.10	19.13	13.69	22.90	16.63	-	-	-	-	-	-
NPV	211.88	146.43	277.39	198.50	331.97	241.10	-	-	-	-	-	-

6% Discount Rate

	Average Site (SI = 57)*						Poor Site (SI = 45)*					
Price Region	North		Central		South		North		Central		South	
Seedling Type	I	U	I	U	I	U	I	U	I	U	I	U
IRR	7.50	6.60	8.10	7.20	8.60	7.70	4.70	-	5.10	-	5.80	-
EAI	4.85	1.62	7.42	3.48	9.87	5.30	-2.87	-	-2.04	-	-.54	-
NPV	70.28	23.51	107.61	49.31	143.05	76.83	-41.57	-	-29.53	-	-7.82	-

Table 29 (cont'd).

<u>8% Discount Rate</u>

	Excellent Site (SI = 70)*						Good Site (SI = 60)*					
Price Region	North		Central		South		North		Central		South	
Seedling Type	I	U	I	U	I	U	I	U	I	U	I	U
IRR	9.50	8.80	10.10	9.40	10.60	9.90	7.90	7.20	-	7.80	-	8.30
EAI	5.44	2.55	8.41	4.91	11.21	7.05	-.20	-2.13	-	-.65	-	.84
NPV	63.38	29.70	98.07	57.27	130.60	82.12	-2.33	-24.80	-	-7.62	-	9.77

<u>8% Discount Rate</u>

	Average Site (SI = 57)*						Poor Site (SI = 45)*					
Price Region	North		Central		South		North		Central		South	
Seedling Type	I	U	I	U	I	U	I	U	I	U	I	U
IRR	7.50	6.60	8.10	7.20	8.60	7.70	4.70	-	5.10	-	5.8	-
EAI	-1.36	-3.31	.34	-2.41	2.15	-.77	-6.78	-	-6.23	-	-5.15	-
NPV	-15.81	-38.60	3.97	-24.94	25.06	-9.02	-79.02	-	-72.64	-	-60.04	-

*Site Index Base Year 25
IRR = Internal Rate of Return
EAI = Equivalent Annual Income
NPV = Net Present Value

I = Improved seedlings
U = Unimproved seedlings

discount rates tested. Table 30 shows a summary of the maximum number of acres in Mississippi and Alabama where cost-shared, cutover

Table 30 Maximum Number of Cutover Timberland Acres Profitable for Cost-Shared Reforestation by State, Discount Rate and Seedling Type

	Mississippi		Alabama	
Discount Rate	Improved Seedlings	Unimproved Seedlings	Improved Seedlings	Unimproved Seedlings
	--------- thousands of acres ---------			
4	16,142.5	13,406.7	21,658.4	13,228.2
6	13,406.7	13,406.7	18,390.6	13,228.2
8	10,654.3	4,260.2	13,228.3	10,740.3

timberland reforestation investments will be profitable at 4, 6, and 8 percent discount rates using improved or unimproved planting stock.

Policy Implications

When more information becomes available or the environment of a program changes, adjustments in program policy may be beneficial. The findings of this study suggest that a number of potential policy changes should be considered.

The economic analysis described shows that pine plantation investments are profitable on many sites, but most profitable on marginal cropland and the more productive forest sites. The profitability of these

investments is also affected by product prices in the locality of the plantation.

Since sustained increased timber production is the primary objective of the Forestry Incentives Program (FIP) (Risbrudt and Ellefson 1983) one could argue that cost-share funds should be targeted for investment on sites with the highest productivity. In 1979, 74.2 percent of FIP reforestation funding in the South was invested on sites that produce 86 to 120 cubic feet per acre per year. This productivity range corresponds to the "Average" site in this evaluation (Risbrudt and Ellefson 1983). It appears that returns to federal and state cost-share funds will be maximized if those funds are invested on the highest productivity sites, where possible. Such allocation would produce the most timber possible for the public money invested. However, since high stumpage prices have a positive effect on profitability, an alternative allocation of cost-share funds could be targeted to high productivity sites in areas with lower prices or less competition, since high stumpage prices and active markets for PNIF timber tend to encourage private investment in reforestation, at least among higher income landowners (Royer 1987). Davis (1980) suggested a sliding scale for cost-share assistance programs based on owner needs and characteristics. Policy evaluation such as this is especially timely since states have begun establishing their own cost-share programs in recent years (Straka and Bullard, 1986). In any case, investment objectives for public cost-share

programs should take land productivity, stumpage markets and profitability into account in order to make the best use of limited public funding.

An alternative concept is to vary the percentage of cost-share funds allocated to a landowner based on a combination of land productivity, stumpage prices and investment profitability. A higher cost-share percentage might be offered for reforestation investments on high productivity sites in less competitive price regions and lower cost-share percentages in timber markets with higher prices. As more timber price information becomes available the concept of profitability can be more readily entered into cost-share funding considerations. It may currently be feasible in the South.

Most actions aimed at stimulating southern PNIF owners to reforest harvested timberland have involved typical, neo-classical, economic measures such as increasing tax incentives and cost-share funding or lowering property and inheritance taxes (Kaiser and Royer 1983, Fesco et al. 1987). These measures require additional public appropriations to implement and their effects may take many years to assess. In addition, they are aimed at a landowner who views his forest as an investment. However, there are landowners who are content with the cost-share funding and other incentives as they are, but find the "red tape" of getting assistance too burdensome (Kaiser and Royer 1983).

Policy changes to streamline cost-share programs and make them more "user friendly" to landowners have not been suggested by researchers but promise as much as a 27% increase in southern PNIF reforestation activity.

Policy changes and educational efforts could eliminate many of the transaction costs that landowners now face. The development and maintenance of reliable site preparation and tree planting vendor publications, complete with sample vendor contracts would lower information costs. A certification program for these vendors would also give landowners confidence in using certified vendors when reforesting.

In 1979, more than 75 percent of FIP funds spent for all practices ($11 million), and more than 90 percent of all FIP reforestation funds were spent in the South. Site preparation and tree planting were the most costly FIP treatments on a per acre basis in that year. (Risbrudt and Ellefson 1983). In addition, many states, Mississippi and Alabama included, have state-funded, cost-share programs (Straka and Bullard 1986). Policies followed in these programs are very important and can have the effect to increase costs or exclude some landowners from participating. State and federal program administrators may feel that "if we're paying 50 percent of the bill, landowners should be willing to go through the process." There is no doubt that some landowners are willing, but 27 percent of the harvested acres in the South are owned by landowners who are not. Increased information about reforestation vendors, their operations and contracts combined with policy revisions to streamline the reforestation process on PNIF lands should lower the transaction costs now faced by thousands of PNIF owners.

Currently, very little information about the site preparation and tree planting market is available to the public. Increased information exchange, availability and publication of reforestation vendors, markets and prices will promote greater competition in the reforestation sector. Greater price competition in PNIF reforestation should promote lower costs which are desirable to landowners and the public. Royer (1987) in his discussion of southern reforestation behavior concludes that "both financial (cost-share programs) and technical assistance seem imperative if the nation's goal is to increase reforestation rates on southern pinelands." He later points out that "...while these programs (cost-share) are carried, researchers and analysts have the responsibility to ask what market mechanisms and institutional changes can be identified that would increase landowners responsiveness to reforestation and reduce our dependence on public programs". It appears from the literature that the effects of institutional changes on reforestation behavior have not been examined. Greater analysis of institutional changes in cost-share programs will likely be a productive research area.

Conclusions

Forestry is an important part of the Alabama and Mississippi economies. The forests of both states are largely owned by private, nonindustrial landowners. Lack of reforestation after harvest of these lands has been inadequate in recent years and is cited as a major reason why pine net annual growth has fallen below removals. Demand for southern pine and other softwoods is projected to rise and southern pine removals are expected to increase 25 percent by 2030. Therefore, increasing pine reforestation, particularly following harvest on PNIF lands, continues to be a high priority in Alabama and Mississippi.

Net present value (NPV) analysis shows that cost-shared, pine plantations on marginal croplands are a profitable investment for PNIF owners on all sites and in all price regions in Mississippi and Alabama. Plantation investments on all site quality classes within each of the six stumpage price regions were profitable when analyzed at the 4 and 6 percent real discount rates. Most sites were also profitable at the 8 percent real discount rate. The only cropland plantation investments not profitable at the 8 percent rate in this study were those using unimproved seedlings on the poor site in the north and central Mississippi price regions.

Reforesting harvested forestland with cost-share funds in Alabama and Mississippi was most attractive on excellent, good or average sites in this study. At the 4 percent discount rate, reforestation was profitable on all sites within all price regions when improved seedlings were used. When unimproved seedlings were used poor sites in all regions became unprofitable. Pine reforestation after harvest was profitable in all price regions on the excellent site using the 8 percent discount rate. Various combinations of site quality, price region, seedling type and discount rate between 4 and 8 percent were unprofitable. Generally, post-harvest cost-shared, reforestation yielded a positive NPV at the higher discount rates (6 and 8 percent) on the better sites in regions with higher stumpage prices when improved seedlings were planted.

In this analysis, the use of improved seedlings increased the net present value of the plantation investment in all situations. The increase in NPV ranged from 25 to 60 percent at the 4 percent discount rate.

Cost-share programs are offered by state and federal agencies as an incentive for PNIF owners to reforest. However, to date, no information to indicate the specific economic attractiveness of these investments and where they are most profitable in Alabama and Mississippi is available to PNIF owners. Within the assumptions of the analysis, this study shows the relative profitability of cost-shared, reforestation investments in Alabama and Mississippi. The results allow PNIF owners to consider site index, prevailing stumpage prices and their preferred discount rate when choosing reforestation investments under cost-share programs. These results will also aid state agency foresters in recommending reforestation alternatives to PNIF owners. Tree planting on marginal cropland can be recommended as an attractive, economic alternative throughout Alabama and Mississippi. Landowners should be more site specific when reforesting harvested forestland because poor quality sites in some areas may not justify intensive site preparation and planting. However, these results can be used to increase PNIF owner interest in cost-share reforestation of harvested stands.

The results of this analysis show profitability of cost-shared pine reforestation on various site classes at discount rates within PNIF real discount rate preferences considering timber incomes only. Other incomes and values, perhaps known only to the owners may increase these returns.

An assessment of plantation production inputs (such as pine seed, seedlings, nursery capacity and site preparation/tree planting services) shows that they are in sufficient supply. Improved pine seed is sold on the open market and is of clonal origin (called first generation by brokers) from forest industry surplus. The seed supply is ample but budget and certification questions can restrict its use by state forestry agencies. State nursery capacity in Mississippi and Alabama is inadequate to produce all the seedlings needed for reforestation but additional seedlings are acquired from forest industry nurseries in other states. Forest industry nursery capacity now equals public nursery capacity on a regional basis.

The supply of site preparation/tree planting services is ample in Mississippi and Alabama. Published lists show at least 19 venders per county available in Alabama and 36 vendors per county available in Mississippi.

APPENDICES

APPENDIX A

Southern Softwood Timber Supply and Demand

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Southern Softwood Timber Supply and Demand

Ensuring an adequate supply of a long-term renewable resource such as timber requires significant amounts of long range planning. The U.S. Forest Service has made periodic assessments of U.S. timber supply for many years, beginning in 1878. Assessments were made on an as-needed basis at the request of Congress until the passage of the McSweeney-McNary Act of 1928. This legislation directed the Secretary of Agriculture to assess the U.S. forest situation on a continuing basis. In 1928, however, significant amounts of old-growth timber remained in parts of the United States. It was not until the late 1950's when the exhaustion of available old-growth stands in the West became a foreseeable reality that more intensive assessments of future supply and demand became necessary.

In 1974, the Renewable Resources Planning Act (and later, the National Forest Management Act of 1976 and the Forest and Rangeland Renewable Resources Research Act of 1978) amended and broadened the assessment provisions of the McSweeney-McNary Act.

Increasing attention has been focused on the forests of the southern United States, particularly the softwood forests since the 1960's when the South's Third Forest report was published (Southern Forest Resource Analysis Committee 1969). During the 1970's, in response to the duties assumed as a result of the National Forest Planning process, the Forest Service developed sophisticated models to forecast the supply and demand for timber in various regions of the United States and for the nation as a whole. These projections were used to develop management plans for the National Forests. Harvest and management schedules are being developed based on anticipated regional timber needs estimated by the planning models. Articles reviewing the development and evolution of these Forest Service planning models have been published (Iverson and Alston 1986, Alston and Iverson 1987).

The results of the U.S. timber assessment studies in the late 1970's indicated that domestic production of wood and fiber products would not expand as rapidly as demand (Adams and Haynes, 1980). Rising stumpage prices and expanded imports particularly for softwood lumber, and paper and paperboard products appeared possible if forest management levels followed current trends. However, one option to alter that projected future was to initiate efforts to increase forest management intensity on private, nonindustrial forest ownerships. By 1980, federal policy makers saw the private, nonindustrial sector as the major source of increased timber harvests in the near and long term. The Administration's strongest emphasis in the nonindustrial, private sector was to enhance regeneration following harvest on nonindustrial, private lands, especially in the South (Fedkiw, 1980). These decisions sowed the seeds for much of the research that has focused on the private nonindustrial forestland owner.

In 1982 the Forest Service published "An Analysis of the Timber Situation in the United States 1952-2030" in response to the directives of the National Forest Management Act. The study was among the first to utilize modern comprehensive, mathematical techniques and showed that consumption of most timber products was rising. Between 1950 and 1978 softwood lumber consumption rose 25 percent. The total consumption of industrial roundwood (converted from various finished product volumes) rose from nearly 10 billion cubic feet in 1950 to about 13 billion cubic feet in 1978.

Demand projections showed an anticipated increase for most timber products in the decades ahead, based on expected increases in population, economic activity and income. The study's medium projection of demand, based on historical price trends, forecast 22.7 billion cubic feet of wood demanded in the year 2000 with demand rising to 28.3 billion cubic feet in 2030. This figure was more than double the 13.3 billion cubic feet consumed in 1976. Since growth in roundwood consumption in the 1960's and 1970's was entirely of timber produced from softwood species and given anticipated declines in old-growth harvesting in the West, this report increased the focus of future softwood supplies on forests other than the West, principally the South.

Adams, et al. (1982) developed an integrated mathematical model to project U.S. private timber supply for the period 1980-2030. The private timber supply model consisted of three principal elements: a set of short-term regional stumpage supply or harvest equations, an inventory projection model that updates inventory volumes used in the stumpage supply equations and a model that determines investment in forest management practices and adjusts parameters of the inventory projection model. This private supply model was then embedded in a larger model of the U.S. forest products and stumpage markets.

Using these models, two projections of U.S. timber supply were developed; a "baseline" projection which assumed intensity of management on private lands at current levels and an "intensive management" projection that allowed private investment to vary as determined by the model. Baseline simulation results for the South project the region's share of total U.S. softwood harvest rising from about 45 percent in 1980 to 53 percent in 2030. However, with intensified investment in forest management, southern production rises to 60 percent of the U.S. softwood harvest by 2030. This increase in production is a consequence of the large number of treatable acres in the South and the shorter rotations. The South has about nine times the commercial forest acreage of the Douglas-fir and California regions combined, but nearly twelve times the treatable area. Even with a decline of one half in the rate of acres treated the southern region would continue to expand output relative to the West. In the baseline simulation the Douglas-fir and California regions have few opportunities for harvest and product output expansion. As the liquidation of old-growth timber ends, the industry faces a transition to younger, smaller timber. These problems include declining harvests with associated loss of employment and income. Simulation results indicate that declining trends in inventory in the Northwest can be stabilized or reversed by increased investment, but no major impacts could be expected before the year 2000. Table 31 shows Southern and U.S. total and private timber harvest projections for selected years from baseline and intensive management simulations by Adams, et al.

TABLE 31. Total and Private Timber Harvest Simulation Projections for the South and the United States.

		1990		2000		2030	
Region	Simulation	Total	Private	Total	Private	Total	Private
		...Millions of Cubic Feet...					
South	Baseline	5,687	5,344	6,238	5,854	7,515	7,007
	Intensive	5,730	5,387	6,462	6,078	9,649	9,158
Total US	Baseline	11,576	8,706	12,065	8,971	14,075	10,328
	Intensive	11,608	8,738	12,303	9,213	16,115	12,608

Source: Adams, et al., 1982

The Land and Resource Management Plan for the National Forests in Mississippi was released in 1985. The plan projects timber demands beginning in 1986 and additional projections are provided for RPA time frames. Table 32 shows annual timber supply and demand comparisons for Mississippi National Forests. Total demand for all wood

TABLE 32. Annual Timber Supply and Demand Comparison by RPA Time Periods - Mississippi National Forests.

Timber Yield	Unit of Measure	1986 1990	1991 2000	2001 2010	2011 2020	2021 2030
•Maximum Timber	MMBF	270	332	394	409	409
	MMCF	54	66.4	78.8	81.8	81.8
•Demand	MMBF	241	281	386	520	588
	MMCF	48.2	56.2	77	104	116.6
•Forest Plan	MMBF	241	316	382	382	382
	MMCF	48.2	63.2	76.4	76.4	76.4
•Current Mgt.	MMBF	212	255	304	354	377
	MMCF	42.4	51	60.8	70.8	75.4
• Minimum Timber	MMBF	5	5	5	5	5
	MMCF	1	1	1	1	1

Source: USDA Forest Service, 1985c

products is projected to increase dramatically until 1990. During the period 1990-2020 demand is expected to continue increasing but at a slower rate of 6 to 10 percent periodic rate increase and then level off. The forest plan is expected to meet anticipated demands entirely until

1990, then exceed projected demand until the year 2000. After 2000, projected demand exceeds forest plan volumes by more than 25 percent.

Dickerhoff (1986) reviewed and analyzed international timber supply and demand data to assess softwood timber markets in relation to international trade and domestic production. After comparing the overall timber harvest/demand/trade situation for each of the major regions of the U.S., Dickerhoff concluded that considerable attention should be focused on program needs and investment opportunities in the South. Because of timber industry trends identified in the U.S. Forest Service 1979 RPA Assessment and more recent supplements, continued forest industry expansion into the South was likely. Dickerhoff cited the increases in southern housing starts, softwood lumber production, softwood plywood production capacity expansion and pulp production capacity as factors contributing to increased concentration of forest industry in the South. He cautioned, however, that projected rapid increases in harvesting could lead to serious timber inventory reductions. The author notes that the forest resources of the North will gain more prominence beginning in the 1990's and should benefit from the emerging structural flakeboard industry. Northwest timber industry capacities are not likely to expand and may even decline in the next decade, principally due to a loss of significant portions of north-central and northeastern markets to Canadian softwood lumber. Expansion of exports to the Far East was offered as an alternative for the Northwestern industries to maintain current timber industry production levels.

In 1986, the Land and Resource Management Plan for the National Forests in Alabama was published. Timber supply and demand projections are presented. Table 33 shows annual timber supply and demand levels for National Forest lands in Alabama. The forest plan was developed using FORPLAN version 2. The plan anticipates an increase

TABLE 33. Annual Timber Supply and Demand Comparison by RPA Time Periods - Alabama National Forests. (Millions Cubic Feet)

Timber Yield	1986 1990	1991 2000	2001 2010	2011 2020	2021 2030
Allowable Sale Quantity					
•Maximum Timber	19.9	28.5	42.0	44.3	44.3
•Demand	18.0	19.0	28.0	36.0	38.0
•Forest Plan	15.0	22.1	25.8	30.8	33.5
•Current Mgt.	14.4	21.9	27.3	34.0	34.0
• Minimum Timber	0	0	0	0	0

Source: USDA Forest Service, 1986

in timber demand of 211% over the 50 year planning horizon. The forest plan is expected to supply 92% of that increasing demand. If the maximum timber benchmark were implemented timber supply would exceed expected demand but other resources would be reduced. The plan anticipates increasing timber supply slightly from present to the year 2000 then producing less than under the current management plan.

A review of trend data for housing starts and wood products used in house construction was published by Marcin (1987). He analyzed softwood lumber consumption and softwood plywood and wood-based panel consumption for the period 1950 to present and provides projections for the period 1990-2030. Marcin anticipates wood products to remain as the dominant home building materials in the United States for the foreseeable future because of tradition and the cost advantage of wood. Housing starts per 1,000 population are projected to decline from 13 in 1950 to 5 in 2030. However, wood use per new house may increase as house size increases and existing houses are upgraded. Total lumber usage is projected to remain on average between 19 and 20 billion board feet (BBF) annually until 2020 and then decline to 16 BBF. Wood based panel consumption peaked in 1978 at about 3.5 billion square feet (1/2 inch equivalent). Wood based panel use (such as OSB and waferboard) is projected to increase to 4.6 billion square feet by 1990 and to over 5.3 billion square feet by 2010. Much of this increase will be made by displacing plywood and fiberboard. The plywood outlook is not clear because of uncertainty about the degree of displacement by other wood panels. Plywood usage declined to less than 7 billion square feet (3/8 inch basis, equivalent) in 1980 from a peak of about 11 billion square feet in 1977 and 1978.

In 1987, the state allocation of the South's Fourth Forest study for Alabama was published (Alabama Forest Resource Center 1987). The study projects a rapid increase in pine plantations between 1985 and 2000. This increase of pine plantations is expected to occur primarily on industry land which will account for 54 percent of the increase while private, nonindustrial lands will supply 43 percent. Conservation Reserve acres are expected to account for 60 percent of the PNIF plantation acres initially.

The projection shows a sharp decline in softwood growth rates southwide and consequently Alabama's softwood growth declines steadily until 1990 followed by a swift recovery. The authors speculate that the cause for this softwood growth decline is two fold. First, is the high pine mortality during the 1970's caused by the southern pine beetle, diseases and two major hurricanes. Secondly, is a problem with the definition of growing stock because it ignores young pines until they are 5 inches DBH. As a result, the time lag between plantation establishment and when its growth is counted is significant when a large number of plantations are established rapidly as occurred during the late 1970's and early 1980's in Alabama. After 1990, these plantations will begin to show their growth. At that time there will be over 3 million acres of premerchantable plantations in Alabama. As these plantations and many areas of natural regeneration become of growing stock size there will be a significant increase in growth, which shows on the projection.

Softwood timber removals in Alabama are expected to be level between 1990 and 2000. Demand for softwood pulpwood is expected to slow accounting for lower harvest levels in Alabama than the South in general. After 2000, softwood demand increases and shows a steady increase until the end of the projection period.

The softwood growth and removal projection for Alabama shows removals in excess of growth until the year 1999. Prior to 1999 there is a large volume of premerchantable growth occurring that is not counted. Beyond the year 2000 softwood growth and removals remain in balance. Table 34 gives softwood supplies, removals, net annual growth and inventory projections for Alabama. Table 35 shows the similar information for Mississippi.

TABLE 34. Softwood supply, removals, net annual growth and inventory for Alabama (millions cubic feet).

		Projection				
	1984	1990	2000	2010	2020	2030
Roundwood Supply	684	733	720	783	837	867
Timber Removals	697	759	741	802	851	878
Net Annual Growth	624	608	749	853	914	953
Inventory	11,653	10,943	10,060	10,120	10,888	11,411

Source: USDA Forest Service, 1988

TABLE 35. Softwood supply, removals, net annual growth and inventory for Mississippi (millions cubic feet).

		Projection				
	1984	1990	2000	2010	2020	2030
Roundwood Supply	530	550	572	654	695	685
Timber Removals	560	570	588	669	706	695
Net Annual Growth	582	514	594	659	693	711
Inventory	9,489	9,100	8,712	8,194	8,046	8,105

Source: USDA Forest Service, 1988

During the early 1980's new forest survey data and research on projection methodology indicated that changes in the timber resource situation in the South were likely to be significantly different from those shown in the last national analysis. Since the next national analysis of the U.S. timber situation was several years away and considering the importance given the South in the previous national analysis, a new comprehensive analysis of the South's timber situation was conceived. The study was named the South's Fourth Forest.

The Fourth Forest analysis uses the most sophisticated timber projection modeling techniques of any such analysis to date. In previous regional and national analyses the Timber Resource Analysis System (TRAS) was used to project future inventory and growth, but the TRAS model was limited because it was not sensitive to forest type, origin, ownership or management intensity (McWilliams 1987). Clearly these factors were important to an assessment of Southern forests so a modified timber resource interaction model was developed. This new model has overcome many of the difficulties associated with previously used methodology. The new system utilizes four analytical models: the area projection model, the timber supply model, the timber demand model and the state allocation model.

The Southern Area Model (Alig 1985) replaced the "expert opinion" method previously used and provides state level timberland acreages by ownership category and forest management type. These estimates are inputs to the timber supply model.

Once acreage projections are available these are used by the Timber Resource Inventory Model (TRIM) to develop timber supply estimates (Tedder 1983). Biological (such as growth, yield, management intensity, stocking, and acreage) and economic (such as timber demand and price) inputs are used in an interactive process between the supply and demand modules in TRIM to produce regional timber supply projections.

The Timber Assessment Market Model (TAMM) (Adams and Haynes 1980) was used to model future demands in forest products markets. In the Fourth Forest projection system, softwood and hardwood TAMM modules interact directly with the TRIM model to balance projections of timber supply and demand. Projections are made under equilibrium conditions with prices and production factors allowed to fluctuate.

In the final stage, the Southern Allocation Regional Inventory model (Apt 1986) is used to disaggregate regional resource projections to the state level. This model gives state estimates of inventory growth, and removals by ownership and forest management type.

The analysis of the southern timber situation was compiled and published as the South's Fourth Forest: Alternatives for the Future (USDA 1988). This comprehensive report describes the history, current situation and projected futures of the southern forests. The future is presented by a series of projections under different circumstances. The report details a base projection which reflects the consensus judgment of the technical experts involved about the most likely future changes in the demand and supply determinants. Other "futures" or projections based on changes in the trends of various factors such as management intensity on private nonindustrial lands are also presented in the study.

The base projections of the South's Fourth Forest report show softwood timber removals rising above net annual growth in the 1990's and softwood inventories declining. Softwood net annual growth is increasing again by the year 2000. After 2000 an increase in net annual growth begins and continues a slow increase to the end of the projection. Softwood roundwood supply continues to increase slowly throughout the projection, as do timber removals. Timber removals rise above net annual growth during the 1990's but net annual growth increases after the year 2000 to rise above timber removals and remains greater than removals until the end of the projection. Table 36 presents the softwood supply removals, net annual growth and inventory summary for the South in 1984 and by decade through the projection period.

In summary, the base projections of the South's Fourth Forest study project that the area of southern timberland will decline by 5 percent by the year 2030. Private, nonindustrial ownerships are

TABLE 36. Softwood supply, removals, net annual growth and inventory (in millions of cubic feet) and timberland area for the South.

		Projection				
	1984	1990	2000	2010	2020	2030
Roundwood Supply	5,049	5,405	5,821	6,146	6,567	6,589
Timber Removals	5,362	5,691	6,074	6,356	6,737	6,721
Net Annual Growth	5,720	5,257	6,090	6,801	7,104	7,254
Inventory	101,836	96,717	91,512	92,812	96,847	100,935
Timberland (Thousand Acres)	182,164	180,006	177,641	176,227	174,793	173,527

Source: USDA Forest Service, 1988

expected to account for most of this decrease. Forest industry timberland is projected to rise slightly. Timberland area projections show an increase in pine forest types from 34 percent of the timberland base in 1985 to 42 percent in 2030. Two thirds of this pine type acreage is projected to be pine plantations by 2030.

The projection indicates that softwood timber supplies will rise by 15 percent in 2000 to 5.8 billion cubic feet of roundwood. Forest industry land is expected to provide most of this increase while supplies from PNIF lands are expected to level off. Softwood supplies from PNIF lands are projected to increase less than 4 percent by 2000. This means that by 2000 forest industry lands will furnish nearly 40 percent of softwood supplies, compared to about 35 percent today.

In the South Central Region which includes Mississippi and Alabama, softwood supplies are expected to increase 17 percent by 2000 and 36 percent by 2030 when they are expected to reach 3.5 billion cubic feet. Softwood supplies from PNIF lands are expected to increase 12 percent by 2030 while those from forest industry lands are projected to increase by 60 percent.

Since 1962 softwood removals in the South have increased 83 percent. Most of this increase is due to increases in softwood product output but significant removal levels are due to land use changes such as urban development. Projections of annual softwood removals in the South follow a similar pattern to softwood roundwood supplies. By the year 2000 annual softwood removals are projected to increase 13 percent above current levels to 6.1 billion cubic feet. About 26 percent of this increase is expected to come from forest industry lands, 2 percent from PNIF lands and 45 percent from public lands between now and

2000. Beyond 2000 removals rise until 2020 when they reach 6.7 billion cubic feet, then decline slightly.

Removals in the South Central Region also are similar to softwood supplies. Total removals of softwood growing stock in this region reached 2.7 billion cubic feet in 1984 with the most significant recent increases in Alabama. By 2030 annual softwood removals in this region are projected to increase 34 percent above current levels to 3.6 billion cubic feet. Most of the increase, 58 percent, is expected to come from forest industry.

Declines in net annual growth have been measured in several areas of the South recently (Knight 1987). Apparently, since 1976 growth has peaked at least temporarily and turned downward. Most of the recent decline in softwood growth has occurred on PNIF ownerships. Net annual growth of softwood on PNIF lands owned by farmers decreased 28 percent between 1976 and 1984. The base projections predict the downturn in net annual softwood growth will continue until the year 2000. After the year 2000 many of the pine plantations established in the 1980's become merchantable and softwood net annual growth increases to 7.2 billion cubic feet by 2030. The problem of softwood net annual growth on PNIF lands is a major concern in southern forestry. Inadequate regeneration on PNIF lands is a major cause of this decline in softwood net annual increment.

Softwood net annual growth in the South Central Region appears to have peaked about 1980. Almost all the recent decline in softwood growth has occurred on PNIF land in this region. Lack of adequate pine regeneration has contributed to losses of pine types as have partial harvests. These factors are estimated to produce a net shift from pine types to hardwood types on PNIF lands of 210,000 acres annually in the South Central Region. Net annual growth of softwood is projected to decline sharply during the 1990's to about 2.6 billion cubic feet and recover after 2000. Beyond 2000 net annual growth recovers to 3.6 billion cubic feet in 2030.

The base projections show a 10 percent decline in softwood inventories in the South between now and 2000. Most of this reduction occurs on PNIF lands. The regional inventory is then projected to begin increasing after 2000 and reach 101 billion cubic feet by 2030, which is about the current inventory level. On PNIF lands, a 19 percent decline in softwood inventory is projected by the year 2030, compared to current levels.

In the South Central Region 1985 softwood inventories were above 1977 levels but softwood inventories have probably peaked. Softwood inventories for the region are expected to decline from 51.4 billion cubic feet in 1985 to 45.4 billion cubic feet in 2010, or about 12 percent. The inventory decline on PNIF land for the same period is about 20 percent and it extends to the year 2020. Softwood inventory is projected to increase after 2010 to 47.6 billion cubic feet in 2030.

The conclusions drawn from the base projections of the South's Fourth Forest study describe a forest that will develop if present trends continue. However, if public programs or other circumstances change current trends a different forest, better or worse, than the one described may develop. The effects of low management intensity, particularly a lack of regeneration following harvest on PNIF lands has been cited as a major factor in declines of net annual growth, inventory and pine type acreage changes. Given that PNIF owners control about 67 percent of southern commercial forest land, significant emphasis is being focused on methods to stimulate these owners to practice more intensive forest management, especially pine regeneration following harvest. This emphasis makes the assessment of the pine regeneration process on the state level important. In addition, examination of public policy is appropriate to identify potential barriers to increased participation in forestry.

APPENDIX B

Seed Estimate Calculations

APPENDIX B

Seed Estimate Calculations

(1) Loblolly seed estimate calculated as follows:

$$S \times .75 = S_{LP}$$

$$S_{LP} \div 18{,}200 = P_{LP}$$

$$P_{LP} \times .1875 = P_{LC}$$

$$P_{LP} + P_{LC} = P_L$$

Where:

S = total seedlings planted that year

S_{LP} = plantable loblolly seedlings

P_{LP} = pounds of loblolly seed used to produce plantable seedlings in a given year

P_{LC} = pounds of loblolly seed used that did not produce a plantable seedling

P_L = pounds of loblolly seed used

.75 is used because I assume loblolly comprises 75 percent of all seedlings planted, 20 percent slash and 5 percent for longleaf and shortleaf combined.

18,200 is the average clean seeds per pound for loblolly pine from the Seeds of Woody Plants of the United States.

.1875 is used because I assume that 25 percent of all seed planted never produces a plantable seedling ($.75 \div 4 = .1875$). This includes seeds that don't germinate or produce cull seedlings. South (1986) reports seed efficiency for

southern nurseries ranges from 40 to 90 percent. Here I assume it is 75 percent so 25 percent is lost.

(2) Slash seed estimate calculated as follows:

$$S \times .20 = S_{SP}$$

$$S_{SP} \div 14{,}500 = P_{SP}$$

$$P_{SP} \times .05 = P_{SC}$$

$$P_{SP} + P_{SC} = P_S$$

Where:

S = total seedlings planted that year

S_{SP} = plantable slash seedlings

P_{SP} = pounds of slash seed used to produce plantable seedlings in a given year

P_{SC} = pounds of slash seed used that did not produce a plantable seedling

P_S = pounds of slash seed used

.20 is used because I assume 20 percent of seedlings planted each year are slash pine.

14,450 is the average clean seeds per pound for loblolly pine from the Seeds of Woody Plants of the United States.

.05 is used because I assume that 25 percent of all seed planted never produces a plantable seedling (.20 ÷ .25 = .05). This includes seeds that don't germinate or produce cull seedlings. South (1986) reports seed efficiency for southern nurseries ranges from 40 to 90 percent. Here I assume it is 75 percent so 25 percent is lost.

(3) Estimated seed used if PL + PS. It is not total seed used because longleaf and shortleaf pine are not included although they only account for 5 percent of planting.

APPENDIX C

Acres of Forestland by Site Class and County in Alabama and Mississippi

APPENDIX C

Acres of Forestland by Site Class and County in Alabama and Mississippi

TABLE 37. Acres of Forestland (thousands) by Site Class and County in Alabama

A. Northern Reporting DistrictΔ

	Site Index 25			
County	70	60	57	45
Blount	6.5	32.5	90.9	97.4
Calhoun	6.2	49.7	68.3	130.3
Cherokee	-	-	84.5	118.3
Clay	5.6	16.9	89.9	202.2
Cleburne	-	59.5	101.2	154.8
Colbert	16. 0	21.3	64. 0	112.0
Cullman	-	6.0	114.7	108.6
DeKalb	19.4	13.0	58.3	168.4
Etowah	5.9	23.8	53.5	101.0
Fayette	17.5	58.2	93.1	151.3
Franklin	21.7	27.1	75.9	135.4
Jackson	-	22.3	72.4	345.4
Jefferson	123.2	151.2	123.2	56.0
Lamar	6.3	37.9	107.3	151.5
Lauderdale	-	6.3	63.2	88.4
Lawrence	-	15.6	83.2	93.6
Limestone	-	17.5	64.0	29.1
Madison	-	49.5	42.4	106.1
Marion	-	41.5	195.9	130.6
Marshall	-	24.8	99.3	74.5
Morgan	4.8	28.6	71.5	52.4
Shelby	-	44.4	209.2	152.2
Talledega	16.1	43.0	86.0	134.4
St. Clair	-	55.3	115.6	140.6
Walker	84.4	106.9	129.4	78.8
Winston	-	29.7	130.8	154.5
Total	333.6	982.5	2487.7	3267.8
% of Total	4.7	13.9	35.1	46.2

*Data from Forest Statistics for Alabama Counties in 1982, USDA Forest Service Southern Forest Experiment Station Resource Bulletin SO-97

Δ Reporting districts for prices after Timber Mart South.

Table 37 (cont'd.)

B. Central Reporting District

County	Site Index 25 70	60	57	45
Autauga	-	34.6	97.9	109.4
Barbour	10.9	71.1	175.0	109.4
Bibb	27.7	116.3	110.8	83.1
Bullock	64.0	98.9	64.0	40.7
Butler	-	134.6	117.0	140.4
Chambers	6.0	59.6	125.1	83.5
Chilton	38.5	49.5	126.5	88.0
Coffee	6.4	44.5	146.3	50.9
Coosa	6.0	30.1	138.7	192.9
Crenshaw	-	42.7	97.6	134.3
Dale	5.4	38.1	103.5	70.8
Dallas	45.4	80.6	126.0	45.4
Elmore	12.3	73.6	104.3	73.6
Geneva	-	9.8	63.8	63.8
Greene	-	35.0	163.1	46.7
Hale	37.0	55.5	104.9	49.4
Henry	-	35.1	100.2	60.1
Houston	-	20.9	50.2	25.1
Lee	-	43.8	48.6	131.3
Lowndes	6.2	67.7	141.5	43.1
Macon	17.5	5.8	93.1	110.5
Montgomery	30.4	30.4	97.2	42.5
Perry	17.2	74.5	114.7	109.0
Pickens	75.6	75.6	157.0	151.1
Pike	6.1	42.9	134.7	79.6
Randolph	10.4	31.3	125.2	114.7
Russell	-	31.0	155.0	99.2
Sumter	18.1	114.5	168.7	66.2
Tallapoosa	-	59.7	173.3	149.4
Tuscaloosa	17.5	87.5	291.8	280.2
Total	458.6	1695.2	3715.7	2844.3
% of Total	5.2	19.4	42.6	32.6

Table 37 (cont'd.)

C. Southern Reporting District

County	Site Index 25 70	60	57	45
Baldwin	6.0	17.9	116.7	535.9
Choctaw	31.2	149.8	274.7	74.9
Clarke	11.2	218.5	296.9	207.3
Connecuh	45.4	201.0	181.6	19.5
Covington	30.9	92.7	160.7	173.1
Escambia	6.2	62.1	173.7	266.8
Marengo	6.2	93.6	218.5	56.2
Mobile	-	6.1	140.3	408.8
Monroe	15.9	137.9	175.0	190.9
Washington	6.1	24.4	292.9	286.8
Wilcox	23.0	103.6	184.2	97.9
Total	182.1	1107.6	2265.2	2318.1
% of Total	3.1	18.8	38.5	39.4

TABLE 38. Acres of Forestland (thousands) by Site Class and County in Mississippi

A. Northern Reporting District

	Site Index 25			
County	70	60	57	45
Alcorn	-	38.3	33.5	66.9
Benton	25.3	44.3	88.7	19.0
Calhoun	7.1	77.9	77.9	49.6
Carroll	46.1	65.8	72.4	39.5
Chickasaw	14.5	80.0	29.1	14.5
Clay	-	71.1	35.5	7.1
DeSoto	23.4	15.6	46.8	7.8
Grenada	20.1	20.1	80.4	20.1
Itawamba	15.6	108.9	67.4	41.5
Lafayette	48.5	66.7	121.3	48.5
Lee	22.0	22.0	22.0	7.3
Marshall	13.5	47.3	155.3	27.0
Monroe	23.5	70.4	111.5	35.2
Montgomery	16.2	21.6	86.4	32.4
Panola	14.5	21.8	29.0	79.9
Pontotoc	6.1	36.6	79.2	24.4
Prentiss	15.7	36.7	41.9	57.6
Tate	27.6	13.8	27.6	13.8
Tippah	10.6	31.8	111.3	42.4
Tishomingo	6.7	66.8	100.2	20.0
Union	9.3	37.1	65.0	9.3
Webster	8.1	40.4	104.9	32.3
Yalobusha	27.1	48.8	81.3	43.4
Total	369.1	1083.8	1668.6	739.5
% of Total	9.5	28.0	43.2	19.1

*Data from USDA Forest Service

Table 38 (cont'd.)

B. Central Reporting District*

County	Site Index 25 70	60	57	45
Attala	23.3	93.3	175.0	64.2
Choctaw	32.4	70.3	70.3	32.4
Clarke	37.5	68.8	137.6	112.5
Hinds	79.1	73.0	42.6	12.2
Holmes	51.2	64.0	121.6	19.2
Jasper	53.0	111.9	111.9	76.6
Kemper	50.0	66.7	150.1	94.5
Lauderdale	52.1	138.9	92.6	63.7
Leake	56.6	77.2	102.9	20.6
Lowndes	19.7	45.9	65.6	6.6
Madison	39.3	29.5	88.5	24.6
Neshoba	34.5	73.8	123.1	4.9
Newton	27.3	92.8	103.7	27.3
Noxubee	34.5	63.2	69.0	46.
Oktibbeha	8.2	65.9	53.5	37.
Rankin	30.7	85.9	177.9	12.3
Scott	49.2	123.0	49.2	37.
Simpson	20.0	46.7	153.5	20.
Smith	5.5	76.7	175.3	27.4
Warren	80.3	45.9	45.9	40.2
Winston	30.6	61.2	128.5	55.1
Yazoo	36.6	124.4	73.2	7.3
Total	851.6	1699.0	2311.5	841.6
% of Total	14.9	29.8	40.5	14.7

*Warren and Yazoo Counties are included (though not in MCES Timber Price Report central district) because pine occurs in part of county.

Table 38 (cont'd.)

C. Southern Reporting District

County	Site Index 25 70	60	57	45
Adams	49.9	94.8	44.9	5.0
Amite	108.8	163.2	38.1	21.8
Claiborne	110.8	29.2	46.7	29.2
Copiah	38.7	101.6	183.8	24.2
Covington	27.9	83.8	48.9	-
Forest	59.5	39.7	79.4	39.7
Franklin	107.4	139.0	44.2	19.0
George	6.2	43.3	98.9	74.2
Greene	45.3	90.7	191.4	55.4
Hancock	-	11.5	85.9	103.1
Harrison	5.1	40.6	126.8	81.1
Jackson	5.7	28.6	85.7	217.0
Jefferson	70.2	87.7	70.2	11.7
Jefferson Davis	5.5	22.	77.1	38.5
Jones	85.4	131.3	78.8	-
Lamar	17.1	51.4	102.8	51.4
Lawrence	35.9	83.7	77.7	6.0
Lincoln	41.3	100.2	70.7	47.2
Marion	16.7	72.3	94.6	27.8
Pearl River	12.4	86.6	92.8	148.4
Perry	54.5	103.0	151.5	42.4
Pike	56.1	49.1	49.1	-
Stone	30.2	64.6	94.8	38.8
Wayne	46.9	129.1	193.7	58.7
Wilkinson	56.4	98.6	155.0	14.1
Total	1093.9	1945.6	2383.6	1154.7
% of Total	16.6	29.5	36.2	17.5

*Claiborne, Jefferson, Adams and Wilkinson Counties are included (though not in MCES Timber Price Report southern district) because pine forests occur there.

APPENDIX D

Computer Simulation Output Examples

APPENDIX D

Computer Simulation Output Examples

WOODFLOW SUMMARY REPORT

STAND NAME: AL MLAND
ACREAGE: 1

--STAND INVENTORY FOR 1988--

SITE INDEX(BASE AGE 25): 77 FEET
STAND AGE: 1 YEARS
SURVIVING # STEMS/ACRE: 726 AT AGE 1

ALABAMA MARGINAL CROPLAND
SITE INDEX 70 DISC RATE 4%
IMPROVED SEEDLINGS CENTRAL AL PRICES
COST SHARE 65%

OLDFIELD LOBLOLLY PINE PLANTATION
HARVESTING SCHEDULE

						RESIDUAL COMPONENT					HARVESTED COMPONENT				
HARVEST NUMBER	YEAR	AGE	HEIGHT	PAI CORDS	THINNING METHOD	BASAL AREA	NUMBER STEMS	M-BDFT DOYLE	NET CORDS	TOTAL CORDS	BASAL AREA	NUMBER STEMS	M-BDFT DOYLE	NET CORDS	TOTAL CORDS
1	2002	15	55	.0	LOW	110	303	.20	29.24	30.89	67	329	.00	16.66	16.66
2	2009	22	71	3.4	LOW	110	191	4.10	10.67	40.25	41	95	.52	10.45	14.76
3	2016	29	84	2.7	LOW	110	137	7.38	5.66	46.48	30	44	1.62	2.39	12.63
4	2022	35	92	2.2	N/A	C L E A R - C U T					131	131	11.58	4.21	59.74
										---TOTALS/ACRE	269	599	13.73	33.70	103.79

TVA YIELDPLUS (v 1.1b) Date: 4-28-1991 Time: 10:41: 8 REGISTERED USER> TOM MONAGAHN

DETAILED WOODFLOW REPORT

STAND NAME: AL MLAND
ACREAGE: 1

--STAND INVENTORY FOR 1988--

SITE INDEX(BASE AGE 25): 77 FEET
STAND AGE: 1 YEARS
SURVIVING # STEMS/ACRE: 726 AT AGE 1

ALABAMA MARGINAL CROPLAND
SITE INDEX 70 DISC RATE 4%
IMPROVED SEEDLINGS CENTRAL AL PRICES
COST SHARE 65%

OLDFIELD LOBLOLLY PINE PLANTATION HARVESTING SCHEDULE

--> HARVEST # 1 YEAR 2002 AGE 15 <--

DBH-RANGE NAME	DBH CLASS	NUMBER STEMS	BASAL AREA	HEIGHT FEET	$ VALUE	MBF DOYLE	NET CORDS	TOTAL CORDS	TONS SAWLOGS	NET TONS	TOTAL TONS	% CUT
NON-COM	3.0	2.2	.1	36.9	.00	.00	.00	.00	.00	.00	.00	100.0
PULPWOOD	4.0	17.8	1.6	43.0	.00	.00	.00	.00	.00	.00	.00	100.0
PULPWOOD	5.0	61.6	8.4	47.2	22.28	.00	1.86	1.86	.00	3.26	3.26	100.0
PULPWOOD	6.0	131.2	25.8	50.2	77.34	.00	6.45	6.45	.00	12.92	12.92	100.0
PULPWOOD	7.0	181.6	48.5	52.5	156.22	.00	13.02	13.02	.00	27.50	27.50	64.2
CHIP-N-SAW	8.0	153.5	53.6	54.3	179.78	.00	14.98	14.98	.00	32.53	32.53	.0
CHIP-N-SAW	9.0	69.5	30.7	55.7	105.67	.00	8.81	8.81	.00	19.46	19.46	.0
CHIP-N-SAW	10.0	14.1	7.7	56.8	31.87	.17	.75	2.24	2.52	2.49	5.01	.0
CHIP-N-SAW	11.0	1.0	.7	57.8	3.37	.02	.04	.20	.29	.15	.45	.0
CUT		329.4	67.0	.0	199.86	.00	16.66	16.66	.00	33.82	33.82	
LEAVE		303.1	110.0	.0	376.67	.20	29.24	30.89	2.82	64.48	67.30	

--> HARVEST # 2 YEAR 2009 AGE 22 <--

DBH-RANGE NAME	DBH CLASS	NUMBER STEMS	BASAL AREA	HEIGHT FEET	$ VALUE	MBF DOYLE	NET CORDS	TOTAL CORDS	TONS SAWLOGS	NET TONS	TOTAL TONS	% CUT
CHIP-N-SAW	8.5	59.5	23.3	67.4	98.34	.00	8.19	8.19	.00	17.95	17.95	100.0
CHIP-N-SAW	9.7	144.8	73.7	69.9	387.69	2.12	9.16	26.70	27.83	31.85	59.68	24.6
CHIP-N-SAW	10.8	66.7	42.8	71.9	279.62	1.84	3.23	15.77	23.13	12.68	35.80	.0
SAWTIMBER	12.0	13.7	10.8	73.5	112.77	.60	.50	4.00	7.01	2.20	9.22	.0
SAWTIMBER	13.2	1.0	.9	74.9	11.53	.06	.03	.35	.68	.14	.82	.0
CUT		95.1	41.4	.0	193.74	.52	10.45	14.76	6.85	25.79	32.64	
LEAVE		190.6	110.0	.0	696.21	4.10	10.67	40.25	51.80	39.03	90.84	

--> HARVEST # 3 YEAR 2016 AGE 29 <--

DBH-RANGE NAME	DBH CLASS	NUMBER STEMS	BASAL AREA	HEIGHT FEET	$ VALUE	MBF DOYLE	NET CORDS	TOTAL CORDS	TONS SAWLOGS	NET TONS	TOTAL TONS	% CUT
CHIP-N-SAW	11.2	102.5	70.1	81.6	560.75	3.77	5.56	29.33	45.18	21.95	67.13	43.0
SAWTIMBER	12.5	63.9	54.9	84.0	724.56	3.92	2.16	23.29	43.51	10.64	54.15	.0
SAWTIMBER	13.9	13.2	13.9	86.1	215.57	1.19	.32	5.95	12.22	1.82	14.04	.0
SAWTIMBER	15.2	1.0	1.2	87.8	21.32	.12	.02	.52	1.13	.12	1.26	.0
CUT		44.1	30.2	.0	241.37	1.62	2.39	12.63	19.45	9.45	28.90	
LEAVE		136.5	110.0	.0	1280.83	7.38	5.66	46.48	82.59	25.09	107.68	

--> HARVEST # 4 YEAR 2022 AGE 35 <--

DBH-RANGE NAME	DBH CLASS	NUMBER STEMS	BASAL AREA	HEIGHT FEET	$ VALUE	MBF DOYLE	NET CORDS	TOTAL CORDS	TONS SAWLOGS	NET TONS	TOTAL TONS	% CUT
SAWTIMBER	12.5	55.2	46.8	89.6	652.37	3.51	2.36	21.20	38.69	10.68	49.37	100.0
SAWTIMBER	14.0	61.8	65.6	92.4	1105.61	6.11	1.54	30.09	62.11	9.10	71.21	100.0
SAWTIMBER	15.4	13.0	16.8	94.7	322.39	1.79	.29	7.76	16.93	1.73	18.65	100.0
SAWTIMBER	16.9	1.0	1.5	96.7	31.62	.18	.02	.69	1.56	.12	1.68	100.0
CUT		130.8	130.7	.0	2112.00	11.58	4.21	59.74	119.29	21.62	140.92	
LEAVE		.0	.0	.0	.00	.00	.00	.00	.00	.00	.00	

--> ACCUMULATED TOTALS <--

CUT	599.4	269.3	.0	2746.98	13.73	33.70	103.79	145.59	90.69	236.27	
LEAVE											

TVA YIELDPLUS (v 1.1b) Date: 4-28-1991 Time: 10:41: 8 REGISTERED USER> TOM MONAGAHN

FINANCIAL PROFITABILITY

STAND NAME: AL MLAND
ACREAGE: 1

FINANCIAL PARAMETER DATA

PLANNING HORIZON IS FROM 1988 TO 2023

MARGINAL FEDERAL TAX BRACKET= 15.0 % CAPITAL GAINS PROPORTION= 100.0 %

DISCOUNT RATE: BEFORE TAX= 4.0 % AFTER TAX= 3.4 %

STUMPAGE PRICES

DBH-RANGE NAME	DBH-RANGE LOW	HIGH	SAWLOG $/MBF	$/TON	INF%	MIN$/ACRE	PULP-TOP-CULL $/CORD	$/TON	INF%	MIN$/ACRE
PULPWOOD	4	7	.00	.00	.0	.00	16.00	.00	.0	.00
CHIP-N-SAW	8	11	119.00	.00	.0	.00	16.00	.00	.0	.00
SAWTIMBER	12	20	186.00	.00	.0	.00	16.00	.00	.0	.00

FINANCIAL PROFITABILITY ANALYSIS

(ADJUSTED FOR INFLATION)

	BEFORE TAX	AFTER TAX
NET PRESENT WORTH	$ 831.84	$ 849.34
INTERNAL RATE OF RETURN	16.8 %	17.0 %
COMPOSITE RATE OF RETURN	10.9 %	7.6 %
ANNUAL EQUIVALENT VALUE	$ 44.57	$ 41.87
DISCOUNTED BENEFIT/COST RATIO	10.4	4.3
SOIL EXPECTATION VALUE	$ 1099.84	$ 1213.50

FINANCIAL TRANSACTIONS

(UNADJUSTED FOR INFLATION)

TYPE	FIRST YEAR	LAST YEAR	REPETITION	$AMOUNT	INFLATION %	DESCRIPTION
REFORESTATION EXPENSE >PL-96-451	1988	1989	1	-20.94	0	P BURN/MPLANT/65%CS
ORDINARY DEDUCTIBLE EXPENSE	1988	2022	1	-2.00	0	MGT &TAXES
HARVEST # 1: PULPWOOD REVENUE	2002	2002	5	266.48	*	ALL WOOD AS CORDS AT PULP-TOP-CULL PRICE
ORDINARY DEDUCTIBLE EXPENSE	2003	2018	5	-5.00	0	BURN EVERY 5 YEARS
HARVEST # 2: CHIP-N-SAW REVENUE	2009	2009	5	236.22	*	ALL WOOD AS CORDS AT PULP-TOP-CULL PRICE
HARVEST # 3: CHIP-N-SAW REVENUE	2016	2016	5	231.46	*	SAWLOG AS MBF, NET-PULP-TOP-CULL AS CORDS
HARVEST # 4: SAWTIMBER REVENUE	2022	2022	5	2221.48	*	SAWLOG AS MBF, NET-PULP-TOP-CULL AS CORDS

* -INFLATION RATE IS COMPUTED AS COMPOSITE OF SPECIFIED SAWTIMBER AND PULPWOOD INFLATION RATES ACCORDING TO PRODUCT MIX

--TOTAL NET CASH FLOW = $ 2823.77 (INCLUDES ALL CASH TRANSACTIONS BEFORE TAXES WITHIN PLANNING HORIZON)

TVA YIELDPLUS (v 1.1b) Date: 4-28-1991 Time: 10:50:11 REGISTERED USER> TOM MONAGAHN

CASHFLOWS BY YEAR REPORT

STAND NAME: AL MLAND
ACREAGE: 1

	BEFORE-TAX				AFTER-TAX			
YEAR	REVENUE	EXPENSE	NET	ACCUMULATED-NET	REVENUE	EXPENSE	NET	ACCUMULATED-NET
				-UNINFLATED DOLLARS PER ACRE-				
1988	.00	22.94	-22.94	-22.94	2.61	22.94	-20.33	-20.33
1989	.00	22.94	-22.94	-45.88	3.03	22.94	-19.91	-40.24
1990	.00	2.00	-2.00	-47.88	1.15	2.00	-.85	-41.09
1991	.00	2.00	-2.00	-49.88	1.15	2.00	-.85	-41.93
1992	.00	2.00	-2.00	-51.88	1.15	2.00	-.85	-42.78
1993	.00	2.00	-2.00	-53.88	1.15	2.00	-.85	-43.63
1994	.00	2.00	-2.00	-55.88	1.15	2.00	-.85	-44.48
1995	.00	2.00	-2.00	-57.88	1.15	2.00	-.85	-45.32
1996	.00	2.00	-2.00	-59.88	.94	2.00	-1.06	-46.38
1997	.00	2.00	-2.00	-61.88	.51	2.00	-1.49	-47.87
1998	.00	2.00	-2.00	-63.88	.30	2.00	-1.70	-49.57
1999	.00	2.00	-2.00	-65.88	.30	2.00	-1.70	-51.27
2000	.00	2.00	-2.00	-67.88	.30	2.00	-1.70	-52.97
2001	.00	2.00	-2.00	-69.88	.30	2.00	-1.70	-54.67
2002	266.48	2.00	264.48	194.60	266.78	41.97	224.81	170.14
2003	.00	7.00	-7.00	187.60	1.05	7.00	-5.95	164.19
2004	.00	2.00	-2.00	185.60	.30	2.00	-1.70	162.49
2005	.00	2.00	-2.00	183.60	.30	2.00	-1.70	160.79
2006	.00	2.00	-2.00	181.60	.30	2.00	-1.70	159.09
2007	.00	2.00	-2.00	179.60	.30	2.00	-1.70	157.39
2008	.00	7.00	-7.00	172.60	1.05	7.00	-5.95	151.44
2009	236.22	2.00	234.22	406.83	236.52	37.43	199.09	350.53
2010	.00	2.00	-2.00	404.83	.30	2.00	-1.70	348.83
2011	.00	2.00	-2.00	402.83	.30	2.00	-1.70	347.13
2012	.00	2.00	-2.00	400.83	.30	2.00	-1.70	345.43
2013	.00	7.00	-7.00	393.83	1.05	7.00	-5.95	339.48
2014	.00	2.00	-2.00	391.83	.30	2.00	-1.70	337.78
2015	.00	2.00	-2.00	389.83	.30	2.00	-1.70	336.08
2016	231.46	2.00	229.46	619.28	231.76	36.72	195.04	531.12
2017	.00	2.00	-2.00	617.28	.30	2.00	-1.70	529.42
2018	.00	7.00	-7.00	610.28	1.05	7.00	-5.95	523.47
2019	.00	2.00	-2.00	608.28	.30	2.00	-1.70	521.77
2020	.00	2.00	-2.00	606.28	.30	2.00	-1.70	520.07
2021	.00	2.00	-2.00	604.28	.30	2.00	-1.70	518.37
2022	2221.48	2.00	2219.48	2823.77	2221.78	335.22	1886.56	2404.93
2023	.00	.00	.00	2823.77	.00	.00	.00	2404.93

TVA YIELDPLUS (v 1.1b) Date: 4-28-1991 Time: 10:50:11 REGISTERED USER> TOM MONAGAHN

WOODFLOW SUMMARY REPORT

STAND NAME: MS MLAND
ACREAGE: 1

--STAND INVENTORY FOR 1988--

SITE INDEX(BASE AGE 25): 70 FEET
STAND AGE: 1 YEARS
SURVIVING # STEMS/ACRE: 726 AT AGE 1

MISSISSIPPI MARGINAL CROPLAND
SITE INDEX 70 DISC RATE 4%
UNIMPROVED SEEDLINGS SOUTH MS PRICES
COST SHARE 65%

OLDFIELD LOBLOLLY PINE PLANTATION
HARVESTING SCHEDULE

						RESIDUAL COMPONENT					HARVESTED COMPONENT				
HARVEST NUMBER	YEAR	AGE	HEIGHT	PAI CORDS	THINNING METHOD	BASAL AREA	NUMBER STEMS	M-BDFT DOYLE	NET CORDS	TOTAL CORDS	BASAL AREA	NUMBER STEMS	M-BDFT DOYLE	NET CORDS	TOTAL CORDS
1	2002	15	50	.0	LOW	110	338	.00	28.03	28.03	54	311	.00	11.49	11.49
2	2009	22	65	3.1	LOW	110	215	2.79	15.08	36.89	39	102	.00	12.84	12.84
3	2016	29	76	2.4	LOW	110	150	5.98	6.96	42.92	29	52	1.02	3.30	10.96
4	2022	35	83	2.0	N/A	CLEAR-CUT					130	143	9.69	5.03	54.90
										---TOTALS/ACRE	252	608	10.71	32.67	90.19

TVA YIELDPLUS (v 1.1b) Date: 4-28-1991 Time: 10:21:53 REGISTERED USER> TOM MONAGAHN

DETAILED WOODFLOW REPORT

STAND NAME: MS MLAND
ACREAGE: 1

--STAND INVENTORY FOR 1988--

SITE INDEX(BASE AGE 25): 70 FEET
STAND AGE: 1 YEARS
SURVIVING # STEMS/ACRE: 726 AT AGE 1

MISSISSIPPI MARGINAL CROPLAND
SITE INDEX 70 DISC RATE 4%
UNIMPROVED SEEDLINGS SOUTH MS PRICES
COST SHARE 65%

OLDFIELD LOBLOLLY PINE PLANTATION HARVESTING SCHEDULE

--> HARVEST # 1 YEAR 2002 AGE 15 <--

DBH-RANGE NAME	DBH CLASS	NUMBER STEMS	BASAL AREA	HEIGHT FEET	$ VALUE	MBF DOYLE	NET CORDS	TOTAL CORDS	TONS SAWLOGS	NET TONS	TOTAL TONS	% CUT
NON-COM	3.0	5.3	.3	34.5	.00	.00	.00	.00	.00	.00	.00	100.0
PULPWOOD	4.0	30.1	2.6	40.1	.00	.00	.00	.00	.00	.00	.00	100.0
PULPWOOD	5.0	87.2	11.9	43.9	45.56	.00	2.40	2.40	.00	4.27	4.27	100.0
PULPWOOD	6.0	160.5	31.5	46.6	137.53	.00	7.24	7.24	.00	14.61	14.61	100.0
PULPWOOD	7.0	188.4	50.3	48.6	235.97	.00	12.42	12.42	.00	26.33	26.33	15.0
CHIP-N-SAW	8.0	128.2	44.8	50.2	218.95	.00	11.52	11.52	.00	25.06	25.06	.0
CHIP-N-SAW	9.0	43.4	19.2	51.5	96.30	.00	5.07	5.07	.00	11.20	11.20	.0
CHIP-N-SAW	10.0	6.0	3.3	52.5	16.61	.07	.30	.87	.98	.97	1.96	.0
CUT		311.2	53.8	.0	218.39	.00	11.49	11.49	.00	22.82	22.82	
LEAVE		337.8	110.0	.0	532.54	.07	27.45	28.03	.98	59.62	60.61	

--> HARVEST # 2 YEAR 2009 AGE 22 <--

DBH-RANGE NAME	DBH CLASS	NUMBER STEMS	BASAL AREA	HEIGHT FEET	$ VALUE	MBF DOYLE	NET CORDS	TOTAL CORDS	TONS SAWLOGS	NET TONS	TOTAL TONS	% CUT
CHIP-N-SAW	8.4	148.1	57.3	62.6	354.27	.00	18.65	18.65	.00	40.80	40.80	68.8
CHIP-N-SAW	9.6	121.7	61.2	64.8	389.59	1.55	7.17	20.50	21.02	24.73	45.75	.0
CHIP-N-SAW	10.8	41.8	26.5	66.6	196.15	1.01	1.90	9.03	13.10	7.35	20.44	.0
SAWTIMBER	11.9	5.8	4.5	68.1	49.22	.23	.20	1.55	2.70	.87	3.56	.0
CUT		101.9	39.5	.0	243.88	.00	12.84	12.84	.00	28.09	28.09	
LEAVE		215.4	110.0	.0	745.35	2.79	15.08	36.89	36.81	45.66	82.47	

--> HARVEST # 3 YEAR 2016 AGE 29 <--

DBH-RANGE NAME	DBH CLASS	NUMBER STEMS	BASAL AREA	HEIGHT FEET	$ VALUE	MBF DOYLE	NET CORDS	TOTAL CORDS	TONS SAWLOGS	NET TONS	TOTAL TONS	% CUT
CHIP-N-SAW	9.8	42.2	22.0	73.0	162.35	.69	2.79	8.31	8.93	9.70	18.63	100.0
CHIP-N-SAW	11.1	114.6	77.2	75.7	698.89	3.72	5.82	29.96	45.56	22.77	68.34	8.9
SAWTIMBER	12.4	40.0	33.8	78.0	459.20	2.14	1.53	13.31	24.13	6.71	30.84	.0
SAWTIMBER	13.8	5.6	5.8	79.8	92.81	.45	.13	2.30	4.68	.72	5.40	.0
CUT		52.3	28.8	.0	224.21	1.02	3.30	10.96	12.97	11.71	24.68	
LEAVE		150.1	110.0	.0	1189.05	5.98	6.96	42.92	70.34	28.18	98.52	

--> HARVEST # 4 YEAR 2022 AGE 35 <--

DBH-RANGE NAME	DBH CLASS	NUMBER STEMS	BASAL AREA	HEIGHT FEET	$ VALUE	MBF DOYLE	NET CORDS	TOTAL CORDS	TONS SAWLOGS	NET TONS	TOTAL TONS	% CUT
SAWTIMBER	12.4	98.8	82.5	83.2	1200.89	5.60	3.99	34.73	62.75	17.80	80.56	100.0
SAWTIMBER	13.8	38.6	40.3	85.8	704.27	3.42	.92	17.18	35.18	5.31	40.50	100.0
SAWTIMBER	15.3	5.5	7.0	87.9	138.53	.68	.12	2.99	6.47	.68	7.15	100.0
CUT		142.8	129.8	.0	2043.70	9.69	5.03	54.90	104.41	23.80	128.20	
LEAVE		.0	.0	.0	.00	.00	.00	.00	.00	.00	.00	

--> ACCUMULATED TOTALS <--

CUT		608.3	251.8	.0	2730.17	10.71	32.67	90.19	117.37	86.41	203.79	
LEAVE												

TVA YIELDPLUS (v 1.1b) Date: 4-28-1991 Time: 10:21:53 REGISTERED USER> TOM MONAGAHN

FINANCIAL PROFITABILITY

STAND NAME: MS MLAND
ACREAGE: 1

FINANCIAL PARAMETER DATA

PLANNING HORIZON IS FROM 1988 TO 2023

MARGINAL FEDERAL TAX BRACKET= 15.0 % CAPITAL GAINS PROPORTION= 100.0 %

DISCOUNT RATE: BEFORE TAX= 4.0 % AFTER TAX= 3.4 %

STUMPAGE PRICES

DBH-RANGE NAME	DBH-RANGE LOW	DBH-RANGE HIGH	SAWLOG $/MBF	SAWLOG $/TON	SAWLOG INF%	SAWLOG MIN$/ACRE	PULP-TOP-CULL $/CORD	PULP-TOP-CULL $/TON	PULP-TOP-CULL INF%	PULP-TOP-CULL MIN$/ACRE
PULPWOOD	4	7	.00	.00	.0	.00	12.00	.00	.0	.00
CHIP-N-SAW	8	11	131.00	.00	.0	.00	12.00	.00	.0	.00
SAWTIMBER	12	20	178.00	.00	.0	.00	12.00	.00	.0	.00

FINANCIAL PROFITABILITY ANALYSIS

(ADJUSTED FOR INFLATION)

	BEFORE TAX	AFTER TAX
NET PRESENT WORTH	$ 589.57	$ 609.80
INTERNAL RATE OF RETURN	14.2 %	14.5 %
COMPOSITE RATE OF RETURN	10.0 %	7.3 %
ANNUAL EQUIVALENT VALUE	$ 31.59	$ 30.06
DISCOUNTED BENEFIT/COST RATIO	7.8	3.9
SOIL EXPECTATION VALUE	$ 779.51	$ 871.26

FINANCIAL TRANSACTIONS

(UNADJUSTED FOR INFLATION)

TYPE	FIRST YEAR	LAST YEAR	REPETITION	$AMOUNT	INFLATION %	DESCRIPTION
REFORESTATION EXPENSE >PL-96-451	1988	1989	1	-19.79	0	P BURN/MPLANT/65%CS
ORDINARY DEDUCTIBLE EXPENSE	1988	2022	1	-2.00	0	MGT &TAXES
HARVEST # 1: PULPWOOD REVENUE	2002	2002	5	137.93	*	ALL WOOD AS CORDS AT PULP-TOP-CULL PRICE
ORDINARY DEDUCTIBLE EXPENSE	2003	2018	5	-5.00	0	BURN EVERY 5 YEARS
HARVEST # 2: CHIP-N-SAW REVENUE	2009	2009	5	154.03	*	ALL WOOD AS CORDS AT PULP-TOP-CULL PRICE
HARVEST # 3: CHIP-N-SAW REVENUE	2016	2016	5	173.50	*	SAWLOG AS MBF, NET-PULP-TOP-CULL AS CORDS
HARVEST # 4: SAWTIMBER REVENUE	2022	2022	5	1785.56	*	SAWLOG AS MBF, NET-PULP-TOP-CULL AS CORDS

* -INFLATION RATE IS COMPUTED AS COMPOSITE OF SPECIFIED SAWTIMBER AND PULPWOOD INFLATION RATES ACCORDING TO PRODUCT MIX

--TOTAL NET CASH FLOW = $ 2121.43 (INCLUDES ALL CASH TRANSACTIONS BEFORE TAXES WITHIN PLANNING HORIZON)

TVA YIELDPLUS (v 1.1b) Date: 4-28-1991 Time: 10:28:39 REGISTERED USER> TOM MONAGAHN

CASHFLOWS BY YEAR REPORT

STAND NAME: MS MLAND
ACREAGE: 1

YEAR	BEFORE-TAX REVENUE	BEFORE-TAX EXPENSE	BEFORE-TAX NET	BEFORE-TAX ACCUMULATED-NET	AFTER-TAX REVENUE	AFTER-TAX EXPENSE	AFTER-TAX NET	AFTER-TAX ACCUMULATED-NET
				-UNINFLATED DOLLARS PER ACRE-				
1988	.00	21.79	-21.79	-21.79	2.48	21.79	-19.31	-19.31
1989	.00	21.79	-21.79	-43.58	2.88	21.79	-18.91	-38.22
1990	.00	2.00	-2.00	-45.58	1.11	2.00	-.89	-39.11
1991	.00	2.00	-2.00	-47.58	1.11	2.00	-.89	-40.00
1992	.00	2.00	-2.00	-49.58	1.11	2.00	-.89	-40.90
1993	.00	2.00	-2.00	-51.58	1.11	2.00	-.89	-41.79
1994	.00	2.00	-2.00	-53.58	1.11	2.00	-.89	-42.69
1995	.00	2.00	-2.00	-55.58	1.11	2.00	-.89	-43.58
1996	.00	2.00	-2.00	-57.58	.90	2.00	-1.10	-44.68
1997	.00	2.00	-2.00	-59.58	.50	2.00	-1.50	-46.18
1998	.00	2.00	-2.00	-61.58	.30	2.00	-1.70	-47.88
1999	.00	2.00	-2.00	-63.58	.30	2.00	-1.70	-49.58
2000	.00	2.00	-2.00	-65.58	.30	2.00	-1.70	-51.28
2001	.00	2.00	-2.00	-67.58	.30	2.00	-1.70	-52.98
2002	137.93	2.00	135.93	68.35	138.23	22.69	115.54	62.56
2003	.00	7.00	-7.00	61.35	1.05	7.00	-5.95	56.61
2004	.00	2.00	-2.00	59.35	.30	2.00	-1.70	54.91
2005	.00	2.00	-2.00	57.35	.30	2.00	-1.70	53.21
2006	.00	2.00	-2.00	55.35	.30	2.00	-1.70	51.51
2007	.00	2.00	-2.00	53.35	.30	2.00	-1.70	49.81
2008	.00	7.00	-7.00	46.35	1.05	7.00	-5.95	43.86
2009	154.03	2.00	152.03	198.37	154.33	25.10	129.22	173.09
2010	.00	2.00	-2.00	196.37	.30	2.00	-1.70	171.39
2011	.00	2.00	-2.00	194.37	.30	2.00	-1.70	169.69
2012	.00	2.00	-2.00	192.37	.30	2.00	-1.70	167.99
2013	.00	7.00	-7.00	185.37	1.05	7.00	-5.95	162.04
2014	.00	2.00	-2.00	183.37	.30	2.00	-1.70	160.34
2015	.00	2.00	-2.00	181.37	.30	2.00	-1.70	158.64
2016	173.50	2.00	171.50	352.87	173.80	28.02	145.77	304.41
2017	.00	2.00	-2.00	350.87	.30	2.00	-1.70	302.71
2018	.00	7.00	-7.00	343.87	1.05	7.00	-5.95	296.76
2019	.00	2.00	-2.00	341.87	.30	2.00	-1.70	295.06
2020	.00	2.00	-2.00	339.87	.30	2.00	-1.70	293.36
2021	.00	2.00	-2.00	337.87	.30	2.00	-1.70	291.66
2022	1785.56	2.00	1783.56	2121.43	1785.86	269.83	1516.02	1807.68
2023	.00	.00	.00	2121.43	.00	.00	.00	1807.68

TVA YIELDPLUS (v 1.1b) Date: 4-28-1991 Time: 10:28:39 REGISTERED USER> TOM MONAGAHN

WOODFLOW SUMMARY REPORT

STAND NAME: AL CUTOV
ACREAGE: 1

--STAND INVENTORY FOR 1988--

SITE INDEX(BASE AGE 25): 70 FEET
STAND AGE: 1 YEARS
SURVIVING # STEMS/ACRE: 726 AT AGE 1

ALABAMA CUTOVER TIMBERLAND
SITE INDEX 70 DISC RATE 4%
UNIMPROVED SEEDLINGS SOUTH AL PRICES
COST SHARE 65%

CUTOVER-SITE LOBLOLLY PINE PLANTATION
HARVESTING SCHEDULE

HARVEST NUMBER	YEAR	AGE	HEIGHT	PAI CORDS	THINNING METHOD	RESIDUAL COMPONENT BASAL AREA	NUMBER STEMS	M-BDFT DOYLE	NET CORDS	TOTAL CORDS	HARVESTED COMPONENT BASAL AREA	NUMBER STEMS	M-BDFT DOYLE	NET CORDS	TOTAL CORDS
1	2002	15	45	.0	LOW	110	425	.00	22.31	22.31	14	128	.00	1.33	1.33
2	2009	22	63	2.9	LOW	110	231	1.83	24.15	31.81	39	137	.00	10.53	10.53
3	2016	29	79	2.3	LOW	110	156	6.31	14.77	38.38	29	53	.91	6.26	9.87
4	2022	35	91	2.0	N/A	CLEAR-CUT					130	145	11.10	12.59	50.45
										---TOTALS/ACRE	212	463	12.02	30.70	72.17

TVA YIELDPLUS (v 1.1b) Date: 4-28-1991 Time: 9:58: 0 REGISTERED USER> TOM MONAGAHN

DETAILED WOODFLOW REPORT

STAND NAME: AL CUTOV
ACREAGE: 1

--STAND INVENTORY FOR 1988--

SITE INDEX(BASE AGE 25): 70 FEET
STAND AGE: 1 YEARS
SURVIVING # STEMS/ACRE: 726 AT AGE 1

ALABAMA CUTOVER TIMBERLAND
SITE INDEX 70 DISC RATE 4%
UNIMPROVED SEEDLINGS SOUTH AL PRICES
COST SHARE 65%

CUTOVER-SITE LOBLOLLY PINE PLANTATION HARVESTING SCHEDULE

--> HARVEST # 1 YEAR 2002 AGE 15 <--

DBH-RANGE NAME	DBH CLASS	NUMBER STEMS	BASAL AREA	HEIGHT FEET	$ VALUE	MBF DOYLE	NET CORDS	TOTAL CORDS	TONS SAWLOGS	NET TONS	TOTAL TONS	% CUT
NON-COM	2.0	1.5	.0	21.5	.00	.00	.00	.00	.00	.00	.00	100.0
NON-COM	3.0	13.7	.7	30.4	.00	.00	.00	.00	.00	.00	.00	100.0
NON-COM	4.0	47.5	4.1	36.1	.00	.00	.00	.00	.00	.00	.00	100.0
PULPWOOD	5.0	101.1	13.8	40.0	.00	.00	2.06	2.06	.00	4.49	4.49	64.3
PULPWOOD	6.0	145.2	28.5	42.9	.00	.00	5.33	5.33	.00	12.11	12.11	.0
PULPWOOD	7.0	137.2	36.7	45.1	.00	.00	7.55	7.55	.00	17.70	17.70	.0
PULPWOOD	8.0	78.5	27.4	46.8	.00	.00	5.92	5.92	.00	14.22	14.22	.0
PULPWOOD	9.0	24.1	10.6	48.1	.00	.00	2.35	2.35	.00	5.78	5.78	.0
CHIP-N-SAW	10.0	3.4	1.9	49.2	.00	.03	.24	.42	.53	.52	1.04	.0
CUT		127.8	13.7	.0	.00	.00	1.33	1.33	.00	2.89	2.89	
LEAVE		424.5	110.0	.0	.00	.03	22.13	22.31	.53	51.93	52.46	

--> HARVEST # 2 YEAR 2009 AGE 22 <--

DBH-RANGE NAME	DBH CLASS	NUMBER STEMS	BASAL AREA	HEIGHT FEET	$ VALUE	MBF DOYLE	NET CORDS	TOTAL CORDS	TONS SAWLOGS	NET TONS	TOTAL TONS	% CUT
PULPWOOD	6.3	28.7	6.2	55.6	.00	.00	1.50	1.50	.00	3.54	3.54	100.0
PULPWOOD	7.5	123.7	37.9	60.0	.00	.00	10.29	10.29	.00	25.24	25.24	87.8
PULPWOOD	8.7	121.0	50.1	63.3	.00	.00	14.32	14.32	.00	36.26	36.26	.0
CHIP-N-SAW	9.9	70.4	37.9	65.9	.00	1.07	6.57	11.09	14.34	14.53	28.87	.0
CHIP-N-SAW	11.1	21.8	14.8	68.0	.00	.62	1.78	4.37	7.80	3.86	11.66	.0
CHIP-N-SAW	12.4	3.1	2.6	69.7	.00	.14	.22	.77	1.63	.46	2.09	.0
CUT		137.3	39.5	.0	.00	.00	10.53	10.53	.00	25.70	25.70	
LEAVE		231.4	110.0	.0	.00	1.83	24.15	31.81	23.77	58.18	81.95	

--> HARVEST # 3 YEAR 2016 AGE 29 <--

DBH-RANGE NAME	DBH CLASS	NUMBER STEMS	BASAL AREA	HEIGHT FEET	$ VALUE	MBF DOYLE	NET CORDS	TOTAL CORDS	TONS SAWLOGS	NET TONS	TOTAL TONS	% CUT
PULPWOOD	8.9	12.9	5.6	74.6	.00	.00	1.85	1.85	.00	4.80	4.80	100.0
CHIP-N-SAW	10.3	108.3	62.7	79.0	.00	2.47	11.89	21.62	30.82	27.11	57.93	37.1
CHIP-N-SAW	11.7	64.5	48.3	82.5	.00	2.98	5.56	16.92	34.75	11.98	46.73	.0
SAWTIMBER	13.1	20.2	19.0	85.3	.00	1.47	1.54	6.69	15.70	3.28	18.99	.0
SAWTIMBER	14.5	2.9	3.3	87.6	.00	.31	.19	1.17	3.03	.38	3.41	.0
CUT		53.1	28.8	.0	.00	.91	6.26	9.87	11.43	14.85	26.28	
LEAVE		155.8	110.0	.0	.00	6.31	14.77	38.38	72.88	32.70	105.57	

--> HARVEST # 4 YEAR 2022 AGE 35 <--

DBH-RANGE NAME	DBH CLASS	NUMBER STEMS	BASAL AREA	HEIGHT FEET	$ VALUE	MBF DOYLE	NET CORDS	TOTAL CORDS	TONS SAWLOGS	NET TONS	TOTAL TONS	% CUT
CHIP-N-SAW	11.6	62.4	45.7	91.2	.00	3.14	5.96	17.62	36.21	12.97	49.18	100.0
SAWTIMBER	13.2	60.6	57.2	95.3	.00	5.05	5.10	22.35	53.37	11.02	64.39	100.0
SAWTIMBER	14.7	19.3	22.8	98.7	.00	2.42	1.36	8.91	23.61	2.84	26.46	100.0
SAWTIMBER	16.3	2.8	4.0	101.5	.00	.49	.18	1.57	4.41	.37	4.79	100.0
CUT		145.0	129.8	.0	.00	11.10	12.59	50.45	117.60	27.21	144.81	
LEAVE		.0	.0	.0	.00	.00	.00	.00	.00	.00	.00	

--> ACCUMULATED TOTALS <--

CUT	463.2	211.7	.0	.00	12.02	30.70	72.17	129.03	70.64	199.67
LEAVE										

TVA YIELDPLUS (v 1.1b) Date: 4-28-1991 Time: 9:58: 0 REGISTERED USER> TOM MONAGAHN

FINANCIAL PROFITABILITY

STAND NAME: AL CUTOV
ACREAGE: 1

FINANCIAL PARAMETER DATA

PLANNING HORIZON IS FROM 1988 TO 2023

MARGINAL FEDERAL TAX BRACKET= 15.0 % CAPITAL GAINS PROPORTION= 100.0 %

DISCOUNT RATE: BEFORE TAX= 4.0 % AFTER TAX= 3.4 %

STUMPAGE PRICES

DBH-RANGE NAME	DBH-RANGE LOW	DBH-RANGE HIGH	SAWLOG $/MBF	SAWLOG $/TON	SAWLOG INF%	SAWLOG MIN$/ACRE	PULP-TOP-CULL $/CORD	PULP-TOP-CULL $/TON	PULP-TOP-CULL INF%	PULP-TOP-CULL MIN$/ACRE
PULPWOOD	4	7	.00	.00	.0	.00	19.00	.00	.0	.00
CHIP-N-SAW	8	11	158.00	.00	.0	.00	19.00	.00	.0	.00
SAWTIMBER	12	20	201.00	.00	.0	.00	19.00	.00	.0	.00

FINANCIAL PROFITABILITY ANALYSIS

(ADJUSTED FOR INFLATION)

	BEFORE TAX	AFTER TAX
NET PRESENT WORTH	$ 695.00	$ 740.31
INTERNAL RATE OF RETURN	10.9 %	11.1 %
COMPOSITE RATE OF RETURN	9.1 %	6.9 %
ANNUAL EQUIVALENT VALUE	$ 37.24	$ 36.49
DISCOUNTED BENEFIT/COST RATIO	5.7	3.4
SOIL EXPECTATION VALUE	$ 918.91	$ 1057.73

FINANCIAL TRANSACTIONS

(UNADJUSTED FOR INFLATION)

TYPE	FIRST YEAR	LAST YEAR	REPETITION	$AMOUNT	INFLATION %	DESCRIPTION
REFORESTATION EXPENSE >PL-96-451	1988	1989	1	-50.55	0	CHOP/BURN/HPLANT/UNIMP
ORDINARY DEDUCTIBLE EXPENSE	1988	2022	1	-2.00	0	MGT &TAXES
HARVEST # 1: PULPWOOD REVENUE	2002	2002	5	25.22	*	ALL WOOD AS CORDS AT PULP-TOP-CULL PRICE
ORDINARY DEDUCTIBLE EXPENSE	2003	2018	5	-5.00	0	BURN EVERY 5 YEARS
HARVEST # 2: PULPWOOD REVENUE	2009	2009	5	199.99	*	ALL WOOD AS CORDS AT PULP-TOP-CULL PRICE
HARVEST # 3: CHIP-N-SAW REVENUE	2016	2016	5	263.49	*	SAWLOG AS MBF, NET-PULP-TOP-CULL AS CORDS
HARVEST # 4: SAWTIMBER REVENUE	2022	2022	5	2471.09	*	SAWLOG AS MBF, NET-PULP-TOP-CULL AS CORDS

* -INFLATION RATE IS COMPUTED AS COMPOSITE OF SPECIFIED SAWTIMBER AND PULPWOOD INFLATION RATES ACCORDING TO PRODUCT MIX

--TOTAL NET CASH FLOW = $ 2768.69 (INCLUDES ALL CASH TRANSACTIONS BEFORE TAXES WITHIN PLANNING HORIZON)

TVA YIELDPLUS (v 1.1b) Date: 4-28-1991 Time: 10: 4:28 REGISTERED USER> TOM MONAGAHN

CASHFLOWS BY YEAR REPORT

STAND NAME: AL CUTOV
ACREAGE: 1

YEAR	BEFORE-TAX REVENUE	BEFORE-TAX EXPENSE	BEFORE-TAX NET	BEFORE-TAX ACCUMULATED-NET	AFTER-TAX REVENUE	AFTER-TAX EXPENSE	AFTER-TAX NET	AFTER-TAX ACCUMULATED-NET
				-UNINFLATED DOLLARS PER ACRE-				
1988	.00	52.55	-52.55	-52.55	5.87	52.55	-46.68	-46.68
1989	.00	52.55	-52.55	-105.10	6.90	52.55	-45.65	-92.33
1990	.00	2.00	-2.00	-107.10	2.36	2.00	.36	-91.97
1991	.00	2.00	-2.00	-109.10	2.36	2.00	.36	-91.62
1992	.00	2.00	-2.00	-111.10	2.36	2.00	.36	-91.26
1993	.00	2.00	-2.00	-113.10	2.36	2.00	.36	-90.90
1994	.00	2.00	-2.00	-115.10	2.36	2.00	.36	-90.54
1995	.00	2.00	-2.00	-117.10	2.36	2.00	.36	-90.18
1996	.00	2.00	-2.00	-119.10	1.84	2.00	-.16	-90.34
1997	.00	2.00	-2.00	-121.10	.81	2.00	-1.19	-91.53
1998	.00	2.00	-2.00	-123.10	.30	2.00	-1.70	-93.23
1999	.00	2.00	-2.00	-125.10	.30	2.00	-1.70	-94.93
2000	.00	2.00	-2.00	-127.10	.30	2.00	-1.70	-96.63
2001	.00	2.00	-2.00	-129.10	.30	2.00	-1.70	-98.33
2002	25.22	2.00	23.22	-105.88	25.52	5.78	19.74	-78.59
2003	.00	7.00	-7.00	-112.88	1.05	7.00	-5.95	-84.54
2004	.00	2.00	-2.00	-114.88	.30	2.00	-1.70	-86.24
2005	.00	2.00	-2.00	-116.88	.30	2.00	-1.70	-87.94
2006	.00	2.00	-2.00	-118.88	.30	2.00	-1.70	-89.64
2007	.00	2.00	-2.00	-120.88	.30	2.00	-1.70	-91.34
2008	.00	7.00	-7.00	-127.88	1.05	7.00	-5.95	-97.29
2009	199.99	2.00	197.99	70.11	200.29	32.00	168.29	71.00
2010	.00	2.00	-2.00	68.11	.30	2.00	-1.70	69.30
2011	.00	2.00	-2.00	66.11	.30	2.00	-1.70	67.60
2012	.00	2.00	-2.00	64.11	.30	2.00	-1.70	65.90
2013	.00	7.00	-7.00	57.11	1.05	7.00	-5.95	59.95
2014	.00	2.00	-2.00	55.11	.30	2.00	-1.70	58.25
2015	.00	2.00	-2.00	53.11	.30	2.00	-1.70	56.55
2016	263.49	2.00	261.49	314.60	263.79	41.52	222.27	278.82
2017	.00	2.00	-2.00	312.60	.30	2.00	-1.70	277.12
2018	.00	7.00	-7.00	305.60	1.05	7.00	-5.95	271.17
2019	.00	2.00	-2.00	303.60	.30	2.00	-1.70	269.47
2020	.00	2.00	-2.00	301.60	.30	2.00	-1.70	267.77
2021	.00	2.00	-2.00	299.60	.30	2.00	-1.70	266.07
2022	2471.09	2.00	2469.09	2768.69	2471.39	372.66	2098.73	2364.80
2023	.00	.00	.00	2768.69	.00	.00	.00	2364.80

TVA YIELDPLUS (v 1.1b) Date: 4-28-1991 Time: 10: 4:28 REGISTERED USER> TOM MONAGAHN

WOODFLOW SUMMARY REPORT

STAND NAME: MS CUTOV
ACREAGE: 1

--STAND INVENTORY FOR 1988--

SITE INDEX(BASE AGE 25): 77 FEET
STAND AGE: 1 YEARS
SURVIVING # STEMS/ACRE: 726 AT AGE 1

MISSISSIPPI CUTOVER TIMBERLAND
SITE INDEX 70 DISC RATE 4%
IMPROVED SEEDLINGS SOUTH MS PRICES
COST SHARE 65%

CUTOVER-SITE LOBLOLLY PINE PLANTATION
HARVESTING SCHEDULE

HARVEST NUMBER	YEAR	AGE	HEIGHT	PAI CORDS	THINNING METHOD	RESIDUAL COMPONENT BASAL AREA	NUMBER STEMS	M-BDFT DOYLE	NET CORDS	TOTAL CORDS	HARVESTED COMPONENT BASAL AREA	NUMBER STEMS	M-BDFT DOYLE	NET CORDS	TOTAL CORDS
1	2002	15	49	.0	LOW	110	360	.11	24.46	24.98	27	192	.00	4.33	4.33
2	2009	22	69	3.2	LOW	110	206	3.25	21.96	34.96	41	115	.00	12.58	12.58
3	2016	29	87	2.7	LOW	110	136	8.39	12.42	42.25	30	53	1.33	6.31	11.37
4	2022	35	100	2.3	N/A	CLEAR-CUT					131	128	13.97	11.23	56.01
										---TOTALS/ACRE	229	488	15.30	34.44	84.28

TVA YIELDPLUS (v 1.1b) Date: 4-28-1991 Time: 10:59:33 REGISTERED USER> TOM MONAGAHN

DETAILED WOODFLOW REPORT

STAND NAME: MS CUTOV
ACREAGE: 1

--STAND INVENTORY FOR 1988--

SITE INDEX(BASE AGE 25): 77 FEET
STAND AGE: 1 YEARS
SURVIVING # STEMS/ACRE: 726 AT AGE 1

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*******************************************************************
*                                                                 *
*     MISSISSIPPI CUTOVER TIMBERLAND                              *
*     SITE INDEX 70   DISC RATE 4%                                *
*     IMPROVED SEEDLINGS   SOUTH MS PRICES                        *
*     COST SHARE 65%                                              *
*                                                                 *
*******************************************************************
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CUTOVER-SITE LOBLOLLY PINE PLANTATION   HARVESTING SCHEDULE

--> HARVEST # 1 YEAR 2002 AGE 15 <--

DBH-RANGE NAME	DBH CLASS	NUMBER STEMS	BASAL AREA	HEIGHT FEET	$ VALUE	MBF DOYLE	NET CORDS	TOTAL CORDS	TONS SAWLOGS	NET TONS	TOTAL TONS	% CUT
NON-COM	2.0	.8	.0	22.6	.00	.00	.00	.00	.00	.00	.00	100.0
NON-COM	3.0	9.2	.5	32.4	.00	.00	.00	.00	.00	.00	.00	100.0
PULPWOOD	4.0	35.5	3.1	38.8	.00	.00	.00	.00	.00	.00	.00	100.0
PULPWOOD	5.0	81.8	11.2	43.2	28.71	.00	1.79	1.79	.00	3.94	3.94	100.0
PULPWOOD	6.0	129.7	25.5	46.4	81.96	.00	5.12	5.12	.00	11.75	11.75	49.6
PULPWOOD	7.0	141.7	37.9	48.9	134.65	.00	8.42	8.42	.00	19.92	19.92	.0
CHIP-N-SAW	8.0	101.0	35.2	50.8	131.55	.00	8.22	8.22	.00	19.97	19.97	.0
CHIP-N-SAW	9.0	42.7	18.9	52.4	72.12	.00	4.51	4.51	.00	11.20	11.20	.0
CHIP-N-SAW	10.0	9.5	5.2	53.6	24.50	.11	.73	1.25	1.60	1.58	3.18	.0
CUT		191.6	27.3	.0	69.33	.00	4.33	4.33	.00	9.76	9.76	
LEAVE		360.3	110.0	.0	404.17	.11	24.46	24.98	1.60	58.59	60.20	

--> HARVEST # 2 YEAR 2009 AGE 22 <--

DBH-RANGE NAME	DBH CLASS	NUMBER STEMS	BASAL AREA	HEIGHT FEET	$ VALUE	MBF DOYLE	NET CORDS	TOTAL CORDS	TONS SAWLOGS	NET TONS	TOTAL TONS	% CUT
PULPWOOD	7.5	55.5	16.9	65.4	79.40	.00	4.96	4.96	.00	12.30	12.30	100.0
CHIP-N-SAW	8.7	125.8	51.8	69.1	257.05	.00	16.07	16.07	.00	41.10	41.10	47.4
CHIP-N-SAW	9.9	91.7	49.0	72.1	335.24	1.56	9.32	15.62	20.27	20.82	41.09	.0
CHIP-N-SAW	11.1	39.3	26.4	74.5	204.45	1.25	3.50	8.52	15.32	7.67	22.99	.0
SAWTIMBER	12.3	8.8	7.3	76.5	93.33	.44	.68	2.36	5.05	1.46	6.51	.0
CUT		115.1	41.4	.0	201.21	.00	12.58	12.58	.00	31.78	31.78	
LEAVE		206.0	110.0	.0	768.27	3.25	21.96	34.96	40.65	51.57	92.22	

--> HARVEST # 3 YEAR 2016 AGE 29 <--

DBH-RANGE NAME	DBH CLASS	NUMBER STEMS	BASAL AREA	HEIGHT FEET	$ VALUE	MBF DOYLE	NET CORDS	TOTAL CORDS	TONS SAWLOGS	NET TONS	TOTAL TONS	% CUT
CHIP-N-SAW	10.3	59.1	33.9	86.8	291.82	1.50	7.09	12.77	18.28	16.33	34.61	89.0
SAWTIMBER	11.7	84.4	62.6	90.7	931.48	4.32	7.98	24.00	49.64	17.37	67.02	.0
SAWTIMBER	13.1	36.7	34.2	93.9	595.33	2.94	3.07	13.19	31.24	6.62	37.86	.0
SAWTIMBER	14.5	8.3	9.5	96.6	189.04	.97	.59	3.65	9.54	1.23	10.77	.0
CUT		52.6	30.2	.0	259.64	1.33	6.31	11.37	16.26	14.53	30.79	
LEAVE		135.9	110.0	.0	1748.03	8.39	12.42	42.25	92.44	27.03	119.47	

--> HARVEST # 4 YEAR 2022 AGE 35 <--

DBH-RANGE NAME	DBH CLASS	NUMBER STEMS	BASAL AREA	HEIGHT FEET	$ VALUE	MBF DOYLE	NET CORDS	TOTAL CORDS	TONS SAWLOGS	NET TONS	TOTAL TONS	% CUT
SAWTIMBER	11.5	5.9	4.3	100.4	70.98	.33	.62	1.81	3.74	1.36	5.10	100.0
SAWTIMBER	13.1	79.0	73.9	105.2	1465.75	7.25	7.31	31.65	76.21	16.01	92.22	100.0
SAWTIMBER	14.7	35.0	41.0	109.1	945.53	4.85	2.73	17.63	47.16	5.78	52.93	100.0
SAWTIMBER	16.2	8.0	11.5	112.3	295.90	1.54	.57	4.92	13.99	1.20	15.19	100.0
CUT		127.9	130.7	.0	2778.16	13.97	11.23	56.01	141.10	24.35	165.45	
LEAVE		.0	.0	.0	.00	.00	.00	.00	.00	.00	.00	

--> ACCUMULATED TOTALS <--

CUT		487.3	229.7	.0	3308.34	15.30	34.44	84.28	157.36	80.42	237.79	
LEAVE												

TVA YIELDPLUS (v 1.1b) Date: 4-28-1991 Time: 10:59:33 REGISTERED USER> TOM MONAGAHN

FINANCIAL PROFITABILITY

STAND NAME: MS CUTOV
ACREAGE: 1

FINANCIAL PARAMETER DATA

PLANNING HORIZON IS FROM 1988 TO 2023

MARGINAL FEDERAL TAX BRACKET= 15.0 % CAPITAL GAINS PROPORTION= 100.0 %

DISCOUNT RATE: BEFORE TAX= 4.0 % AFTER TAX= 3.4 %

STUMPAGE PRICES

DBH-RANGE NAME	DBH-RANGE LOW	HIGH	SAWLOG $/MBF	SAWLOG $/TON	SAWLOG INF%	SAWLOG MIN$/ACRE	PULP-TOP-CULL $/CORD	PULP-TOP-CULL $/TON	PULP-TOP-CULL INF%	PULP-TOP-CULL MIN$/ACRE
PULPWOOD	4	7	.00	.00	.0	.00	12.00	.00	.0	.00
CHIP-N-SAW	8	11	131.00	.00	.0	.00	12.00	.00	.0	.00
SAWTIMBER	12	20	178.00	.00	.0	.00	12.00	.00	.0	.00

FINANCIAL PROFITABILITY ANALYSIS

(ADJUSTED FOR INFLATION)

	BEFORE TAX	AFTER TAX
NET PRESENT WORTH	$ 712.81	$ 761.90
INTERNAL RATE OF RETURN	10.6 %	10.9 %
COMPOSITE RATE OF RETURN	8.9 %	6.9 %
ANNUAL EQUIVALENT VALUE	$ 38.19	$ 37.56
DISCOUNTED BENEFIT/COST RATIO	5.5	3.4
SOIL EXPECTATION VALUE	$ 942.46	$ 1088.58

FINANCIAL TRANSACTIONS

(UNADJUSTED FOR INFLATION)

TYPE	FIRST YEAR	LAST YEAR	REPETITION	$AMOUNT	INFLATION %	DESCRIPTION
REFORESTATION EXPENSE >PL-96-451	1988	1989	1	-56.36	0	CHOP/BURN/HPLANT/IMPROV
ORDINARY DEDUCTIBLE EXPENSE	1988	2022	1	-2.00	0	MGT &TAXES
HARVEST # 1: PULPWOOD REVENUE	2002	2002	5	52.00	*	ALL WOOD AS CORDS AT PULP-TOP-CULL PRICE
ORDINARY DEDUCTIBLE EXPENSE	2003	2018	5	-5.00	0	BURN EVERY 5 YEARS
HARVEST # 2: PULPWOOD REVENUE	2009	2009	5	59.55	*	ALL WOOD AS CORDS AT PULP-TOP-CULL PRICE
HARVEST # 2: CHIP-N-SAW REVENUE	2009	2009	5	91.35	*	ALL WOOD AS CORDS AT PULP-TOP-CULL PRICE
HARVEST # 3: CHIP-N-SAW REVENUE	2016	2016	5	250.43	*	SAWLOG AS MBF, NET-PULP-TOP-CULL AS CORDS
HARVEST # 4: SAWTIMBER REVENUE	2022	2022	5	2621.50	*	SAWLOG AS MBF, NET-PULP-TOP-CULL AS CORDS

* -INFLATION RATE IS COMPUTED AS COMPOSITE OF SPECIFIED SAWTIMBER AND PULPWOOD INFLATION RATES ACCORDING TO PRODUCT MIX

--TOTAL NET CASH FLOW = $ 2872.11 (INCLUDES ALL CASH TRANSACTIONS BEFORE TAXES WITHIN PLANNING HORIZON)

TVA YIELDPLUS (v 1.1b) Date: 4-28-1991 Time: 11: 4: 5 REGISTERED USER> TOM MONAGAHN

CASHFLOWS BY YEAR REPORT

STAND NAME: MS CUTOV
ACREAGE: 1

	BEFORE-TAX				AFTER-TAX			
YEAR	REVENUE	EXPENSE	NET	ACCUMULATED-NET	REVENUE	EXPENSE	NET	ACCUMULATED-NET
-UNINFLATED DOLLARS PER ACRE-								
1988	.00	58.36	-58.36	-58.36	6.51	58.36	-51.85	-51.85
1989	.00	58.36	-58.36	-116.72	7.66	58.36	-50.70	-102.55
1990	.00	2.00	-2.00	-118.72	2.59	2.00	.59	-101.96
1991	.00	2.00	-2.00	-120.72	2.59	2.00	.59	-101.36
1992	.00	2.00	-2.00	-122.72	2.59	2.00	.59	-100.77
1993	.00	2.00	-2.00	-124.72	2.59	2.00	.59	-100.17
1994	.00	2.00	-2.00	-126.72	2.59	2.00	.59	-99.58
1995	.00	2.00	-2.00	-128.72	2.59	2.00	.59	-98.99
1996	.00	2.00	-2.00	-130.72	2.02	2.00	.02	-98.96
1997	.00	2.00	-2.00	-132.72	.87	2.00	-1.13	-100.09
1998	.00	2.00	-2.00	-134.72	.30	2.00	-1.70	-101.79
1999	.00	2.00	-2.00	-136.72	.30	2.00	-1.70	-103.49
2000	.00	2.00	-2.00	-138.72	.30	2.00	-1.70	-105.19
2001	.00	2.00	-2.00	-140.72	.30	2.00	-1.70	-106.89
2002	52.00	2.00	50.00	-90.72	52.30	9.80	42.50	-64.39
2003	.00	7.00	-7.00	-97.72	1.05	7.00	-5.95	-70.34
2004	.00	2.00	-2.00	-99.72	.30	2.00	-1.70	-72.04
2005	.00	2.00	-2.00	-101.72	.30	2.00	-1.70	-73.74
2006	.00	2.00	-2.00	-103.72	.30	2.00	-1.70	-75.44
2007	.00	2.00	-2.00	-105.72	.30	2.00	-1.70	-77.14
2008	.00	7.00	-7.00	-112.72	1.05	7.00	-5.95	-83.09
2009	150.91	2.00	148.91	36.18	151.21	24.64	126.57	43.48
2010	.00	2.00	-2.00	34.18	.30	2.00	-1.70	41.78
2011	.00	2.00	-2.00	32.18	.30	2.00	-1.70	40.08
2012	.00	2.00	-2.00	30.18	.30	2.00	-1.70	38.38
2013	.00	7.00	-7.00	23.18	1.05	7.00	-5.95	32.43
2014	.00	2.00	-2.00	21.18	.30	2.00	-1.70	30.73
2015	.00	2.00	-2.00	19.18	.30	2.00	-1.70	29.03
2016	250.43	2.00	248.43	267.61	250.73	39.56	211.17	240.19
2017	.00	2.00	-2.00	265.61	.30	2.00	-1.70	238.49
2018	.00	7.00	-7.00	258.61	1.05	7.00	-5.95	232.54
2019	.00	2.00	-2.00	256.61	.30	2.00	-1.70	230.84
2020	.00	2.00	-2.00	254.61	.30	2.00	-1.70	229.14
2021	.00	2.00	-2.00	252.61	.30	2.00	-1.70	227.44
2022	2621.50	2.00	2619.50	2872.11	2621.80	395.22	2226.57	2454.01
2023	.00	.00	.00	2872.11	.00	.00	.00	2454.01

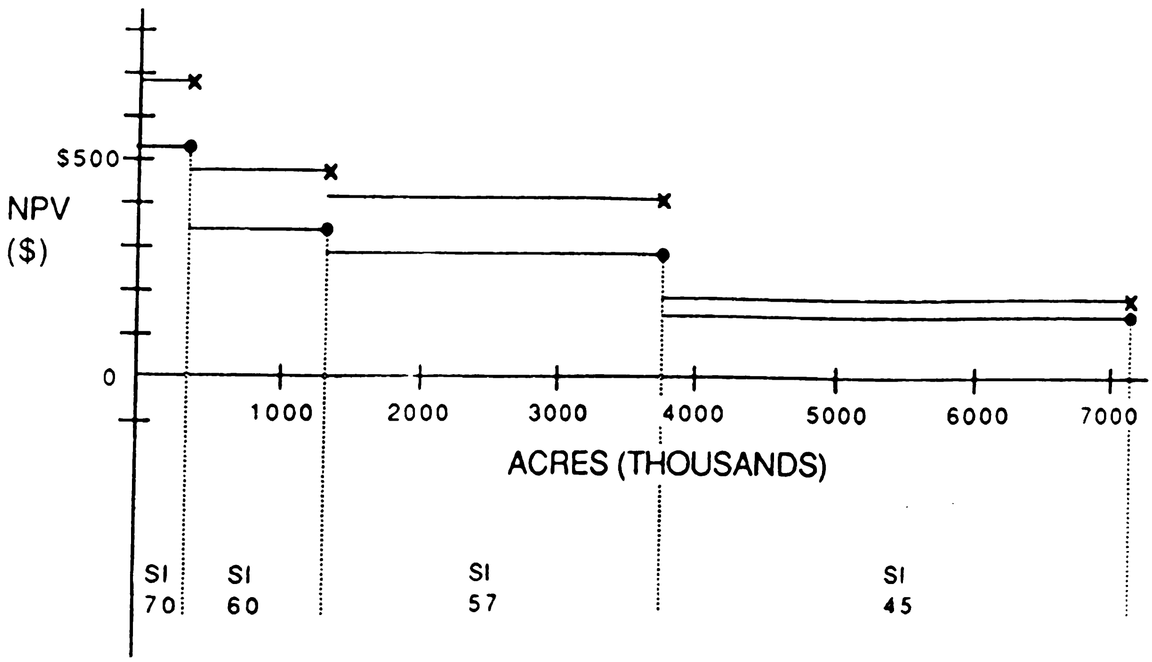
TVA YIELDPLUS (v 1.1b) Date: 4-28-1991 Time: 11: 4: 5 REGISTERED USER> TOM MONAGAHN

APPENDIX E

Profitability Curves
for Pine Plantation Investments in Alabama and Mississippi

APPENDIX E

Profitability Curves
for Pine Plantation Investments in Alabama and Mississippi



SITE INDEX

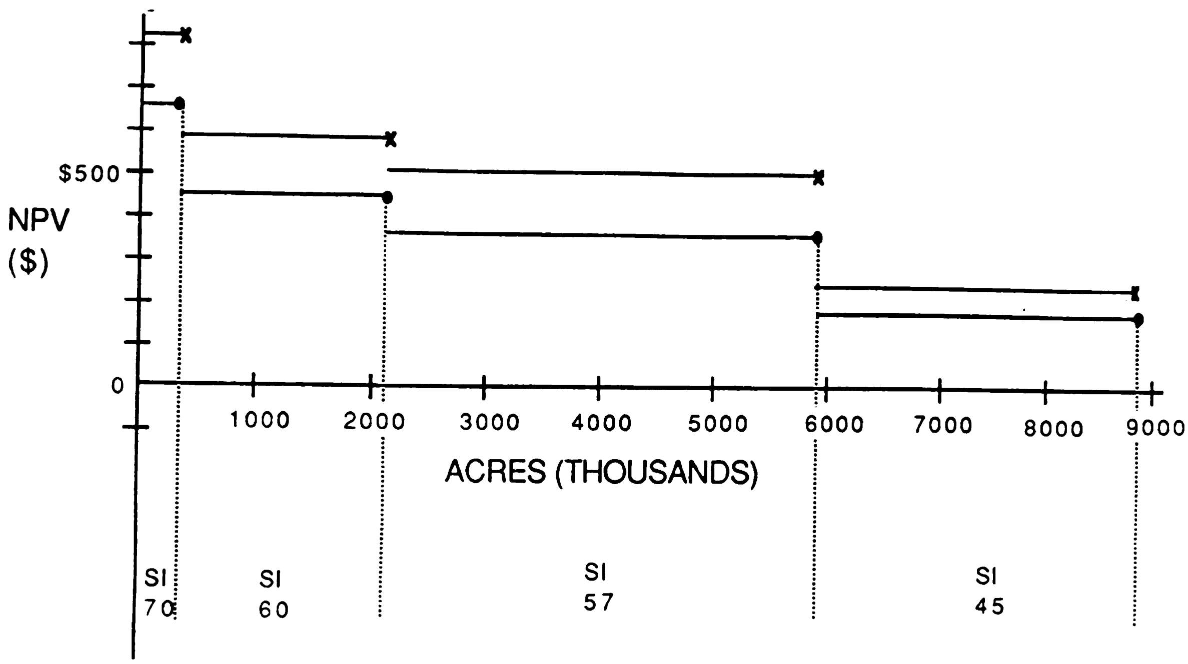
	70	60	57	45
NPV UNIMPROVED	$534.16	$331.50	$288.59	$138.80
NPV IMPROVED	$673.35	$469.42	$413.72	$194.28

ACRES (THOUSANDS)

	SI 70	SI 60	SI 57	SI 45	TOTAL
	333.6	982.5	2487.7	3267.8	7071.6
PERCENT	4.7	13.9	35.2	46.2	100.0

●—●—●—● UNIMPROVED
x—x—x—x IMPROVED

Figure 11: Profitability curve for marginal cropland pine reforestation using cost-share program, North Alabama.



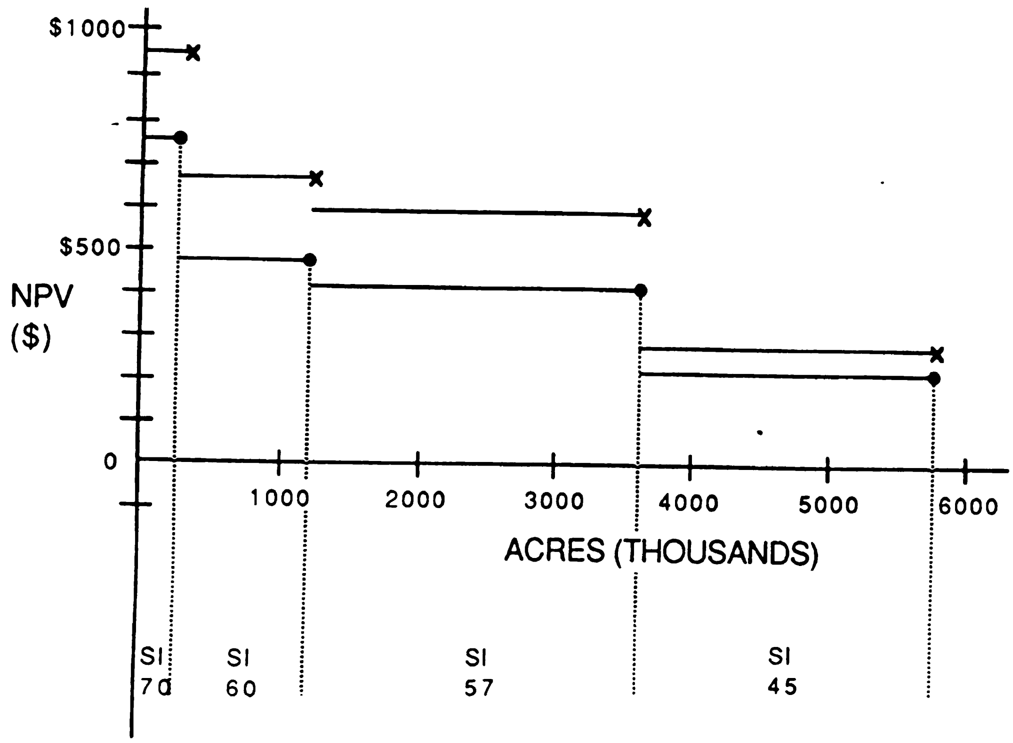
SITE INDEX	70	60	57	45
NPV UNIMPROVED	$665.04	$441.52	$357.35	$183.34
NPV IMPROVED	$831.84	$585.19	$517.27	$252.35

ACRES (THOUSANDS)

	SI 70	SI 60	SI 57	SI 45	TOTAL
	458.6	1695.2	3715.7	2844.3	8713.8
PERCENT	5.3	19.5	42.6	32.6	100.0

●——●——●——● UNIMPROVED
×——×——×——× IMPROVED

Figure 12: Profitability curve for marginal cropland pine reforestation using cost-share program, Central Alabama.



SITE INDEX

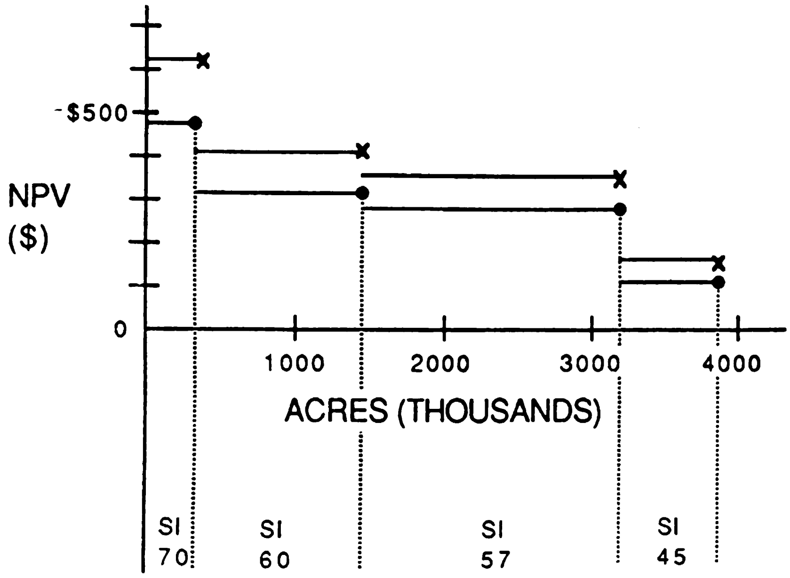
	70	60	57	45
NPV UNIMPROVED	$760.41	$486.57	$430.03	$219.23
NPV IMPROVED	$952.95	$673.02	$597.12	$296.17

ACRES (THOUSANDS)

	SI 70	SI 60	SI 57	SI 45	TOTAL
	182.1	1107.6	2265.2	2318.1	5873.0
PERCENT	3.3	18.8	38.5	39.4	100.0

UNIMPROVED
IMPROVED

Figure 13: Profitability curve for marginal cropland pine reforestation using cost-share program, South Alabama.



SITE INDEX

	70	60	57	45
NPV UNIMPROVED	$483.68	$313.03	$274.18	$122.02
NPV IMPROVED	$610.03	$411.31	$361.36	$161.62

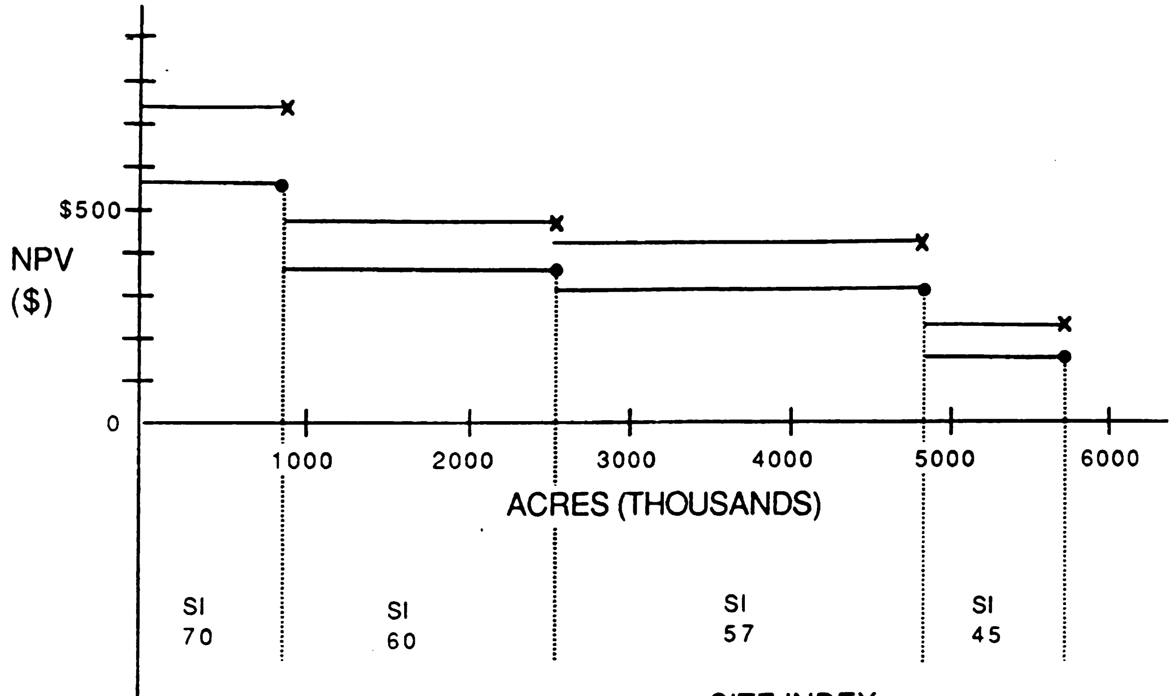
ACRES (THOUSANDS)

	SI 70	SI 60	SI 57	SI 45	TOTAL
	369.1	1083.8	1668.6	739.5	3861
PERCENT	9.5	28.1	43.2	19.2	100.0

UNIMPROVED

IMPROVED

Figure 14: Profitability curve for marginal cropland pine reforestation using cost-share program, North Mississippi.



SITE INDEX

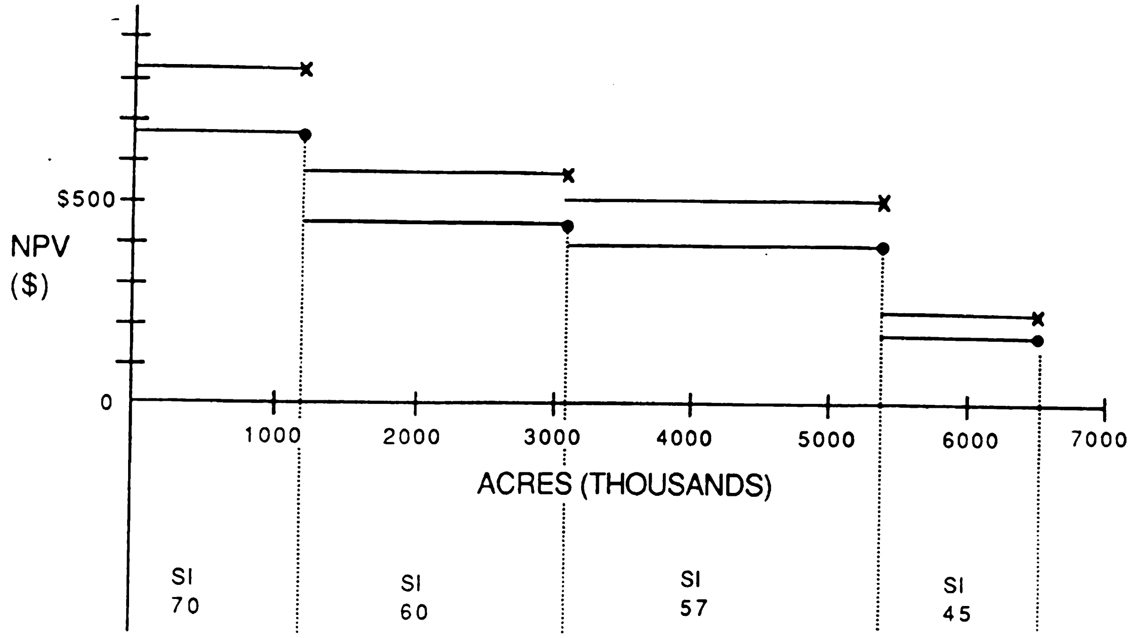
	70	60	57	45
NPV UNIMPROVED	$576.02	$378.33	$334.17	$156.90
NPV IMPROVED	$714.69	$489.87	$431.54	$202.86

ACRES (THOUSANDS)

	SI 70	SI 60	SI 57	SI 45	TOTAL
	851.6	1699.0	2311.5	841.6	5703.7
PERCENT	14.9	29.8	40.6	14.7	100.0

●—●—●—● UNIMPROVED
×—×—×—× IMPROVED

Figure 15: Profitability curve for marginal cropland pine reforestation using cost-share program, Central Mississippi.



SITE INDEX

	70	60	57	45
NPV UNIMPROVED	$671.32	$445.81	$395.36	$190.85
NPV IMPROVED	$826.91	$574.84	$508.25	$243.84

ACRES (THOUSANDS)

	SI 70	SI 60	SI 57	SI 45	TOTAL
	1093.9	1945.6	2383.5	1154.7	6577.7
PERCENT	16.6	29.6	36.2	17.6	100.0

●——●——●——● UNIMPROVED
x——x——x——x IMPROVED

Figure 16: Profitability curve for marginal cropland pine reforestation using cost-share program, South Mississippi.

SITE INDEX

	70	60	57	45
NPV UNIMPROVED	$470.38	$269.67	$213.04	$-2.76 1/
NPV IMPROVED	$622.82	$374.45	$324.14	$86.42

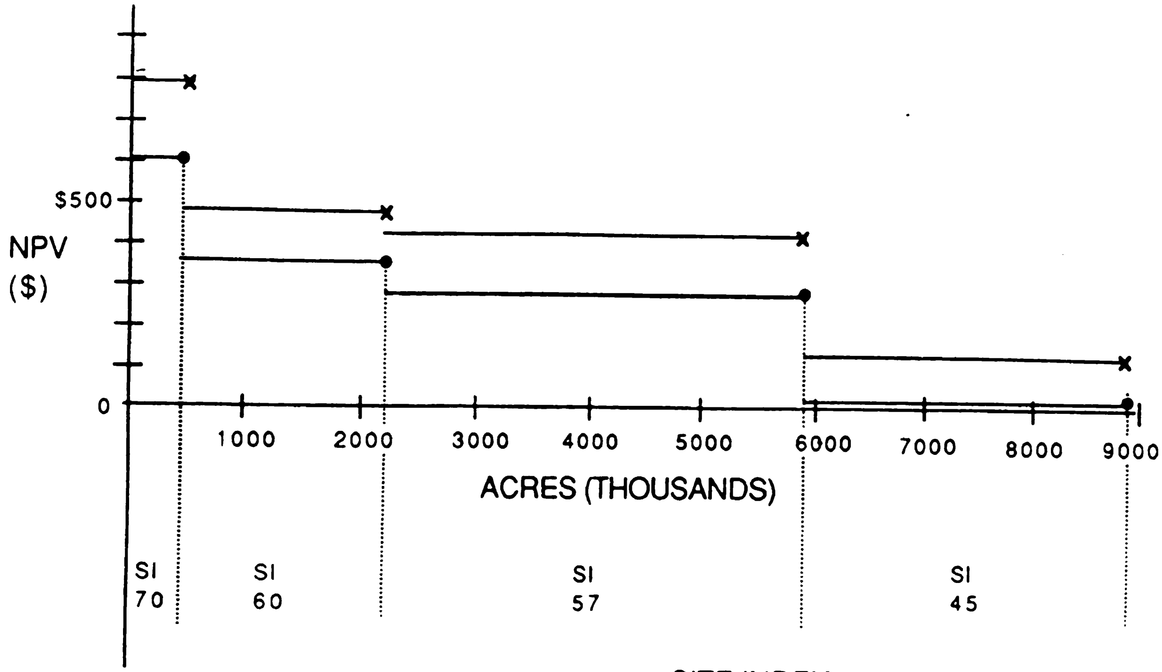
1/ Harvest schedule changed from 4 to 3 cuttings

ACRES (THOUSANDS)

	SI 70	SI 60	SI 57	SI 45	TOTAL
	333.6	982.5	2487.7	3267.8	7071.6
PERCENT	4.8	13.9	35.1	46.2	100.0

●—●—●—● UNIMPROVED
x—x—x—x IMPROVED

Figure 17: Profitability curve for cutover timberland pine reforestation using cost-share program, North Alabama.



SITE INDEX

	70	60	57	45
NPV UNIMPROVED	$606.83	$359.54	$288.35	$18.74[1/]
NPV IMPROVED	$794.24	$488.60	$426.94	$131.07

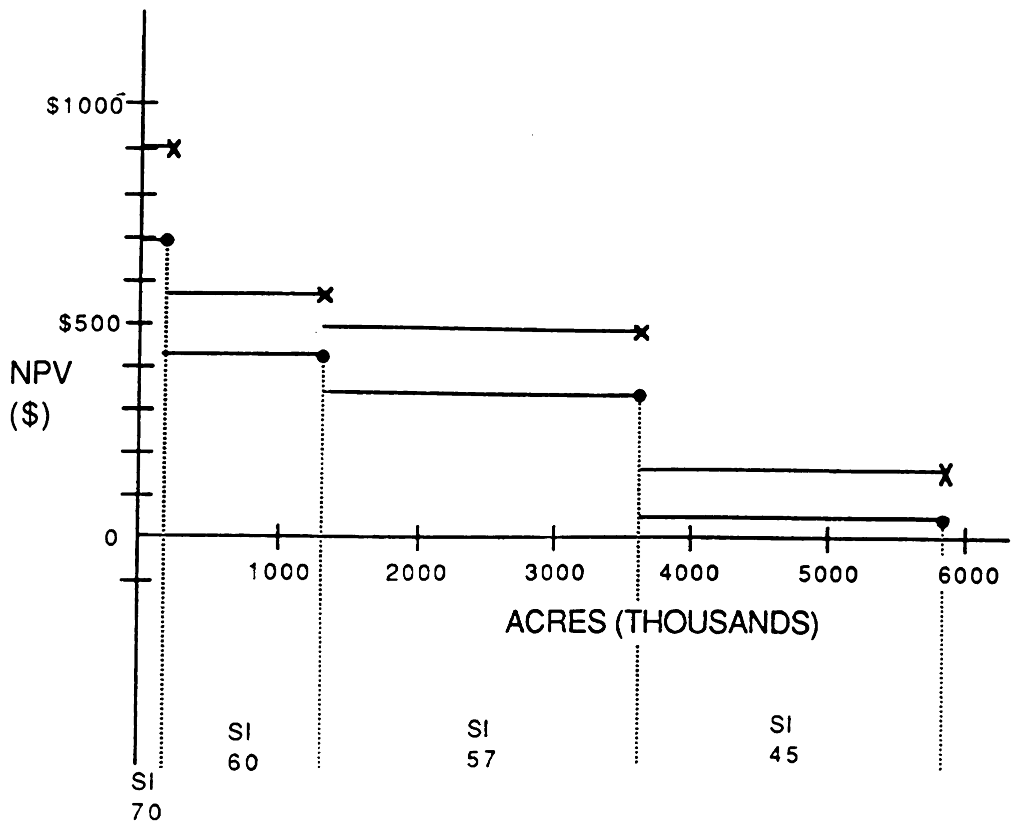
1/ Harvest schedule changed from 4 to 3 cuttings

ACRES (THOUSANDS)

	SI 70	SI 60	SI 57	SI 45	TOTAL
	458.6	1695.2	3715.7	2844.3	8713.8
PERCENT	5.3	19.5	42.6	32.6	100.0

●——●——●——● UNIMPROVED
x——x——x——x IMPROVED

Figure 18: Profitability curve for cutover timberland pine reforestation using cost-share program, Central Alabama.



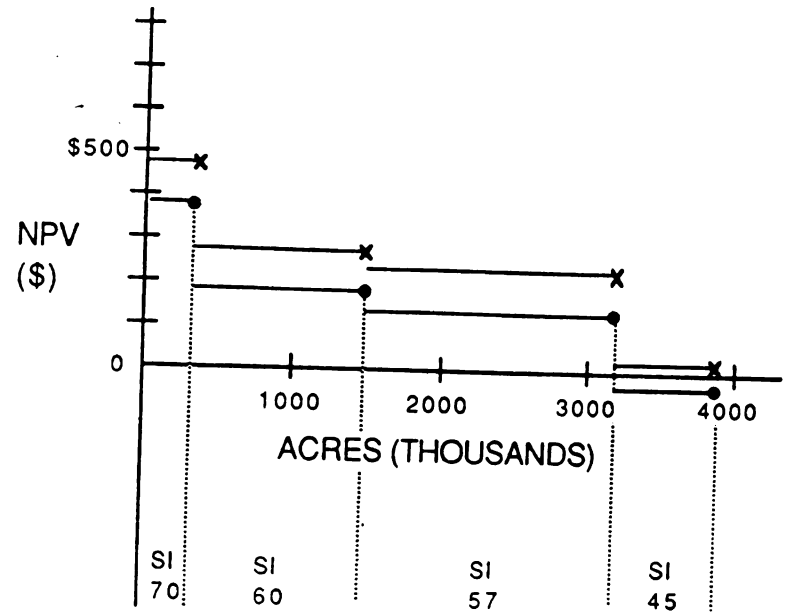
	SITE INDEX			
	70	60	57	45
NPV UNIMPROVED	$695.00	$419.77	$343.58	$53.13[1]
NPV IMPROVED	$906.07	$567.02	$497.60	$175.63

1/ Harvest schedule changed from 4 to 3 cuttings

	ACRES (THOUSANDS)				
	SI 70	SI 60	SI 57	SI 45	TOTAL
	182.1	1107.6	2265.2	2318.1	5873.0
PERCENT	3.3	18.8	38.5	39.4	100.0

●—●—●—● UNIMPROVED
x—x—x—x IMPROVED

Figure 19: Profitability curve for cutover timberland pine reforestation using cost-share program, South Alabama.



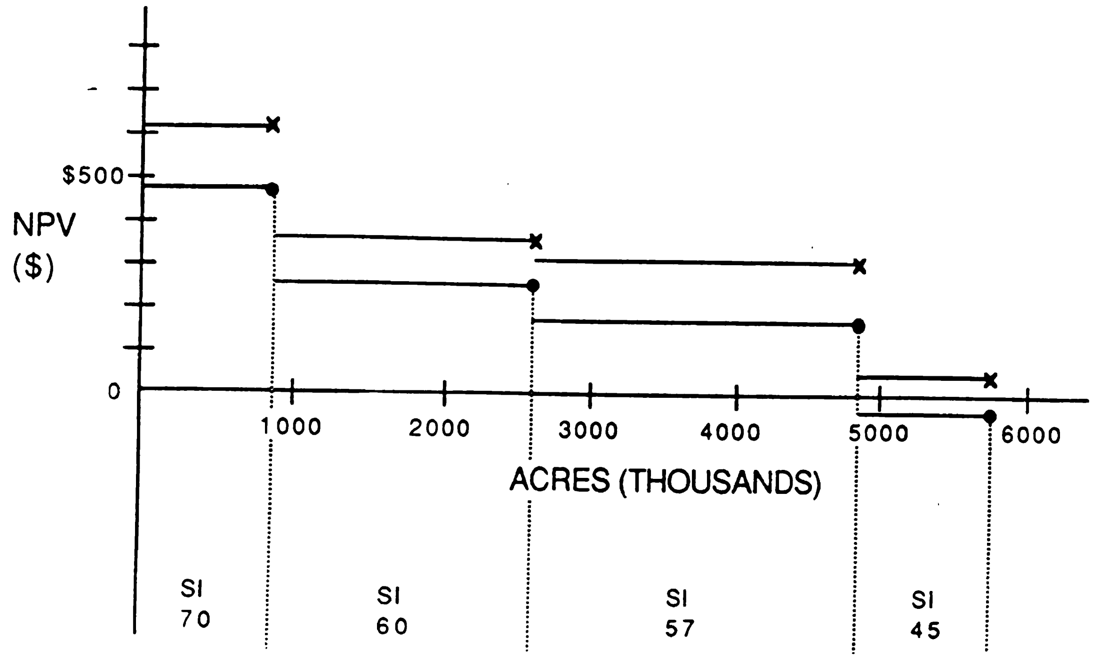
	SITE INDEX			
	70	60	57	45
NPV UNIMPROVED	$369.60	$191.89	$143.89	$-35.80 1/
NPV IMPROVED	$493.52	$279.89	$234.53	$31.84

1/ Harvest schedule changed from 3 to 4 cuttings

	ACRES (THOUSANDS)				
	SI 70	SI 60	SI 57	SI 45	TOTAL
	369.1	1083.8	1668.6	739.5	3861
PERCENT	9.6	28.0	43.2	19.2	100.0

UNIMPROVED
IMPROVED

Figure 20: Profitability curve for cutover timberland pine reforestation using cost-share program, North Mississippi.



SITE INDEX

	70	60	57	45
NPV UNIMPROVED	$469.10	$253.87	$193.20	$-31.47 1/
NPV IMPROVED	$618.71	$360.22	$305.88	$54.85

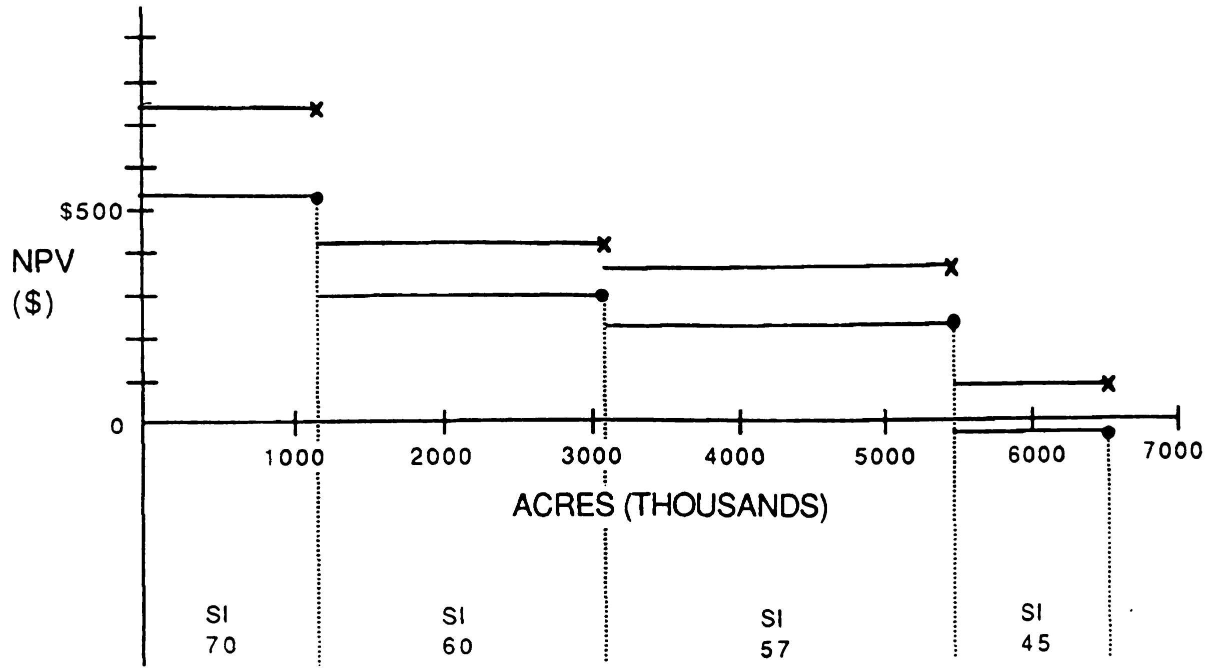
1/ Harvest schedule changed from 4 to 3 cuttings

ACRES (THOUSANDS)

	SI 70	SI 60	SI 57	SI 45	TOTAL
	851.6	1699.0	2311.5	841.6	5703.7
PERCENT	14.9	29.8	40.5	14.8	100.0

UNIMPROVED
IMPROVED

Figure 21: Profitability curve for cutover timberland pine reforestation using cost-share program, Central Mississippi.



SITE INDEX

	70	60	57	45
NPV UNIMPROVED	$543.92	$307.20	$241.80	$-2.81[1/]
NPV IMPROVED	$712.81	$428.93	$366.96	$93.09

1/ Harvest schedule changed from 4 to 3 cuttings

ACRES (THOUSANDS)

	SI 70	SI 60	SI 57	SI 45	TOTAL
	1093.9	1945.6	2383.5	1154.7	6577.7
PERCENT	16.6	29.5	36.3	17.6	100.0

UNIMPROVED
IMPROVED

Figure 22: Profitability curve for cutover timberland pine reforestation using cost-share program, South Mississippi.

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