POTENTIAL EFFECTS OF TECHNICAL ASSISTANCE FORESTERS ON PINE PLANTING ON NON-INDUSTRIAL PRIVATE FORESTLAND IN THE SOUTH

by

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(ABSTRACT)

Over the next few decades, timber harvest levels on the South's non-industrial private forestlands (NIPFs) are projected to increase by 40 percent. These ownerships include 75 percent of the commercial timberland in the South, and account for 64 percent of the timber volume harvested in the region annually. Long-term sustained yield of softwood timber volumes from NIPFs depends on successful reforestation of harvested pine stands and afforestation of marginal agricultural lands. Available technical assistance is regarded as a significant factor in NIPF tree planting accomplishment.

This study compares technical assistance available to NIPFs from various sources and attempts to measure response to technical assistance in terms of acres planted. Four sources of technical assistance are considered: state forestry agencies, consulting foresters, industry landowner assistance departments, and industry procurement staffs. Extensive south-wide surveys of technical assistance available from these four sources were conducted to determine the types and degrees of assistance available. Cross-sectional comparisons were made between 29 sub-state zones in 12 southern states to explore variation in NIPF acres planted attributable to variation in technical assistance.

The surveys located just under 2,000 foresters having some professional involvement with southern landowners in 1985. The number of consulting foresters operating in the South seems to be growing, while the number of landowners enrolled in industry landowner assistance programs (LAPs) is also increasing. Assistance available to NIPF owners from all sources ranges from advice

and recommendations to actual performance of site preparation and tree planting. The types and intensities of technical assistance are variable both within and across forester types.

A cross-sectional statistical analysis using multiple linear regression was unable to demonstrate a significant south-wide effect of technical assistance on NIPF tree planting. Within the range of technical assistance presently available, variation in technical assistance did not prove to be a significant predictor of tree planting accomplishment. The results of this study indicate that diversity in the NIPF population, combined with diversity in silvicultural and market potential pine production, prevents quantification of a regional effect of technical assistance. A positive correlation between forester numbers and NIPF tree planting accomplishments was found. But only timber harvest levels and cost share expenditures were significant predictors of acres planted in multiple variable models.

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Chapter 1

INTRODUCTION

Much attention has been focused in recent years on the twelve Southern states and their role in producing a significant portion of the Nation's softwood timber. In 1984, the South provided one-third of the softwood lumber and almost one-half of the softwood plywood produced nationally. Two-thirds of the Nation's wood pulp was provided by this region. Forest-based industry, in turn, is a critical component of the Southern economy. In 1984, Southern roundwood timber production was valued at $6.1 billion. Harvested timber ranked among the top three crops in terms of value of production in all 12 Southern states, and ranked first in six states (Forest Service 1988).

The non-industrial private forestland owner (NIPF) plays a critical role in the South's timber production. Seventy-five per cent of the commercial timberland in the South is owned by NIPFs. These ownerships account for 64 percent of the timber volume harvested in the region annually (Forest Service 1981). While commercial timberland acreage and tree growth rates have been declining in recent years, the demand for timber from non-industrial private forests has steadily increased. Projections indicate a 40 percent increase in harvest levels on these lands over the next few decades (Forest Service 1982). The NIPF's of the South can achieve these harvest levels, and

maintain present growing stock inventories, only with significant investment in reforestation of cut-over lands and afforestation of marginal agricultural lands.

Problem Statement

There is evidence that critical NIPF reforestation is not being accomplished.[1] A U. S. Department of Agriculture study (Fecso et al. 1982) found that, of landowners carrying out a final harvest on pine lands during the decade ending in 1981, only 36 percent planted pine seedlings on the harvested areas. Another 10 percent left seed trees or direct seeded the sites, but more than half made no provision for re-establishing pine on the cut-over lands. An analysis of ten years of Forest Survey data in 1984 indicated that in the Southeast (Atlantic coast states from Virginia to Florida) only 20 percent of the pine and oak-pine stands harvested by NIPF owners were artificially regenerated to pine. Only 54 percent of the pine and oak-pine harvested areas were successfully regenerated to the same types, with the balance becoming hardwood stands (Knight 1984). Similar trends have been documented in the Midsouth Region (Alabama and Tennessee west to Texas and Oklahoma) (Rosson and Doolittle 1987, Birdsey and McWilliams 1986). Pine establishment on abandoned agricultural lands is also far below the potential, with up to half of such sites being dominated by hardwoods (Birdsey and McWilliams 1986).

Persons concerned with long term timber supply have routinely listed lack of forestry knowledge on the part of NIPF owners as one reason for sub-potential tree planting performance. Royer and Kaiser (1985) found that a large number of landowners responding to a South-wide survey took no measures to re-establish pine after a harvest. Seventy-five percent of these landowners felt that

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[1] This study will not pursue the question of whether or not government intervention in NIPF tree planting activities is appropriate or or justifiable from a social welfare perspective, although debate over this issue is acknowledged (Clawson 1979). The study will explore potential effects of technical assistance *given* that government intervention is deemed appropriate and justifiable.

pine would come back naturally. NIPF owners were also found to be doubtful of acceptable returns from pine investments. A study of landowners in three Northern states (Faulkner 1980) found that between 51 and 66 percent of landowners did not know how to obtain forestry assistance. The level of landowner knowledge about timber harvest techniques may also affect reforestation. Harvesting an existing stand is the first step in establishing a new stand, and the harvesting method used can significantly impact site preparation costs and the probability of natural pine regeneration.

Cubbage et al. (1985) concluded that landowners who received professional forestry assistance received significantly higher returns from timber sales than did non-assisted landowners. Since perceived returns from future timber harvests is one determinant of reforestation investment (McMahon 1964), then higher harvest revenues corresponding to forester involvement may result in increased investment levels. The U.S.D.A. survey (Fecso et al.) found a strong correlation between forester involvement in planning timber harvests, and reforestation investment. Landowners receiving professional assistance made provisions for reforestation on 63 percent of the harvested acres, compared to only 12 percent of the acres when foresters were not consulted. Apparently, availability of technical assistance is a key factor in NIPF reforestation accomplishment.

Several studies of landowner assistance programs resulted in recommendations for increased levels of technical forestry assistance. In evaluating the 1979 Forestry Incentives Program, Risbrudt and Ellefson (1983) recommended improved state-level supervision of practices, including tree planting. More critical evaluation of timber management opportunities by trained professionals was also recommended. Kurtz et al. (1980), in examining the retention of cost-shared tree plantings, recommended individual case follow-up by foresters. A second recommendation also implied a need for more technical assistance, calling for careful selection and timing of practices. Boyd (1983) found that in the long run, information dissemination and technical assistance by foresters were more effective than subsidies in increasing timber supply.

A number of researchers have recently developed models to predict the probability of landowner investments in reforestation. The variables incorporated in these models range from land-owner socio-economic characteristics (age, income, occupation) to characteristics of the investment itself (planting costs, stumpage prices). Public policy variables such as financial incentives and technical assistance are also given consideration. In reviewing recent efforts to model investment decisions, Royer and Vasievich (1987) noted mixed findings across studies on the explanatory powers of many of the variables used. They noted, however, that "Unanimity exists ... on the positive effect of technical assistance." Apparently, contact with professional foresters has a significant influence on the NIPF owner's decision whether or not to plant trees.

Three types of foresters are generally available to non-industrial landowners for technical assistance: state-employed county or service foresters,[2] forest industry foresters made available to landowners through a variety of cooperative programs, and self-employed consulting foresters. While reforestation may not be an objective of all foresters in these positions, all three types were found by Fecso et al. (1982) to have been involved in landowner reforestation decisions. "Advice of a forester" was one of the reasons most commonly given to be of high importance in deciding to plant pines. The availability of each of these three types, and the services they offer, are highly variable across the South.

In many cases, the only forester in contact with a landowner planning to harvest timber is a fourth forester-type, an industry procurement forester. Procurement foresters are usually not considered responsible for reforestation, but many wood-consuming companies administer landowner assistance programs (LAPs) through their procurement staffs. Even if they have no LAP to offer, procurement foresters are in a position to refer landowners to government foresters or consultants for reforestation assistance. The effect of procurement foresters has been given little attention in

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[2] "State foresters" shall be the term hereafter used for state-employed foresters whose responsibility includes direct forest management assistance to non-industrial private forestland owners.

NIPF reforestation studies. The chance for successful pine regeneration may increase with the involvement of any professional forester in the landowner's harvest and reforestation decision.

Several interesting questions then arise. Are the four types of foresters equally effective in evoking NIPF tree planting? To what extent do forester-types interact? Do differences in the effects of foresters correspond to differences in landowner characteristics? How is the impact of technical assistance affected by other factors such as timber markets, cost-share programs, harvest levels, etc.? Is there a saturation point, above which additional foresters have little or no effect?

Justification

In a time of intense pressure to reduce government spending, continued justification of public technical assistance programs is necessary just to maintain present program levels. But increases in timber production on NIPF lands may require program expansion. Commenting on the NIPF situation, Stephen Saterfield, of the federal Office of Management and Budget, stated, "...data on physical potential are probably adequate, but better data on economic feasibility and production response to federal programs would be helpful... We need to know the most cost-effective alternatives for influencing supply." (Royer and Convery 1981). The U. S. Forest Service is currently interested in evaluating such cost-effectiveness in technical assistance programs to increase pine planting on NIPF lands in the South.

This study will differ from previous studies in that it will compare and contrast technical assistance available to NIPFs from various sources, and will attempt to measure the cost-effectiveness of increasing levels of technical assistance. Instead of concentrating on individual landowners and their planting performance, the study will make an extensive South-wide appraisal of available technical assistance. It will examine trends, conflicts, and synergisms in current forester activities.

Finally, through cross-sectional comparison, it will attempt to measure variation in NIPF acres planted attributable to variation in technical assistance.

Objectives

The objective of this study is to explore the relationship between the number of foresters providing technical assistance to non-industrial private forestland owners in the South, and the acreage planted to southern pine on NIPFs. To this end, the study will:

1. Locate, identify, and define region-wide differences in technical assistance available and in reforestation and afforestation accomplishments.
2. Explore the extent to which NIPF pine reforestation efforts can be attributed to technical assistance given by different types of foresters.
3. Attempt to describe potential effects of varying the number of public agency foresters on acres of southern pine planted by NIPFs.

Chapter 2

LITERATURE REVIEW

Surveys of Landowner Attributes

Several studies have examined the extent to which land-owner attributes are associated with given attitudes and behaviors (e.g. tree planting). Birch et al. (1982) conducted a nation-wide survey of private forest-land owners and produced a regional tabulation of ownership types and traits. Similar studies were carried out for specific states and regions of the Northeast (Kingsley 1975, 1976 and Birch 1983), in Missouri (Trokey and Kurtz, 1982) and in the coastal plain of Georgia (Holemo and Brown, 1975). These studies involved extensive interviews with landowners which explored not only socio-economic variables such as age and income, but also included questions concerning attitudes toward timber management and production. Some general conclusions are evident. While there are almost eight million forest landowners in the United States, most of the acreage is controlled by a relatively small percentage of the owners. That is, most of the land is in large tracts of 100 acres and larger. Farmers are the largest occupational group in terms of acres owned, while white collar workers are largest in terms of total number of individuals. Owners of larger tracts are

more inclined to give timber production a high priority. For the NIPF population as a whole, however, timber production is seldom the primary reason for owning land.

Fecso et al. (1982) conducted a survey with the more specific objective of studying NIPF harvesting and reforestation decisions. Their findings generally agree with the above-mentioned studies, but included more specific treatment of the role of professional foresters. They found that foresters were involved with harvest planning on only 37 percent of the acres harvested, and that active reforestation was much more likely on these areas. While causality cannot be proven (Royer and Kaiser, 1985), the results suggest that putting foresters in contact with landowners at the time of harvest would increase reforestation. Trokey and Kurtz (1982) found that public foresters were most used by land-owners highly interested in timber production and those strongly oriented toward non-timber outputs (amenity and recreation values). Importantly, the large body of non-users of technical assistance were willing to sell timber, but were passive about forest management.

While significant numbers of landowners indicated that they would never harvest timber (over 40 percent in one study), they tended to own small tracts. Furthermore, a statement of no intention to harvest does not necessarily mean the timber on the property will never be available. Turner et al. (1977), found 35 percent of NIPF owners surveyed changed their minds regarding timber harvests over a four year period. They concluded that "It seems likely that sometime during a timber crop's merchantable life most ... owners will be willing to permit some harvesting." Therefore, a regeneration opportunity is likely on most commercial NIPF lands over the period of a normal rotation.

Afforestation Opportunities

Not all tree planting opportunities in the South are reforestation of cutover sites. A Department of Agriculture study (USDA 1983) estimated that between 14 and 17 million acres of marginal crop lands would be more profitable in pine plantations. The study also found that, of the 800,000 acres of agricultural land being abandoned annually, only 66 percent was reverting to pine or mixed pine-hardwood stands. The balance, 354,000 acres, was reverting to hardwoods, generally representing less profitable land use.

Landowner Behavior Models

Recent models of landowner behavior have tested the significance of landowner characteristics on forestry decisions. The models can be classed broadly as harvest choice models or investment choice models (Royer and Vasievich 1987), and generally examine the effect of a number of variables on the decisions whether to harvest timber or invest in forest management. Harvest choice models (Binkley 1981; Max 1983; Young and Reichenbach 1987) have tended to concentrate on the effect of stumpage price, but other independent variables such as income, farm (vs. non-farm) occupation, tract size, and tax policies, have also been discussed. Investment models have included a variety of dependent variables such as tree planting, thinning, and management planning. In addition to the variables common in harvest models, investment models have included age, education, tenure of ownership, financial assistance in the form of cost-share and tax incentives. Romm et al. (1987) found full-time residence, high income, and young age as significant predictors of investment, defined as the expenditure of time or money on forestry. Using a similar dependent variable, Green and Blatner (1986) identified a positive relationship with farm occupation, high education levels, and contact with a forester.

With regard to cost-share programs, Boyd (1983) found little effect of the subsidies on timber supply, and concluded that technical assistance was more cost effective. Brooks (1985), on the other hand, modeled cost-sharing in conjunction with softwood lumber and plywood markets, and found that the incentives programs had significant positive effects on supply. Royer (1987) and Royer and Moulton (1988) found the effect of cost-sharing to be significant and positive, along with tax incentives and technical assistance. High reforestation costs and low personal income deterred landowners from investing. Finally, Royer and Vasievich (1987) found landowners were not responsive to rate of return on tree planting, and suggested that NIPF owners act more as utility maximizers than profit maximizers.

Technical Assistance Availability

There have been a number of studies of technical assistance available to NIPF owners. Surveys of industry LAP's (Skinner and Cubbage 1985) and consulting services (Hodges and Cubbage 1986) were recently completed in Georgia. Hoyt, Young, and Wells (1988) reviewed a joint Tennessee Valley Authority/Association of Consulting Foresters program to establish new consultants in private professional forestry in the Tennessee Valley. While the program was deemed cost effective, almost half of 76 consultants responding to a survey felt the program should be phased out. Lewis and Ellefson (1983) list multiple agencies from which forestry information is available to the public. Kronrad and Albers (1984) found that the type of services available tends to be responsive to landowner needs.

There are indications that the three most common types of assistance foresters (state foresters, industry landowner assistance program (LAP) foresters, and consultants) may reinforce each other's effect in a given area (Royer and Kaiser 1985, Cubbage and Hodges 1985). State foresters tend to serve smaller ownerships, LAP's serve the very large ownerships, while consultants seem to occupy

the middle ground. Cooperation was found to be more common than competition between the types. (Hubbard and Abt 1988). Large numbers of NIPF owners, however, remain unaware that technical assistance is available (Stevens 1985; Birch 1983).

Effectiveness and Efficiency of Technical Assistance

The effectiveness of technical assistance programs was the focus of several recent studies. Cubbage (1983) discussed the physical effects of advice from state foresters, in terms of differences in residual stands following harvests. Harvests in which state foresters were involved left more pine trees for seed purposes or for future timber harvests than harvests conducted without the advice of a forester. Cubbage et al. (1985) conducted an economic evaluation of Georgia's Rural Forestry Assistance Program, and determined that forester involvement in timber harvests resulted in significantly higher stumpage prices for landowners. Straka et al. (1986) analyzed the effects of adding a forester to the Mississippi Forestry Commission staff in two counties of eastern Mississippi. The study measured the effects of the additional forester in terms of acres brought under management and the efficiency of the additional manpower from a cost/benefit perspective. Promotional activities of the additional foresters were found to significantly increase landowner assistance requests and acres of NIPF forest management activities, including tree planting. Positive benefit/ cost ratios were found for the additional forester in both cases.

Few if any detailed studies have been made concerning the relative effectiveness of the three types of technical assistance foresters, although the types have occasionally been compared in other studies. The "South's Fourth Forest" (Forest Service 1988), notes that data gathered in Georgia indicated that industrial program foresters, consultants, and state foresters each fulfilled separate landowner needs. Each offered a different array of services, and served ownerships of different average size. In describing TVA's consulting forester establishment program, the Forest Service

(1983) noted a 30:1 savings in public costs with establishment of consultant versus provision of similar services through a public forester.

Chapter 3

QUESTIONNAIRES AND RESULTS

Survey Methods

A mail survey of state agencies, industry landowner assistance programs, and consulting foresters was conducted to examine the levels of technical assistance available throughout the South. Because industry procurement foresters are often in touch with landowners at the time a harvest decision is made, the survey included industry procurement staffs. The study area was the twelve Southern states: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia. Data were compiled for cross-sectional comparison between the 34 sub-state Timber-Mart South (TMS) stumpage market zones. Figure 1 shows the southern states and the sub-state zones.

The survey had two objectives. The first was to ascertain the number of foresters of each type working in each sub-state zone. These data were important for the statistical analysis to be discussed in Chapter IV. The second objective was to gather information about the foresters' in-

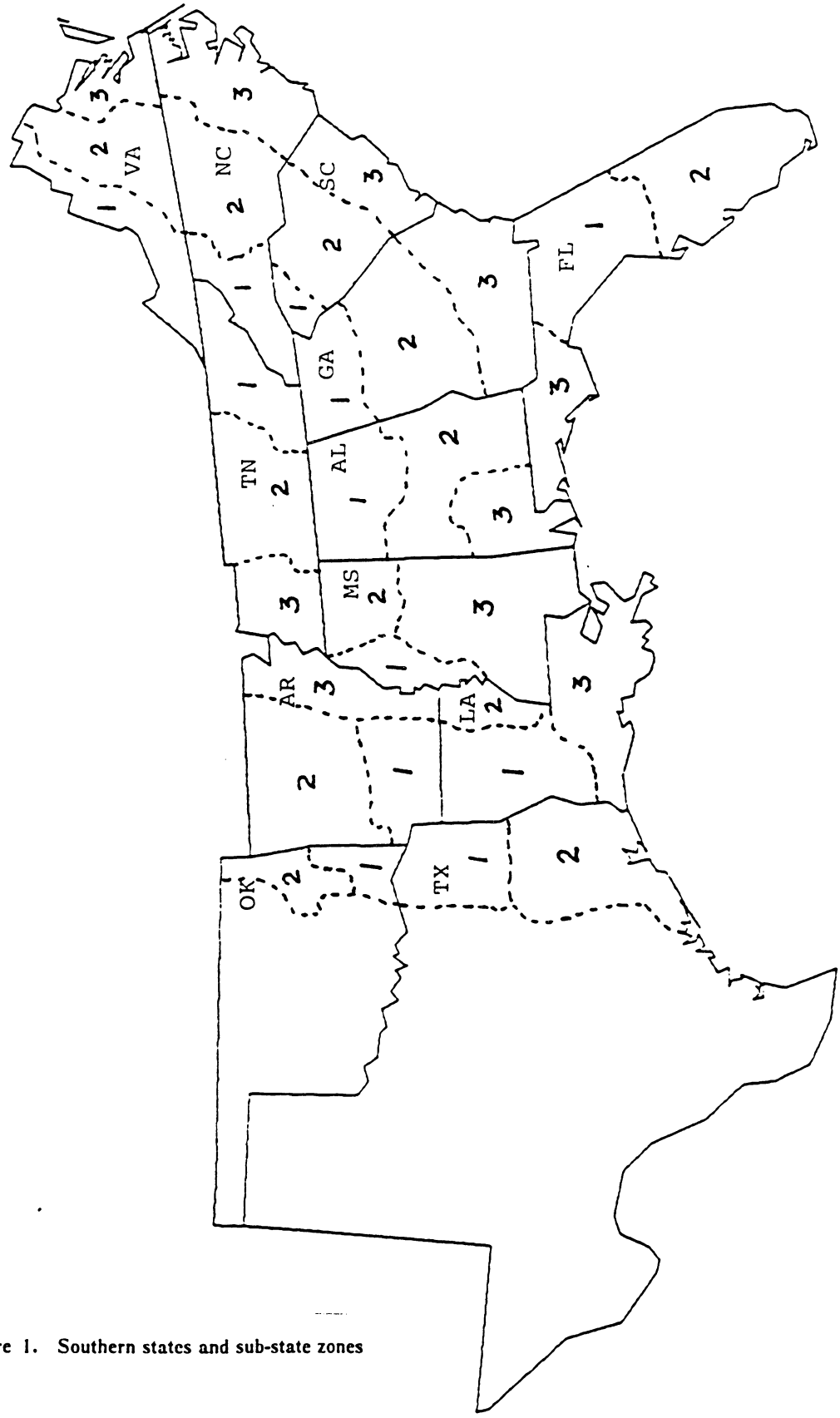

Figure 1. Southern states and sub-state zones

volvement with NIPF tree planting activities, to compare and evaluate potential effects of the forester types. Separate questionnaires were used for each of the four forester types. Copies are included in Appendix A. The study was limited to calender year 1985. This helped assure complete data sets were available for the variables of interest, and avoided possible distorting effects of the Conservation Reserve Program, which began in late spring of 1986.

Accurate estimation of the number of foresters in each zone was considered critical for cross-sectional statistical analysis. The survey included follow-up mailings and phone calls to non-respondents to achieve as large a response rate as possible. Key persons in each zone (state foresters, SAF and ACF officers, etc.) were contacted to help account for non-respondents. Information from these sources was used to augment the survey results in estimating forester numbers. Use of a survey to document types of forester activities and services available to landowners does not require extremely high response levels (Wellman et al. 1980). With the number of foresters in each zone ascertained through a combination of approaches, the additional information from the surveys was useful in characterizing technical assistance available to NIPFs. Survey results were placed into a computer database system for compilation and analysis.

Survey Results

State Forestry Agencies

Following pre-survey telephone interviews, questionnaires were mailed to the forest management chiefs of the twelve Southern states' forestry agencies. The questionnaires requested information, by TMS zone, on NIPF acres planted, acres naturally regenerated, cost-share funds spent, and

levels of forester and forestry technician staffing. All twelve states responded with completed questionnaires.

Since most state agencies keep tree planting records by planting season instead of by calendar year, planting data were reported for the 1985-86 season (fall of '85 and spring of '86). The twelve agencies reported a total of 728,799 acres of pine planted by NIPF owners during that period. An additional 186,030 acres were estimated to have been adequately restocked by natural methods.

The states reported disbursing a total of $18,002,368 in cost share monies for tree planting during the same planting season. A total of $8,126,533 was distributed through the federal Forestry Incentives Program (FIP); $3,594,533 was distributed through the federal Agricultural Conservation Program (ACP); and an additional $6,281,768 was paid out through various state administered programs. Seven of the twelve states administered their own cost-share programs during the 1985-86 season. The agencies reported unmet demand for cost-share funds in 26 of the 34 zones, with the most common results being that landowners delayed planting until funds were available, or failed to replant.

State forestry agencies employed 516 professional foresters in 1985 who were in routine contact with NIPF owners. (Supervisory personnel who had little or no landowner contact were not included). In addition, ten states reported 490 non-professional forestry technicians as having had routine landowner contact and a possible significant impact on NIPF forest management. Four of the ten states reported that such technicians outnumbered professional foresters. Responses to the state agency questionnaires are summarized in Table 1.

TABLE 1

Summary of results of state agency questionnaires

(All estimates are for the 1985-86 planting season)

1.	Total estimated acres planted to pine:	728,799
2.	Total estimated acres reforested by natural methods:	186,030
3.	Cost-share dollars spent by program:	
	Forestry Incentives Program	$8,126,533
	Agricultural Conservation Program	3,594,068
	State Funded Programs (7 states)	6,281,768
4.	Significant unmet demand for cost-share funds:	26 zones[1]
	No significant unmet demand for cost-share funds:	8 zones
5.	Consequence of unmet demand for cost-share funds: (number of times each result mentioned)	
	Landowners remain on waiting list until funds available	23 zones
	Landowners fail to plant	5 zones
	Landowners plant with own funds	3 zones
6.	Total number of foresters routinely in contact with NIPFs:	516
7.	Total number of forestry technicians with impact on NIPF forest management: (10 states)	490

[1] Thirty four sub-state Timber-Mart South zones used in cross-sectional analysis.

Industry Landowner Assistance Programs

A list of forest industry firms offering landowner assistance programs (LAPs) was taken from *Forest Farmer* magazine's 1987 Manual Edition. As the survey process proceeded, the list was augmented through information obtained from state forestry agencies, and responses to the procurement forester survey. A total of 35 firms offering LAPs were included. Twenty-eight responded to the questionnaire, for a response rate of 80 percent. No attempt was made to contact firms which failed to respond to a second mailed request for their participation.

The LAP questionnaire was designed to include only firms which ran independent assistance programs that were separate from their procurement operations. The second item of the questionnaire instructed respondents to return the form without completing it, if their LAP was administered by procurement foresters. This avoided a potential problem of double counting, since LAPs administered through procurement operations were reported in the questionnaires mailed directly to procurement departments (to be discussed later in this chapter).

Twelve of the 28 firms responding to the questionnaire had no independent landowner assistance program in 1985. (Four of the twelve offered management services through procurement foresters). Sixteen firms reported LAPs active in 1985; three divisions of one firm responded as separate operating units. Therefore, 18 independent units (all referred to as firms or companies hereafter) completed the LAP questionnaire.

The 18 firms employed a total of 115 foresters, other than procurement foresters, who spent all or part of their time assisting NIPF owners. Ninety one of these foresters (79 percent) were assigned full time to landowner assistance (Table 2); the balance of the foresters split their time between LAP programs and other responsibilities, usually company land management.

TABLE 2

Time spent by LAP foresters and firms assisting NIPFs

Percent of time	Number of foresters	Percent of foresters	Number of firms	Precent of firms
100	91	79	11	61
75-99	7	6	2	11
50-74	--	--	--	--
25-49	6	5	2	11
1-24	11	10	3	17
Totals	115	100	18	100

The LAP programs varied widely in the types of services offered. In terms of landowner tree planting activities, it is significant that 13 of the 18 firms assisted with locating and supervising tree planting vendors. Vendor contact and supervision was listed more than any other service available through LAPs. Other services commonly offered were written management plans, and timber marking and sales assistance (Table 3).

Fifteen of the eighteen LAP firms required some sort of written agreement between the company and the landowner. The agreements of 12 of the firms called for "right of first refusal" for any timber sold from the managed property. This arrangement allows the assisting firm to match or exceed the highest bid offered for the landowner's timber, and provides the firm with some assurance that it may purchase the timber if it so desires. The other three firms using written agreements required only the opportunity to bid for the enrolled landowner's timber.

Respondents estimated that 3,889 landowners were enrolled in independent LAPs in 1985. Current enrollment (spring of 1988) was estimated at 6,268 landowners, for an increase of 2,379 (61 percent) over the last three years. Fourteen firms reported increased participation, 3 reported decreased participation, and 1 remained constant. This large increase in LAP participation reflects the trend away from long term leases and toward LAPs described by Meyer (1984).

Ten firms reported that there was no minimum acreage requirement for their LAPs, while eight programs had some minimum size for participating landholdings. The largest minimum acreage requirement was 300 acres (Table 4). The average size of tracts managed under LAPs ranged from 50 to 5,000 acres, with most firms reporting average tract sizes between 100 and 1,000 acres (Table 5).

Eight of the LAP firms reported that they had increased forester staffing since 1985, while 3 had reduced the number of foresters committed to their programs. Seven firms had maintained constant forester numbers. This is interesting in light of the fact that 14 of the programs had experienced

TABLE 3

Services offered through LAP programs

Type of service offered[1]	Number of firms
Vendor location and supervision	13
Written management plan	11
Timber marking	9
Timber sales assistance	7
Site preparation and/or prescribed burning	5
Boundary line maintenance	4
Other *	15

* Other services mentioned included seedlings at or below cost, assistance in obtaining cost-share funds, road maintenance, tree farm inspections, etc.

[1] Not mutually exclusive. Firms could indicate more than one service.

TABLE 4

Minimum acreage required by LAP programs

Acres Required	Number of firms
0	10
1-99	3
100-250	4
251-300	1

TABLE 5

Average tract size in LAP programs

Average Acres	# Firms
< 100	1
100-250	6
251-500	4
501-1000	5
1000-5000	2

enrollment increases. This suggests that foresters have less time on average to spend with each landowner than they had three years ago, and several respondents did comment that their foresters were straining to keep up with the workload.

Industry-run landowner assistance programs are increasing in terms of landowners enrolled and foresters involved. But the number of landowners appears to be increasing faster than the number of foresters. LAPs provide industry with some assurance of access to stumpage, and provide landowners with management services at no cost or reduced cost. The impact of LAPs on tree planting may be larger than on any other forest management activity, as evidenced by the fact that coordination of planting contractor activities was the most commonly offered service.

Consulting Foresters

The consulting foresters of the southern states proved to be a difficult population to identify. While all twelve state forestry agencies provide lists of consultants operating within their respective states, the lists vary widely in quality. Some states list almost anyone's name on request, while others require a degree in forestry and an assertion of full time consulting employment. Several states have registration for foresters, but it is not mandatory in all cases, and "grandfather clauses" allow non-foresters to remain on registered forester roles.

The consulting forester survey was limited to forestry school graduates in order to separate wood dealers and others not in the business of providing land management assistance from practicing foresters. The state foresters' consultants lists were the basis for the survey. Persons known to be non-foresters were removed from the lists, in consultation with the state agencies. The lists were cross-checked with the Membership Directory of the Association of Consulting Foresters, and names were added as appropriate.

Five hundred and forty-five questionnaires were mailed. Due to the size of the mailing and time constraints of the project, no follow-up mailings were made. One hundred eighty three questionnaires were returned, for a response rate of 34 percent. Thirty-one of the returned forms were eliminated from the study because the firms were not in business in 1985, or did not offer traditional consulting services (e.g., were actually real estate or surveying firms), or operated only on a part-time basis. One hundred fifty-two full-time firms, representing 304 foresters, returned useable questionnaires.[3]

Sixty-nine firms, slightly fewer than half of the respondents, offered services other than forestry, such as real estate or surveying services. But 38 of the 69 firms spent at least 90 percent of their time in consulting forestry activities. Thus almost 80 percent of the responding firms (119 firms) were engaged in forestry activities 90 percent of the time or more (Table 6).

Forty-one firms used part-time foresters at some time during 1985. Most of these used part-time services for less than 100 working days (Table 7). Nevertheless, the 41 responding firms using part-time help used a total of 3,140 forester days, or the equivalent of over 12 full time foresters per year. Fifty-seven firms employed technicians who were in regular contact with NIPF owners. Almost all of these firms had only one or two technicians (Table 8). These technicians represent 116 persons who may have had some influence on NIPF tree planting performance.

Responding to specific questions concerning involvement with NIPF tree planting, 142 of the responding firms (95 percent) indicated that they routinely offered advice and recommendations concerning tree planting. Only 43 consulting firms (30 percent of the respondents) operated planting crews and machinery, while 107 (73 percent) used subcontracted vendors. With less than one third of the consulting firms actually performing tree planting, the presence of consultants in a region

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[3] In the following summary of responses to the consulting forester survey, the figures may not always sum to the sample population total of 152. This is because some respondents skipped questions, and some answers were unintelligible. "Respondents" refers always to respondents to the question being described.

TABLE 6

Time spent by consulting firms and foresters on non-forestry services

Percent of time	Number of firms	Percent of firms	Number of foresters	Percent of foresters
0	81	54	157	52
1-10	38	25	102	34
11-20	12	9	18	6
21-30	9	6	13	4
31-50	8	5	9	3
51-100	2	1	3	1
Totals	150	100	302	100

TABLE 7

Use of part-time foresters by consulting firms

Working days of part-time help used	Number of firms
0	108
1-100	33
101-200	5
200-450	3

Total working days used: 3,140

TABLE 8

Technicians employed by consulting firms

Number of technicians	Number of firms
0	95
1 - 2	50
3 - 5	5
5 -14	2

Total Employed: 116

does not necessarily mean tree planting services are available. Vendors willing to sub-contract tree planting jobs seem to represent a critical factor.

Consultants, like LAP programs, reported a wide range in average tract sizes for their NIPF clients (Table 9). While 86 firms (59 percent) reported average tract sizes of 250 acres or less, 36 firms (24 percent) indicated that their clients averaged over 1,000 acres of timberland holdings. NIPF clients represent the bulk of the workload for southern consulting foresters. Sixty two percent of the firms responding, representing 46 percent of the foresters, reported that they spent essentially all of their time with non-industrial, non-governmental clients. Approximately seventy percent of the firms (and foresters) spent 90 percent or more of their time with NIPF owners (Table 10).

The number of consulting foresters in the South appears to be increasing. Thirty two (24 percent) of the firms responding reported increases in the number of foresters in their firms between 1985 and 1988. Eleven firms (8 percent) reported decreases in forester staffing, while 92 firms (68 percent) remained constant.

Southern consulting foresters are a dynamic population. As independent small businesses, often sole proprietorships, they are capable of adjusting their operations relatively quickly to meet client demands. While many consultants offer non-forestry services, or serve non-NIPF clients, the large majority of the consultants responding to the survey cater mostly to NIPF owners and provided forestry services. The direct accomplishment of consulting foresters in terms of NIPF acres planted may be smaller than expected, since only 30 percent of the firms operate tree planting crews and machinery. But the effect of consultants on tree planting, through management recommendations and assistance with vendor location and supervision, could be significant.

TABLE 9

Average timberland acreage owned by consulting firm clients

Average ownership acreage	Number of firms	Percent of Firms
1 - 100	45	31
101 - 250	41	28
251 - 500	16	11
501 - 1000	9	6
> 1000	36	24
Totals	147	100

TABLE 10

Time spent by consulting firms and foresters with non-NIPF clients

Percent of time	Number of firms	Percent of firms	Number of foresters	Percent of foresters
0	93	62	138	46
1-10	14	9	68	23
11-25	25	17	53	17
26-50	11	7	29	10
> 50	7	5	12	4
Totals	150	100	300	100

Procurement Foresters

Company procurement foresters' primary responsibility is to purchase standing timber and wood for their employers' mills. These foresters are naturally in touch with landowners who are planning timber harvests. A number of forest industry landowner assistance programs are administered by procurement departments. In addition to these specific programs, there is the possibility that procurement foresters casually pass information to landowners concerning regeneration of cutover stands. As part of this study, a survey of procurement staffs was conducted to try to assess the extent and effect of procurement foresters in terms of NIPF tree planting accomplishments.

The mailing list for the procurement forester questionnaire was derived from *Forest Farmer* magazine's 1987 Manual Edition, *The Directory of Forest Products Industries* (1988), and *Timber Harvesting* magazine's annual woodlands directory. The list was cross-checked with the landowner assistance program list for possible additions. Firms which did not respond to the first mailing were sent a follow-up request about six weeks later.

A total of 64 firms were contacted, and 45 responded, for a response rate of 70 percent. Six of the respondents had no procurement foresters in 1985, and were eliminated from the survey. Nine firms submitted responses from more than one individual division, and, as with the LAP survey, each division was treated as a separate unit and shall hereinafter be called a firm or company. Sixty completed questionnaires were useable.

The questionnaire was designed to gather information on the amount of contact between procurement foresters and landowners and the extent to which tree planting information was made available to landowners. If the respondent's company offered a landowner assistance program through the procurement foresters, information on the program was solicited.

The 60 responding firms employed 561 foresters who were in frequent contact with NIPF owners. Forty eight of the responding firms (80 percent) reported that their foresters routinely offer reforestation advice. These firms employ 467 procurement foresters. Forty three firms (73 percent of those responding) indicated that their foresters refer landowners to government or consulting foresters for tree planting assistance. Slightly less than half of the respondents, 28 firms, indicated that they offer some other type of technical assistance. Table 11 summarizes general assistance available from procurement foresters.

Firms indicating that they offer "other technical assistance" were asked to specify the type offered. Timber harvesting prescriptions, including marking and thinning, were most often mentioned. Twelve firms indicated that their foresters offered "all types of management advice." Possible impacts on reforestation were suggested with a number of firms reporting that they referred landowners to site preparation and tree planting vendors and/or supervised vendor activities. Several firms offered assistance in obtaining government cost share funds for planting, and in obtaining seedlings. Significantly, most of these "other services" were offered by firms which offered no organized LAP, either through their procurement staff or through a separate LAP program. Eleven firms indicated that the written job description for their procurement foresters included some requirement for offering management assistance to landowners.

Eleven of the 60 firms responding reported that their procurement staffs offered formal landowner assistance programs which required a written agreement with the landowner. These firms employed 119 procurement foresters. Six of the firms required right of first refusal on timber sales in exchange for the LAP services, while 5 required only the opportunity to bid, or provided the services with no formal obligation on the part of the landowner (Table 12).

Only three of the 11 LAPs offered through procurement foresters had minimum acreage requirements. The minimum acreages ranged from 50 to 500 acres. The estimated average tract size in the LAPs ranged from 80 to 2000 acres. Six of the programs had tracts averaging less than 200

TABLE 11a

Assistance offered to NIPFs
through industry procurement programs

	Number of firms	Percent of firms	Number of foresters	Percent of foresters
Routinely offer reforestation advice:	48	80	467	83
Refer landowners to consultants or government foresters:	43	73	409	76
Offer other technical assistance:	29	48	335	60

TABLE 11b

Types of other technical assistance offered
through industry procurement programs

Type of assistance	Firms with formal LAP through procurement	Firms w/o formal LAP through procurement
Comprehensive management advice:	4	8
Timber marking/ harvesting assistance:	1	10
Refer/supervise planting vendor:	1	7
Assist with cost-share program:	0	3
Provide seedlings at or below cost:	0	3
Recommend/provide site preparation:	2	1
Other services (road maint., property line marking, insect and disease assessment etc.)	1	7

TABLE 12

Requirements and conditions of
procurement-administered written LAP agreements

Written agreement required:

	Number of firms	Number of foresters
Yes	11	119
No	49	442

Conditions of written agreements:

	Number of firms
Right of first refusal:	6
Opportunity to bid:	5

acres, two had tracts averaging 201 to 500 acres, and three had average tracts in excess of 500 acres. Information on procurement LAP tract sizes is shown in Table 13.

The eleven firms with procurement administered LAPs had 540 written agreements in 1985. By 1988, the number of agreements had expanded to 735, an increase of 36 percent. Ten of the firms showed an increase in landowners enrolled, while one firm reported a decrease (Table 14).

The primary duty of procurement foresters, as was stated earlier, is not to assist landowners, but to procure raw materials for their mills. But since the large majority of procurement programs responding to the survey offered some sort of reforestation advice, an important question becomes "How much time do these foresters spend with landowners?" Thirty of the 60 firms estimated that their foresters spent 15 percent of their time or less in direct contact with landowners. These firms employed 345 foresters, or 61 percent of the foresters represented by completed questionnaires. An additional 82 foresters (15 percent) were reported as spending 16 to 25 percent of their time with landowners (Table 15). So more than 75 percent of the foresters in the survey spent 25 percent of their time or less in direct contact with NIPF owners.

The potential impact of procurement foresters is large, however, even with a small proportion of each forester's time spent with NIPF owners. If each forester spends only ten percent of his or her time in contact with landowners, this still amounts to about 25 days per forester per year (assuming 250 working days per year). At this rate, the 561 procurement foresters represented by the survey would spend a total of over 14,000 days with NIPF owners each year.

Southern forest industries seem to recognize potential for procurement organizations to influence NIPF forest management, particularly tree planting. Most of the responding firms apparently encourage their foresters to at least provide advice and recommendations, and in some cases offer free management assistance. And while at first it seems that procurement foresters spend a relatively small percent of their time with landowners, the amount of time probably compares favorably with

TABLE 13

Acreage involved in procurement-administered written LAP agreements[1]

Estimated average tract size:

Acres	Number of firms
80-200	6
201-500	2
> 500	3

[1]Number of firms with minimum acreage requirement: 3
Number of firms with no minimum acreage requirement : 8

TABLE 14

Trends in LAP participation

Year	Number Participants
1985	540
1988	735

(% change 1985-88: 36)

Firms reporting increase (1985 to 1987): 10
Firms reporting decrease (1985 to 1987): 1

TABLE 15

Time spent by procurement foresters with NIPF owners, by firms and number of foresters

Percent of time	Number of firms	Percent of firms	Number of foresters	Percent of foresters
0 - 15	30	50	345	61
16 - 25	12	20	82	15
26 - 50	12	20	97	17
> 50	6	10	37	7
Totals	60	100	561	100

the other forester types, who must also spend time on office work, travel, other programs, etc. There is reason to suspect that the cumulative effect of procurement foresters offering tree planting advice has a significant impact on NIPF tree planting activities.

Chapter 4

STATISTICAL ANALYSIS

Model Development

The objective of this study was to explore the relationship between technical assistance available and non-industrial private forestland acres planted to pine in the South. While technical assistance in the form of forester availability is the variable of interest, other factors certainly affect the probability that landowners will choose to invest in pine plantations. The influence of such variables as government cost-sharing programs, landowner income, and the financial return on tree planting investments must be taken into account. Therefore, multiple linear regression was used to describe the relationship between technical assistance and tree planting.

A cross-sectional analysis was undertaken, comparing tree planting accomplishments between Timber-Mart South (TMS) stumpage market zones. There are 34 zones in the twelve southern states (Figure 1, Chapter III). Multiple linear regression equations were developed expressing acres of NIPF pine reforestation per zone in the South as a function of numbers of assistance foresters

by types, and several other independent variables. To account for differences in acreage available for pine forestation between zones, the dependent variable used was the ratio of acres planted to acres of NIPF-owned commercial pine land, by zone. Candidate explanatory variables included acres of farm ownership, cost share dollars spent, timber harvest levels, per capita income, rate of return on tree planting, average tract size, and number of foresters.

Explanatory Variables

Farm ownership, as discussed earlier, has often been a variable of consideration as a possible factor in harvest and reforestation behavior, but research results have been inconclusive. While farmers are more likely to harvest than non-farmers, they seem less likely to reforest. Perceptions of timber as a renewable crop should be strong in farmers, but they may also have higher alternative rates of return which discourage reforestation investment. The expected sign for the coefficient of this variable is undetermined.

The availability of cost-share funds reduces the capital needed by the landowner. This makes the tree planting investment more attractive relative to alternative investments by increasing the expected rate of return, and tree planting would therefore be expected to be positively correlated with cost-share expenditures.

Since tree planting opportunities usually result from timber harvests on pine sites, reforestation is correlated with levels of pine harvest; the relationship should be positive.

Landowner income affects his alternative rate of return (ARR). As income increases, ARR decreases, and forestry investments with lower rates of return become more attractive (Straka et al. 1984). Therefore the average income of landowners in a region should be positively correlated with forestry investment.

The expected rate of return on tree planting is not constant across the South. Areas with a concentration of forest industry have higher stumpage prices due to intense competition, shorter average log hauls, and better utilization. Areas with relatively moderate terrain have lower reforestation and logging costs. These and other factors cause the average expected return on tree planting to vary between regions. Since higher returns may be associated with higher investment levels, a measure of average regional rate of return must be included in the model.

Row (1978) enumerated reasons why tract size affects landowners' propensity to invest in timber production. Essentially, the influence of tract size has two components. First, tract size is related to economies of scale in timber production, which affect investment returns. Second, the conflict between the production of timber and non-timber outputs is exacerbated on small tracts, resulting in higher opportunity costs of timber production, and lower rates of return. Tract size is expected to be positively correlated with forestation investment. NIPF tree planting, as has been discussed, is expected to be positively correlated with the number of foresters.

The proposed model takes the following form:

$$ACPL = b_0 + b_1 FSTR + b_2 FMAC + b_3 SHARE + b_4 HARV + b_5 INC + b_6 ROR + b_7 SIZE + u$$

All b's are regression coefficients. u is the residual disturbance, which is assumed to be normally distributed with a mean of zero, constant variance, and zero covariance. The variables and their expected signs are summarized in Table 16.

Sources of Data

To estimate the model, data for each zone were compiled from a number of sources. Acres planted in the 1985-86 season by NIPF owners in each of the sub-state zones were reported by the forestry agencies in the questionnaires described in Chapter III. The state foresters' questionnaires

Table 16

Variables and expected signs

Variable	Description	Expected Sign of Coefficient
ACPL	number of ac. planted / ac. NIPF pine timberland	
FSTR	number of foresters, by type	+
FMAC	acres of farm ownership	?
SHARE	cost share dollars spent	+
HARV	average annual removals of pine growing stock in MCF	+
INC	total per capita income	+
ROR	average rate of return on pine planting	+
SIZE	average tract size	+

were also the source of data on cost-share monies spent, and number of state employed assistance foresters and technicians, by zone.

Data on the forest resource, such as acres of commercial pine land in NIPF ownership and acres of farm ownership, were obtained from the U. S. Forest Service forest surveys, compiled by the appropriate zones. To estimate harvest levels, data on average annual removals of pine growing stock (million cubic feet) on NIPF ownerships over the ten year forest survey period were used. These data were kept as specific to the model as possible. The Forest Survey Unit offices involved (Southern and Southeastern) compiled the data by zone, limiting the ownership acreage to NIPF pine and oak-pine timber types. Pine removals were from NIPF lands only.

Because non-industrial private owners are such a diverse group, average NIPF income by zone is impossible to ascertain. As a proxy, U. S. Department of Census data on per capita income were compiled for each zone.

Rates of return (RORs) on tree planting were obtained from Forest Service data sets compiled for the *South's Fourth Forest* report. The data sets contained estimated returns to tree planting by Timber-Mart South zones for a matrix of planting investments by forest type, site category, and reforestation cost category. The return on regenerating a natural pine stand of meduim site index, and medium site preparation and planting costs was used as an indicator of relative ROR between zones. The estimated ROR for this regeneration investment, expressed in percent, was extracted for each zone from the *South's Fourth Forest* data set.

The average tract sizes were computed for each state by refining a data set developed from a nationwide landowner survey (Birch et al. 1982). The landowner study estimated the total number of NIPF owners in each state. Total NIPF acres taken from the Forest Surveys were divided by the number of private landowners derived from the landowner study to estimate average tract size.

Because the ownership data was not available at the sub-state level, state average tract sizes were used for all zones in a given state.

Data on number of foresters by type were taken from the survey results. Maps of the Southern states showing the sub-state zones were attached to each questionnaire, and respondents were asked to indicate the number of foresters working in each zone. Since high response rates were achieved for the LAP and procurement forester surveys, numbers for these two forester types were taken directly from the survey results.

The number of consultants responding to the questionnaire was sufficient to characterize the nature of consulting services in the South, but a better estimate was needed of the number of foresters in each zone. The original mailing list for each state was edited to remove those firms which had responded to the mailed questionnaire. Contacts were made in each state with persons who were familiar with the consulting firms, such as state forestry department employees, ACF officers, and university extension personnel. These persons were mailed the lists of non-respondents, and asked to indicate next to each name whether the person was a full time consultant, a part time consultant, or not a consultant. No comments were made next to unfamiliar names. Through this process, some indication as to the status of more than 80 percent of the non-respondents was obtained. The balance of the non-respondents were assumed to be active, single-forester firms. The town of residence for each non-respondent was located on state maps, and the firm was assumed to do business 100 percent of the time in the TMS zone of residence. For the regression model, the number of consulting foresters was the sum of the questionnaire respondents plus the non-respondents, by zone.

Data Refinement

Examination of the data set indicated that refinement was necessary before fitting the model. The ratio of commercial pine land to commercial timberland was calculated for each zone (Table 17). Five of the sub-state zones (Arkansas Zone 3, Louisiana Zone 2, Mississippi Zone 1, and Tennessee Zones 2 and 3) stood out as inappropriate for inclusion in the study. In each of these zones, pine land was less than 10 percent of commercial timberland. In such hardwood regions, cost-share dollars, landowner interest, and technical assistance would likely be directed toward hardwood establishment and management. A different model of NIPF pine planting activities than the model for pine regions would apply. It was felt that including these regions in an analysis of pine planting in pine areas would add "noise" (uncontrollable variation) to model development, and the five zones of low pine acreage were eliminated from the analysis.

Acceptable rate of return data were available for only 25 of the 34 zones. Rate of return was represented by the return on regeneration of a natural pine stand on medium site, with medium treatment cost. These data were extracted from a Forest Service data set, but the preferred specific investment opportunity was not described in all zones. Five of the missing data points, however, were from the five zones eliminated from the study due to low pine acreage. Rate of return data were available for 25 of the 29 relevant zones. Ultimately, the significance of rate of return on pine planting had to be evaluated over 25 observations.

Three variables were scaled to minimize the effect of size differences between zones. Farm acreage was included as the proportion of farmer owned commercial timberland to total commercial timberland. Cost share expenditures were included as dollars per thousand acres of NIPF owned pine land. Harvests levels were expressed as thousand cubic feet harvested per thousand acres of pine land.

TABLE 17

Percent commercial timberland in commercial pine land by zone
(NIPF ownership only)

Zone	Percent	Zone	Percent	Zone	Percent
AL 1	58	LA 1	66	SC 1	47
AL 2	50	* LA 2	6	SC 2	56
AL 3	40	LA 3	22	SC 3	50
AR 1	51	* MS 1	2	TN 1	23
AR 2	23	MS 2	40	* TN 2	4
* AR 3	1	MS 3	49	* TN 3	9
FL 1	50	NC 1	28	TX 1	42
FL 2	35	NC 2	45	TX 2	56
FL 3	55	NC 3	50	VA 1	17
GA 1	55	OK 1	36	VA 2	35
GA 2	56	OK 2	23	VA 3	43
GA 3	59				

* Zones with less than 10 percent commercial pine land to commercial timberland ratio, which were eliminated from the statistical analysis portion of this study.

Table 18 shows the final data set for all variables in the 29 relevant zones. Simple two-variable scatter plots for variable pairs of interest are shown in Appendix B.

Regression Analysis

The variable names and descriptions are listed in Table 19. Each model is shown in Table 20, along with relevant statistics. The numbers in parentheses (#) in the text correspond to the model number in Table 20.

The following convention shall be used for describing the reliability of the parameter estimates: The value of the test statistic (t or F) will be given for the test of the null hypothesis (the parameter in question is equal to 0). The probability greater than t (or F) will be indicated as $p = x$, where x is the relevant probability. Thus, $t = 1.5$, $p = .25$ means the test statistic calculated for the parameter in question is 1.5, and the probability of obtaining that value or a larger value of t under the null hypothesis is 25 percent. Generally, a 95 percent confidence level ($p <= .05$) will be sought (although a 90 percent confidence level will occasionally be accepted). A parameter will have to meet this criterion to be called "significant".

Multiple Variable Models

The full model (1) was tested with the variables described in the previous section. Early tests of the model used only 25 observations, since rate of return data were not available for five of the pine zones. The model using all variables and 25 observations had an R^2 of .34, but neither the model nor any of the coefficients were significant ($F = 1.27$, $p = .32$). The variables HARV (harvest levels) and SHARE (cost share expenditures) showed the strongest coefficients, with SHARE being

TABLE 18

Full data set used in analysis

ZONE	ACPL	HARV	SHARE	INC	FMAC	SIZE	ROR	STFOR	PROFOR	LAPFOR	CONFOR	FSTR	TECH
AL1	10.9170	42.8975	207.68	6262	1341.9	37.8	7.8	17.0	28.30	2.9	10.00	58.20	48
AL2	12.1397	51.0111	306.97	5385	2736.8	37.8	9.5	21.0	58.80	4.3	18.05	102.25	55
AL3	19.3279	45.0143	177.06	5834	1802.0	37.8	8.8	13.0	22.60	6.5	8.80	52.90	33
AR1	8.2130	57.8048	195.67	5341	868.8	32.5	8.8	19.0	18.60	13.7	18.40	70.70	22
AR2	6.3807	19.0852	179.12	5955	1885.2	32.5	7.7	18.0	8.30	4.3	8.40	37.00	32
FL1	36.7832	64.4565	514.13	6510	466.5	30.8	9.7	20.0	34.55	1.5	15.90	71.95	0
FL2	3.4743	25.8771	208.61	7750	212.2	30.8	9.0	6.0	5.70	0.0	1.90	13.60	0
FL3	21.9411	46.4168	480.69	5969	456.2	30.8	9.4	13.0	20.10	0.0	13.50	46.60	0
GA1	13.5316	47.8382	68.69	7192	1045.8	59.2	7.8	21.0	18.25	1.0	23.90	84.15	0
GA2	23.6827	78.8271	230.20	5627	2187.8	59.2	8.3	32.0	41.05	0.0	45.15	118.20	0
GA3	31.4483	68.1613	298.57	5338	2117.1	59.2	8.8	26.0	38.35	11.0	31.00	104.35	0
LA1	3.3683	53.1640	132.08	6046	368.7	39.6	8.5	17.5	24.10	7.9	26.00	75.50	2
LA3	4.8456	33.2071	187.27	6637	424.0	39.6	8.3	8.0	1.50	0.0	10.90	20.40	0
MS2	19.9635	42.1045	1022.10	4861	1208.4	64.8	8.2	26.0	10.10	3.8	12.30	52.20	10
MS3	4.3112	54.4891	615.76	5484	2713.1	64.8	8.5	43.0	18.50	2.2	22.85	84.55	22
NC1	8.9092	31.8225	143.57	5859	948.2	20.7	*	11.0	5.00	0.0	12.00	28.00	34
NC2	11.4047	50.8755	469.03	6850	2577.8	20.7	8.4	17.0	2.70	2.7	36.05	58.45	36
NC3	8.2410	70.9175	388.91	5484	1984.2	20.7	9.0	11.0	40.80	0.0	31.25	82.85	40
OK1	5.7445	18.4835	199.18	4869	318.2	54.8	8.4	4.0	2.50	0.0	3.00	9.50	3
OK2	0.7765	13.8889	36.30	5134	578.2	54.8	*	3.0	1.50	0.0	0.00	4.50	0
SC1	15.5898	37.1490	532.43	6468	391.0	34.3	*	5.0	1.00	0.0	7.30	13.30	1
SC2	10.6224	65.8242	383.08	6020	1451.1	34.3	9.1	18.0	21.80	13.8	45.80	97.00	2
SC3	14.9914	67.9348	512.38	5721	1294.3	34.3	9.2	9.0	34.30	13.5	35.95	92.75	4
TN1	4.4215	12.4932	241.08	6087	1494.8	47.2	*	12.0	24.00	1.7	4.00	41.70	8
TX1	10.6002	69.8916	188.99	6865	686.9	40.1	9.5	11.0	4.00	0.0	13.80	28.80	7
TX2	3.1649	35.3540	182.17	6250	682.9	40.1	9.5	12.0	12.00	0.1	37.05	61.15	8
VA1	10.6249	13.1017	556.18	6135	1514.1	28.3	8.4	20.0	17.95	9.5	15.00	82.45	31
VA2	13.6860	41.7324	611.62	5223	1746.0	28.3	8.5	31.0	27.10	7.8	28.80	92.50	39
VA3	23.2007	56.1873	946.84	6099	903.8	28.3	8.5	24.0	14.00	2.4	16.40	56.80	39

TABLE 19

Variable descriptions

Variable	Description
ACPL (dependent)	Acres planted on NIPF ownerships per thousand acres of NIPF-owned commercial pine land.
INTER	Intercept term
HARV	Annual pine growing stock removals (thousand cubic feet) per thousand acres NIPF commercial pine land.
SHARE	Cost share dollars spent per thousand acres NIPF commercial pine land.
INC	per capita income
FMAC	farmer-owned commercial timberland acres per acre commercial timberland.
SIZE	state average acreage of commercial timberland per NIPF owner.
ROR	rate of return on pine planting (estimated for regenerating natural pine stands on medium sites at medium cost).
FSTR	sum of all forester types
STFOR	state-employed foresters
PROFOR	procurement foresters
LAPFOR	landowner assistance program foresters (independent of procurement staffs).
CONFOR	consulting foresters
ASTFOR	sum of STFOR, LAPFOR, and CONFOR
TECH	state-employed technicians
STTECH	sum of STFOR and TECH

TABLE 20

Results of multiple linear regression analysis

Model no.	Variable	Coefficient	t value	Prob>t	R^2
1.	INTER	-0.4030	-0.012	0.991	
	SHARE	0.0139	1.726	0.102	
	HARV	0.1679	1.023	0.321	
	INC	0.0008	-0.331	0.744	
	FMAC	-11.8131	-0.521	0.609	
	SIZE	0.0423	0.302	0.766	
	ROR	0.6644	0.225	0.825	
	FSTR	0.0262	0.297	0.770	0.343
2.	INTER	-12.5656	-0.656	0.518	
	ROR	2.9214	1.352	0.189	0.074
3.	INTER	3.7449	0.202	0.842	
	SHARE	0.0139	2.137	0.044	
	HARV	0.2166	2.670	0.014	
	INC	-0.0008	-0.378	0.709	
	FMAC	-11.3996	-0.664	0.513	
	SIZE	0.0486	0.430	0.671	
	FSTR	13.0713	0.323	0.749	0.415
4.	INTER	10.765	3.330	0.002	
	FMAC	0.001	0.570	0.576	0.006
5.	INTER	10.801	2.060	0.050	
	SIZE	0.039	0.380	0.761	0.003
6.	INTER	21.640	1.730	0.096	
	INC	-0.002	-0.750	0.460	0.020
7.	INTER	-1.7100	-0.460	0.649	
	SHARE	13.1284	2.328	0.028	
	HARV	209.1109	2.902	0.007	0.395
8.	INTER	-1.7414	-0.458	0.651	
	SHARE	0.0130	2.247	0.033	
	HARV	0.2008	1.995	0.057	
	FSTR	0.0074	0.120	0.905	0.395
9.	INTER	-1.6149	-0.439	0.665	
	SHARE	0.0151	2.630	0.015	
	HARV	0.2157	2.205	0.037	
	ASTFOR	-0.1070	-1.162	0.256	
	PROFOR	0.1645	1.455	0.158	0.456

TABLE 20 (continued)

Model no.	Variable	Coefficient	t value	Prob>t	R^2
10.	INTER	-1.7063	-0.442	0.662	
	SHARE	0.0140	2.204	0.037	
	HARV	0.1603	1.833	0.079	
	STFOR	-0.0386	-0.206	0.838	
	PROFOR	0.1328	1.144	0.264	0.427
11.	INTER	-1.8242	-0.470	0.642	
	SHARE	0.0127	2.024	0.053	
	HARV	0.2052	2.608	0.015	
	STFOR	0.0247	0.138	0.892	0.395
12.	INTER	-1.8750	-0.507	0.616	
	SHARE	0.0134	2.398	0.024	
	HARV	0.1572	1.860	0.075	
	PROFOR	0.1257	1.156	0.259	0.426
13.	INTER	7.6002	2.994	0.005	
	PROFOR	0.2481	2.328	0.027	0.167
14.	INTER	6.5180	1.976	0.058	
	STFOR	0.3467	1.998	0.056	0.129
15.	INTER	11.2075	5.203	0.000	
	LAPFOR	0.2906	0.810	0.425	0.024
16.	INTER	9.5574	3.253	0.003	
	CONFOR	0.1464	1.135	0.266	0.045
17.	INTER	5.5340	1.680	0.105	
	FSTR	0.1159	2.32	0.028	0.16
18.	INTER	2.5076	0.841	0.408	
	SHARE	15.3874	2.667	0.013	
	PROFOR	0.2332	2.419	0.023	0.346
19.	INTER	1.3780	0.37	0.716	
	HARV	0.1947	2.15	0.040	
	PROFOR	0.1127	0.95	0.349	0.29
20.	INTER	4.5650	1.37	0.182	
	SHARE	0.0129	1.85	0.075	
	STFOR	0.1931	1.04	0.308	0.231

TABLE 20 (continued)

Model no.	Variable	Coefficient	t value	Prob>t	R^2
21.	INTER	0.0419	0.011	0.991	
	HARV	0.2071	2.487	0.019	
	STFOR	0.1745	1.007	0.323	0.296
22.	INTER	11.5011	3.790	0.001	
	STTECH	0.0251	0.328	0.746	0.004

significant at the $p = .10$ level. INC (per capita income) and FMAC (proportion of acreage owned by farmers) showed negative signs. While the predicted sign for FMAC was undetermined, the predicted sign for INC was positive, the opposite of the regression result for this model.

The ROR (rate of return on tree planting) was closely scrutinized, since this variable was limiting the number of useful observations to 25. The t value for ROR in the full model was .225 ($p = .82$). To assess the usefulness of ROR, it was regressed by itself against the dependent variable ACPL (acres planted per pine acre)(2). The linear relationship between ROR and ACPL was insignificant ($F = 1.83$, $p = .19$), as was the coefficient for ROR ($t = 1.35$). ROR was dropped from consideration, and the model was tested using all other variables and 29 observations.

Model 3, using six variables and all 29 pine zones, was significant ($F = 2.6$, $p = .046$). The R^2 improved to .415, indicating that the six variable model accounted for about 42 percent of the variation in ACPL. Only SHARE and HARV, however, had significant coefficients ($t = 2.14$, $p = .04$ and $t = 2.67$, $p = .01$, respectively). INC and FMAC retained their negative signs. The variable composed of all forester types, FSTR, was insignificant ($t = .32$, $p = .75$).

To further assess the predictive properties of the six remaining variables, a "Pressall" function was run with the SAS (C) program on Virginia Tech's mainframe computer system. The Pressall function examines all possible combinations of the model (from single variable models to the full model) and ranks them by PRESS (PREdiction Sum of Squares) statistic. The computer generates the PRESS statistic by withholding the observations in the data set one at a time and estimating the coefficients for the candidate model using the remaining observations. The deleted response is estimated each time, and the prediction error (the difference between the deleted response and its predicted value) is calculated. PRESS is equal to the squared sum of the prediction errors, and represents variation in the response variable not explained by the model (Myers 1986). On the basis of the PRESS criterion, the lower the PRESS, the better the model.

The Pressall procedure was run with the forester data separated by forester type, resulting in a nine variable model. The procedure generated 512 possible models, ranked by PRESS statistic. HARV and SHARE were present in the first 31 models, adding to the evidence that they were strong predictor variables. Among the forester variables, STFOR (the number of state foresters) and PROFOR (the number of procurement foresters) showed promise, appearing often in the first 50 models ranked by PRESS.

At this point in the analysis, FMAC and SIZE (average tract size) showed little predictive power relative to the response variable. While INC showed some significance, it was unstable, changing signs when used in different combinations of explanatory variables. These three variables were tested in simple regressions on ACPL (Table 20, models 4,5, and 6), and all were found to have insignificant correlations with the dependent variable. (INC was negative in simple regression against ACPL). Based on this poor performance, and because the forester types were the variables of interest in this study, FMAC, SIZE, and INC were dropped from further consideration.

The task, then, was to test for a forester variable or combination of variables which would enhance a model containing SHARE and HARV. When SHARE and HARV were used together in a two variable model (7), the model accounted for almost 40 percent of the variation in ACPL ($R^2 = .395$). The forester types were combined into one variable (FSTR) and were tested in a three variable model with SHARE and HARV (8). There was no improvement in fit (R^2 remained at .395), and the coefficient for FSTR was insignificant ($t = 0.12$, $p = .90$).

FSTR was the sum of all foresters: state agency foresters, LAP foresters, consultants, and procurement foresters. A plausible refinement of this variable was to separate the procurement foresters from the other three, since procurement foresters were the only type with little or no direct responsibility for providing services to landowners. The variable ASTFOR was defined as the sum of the three assistance-type foresters (state, LAP and consultants); PROFOR became the number of procurement foresters per zone.

The four variable model including SHARE, HARV, ASTFOR, and PROFOR (9) explained 45 percent of the variation in ACPL ($R^2 = .456$). But the adjusted R^2 for the four variable model was 0.366, while the two variable model including SHARE and HARV had an adjusted R^2 of .348. The addition of the two forester variables to the model apparently contributed little to the goodness of fit in excess of the gains from changing the degrees of freedom. The coefficients of both ASTFOR and PROFOR were insignificant at the .10 level of confidence ($t = -1.16$, $p = .25$ and $t = 1.45$, $p = .16$ respectively), and the coefficient for ASTFOR had the wrong sign. The separation of PROFOR improved the model fit only slightly over the FSTR variable, but seemed to move the forester variables toward significance.

Since STFOR (the number of state foresters per zone) showed some promise in the PRESS analysis, the LAP and consulting forester components were deleted from ASTFOR, and STFOR was tested first in a model with PROFOR, SHARE and HARV (10), and then with PROFOR deleted (11). The four variable model (10) was significant ($F = 4.46$, $p = .007$) and had $R^2 = .42$. But the coefficients of the other three variables were weakened relative to the model with ASTFOR. The coefficient for STFOR was negative, but not significant. When PROFOR was deleted from the model (11), the coefficient for HARV gained strength, but the SHARE coefficient became marginal at the .05 confidence level ($t = 2.0$, $p = .053$). The coefficient for STFOR became positive again, but remained insignificant ($p = .89$). R^2 for the three variable model was .395.

Finally, PROFOR was tested alone in the model with SHARE and HARV (12). The model had an R^2 of 0.425, but the adjusted R^2 (0.357) again indicated little gain in fit from the addition of the forester variable. The coefficient for HARV became insignificant at the .05 level, but was significant at the 10 percent level ($t = 1.86$, $p = .074$). The coefficient for PROFOR was not significant ($t = 1.15$, $p = .26$).

Further Analysis on the Forester Variables

No combination of the forester data produced a variable with a statistically significant coefficient when used in combination with the SHARE and HARV variables. The various forms of the forester variable were tested in simple linear regression models for correlation with the dependent variable ACPL. The results of these tests are shown in Table 20, model numbers 13 through 17.

PROFOR showed the strongest association with ACPL (13). The coefficient was positive at the 95 percent level of confidence ($t = 2.33$, $p = .027$) and coefficient of determination (R^2) was .167, indicating positive correlation between PROFOR and ACPL.

STFOR also showed positive correlation with the dependent variable (14), but was only marginally significant at 95 percent confidence ($t = 1.99$, $p = .055$). Neither LAPFOR (number of LAP foresters) nor CONFOR (number of consultants) showed statistically significant association with ACPL (models 15 and 16). CONFOR had the larger coefficient of determination ($R^2 = .045$) but the slope coefficient was insignificant even at the 90 percent confidence level ($t = 1.13$, $p = .26$). For the simple regression of LAPFOR on ACPL, the coefficient for LAPFOR was insignificant, with $t = 0.8$ and the probability greater than t at 0.42.

All four forester types were summed into one variable, FSTR, and a simple regression of FSTR on ACPL was tested (17). The model produced an R^2 of .16, and the slope coefficient was significant ($t = 2.32$, $p = .028$). But the predictive power of this model, with PROFOR used in combination with the other forester variables, was not demonstrably better than that of the model using PROFOR alone. The coefficient of determination was the same for both.

Alternate Model Formulations

Models described in this section are shown in Table 20, model numbers 18 through 22.

The most useful predictive model developed from the data set, in terms of explaining variation in acres planted per acre of pine timberland, was the two variable model using SHARE and HARV (Table 20, Model 7). When forester variables were added to this model, they made no significant contribution to explaining the variation in acres planted. The variable PROFOR, the forester variable with the strongest correlation with the dependent variable ACPL, was tested in two variable models using SHARE and HARV alternately as the second explanatory variable.

In the two variable model including PROFOR and SHARE (18), both variables displayed significant coefficients ($t = 2.42$, $p = .02$ and $t = 2.67$, $p = .01$ respectively). The coefficient of determination for the model was $R^2 = .346$. The model using HARV and SHARE, however, had a larger $R^2 = .395$. The substitution of PROFOR for HARV resulted in a loss of predictive power for the model.

Next, PROFOR was tested in combination with HARV (19). PROFOR became insignificant in this model ($t = .95$, $p = .34$). STFOR, the other forester variable of some significance, was then tried alternately with SHARE (20) and HARV (21). The coefficient for STFOR was not significantly different from 0 in either case (90 percent confidence level).

The state forester survey questionnaires included information about non-foresters (technicians) which some states use extensively to promote forest management by NIPF owners. The technician data were entered into the regression analysis data set, and combined with the state forester numbers to test whether the presence of technicians increased the correlation between state-employed

forestry personnel and tree planting. The variable name used for the technician data was TECH, and the sum of the technicians and the state foresters was named STTECH.

In simple regression of STTECH on ACPL (22), the coefficient for STTECH was not significant ($t = .328$, $p = .74$). The addition of the technician data to the state forester data lessened the predictive power of the variable.

Discussion of the Modeling Results

Multiple linear regression was used to model changes in acres of NIPF pine planting per acre of NIPF pine ownership (the response variable) that would result from changes in a number of factors (the explanatory variables) believed to impact planting performance. The purpose of such a model is to consider all explanatory variables simultaneously, and estimate the change in the response variable that would result from changes in the explanatory variables. The coefficients of the explanatory variables, which are generated by the regression procedure, represent the unit change in the response variable which would result in a unit change in a given explanatory variable, all other influences held constant.

This study originally aimed to develop a model which would predict changes in acres planted to pine that would result from changes in the number of foresters made available to NIPF owners for technical assistance. The desired model did not result. Within the range of technical assistance presently available, variation in technical assistance did not prove to be a significant predictor of tree planting accomplishment. The data used would not support the contention that foresters had a significant positive influence on NIPF tree planting, considering all other potential influences. No multi-variable model which included a statistically significant coefficient for a forester variable could be specified. Two factors may have contributed to the inability to develop the desired model. The

first was the complexity of the system being modeled; the second was suspected deficiencies in the data.

Complexity of the NIPF System

When prediction is the objective, the success of modeling with multiple linear regression techniques depends on the extent to which variation in the response variable can be attributed to variation in the explanatory variables. The response variable in this study was tree planting by NIPF owners. Explaining variation in this NIPF owner activity was the objective. Obviously, the extent to which individual landowners differ in interest, motivation, and objectives with respect to their forest holdings contributes to variation in the tree planting activities.

All of the candidate explanatory variables used in this study had been demonstrated by earlier research to hold some potential for predicting landowner behavior. Most such studies centered on samples of individual landowners. A level or value of each explanatory variable could be measured or estimated for each landowner and comparisons made in responses associated with various levels of landowner attributes. A problem with applying this approach to the question of technical assistance is that technical assistance does not come in increments. A landowner either gets technical assistance, or does not. Under this circumstance, analysts are limited to logit-type models, measuring the increase in probability of tree planting given contact with foresters. Incremental estimates of increases in planted acres attributable to technical assistance are not possible.

This study attempted to define intra-zonal differences in landowner (and investment opportunity) attributes, and model the correlation between those attributes and landowner response. The landowner response was measured in acres planted (not the probability of planting) and measurement of incremental responses to changes in technical assistance was theoretically possible. Unfortunately, this approach had to assume an average landowner for each zone. That average

landowner had a certain income, timber tract size, and proportion of farm versus non-farm employment. The extent to which landowners deviated from these zonal averages, and behaved differently due to their individual deviations, brought uncontrollable variance into the model building process. The uncontrollable variation in the dependent variable reduced the coefficient of determination (R^2).

An assumption of the ordinary least squares estimation used in regression analysis is that the predictor variables are non-stochastic or fixed. That is, we are estimating the value of the dependent variable for given, or fixed, values of the predictor variables. If the predictor variables are not fixed, but are actually estimates of variables which have a probability distribution, then sampling errors in the predictor variables are possible. If such sampling errors exist, they will lead to bias in the estimates of the model parameters (Gujarati 1978). In terms of this study, if zonal averages for a variable differed significantly from the true value of the variable for landowners facing tree planting opportunities, then bias was introduced, and a reliable estimate of the variable coefficient was not possible. The problem of zonal averaging may have reduced the predictive power of the rate of return variable, as well as the income, tract size, and farm employment variables.

Deficiencies in the Data

In addition to the sampling errors, errors of measurement may have occured in the predictor variables. To make a South-wide study of potential effects of technical assistance on NIPF tree planting, a number of sources were relied on for data. The USFS Forest Survey was the source of resource information (acres by forest type and ownership, harvest levels, etc.). The U.S. Bureau of the Census was the source of income information. State forestry agencies provided data on cost share expenditures, acres planted, and state employed foresters. Rate of return and tract size data came from separate U.S. Forest Service studies. Finally, the estimates of procurement, LAP, and consulting forester numbers were obtained by surveying the foresters themselves.

While the quality of the Forest Survey data is not suspect, its application to this purpose was difficult. The Survey data had to be reduced to the county level and then reassembled by the zones defined in this study, to be compatible with data available from other sources. General forest types had to be used in estimating harvest levels and opportunity for planting pine.

Census Bureau data is also accurate, but average per capita income by zone had to be used as a proxy for NIPF owner per capita income. The assumption was that relative differences in income were the same across zones for both forestland owners and the general population. This assumption may not be correct. NIPF owners may be poorer than average in one zone, and richer than average in another.

The state forestry agencies were asked to assimilate data on acres planted, cost share expenditures, and forester staffing by geographic zones different than those by which they usually keep such records. While all were asked early in the study formulation if they could provide the needed data sort, their success in doing so may have varied from state to state.

The rate of return data were developed for the *South's Fourth Forest* (Forest Service 1988) from estimated zonal averages for stumpage prices and treatment costs. The relative intra-zonal variation in ROR depends on the accuracy of these estimates. But the estimates were originally made for assessment of South-wide investment opportunities, and not for inter-zonal comparisons.

Estimation of forester numbers by zone was highly dependent on the accuracy of the survey responses. With so many people involved in a voluntary exercise, the commitment to accuracy was undoubtedly variable. This is a common dilemma in social research and could not be avoided in this situation. The problem of inaccurate reporting may have been compounded in the case of the consulting forester survey. A low response rate required additional estimates by volunteers.

Influence diagnostics in the regression program were used to search for strong influence points which might distort the results of the analysis. Two zones, GA3 and FL1, exerted strong influence on the regression coefficients. These two zones had the largest values for the dependent variable, acres planted per acre of pine land. The two observations were examined for possible measurement errors, and no errors could be identified. Additionally, both zones were considered genuine pine producing regions in terms of proportion of commercial timberland in pine (Table 17) and pine harvest levels (Table 18). Since reevaluation verified that the two influence points were valid observations, there was no reasonable justification for removing them from the model (Myers 1986).

Problems of undetectable errors in the data (errors of measurement), combined with the complexity of the NIPF system (resulting in sampling errors), may have prevented the successful estimation of coefficients for variables which would otherwise have been useful predictors of NIPF tree planting accomplishments.

Chapter 5

DISCUSSION AND CONCLUSIONS

This study was undertaken to explore the relationship between foresters providing technical assistance to non-industrial private forestland owners in the South and acres planted to southern pine on NIPFs. The study was carried out in two related parts. The first involved surveying the forester groups to gather information on the type and extent of services available to landowners, and the number of foresters working in each of 34 sub-state zones. The second part of the study was an attempt through multiple linear regression to develop a model to predict changes in NIPF acreage planted to southern pine in response to changes in forester numbers.

Discussion of Study Results

Assistance available to NIPFs

Technical assistance, ranging from recommendations to implementation of management practices, is available to southern landowners from four types of foresters: state foresters, private consulting foresters, industry LAP foresters, and industry procurement foresters. Survey results showed 1,929 foresters with at least some professional involvement with southern landowners in 1985. This is a conservative estimate of forester numbers. Undoubtedly, some firms were not listed on the various master lists used for the survey populations. Additionally, 20 percent of the LAP programs and 30 percent of the procurement programs failed to respond to the questionnaire, and were not included in the count.

Assistance was also available to landowners from foresters working part-time, and from technicians employed by the state agencies and by consulting foresters. In 1985, there were an estimated 606 technicians and 69 part time foresters working in the South. The number of part time consultants probably would be much larger if foresters who are otherwise employed but "moonlight" as consultants were counted. Only part time consultants whose names appeared on state agency lists of consulting foresters were counted in this study.

Forty-four percent of the respondents to the LAP survey, and 24 percent of the respondents to the consultants survey reported increases in foresters employed between 1985 and 1988. Seventeen percent of the LAPs and eight percent of the consulting firms reported decreases. Since the magnitude of the change for each firm was not reported, the net change cannot be ascertained. But since the number of firms reporting increases is more than twice the number reporting decreases, it is likely that the number of foresters available to landowners for assistance is growing.

There is evidence that the number of landowners receiving assistance is increasing. Industry LAPs are increasing in terms of landowners enrolled, and foresters involved. Most consulting foresters depend directly on landowner interest for their livelihood. The fact that the number of consultants is increasing (based on survey results and conversations with state agency foresters) indicates increasing demands by landowners for professional services.

Industry landowner assistance programs, whether administered through procurement foresters or separate departments, tend to concentrate on encouraging tree planting. Services available range from coordinating vendor activities to carrying out prescribed burning. There are apparent differences, however, between procurement administered programs and those separate from procurement departments. Timber harvesting assistance was more commonly available than tree planting assistance from procurement administered programs, while the reverse was true with separate LAPs. Eighty percent of the separate LAPs had a right of first refusal requirement, while only half of the procurement administered programs had the same requirement. Of course, the percent of each foresters time spent with NIPF owners was much greater for separate LAPs than for procurement LAPs.

There is some evidence of a "niche" effect for the size tracts served by the different forester types. The contention is that state agencies serve smaller landowners, LAP programs serve mostly large holdings, while consultants occupy the middle ground (Cubbage and Hodges 1985). While this study did not explore tract size associated with state forester contacts, average tract size was reported by consultants and the two industry forester types. It is interesting that there was a significant difference in the average tract size reported by procurement-run LAPs and LAPs run by separate departments. Two thirds of the procurement programs reported average LAPs below 250 acres, while only one third of the separate LAP programs reported averages in this range. Consulting foresters often commented that they catered to any size client. But the distribution of their reported average client tract size was bimodal, with 60 percent below 250 acres, 30 percent above 1000 acres, and

10 percent in between. The large majority of industry LAPs of both types had either no minimum acreage requirement, or a requirement which was below 100 acres.

A competitive stance could be posited for procurement staffs administering LAPs. They may be willing to work with small landowners to prevent those landowners from going to consultants, who usually encourage competitive bid timber sales. Consultants, on the other hand, seem to prefer and seek out large landowners due to economies of scale, but work with large numbers of small landowners simply because there are so many more small tracts.

Southern state agencies reported 728,799 acres of pine planted by NIPF owners during the 1985-86 planting season. Landowners received $8,126,533 in government cost share funds for tree planting during that same period. State agencies reported unmet demand for cost share funds in 26 of the 34 sub-state zones.

Correlation Between Technical Assistance and Tree Planting

This study was unable to estimate a statistically meaningful model for predicting landowner response to varying levels of technical assistance within the range of existing assistance levels. But a positive correlation was found between acres planted and procurement foresters, and between acres planted and state foresters.

It could be argued that the positive correlation between procurement foresters and tree planting was coincidental. In a simple regression test, procurement foresters were positively correlated with timber harvests (R^2 = .28). Timber harvests, in turn, were positively correlated with acres planted. The association between procurement foresters and tree planting could be due to both being associated with harvests. But the survey results indicate strong industry involvement in encouraging reforestation, and a direct effect from procurement foresters is plausible.

The positive correlation between state foresters and acres planted, although weaker, is less suspect. Simple regression of state foresters on acres planted produced a positive slope coefficient of .35, which was different from zero with 90 percent confidence, and marginally, with 95 percent confidence. Given the modeling difficulties described earlier, this is evidence of a positive correlation between state foresters and tree planting.

A statistically significant relationship could not be demonstrated between either consulting foresters or LAP foresters and acres planted, even at the 90 percent confidence level. LAP foresters were by far the smallest group surveyed, and their distribution across zones was irregular. Their potential effect on acres planted may simply have been too small to have been captured in a South-wide analysis. Consultants, on the other hand, were the most difficult forester type to survey, and errors in estimating consultant numbers by zone were possible. Also, consultants, like the NIPF owners themselves, are a diverse group of individuals. While the activities of industry foresters and state foresters may tend to be standardized by policies of the employer, each consultant may adopt his or her own stance as to encouraging planting. A distinct average effect from consultants is not likely, and uncontrollable variance is again introduced into the modeling process.

The presence of positive correlation between state foresters and acres planted does not prove causality. Causality cannot be proven by regression analysis (Gujarati 1978). It could be argued, then, that the reverse effect is at work: foresters move into an area due to unmet demand for technical assistance with tree planting. State forestry officials could allocate manpower (foresters) in response to demands for services from citizens. Tree planting, in a sense, could be causing high forester numbers in a given zone. To explore this hypothesis each state chief of forest management was interviewed to explore whether or not foresters were allocated to given areas in response to landowner demands for services. The object of the interviews was not disclosed in advance. Most management chiefs felt that their agencies allocated foresters across their state according to the potential of the resource base to respond to increased management. The foresters, in turn, were expected to promote forest management, including tree planting, and engage the interest of

landowners. Occasionally foresters were temporarily assigned to assist an adjacent forester station with a backup in workload, but there was little evidence that demand for tree planting services caused foresters to be moved into an area.

Interpretation and Application of Results

Acknowledging possible data deficiencies, the study found that, considering all potential influences, increasing or decreasing technical assistance within the range of existing levels would have little effect on NIPF tree planting in the South. In cross-sectional comparisons between zones, acres of pine planting was found to be responsive only to acres harvested and cost-share expenditures. Acres harvested was included in the model as a measure of the opportunity for tree planting. In terms of policy implications, cost-share expenditure is the only variable which was found significant and is controllable by policy makers. It is not clear that increasing the number of foresters available for technical assistance (within the range of existing levels) will produce an increase in the number of acres planted to pine.

Additional complexities of the NIPF system

Using other approaches, a number of studies have found significant positive correlation between the presence of foresters and NIPF tree planting. Uncontrollable variation in landowner attributes was discussed earlier as a possible reason for the difference between those results and the results of this study. Variation is present not only in landowner attributes, but also in planting opportunities and in the foresters themselves. Because this variation makes development of a South-wide model difficult, the types of variation deserve a closer look.

NIPF owners are a diverse population. Even if a sub-population of landowners who all had the same income, occupation, and ownership size could be found, it is unlikely that all would react equally to available technical assistance. Each owner's objectives, motivation for owning land, and emotional reaction to different land management scenarios would temper tree planting performance.

Harvest levels and acres of pine forestland were included in the regression model to account for inter-zonal differences in tree planting opportunity, but other factors may be significant. Opportunities for afforestation, planting idle non-forest land with pine, may vary widely between zones, and should be independent of the opportunity for reforesting harvested stands. Sub-state measurements of afforestation opportunity were not available for this study and afforestation opportunity was not treated separately in the model development process.

Potential for natural regeneration also varies across the South, and may reduce the need for reforestation in some areas. A number of survey respondents commented that natural regeneration was not given enough attention as a means of stand re-establishment. Conversations with state agency management chiefs revealed that the states differed in their reliance on natural regeneration. At least two management chiefs reported significant reliance on natural regeneration to reforest cut-over stands, while one commented that natural regeneration was silviculturally unfeasible for most reforestation needs in his state. Biological differences in pine species result in differences in potential for natural regeneration. The loblolly and shortleaf pine types of the more northern and piedmont zones seed in on cutover areas more readily than the longleaf and slash pine types of the southern costal plain. Therefore, reforestation objectives may be accomplished in some zones with relatively low levels of pine planting. The response of landowners to afforestation opportunities and to opportunities for natural regeneration may produce intra-zonal differences in tree planting accomplishments.

Just as landowners vary in objectives and personalities, foresters are also distinct individuals. This study attempted to identify different effects on tree planting for each forester-type, on the

premise that one type might be more effective or less effective than another in producing NIPF tree planting. But personal differences between foresters, (differences in attitude, interests, and personality) may be more important than occupational differences. The task of convincing landowners to plant trees is a task of salesmanship, and different foresters undoubtedly vary in salesmanship talents. If the addition of a forester does indeed produce an increase in tree planting activity in a given area, the magnitude of the increase may depend more on the personality and motivation of the forester than on the type of forester involved.

Cautions on application of the results

With simple correlation analysis, this study demonstrated a positive relationship between the presence of acres planted by NIPF owners and two separate forester types, procurement foresters and state foresters. Correlation, as stated earlier, does not prove causality. A cause and effect relationship should be posited only from a priori or theoretical considerations (Gujarati 1978). Even earlier logit-type studies, which found correlations between foresters and the probability of NIPF tree planting, could not conclude causality (Royer and Kaiser 1985). Through interviews with state agency personnel, described earlier in this report, this study attempted to ascertain whether state foresters were allocated according to factors other than landowner demands for technical assistance, or were moved into a given area in response to landowner demands. Little evidence was found that landowner demands cause increases in forester numbers.

Even these findings, however, are not clear evidence of a causal relationship between foresters and tree planting. Just as the correlation between procurement foresters and tree planting can be attributed to a coincidental association with timber harvests, the correlation between state foresters and tree planting can be attributed to a coincidental association with planting opportunity. State foresters are assigned to areas where agency decision makers perceive an opportunity for NIPF forest management activity. But NIPF tree planting was demonstrated by this study to be positively

correlated with timber harvests, which are in a sense a measure of planting opportunity. Whether landowners respond independently to higher levels of planting opportunity in certain areas, or to the efforts of state foresters in those same areas, is undetermined by this study.

Earlier studies have described increases in reforestation with increases in technical assistance for specific localities in the South (Cubbage et al. 1985, Straka et al. 1986), but this study failed to find demonstrable Southwide effects. Caution should therefore be used in applying the results of local studies to other localities, and in assuming local results apply generally to larger areas. The results of this study indicate that, while there is a positive correlation between NIPF tree planting and technical assistance, other factors such as timber harvest levels and cost share expenditures tend to override the effect of technical assistance in a given area.

There are probably diminishing returns to technical assistance for any given landowner. That is, first contact with a forester may produce significant increases in a landowner's forest management activities, but as the landowner learns about forest management, continuing forester contact becomes less critical. The impact of additional foresters in a given area is thus dependent on present technical assistance levels (how many landowners are already in contact with foresters) and past levels (how many landowners have had previous contact with foresters). As these conditions vary from locality to locality, so will the effect of additional foresters.

Use of the coefficients from the models estimated in this study, for the purpose of predicting specific effects from adding foresters to an area, is not recommended. For example, the simple regression of state foresters on acres planted (Table 20, model 14) produced the model

$$ACPL = 6.518 + 0.3467\ STFOR + u$$

This could construed to mean that for every state forester added to a given area, an additional one third acre would be planted for every 1,000 acres of NIPF owned pine land. But confidence in this

coefficient for state foresters is marginal at the 95 percent level ($t = 1.998$, $p = 0.056$). Additionally, this coefficient is known to be biased by the exclusion of significant predictors (harvest levels and cost-share expenditures) from the model, and suspected to be biased by errors in the variables discussed earlier. Finally, as just discussed, additional foresters have not been shown to cause additional acres to be planted, and the impact of foresters may be obscured by other influences on NIPF tree planting activity.

The inability of this study to describe and quantify a strong correlation between technical assistance foresters and NIPF tree planting should not suggest that foresters have no positive impact on planting activities. The model can say nothing about the effects of major changes in technical assistance, for example doubling the number of foresters or eliminating all programs. Although such drastic changes intuitively should effect NIPF reforestation, they lie far beyond the data variations underlying the model. There are sound theoretical reasons to suspect that a positive correlation exists between NIPF tree planting and large scale assistance. Evidence suggests that significant numbers of landowners are misinformed about timber management and reforestation principles. Royer and Kaiser (1985) found that 75 percent of landowners who harvested pine timber and took no measures to re-establish pine expected pine to come back naturally on their lands. The natural tendency, however, is for harvested pine stands to succeed toward hardwood stands. In the six Southeastern states, 46 percent of pine and oak-pine stands harvested by NIPF owners over the last decade became predominantly hardwood stands (Knight 1984). While some portion of landowners facing a reforestation decision may choose, for whatever reason, not to plant pine, the availability of technical assistance may certainly be important to those who want to replant. Numerous studies have described a positive correlation between forester contact with landowners and the probability of tree planting. Fecso et al. (1982) found that landowners receiving professional forestry assistance made provisions for reforestation on 63 percent of the harvested acres, compared to only 12 percent of the acres when foresters were not consulted. This study demonstrates that a South-wide model of the relationship between technical assistance and NIPF tree planting may be

impossible to estimate. It does not ascertain that foresters have no impact on NIPF reforestation activities.

Conclusion

Technical assistance is available to southern non-industrial private forestland owners from a number of sources: state forestry agencies, consulting foresters, industry landowner assistance departments, and industry procurement staffs. Assistance available from the private sector seems to be increasing, as evidenced by increases in the number of consulting foresters, and in the number of landowners enrolled in industry LAPs. Forester staffing for industry LAPs, however, may not be keeping up with the demand for services. Increases in forester numbers seem to be proportionately smaller than increases in landowners enrolled. Surveys of the four sources of technical assistance resulted in a conservative estimate of almost 2,000 foresters with some professional involvement with southern landowners in 1985. The types and intensities of tree planting assistance were highly variable across forester types

A cross-sectional statistical analysis was unable to demonstrate a significant southwide effect of technical assistance on NIPF tree planting within the existing range of assistance levels. This result suggests that diversity in the NIPF population, combined with diversity in the silvicultural and market potential for pine production across the South, prevents quantifying the effect of small changes in technical assistance. A positive correlation between two forester types, state foresters and procurement foresters, was found, but a causal relationship cannot be statistically determined. It is not clear whether landowners are influenced by foresters or by the silvicultural and market opportunities which are positively correlated with forester numbers.

The objective of this project was to explore the relationship between technical assistance available to Southern NIPF owners, and NIPF acreage planted to southern pine. An underlying purpose was to determine if available technical assistance is "adequate" to assure that pine production on non-industrial private lands will keep pace with projected large increases in demand for wood as a raw material. If technical assistance is presently "inadequate", what changes in types or levels of assistance will make it better?

"Adequate" is defined by the urgency of the task at hand. The more urgent the task, the higher the level of performance required of the means of accomplishment. Projections of 40 percent increases in harvest levels on NIPF ownerships imply a huge reforestation and afforestation task. Urgency can be evoked by pointing out pine-dependent local and regional economies, the need for affordable paper and building materials for American consumers, and the role of wood products in the Nation's balance of trade. Tree planting is a part of a most pressing environmental issue of the day, global warming. What levels of technical assistance to NIPF tree planting are adequate? One could argue that any gains that can be made without exorbitant cost should be pursued.

On the other hand, in our free capitalist system, government intervention into economic markets is supposed to be reserved for instances of market failure. The stumpage supply market, as it applies to non-industrial private timberlands, is certainly less than perfect. Price information is difficult to obtain, long time horizons contribute to uncertainty, and there are significant transaction costs for market entry and exit. But there are signs that the market is functioning properly. Corporations other than forest industries are investing in Southern timberlands. The number of consulting foresters continues to grow, indicating a clientele that recognizes the value of forest management and the potential for acceptable returns from investment in forestry. Forestry industry seems to be engaged in ongoing evaluation of landowner assistance programs, and is making a direct commitment of forester personnel to help assure future timber supplies.

This study (and several studies before it) demonstrates a positive relationship between availability of technical assistance, and NIPF tree planting accomplishments. Unfortunately, precise quantification of the relationship eludes us. The systems are complex. The most complex element remains the landowners themselves. Study after study has produced only the most basic statistics; we know landowners' average age, average income, and average level of education. Common occupations include farmer, retired persons, and business professionals. But only foggy images of the subject are produced, and no model of the NIPF owner has been developed which reliably predicts management activity response to changes in real world conditions. There is no directory of NIPF owners, and organizations of owners, though they exist, have tiny memberships relative to the total owner population.

Questions were posed early in this study concerning interaction between various forester types interact, and whether or not each type has a unique effect on landowners. If specific interactions and effects could be described, this would imply that a certain mix of technical assistance might be optimal (in terms of efficiency and effectiveness) in evoking desired NIPF tree planting levels. Is there an optimal mix of technical services that should be maintained to assure adequate NIPF inputs into timber production? There is evidence that the best mix is not only different for different locations, but is also different for individual landowners. An important qualification of the optimal mix question is "Optimal for whom?" Optimal forest management for large numbers of landowners may not include maximum timber production. Amenity values and recreation opportunities are often important to NIPF owners, and maximum financial returns are not always sought. Uneven-aged management, natural regeneration and stands of mixed species composition are management alternatives to be considered by any landowner. To be effective in maintaining high levels of NIPF tree planting accomplishment, technical assistance from any source should strive to apply professional knowledge of local markets and silvicultural opportunities to finding the best mix of forest management activities to meet the specific needs of each non-industrial private forestland owner.

REFERENCES

Alig, R. J. 1986. Econometric analysis of the factors influencing forest acreage trends in the Southeast. Forest Science 32(1):119-134.

Alig, R. J., T. J. Mills, and R. L. Shackelford. 1980. Most soil bank plantings in the South have been retained; some need follow-up treatments. Southern Journal of Applied Forestry 4(2):60-64.

Binkley, C. S. 1981. Timber supply from private non-industrial forests: a micro-economic analysis of landowner behavior. Yale University School of Forestry and Environmental Studies. Bulletin #92.

Birch, T. W. 1986. Communicating with non-industrial private forestland owners. Journal of Forestry 84(12):25-33.

Birch, T. W. 1983. The forest-land owners of New York. USDA Forest Service Res. Bull. NE-78.

Birch, T. W., D. G. Lewis, and H. F. Kaiser. 1982. The private forest-land owners of the United States. USDA Forest Service Res. Bull. WO-1.

Birdsey, R. A. and W. H. McWilliams. 1986. Mid-south forest acreage trends. USDA Forest Service Res. Bull. SO-107.

Boyd, R. 1983. The effects of FIP and forester assistance on nonindustrial private forests. IN: Nonindustrial Private Forests: A review of economic and policy studies. Duke University, Durham, NC.

Brooks, D. J. 1985. Public policy and long term timber supply in the South. Forest Science 31(2):342-357.

Carlen, Ola and Karl-Gustaf Lofgren. 1986. Supply consequences of subsidizing thinning activities in Sweden. Scandinavian Journal of Forest Resources 1:379-386.

Clawson, Marion. 1979. The economics of U.S. non-industrial private forests. Resources for the Future. Res. Pap. R-14. Washington D.C.

Cubbage, F. W. 1983. Economics of forestry tract size: Theory and literature. USDA Forest Service Gen. Tech. Rpt. SO-41.

Cubbage, F. W. 1983. Measuring the physical effects of technical advice from service foresters. In: Non-industrial private forests: A review of economic and policy studies. Duke University, Durham N.C.

Cubbage, F. W. and J. E. Gunter. 1987. Conservation Reserves. Journal of Forestry 85(4):21-27.

Cubbage, F. W. and D. G. Hodges. 1985. Public and private forest management assistance programs available in Georgia. Final Report. University of Georgia School of Forest Resources, Athens, Ga.

Cubbage, F. W., T. M. Skinner, and C. D. Risbrudt. 1985. An economic evaluation of the Georgia Rural Assistance Program. University of Georgia Agric. Exp. Sta. Resour. Bull. 322.

Doolittle, L., and T. J. Straka. 1987. Regeneration following harvest on non-industrial private pine sites in the South: A diffusion of innovations perspective. Southern Journal of Applied Forestry 11(1):37-41.

Ellefson, P. V. and F. W. Cubbage. 1980. State forest practice laws and regulations: a review and case study for Minnesota. Univ. of Minnesota Ag. Exp. Station. Sta. Bul. #536.

Faulkner, C. R. 1980. How can state, federal, and private foresters help improve communications with woodlot owners? In: Town Meeting Forestry, Proceedings from SAF National Convention.

Fecso, R. S., H. F. Kaiser, J. P. Royer and M. Weidenhamer. 1982. Management practices and reforestation decisions for harvested southern pinelands. USDA Statistical Reporting Service Staff Report #AGES821230.

Friedman, Milton. 1962. Price Theory: A Provisional Text. Aldine Publishing Co. Chicago. p. 148-161.

Green, J. L., and K. A. Blatner. 1986. Identifying woodland owner characteristics associated with timber management. Forest Science 32(1):135-146.

Gray, J. L. 1978. The non-industrial private forest ownership "problem": a viewpoint. Journal of Forestry 78(8):466.

Gujarati, Damodar. 1978. Basic Econometrics. McGraw-Hill. New York.

Hodges, D. G., and F. W. Cubbage. 1986. Private forestry consultants: 1983 status and accomplishments in Georgia. Southern Journal of Applied Forestry 10(3):225-230.

Holemo, F. J. and E. E. Brown. 1975. A profile of the non-industrial forest landowner in Georgia's costal plain. Ga. For. Res. Pap. # 82. Ga. Forest Research Council.

Holley, D. L. and H. J. Green. 1981. Information needs of the forest landowner. In: Data and information needs conference proceedings. Duke University, Durham, N.C.

Hoyt, K. P., T. Young, and G. R. Wells. 1988. The TVA/ACF consulting forester assistance program. In: Proceedings of the 1988 Southern Forest Economists Workshop. Orlando, Fl.

Hubbard, W. G. and R. C. Abt. 1988. The effect of timber sale assistance on returns to landowners. In: Proceedings of the 1988 Southern Forest Economists Workshop. Orlando, Fl.

Kingsley, N. P. 1975. The forest-land owners of New Jersey. Resour. Bull. NE-39. Broomall, PA. USDA Forest Service. NE Forest Experiment Station.

Kingsley, N. P. 1976. The forest-land owners of southern New England. Resour. Bull. NE-41. Broomall, PA. USDA Forest Service. NE Forest Experiment Station.

Knight, Herbert A. 1984. An overview of the timber resource in the Southeast. In: Proceedings, Fall Meeting of Southeastern Technical Division, American Pulpwood Assoc.

Kronrad, G. D., and C. A. Albers. 1984. Factors affecting the business of consulting foresters. The Consultant 29(3):58-62.

Kurtz, W. B., R. J. Alig, and T. J. Mills. 1980. Retention and condition of ACP conifer plantings. Journal of Forestry 78(5):273-276.

Lawrence, G. D. 1985. Stumpage price expectations: An empirical analysis of non-industrial private landowners in the Mid-Atlantic states. Masters thesis VPI&SU.

Lewis, B. J. and P. V. Ellefson. 1983. Information for timber management and planning: an assessment of availability and adequacy in Minnesota. Univ. of Min. Ag Exp. Sta. Bull. 547.

Max, W. 1983. 1983. Landowner response to alternative tax policies in Santa Cruz County, California. IN: Nonindustrial Private Forests: A review of economic and policy studies. Jack P. Royer and Christopher D. Risbrudt, eds. Duke University, Durham, NC.

McMahon, R. O. 1964. Private nonindustrial ownership of forest land. Yale Univ. Sch. For. Bull. 68, New Haven, CT.

McWilliams, W. H. 1988. Status of privately owned harvested timberland in Mississippi, 1977-87. (Soon to be published).

McWilliams, W. H. and D. J. Skove. 1987. Status of privately owned harvested timberland in Texas, 1975-86. USDA Forest Service Res. Note SO-338.

McWilliams, W. H. and P. D. Frey. 1986. Status of privately owned harvested timberland in Louisiana, 1974-84. USFA Res. Note SO-329.

Meyer, Richard D. 1984. An analysis of longterm leasing and cutting contracts in the South. Masters thesis. VPI&SU, Blacksburg, Va.

Myers, Raymond H. 1986. Classical and Modern Regression with Applications. PWS Publishers, Boston.

Norris, F. 1987. Timber-Mart South. Highlands, N.C.

Rideout, Doug and John Hoff. 1987. Cost sharing in multiple use forestry: a game theoretic approach. Forest Science 33(1):81-88.

Risbrudt, C. D. and P. V. Ellefson. 1983. An economic evaluation of the 1979 forestry incentives program. University of Minnesota Agric. Exp. Station Bull. 550.

Romm, J., R. Tuazon, and C. Washburn. 1987. Relating forestry investment to the characteristics of NIPF owners in Northern California. Forest Science 33(1):197-209.

Rosson, J. F. Jr., and L. Doolittle. 1987. Profiles of mid-south non-industrial private forest owners. USDA Forest Service Res. Bull. SO 125.

Row, Clark. 1978. Economics of tract size in timber growing. Journal of Forestry 76(9):576-579,82.

Royer, J. P. 1987. Determinants of reforestation behavior among southern landowners. Forest Science 33(3):654-667.

Royer, J. P. 1986. Use and effects of the reforestation tax incentive and cost sharing in the South. School of Forestry and Environmental Studies. Duke Univ. Durham, N. C.

Royer, J. P. and F. J. Convery. 1981. Non-industrial private forests: data and information needs. Conference proceedings. Duke University, Durham, NC.

Royer, J. P. and H. F. Kaiser. 1985. Influence of professional foresters on pine regeneration in the South. Southern Journal of Applied Forestry 9(1):48-52.

Royer, J. P. and R. J. Moulton. 1987. Reforestation incentives: Tax incentives and cost sharing in the South. Journal of Forestry 85(8): 45-47.

Royer, J. P., and M. J. Vaseivich. 1987. Economic opportunities and landowner behavior: The responsivness of southern landowners to market incentives. Proceedings of SOFEW-MWFE Annual Meeting, Asheville, N.C.

Skinner, T. M., and F. W. Cubbage. 1985. A survey of industrial forest management assistance and leasing programs for nonindustrial private forests in Georgia. Univ. of Georgia College of Agric. Exp. Sta. Res. Rpt. 470.

Sedjo, R. A. 1983. The comparative economics of plantation forestry: a global assessment. Resources for the Future. Washington, D.C.

Sedjo, R. A. and D. M. Ostermeier. 1978. Policy alternatives for non-industrial private forests. Society of American Foresters and Resources for the Future. Washington, D.C.

Stevens, W. B., ed. 1985. A focused discussion of assistance and incentives for private forest owners. Proceedings of Minnesota Forest Products Industrial Development Council.

Straka, T. J., W. C. Anderson, and S. H. Bullard. 1986. An economic appraisal of service forester activities in Mississippi. Miss. Agric. and For. Exp. Sta. Mississippi State Univ. Tech. Bull. 137.

Straka, T. J., H. W. Wisdom, and J. E. Moak. 1984. Size of forest holding and investment behavior of nonindustrial private owners. Journal of Forestry 82(8):495-496.

Tarrant, R. F., R. A. Ewing, and D. R. Gedney. 1978. Forest survey and the non-industrial private ownership. Journal of Forestry 76(8):470-472.

Trokey, C. B. and W. B. Kurtz. 1982. Increasing timber management through a better understanding of nonindustrial private forest owners' motivations and objectives. The Consultant 27(3):57-59.

Turner, B. J., J. C. Finley, and N. P. Kingsley. 1977. How reliable are woodland owners intentions? Journal of Forestry 75(8):498-499.

U.S. Department of Agriculture. 1983. Conversion of southern cropland to southern pine tree plantings - conversion for conservation feasibility study. Office of Budget and Program Analysis. Washington D.C.

USDA Forest Service. 1980. Pine reforestation action plan for Southern forests. State and Private Forestry. SA-TP-10.

USDA Forest Service. 1981. Trends in commercial timberland area in the United States, by state and ownership, 1952-77, with projections to 2030. General Tech. Rpt. WO-31.

USDA Forest Service. 1982. An analysis of the timber situation in the United States by state and ownership, 1952-1977, with projections to 2030. USDA Forest Service For. Res. Rep. No. 23.

USDA Forest Service. 1983. Background paper on nonindustrial private forest lands, their management, and related public and private assistance. Office of Budget and Program Analysis. USDA.

USDA Forest Service. 1988. The South's Fourth Forest: Alternatives for the Future. Forest Resource Report No. 24. Washington D.C.

Wellman, J. D., E. G. Hawk, J. W. Roggenbuck, and G. J. Buhyoff. 1980. Mailed questionnaire surveys and the reluctant respondent: An empirical examination of differences between early and late respondents. Journal of Lesiure Research 12(2):164-172.

Widmann, R. H. and T. W. Birch. 1988. Forest-land owners of Vermont, 1983. USDA Forest Service Res. Bull. NE-102.

Young, R. A. and M. R. Reichenbach. 1987. Factors influencing the harvest intentions of NIPF owners. Forest Science 33(2):381-393.

Zivnuska, J. A. 1978. Two studies of private non-industrial forestlands - A critical review. Journal of Forestry 76(8):467-469.

Appendix A

Questionnaires

QUESTIONNAIRE
TECHNICAL ASSISTANCE FROM STATE FORESTERS

Name, title, and business address
of person completing questionnaire:

_____

_____

_____

_____

_____

Phone ( )

Date: _____

Return questionnaire to:

Michael D Skinner
Virginia Tech Dept. of Forestry
Rm. 310 Cheatham Hall
Blacksburg, Va. 24061

1) Referring to the sub-state zones on the attached map, how many acres were planted to pine in each zone during the 1985-86 planting season, on non-industrial private lands? (** Exclude if possible acreage under long-term lease to forest industry. Include acres hand planted, machine planted, or direct seeded. Include to the fullest extent possible planting carried out under assistance from your agency, under industry assistance, or by unassisted landowners.**)

Zone 1:_____ Zone 2:_____ Zone 3:_____

2) In your estimation, how many acres in each zone were reforested by natural methods after a timber harvest on NIPF lands during the 1985-86 season? (** Include only acres which received a seed tree or shelterwood treatment, or on which advanced regeneration was judged to be adequate to restock the stand. We recognize that these figures may be very difficult of ascertain. Note that we are more interested in determining how significant natural regeneration is, and in finding differences between zones and states. While precise figures are less important, please give the question some consideration, and estimate as closely as possible.**)

Zone 1: _____ Zone 2:_____ Zone 3:_____

3) What amount of public funds was spent, in thousands of dollars, through cost-share programs to assist NIPF's in aforesting or reforesting timberlands, during the 1985-86 planting season?

Program	Zone 1	Zone 2	Zone 3
FIP	_____	_____	_____
ACP	_____	_____	_____
State-funded program (if applicable)	_____	_____	_____

4) Is there a significant amount of unmet demand for cost-share funds in the three zones in your state? (i.e. would more funds be spent if available?) Yes or no:

Zone 1:_____ Zone 2:_____ Zone 3:_____

5) What is the most common result of this unmet demand? (Landowners fail to plant; plant anyway with own funds; remain on waiting list until funds available, etc.)

6) Please indicate the number of professional foresters employed by your agency stationed in each zone who have routine contact with NIPF owners. (Exclude supervisory personnel who have little or no direct contact with landowners.)

Zone 1:_____ Zone 2:_____ Zone 3:_____

7) Please indicate the number of non-professional forestry technicians stationed in each zone who have routine contact with NIPF owners, and who have a significant impact on forest management.

Zone 1:_____ Zone 2:_____ Zone 3:_____

8) We would welcome any further comments or suggestions you would care to make below or on the reverse side concerning NIPF tree planting performance and the impact of technical assistance. Please feel free to qualify in detail any answers you have given above.

QUESTIONNAIRE:
TECHNICAL ASSISTANCE FROM INDUSTRY LANDOWNER
ASSISTANCE PROGRAM FORESTERS

Name, title, and business address
of person completing questionnaire:

_____

_____

_____

_____

_____

Phone ( )

Please indicate whether your responses
for the southern states apply to:

_____ firm's entire southern operations

_____ one division (indicate in address)

Date: _____

Return questionnaire to:

Michael D. Skinner
Virginia Tech Dept. of Forestry
Rm. 310 Cheatham Hall
Blacksburg, Va. 24061

NOTE: This study deals with landowner assistance programs (LAPs) under which the landowner retains control of management decisions, and is assisted and advised by foresters. Lands under long-term lease to forest industry are excluded from this study. The study is based on the 1985 calender year. Please provide the information for your program as it was administered in 1985.

1) Was your company's landowner assistance program (LAP) administered in the field by foresters who were separate from your procurement staff (that is, foresters who had no direct wood procurement responsibility)? (Yes_____, No_____)

2) If not, did your procurement foresters offer management services to landowners which required a written agreement between the landowner and your company? (Yes_____, No_____)

IF THE ANSWER TO QUESTION 1 IS NO, PLEASE STOP HERE AND RETURN THE QUESTIONNAIRE TO THE ADDRESS GIVEN ON THE PREVIOUS PAGE.

3) Referring to the sub-state zones on the attached map, please indicate the number of LAP foresters in each zone who had routine contact with NIPF owners in 1985. (Exclude supervisory and management personnel who had little direct contact with landowners.) If a forester divided time between two or more zones, you may so indicate by using decimal numbers. For example, a forester spending 40% of the time in N.W. Georgia and 60% of the time in N. E. Alabama would be recorded as:

	ZONE 1	ZONE 2	ZONE 3
Alabama	0.6	—	—
Georgia	0.4	—	—

The total time for a given forester should add to 1.0. Please note that this question is asking for the portion of the total on-the-job time each forester spent in each zone, not the portion of time spent with landowners. That information is requested in a later question.

Indicate the number of foresters, if any, in each zone during 1985:

	ZONE 1	ZONE 2	ZONE 3
ALABAMA	_____	_____	_____
ARKANSAS	_____	_____	_____
FLORIDA	_____	_____	_____
GEORGIA	_____	_____	_____
LOUISIANA	_____	_____	_____
MISSISSIPPI	_____	_____	_____

3) continued	ZONE 1	ZONE 2	ZONE 3
NORTH CAROLINA	_____	_____	_____
OKLAHOMA	_____	_____	_____
SOUTH CAROLINA	_____	_____	_____
TENNESSEE	_____	_____	_____
TEXAS	_____	_____	_____
VIRGINIA	_____	_____	_____

4) Did your LAP foresters have other responsibilities besides assisting NIPFs (e.g. managing company lands)? (Yes _____, No _____). If so, what percent of their time was spent with NIPFs?

_____%

5) Please list the services offered under your LAP program in 1985:

6) Did your LAP program require a written agreement with the landowner? (Yes _____, No _____)

What was required of the landowner in terms of timber sales under the agreement?

7) How many landowners are currently enrolled in your LAP? _____

How many were enrolled in 1985? _____

8) Does your LAP have a minimum acreage requirement? (Yes _____, No ____)

Minimum = _____acres

9) In your estimation, what is the average tract size in your landowner assistance program?

_____ acres

10) Have there been any significant changes in your LAP since 1985 (additions or reductions in manpower, landowner requirements, etc.)? (Yes _____, No _____) Comments:

11) We would welcome any further comments or suggestions you would care to make on the reverse side concerning NIPF tree planting performance and the impact of technical assistance. Please feel free to qualify in detail any answer you have given above.

QUESTIONNAIRE:
TECHNICAL ASSISTANCE FROM
CONSULTING FORESTERS

Name, title, and business address
of person completing questionnaire:

_____

_____

_____

_____

_____

Phone ( )

Please indicate whether your responses
for the southern states apply to:

_____ your firm's entire southern operations

_____ one southern division (indicate in address)

Date: _____

Return questionnaire to:

Michael D. Skinner
Virginia Tech Dept. of Forestry
Rm. 310 Cheatham Hall
Blacksburg, Va. 24061

We would welcome any further comments or suggestions you would care to make on the back of this form concerning NIPF tree planting performance and the impact of technical assistance. Please feel free to qualify in detail any answer you have give below.

NOTE: This study deals with technical assistance available during the 1985 calendar year. Please provide information on your firm as it operated in 1985. If you are a sole proprietor, please complete the form with information on your own activities during 1985.

1) Referring to the sub-state zones on the attached map, please indicate the number of foresters, including proprietors, working for your firm in each zone who had routine contact with NIPF owners in 1985. (Exclude supervisory and management personnel who had little direct contact with landowners.) Please include only foresters who were employed full time in consulting or related activities. (Approx. 40 hours per week, all year.) If a forester divided time between two or more zones, you may so indicate by using decimal numbers. For example, a forester spending 40% of the time in N.W. Georgia and 60% of the time in N. E. Alabama would be recorded as:

	ZONE 1	ZONE 2	ZONE 3
Alabama	0.6	—	—
Georgia	0.4	—	—

This question is asking for the portion of the total on-the-job time each full-time forester spent in each zone. The total time for a given forester should add to 1.0.

Indicate the number of foresters, if any, in each zone during 1985:

	ZONE 1	ZONE 2	ZONE 3
ALABAMA	_____	_____	_____
ARKANSAS	_____	_____	_____
FLORIDA	_____	_____	_____
GEORGIA	_____	_____	_____
LOUISIANA	_____	_____	_____
MISSISSIPPI	_____	_____	_____
NORTH CAROLINA	_____	_____	_____
OKLAHOMA	_____	_____	_____
SOUTH CAROLINA	_____	_____	_____
TENNESSEE	_____	_____	_____
TEXAS	_____	_____	_____
VIRGINIA	_____	_____	_____

2) Did your firm offer other services besides forestry services? (For this study, real estate services and land surveying are not considered forestry services.) (Yes _____, No _____) If so, what percent of foresters' time was spent on non-forestry activities?

_____%

3) If you are a sole proprietor, did you work full time in your consulting business in 1985? (Yes _____, No _____) If not, approximately how many working days (8 hours = 1 working day) did you spend in your consulting business?

_____days

If part-time, in which zone above did you primarily work? Zone_____

4) Other than the proprietor, did your firm employ any foresters part-time in 1985? (Yes _____, No_____) Approximately how many days were worked by part-time foresters?

_____days

In which zone did part-time forester(s) primarily work? Zone_____.

5) Did your firm employ forestry technicians and other non-foresters who had routine contact with NIPFs during 1985? (Yes _____, No _____) If so, how many persons were employed, and in which zone did they primarily work?

persons:_____ Zone:_____

6) Did your firm routinely offer advice and recommendations concerning tree planting? (Yes ____, No ____) Operate tree planting crews and machinery as part of your services to land-owners? (Yes ____, No ____) Provide tree planting services to landowners through separate, subcontracted vendors? (Yes ____, No ____)

7) In your estimation, what was the average timberland acreage owned by your firm's NIPF clients in 1985?

_____ acres

8) Did your firm's foresters spend a significant amount of time with clients other than NIPFs (e.g. forest industry clients)? (Yes ____, No ____) If so, what percent of the average full-time forester's time was spent with such clients?

_____%

9) Have there been any significant changes in services offered by your firm since 1985? (Yes ____, No ____) Any increases or reductions in forester manpower? (Yes ____, No ____) Comments:

QUESTIONNAIRE
TECHNICAL ASSISTANCE FROM PROCUREMENT FORESTERS

Name, title, and business address
of person completing questionnaire:

_____

_____

_____

_____

_____

_____

Phone: ( )

Please indicate whether your responses
for the southern states apply to:

_____ firm's entire southern operations

_____ one division (indicate in address)

Date: _____

Return questionnaire to:

Michael D. Skinner
Virginia Tech Dept. of Forestry
Rm. 310 Cheatham Hall
Blacksburg, Va. 24061

We would welcome any questions or comments you would care to make on the back of this form concerning NIPF tree planting performance and the impact of forester contacts. Please feel free to qualify in detail any answers you give below.

NOTE: This study is based on the 1985 calender year. Please provide the information for your program as it was administered in 1985.

1) Referring to the sub-state zones on the attached map, please indicate the number of procurement foresters in each zone who had routine contact with NIPF owners in 1985. (Exclude supervisory and management personnel who had little or no direct contact with landowners.) If a forester divided time between two or more zones, you may so indicate by using decimal numbers. For example, a forester spending 40% of the time in N.W. Georgia and 60% in N.E. Alabama would be recorded as:

	ZONE 1	ZONE 2	ZONE 3
Alabama	0.6	—	—
Georgia	0.4	—	—

The total time for a given forester should add to 1.0. Please note that this question is asking for the portion of the total on-the-job time each forester spent in each zone, not the proportion of time spent with landowners. That information is requested in a later question.

Indicate the number of foresters, if any, in each zone during 1985:

	ZONE 1	ZONE 2	ZONE 3
ALABAMA	_____	_____	_____
ARKANSAS	_____	_____	_____
FLORIDA	_____	_____	_____
GEORGIA	_____	_____	_____
LOUISIANA	_____	_____	_____
MISSISSIPPI	_____	_____	_____
NORTH CAROLINA	_____	_____	_____
OKLAHOMA	_____	_____	_____
SOUTH CAROLINA	_____	_____	_____
TENNESSEE	_____	_____	_____
TEXAS	_____	_____	_____
VIRGINIA	_____	_____	_____

2) Did your procurement foresters routinely offer reforestation advice? (Yes___, No___) Refer landowners to consultants or government foresters? (Yes___, No___) Offer other technical assistance? (Yes___, No___) Please specify other assistance:

3) Was your policy concerning management assistance to landowners specific and written (e.g. part foresters' job descriptions) or just casually understood? Comment:

4) Did your procurement foresters offer management services to landowners which required a written agreement between a landowner and your company? (Yes____, No____)

IF THE ANSWER TO QUESTION 4 IS NO, GO DIRECTLY TO QUESTION 9. OTHERWISE CONTINUE ON TO QUESTION 5.

5) What was required of the landowner in terms of timber sales under the agreement mentioned in question 4?

6) Was there a minimum acreage requirement under this program? (Yes ____, No ____)

minimum = _____acres

7) In your estimation, what was the average tract size in this assistance program?

_____acres

8) How many signed management agreements did your company have with landowners in 1985 which were administered by your procurement staff?

_____

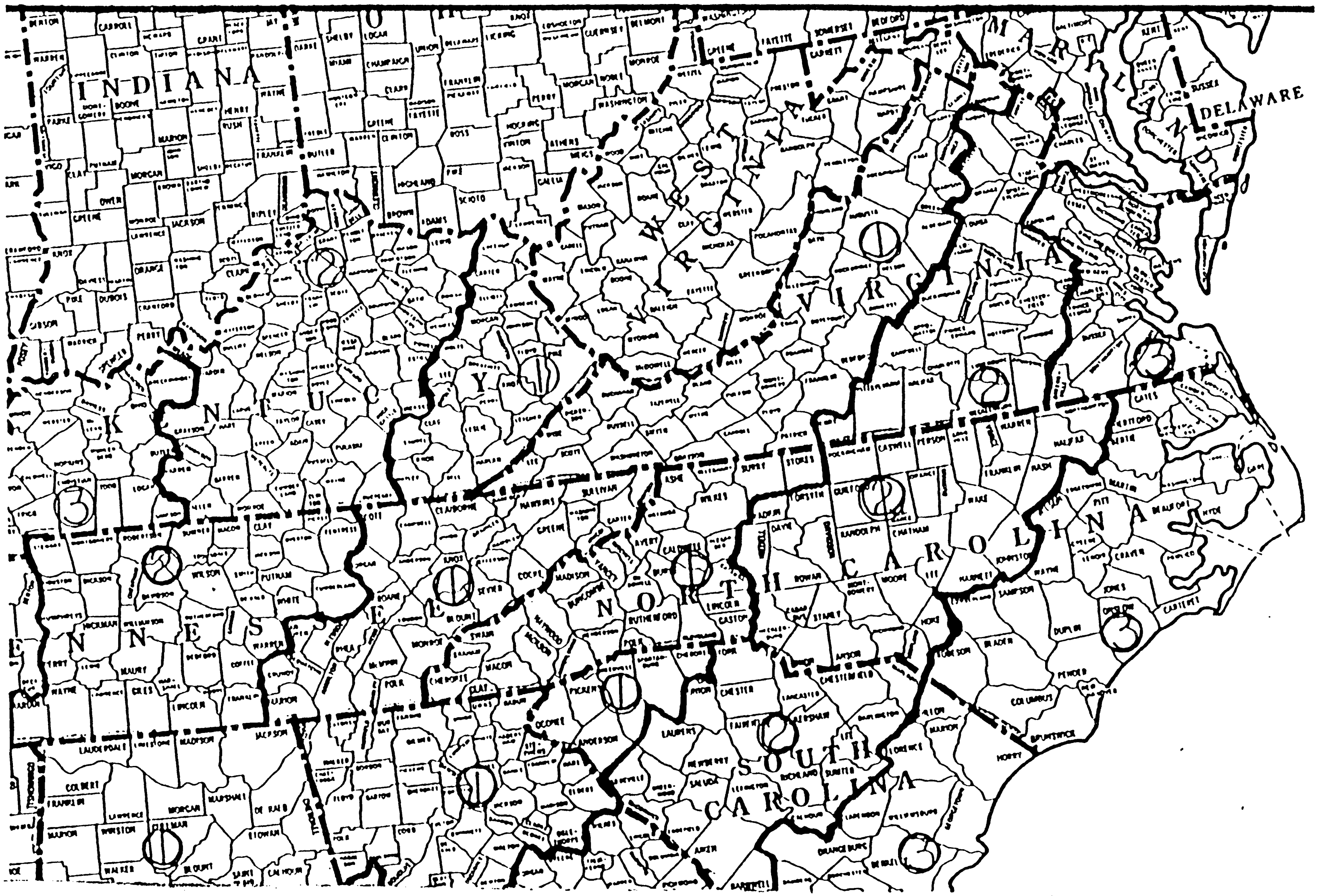
How many do you currently have? _____

9) In your estimation, what proportion of each forester's time (based on a forty hour week) was spent with landowners (walking timber boundaries, negotiating timber purchases, etc.)?

_____%

10) Does your company, through a division or program other than procurement, offer technical assistance to landowners? (Yes___, No___)
Was such a program offered in 1985? (Yes___, No___)

If the answer to either part of question 10 is yes, please provide the name and address of the person who could provide us with more detailed information on such programs.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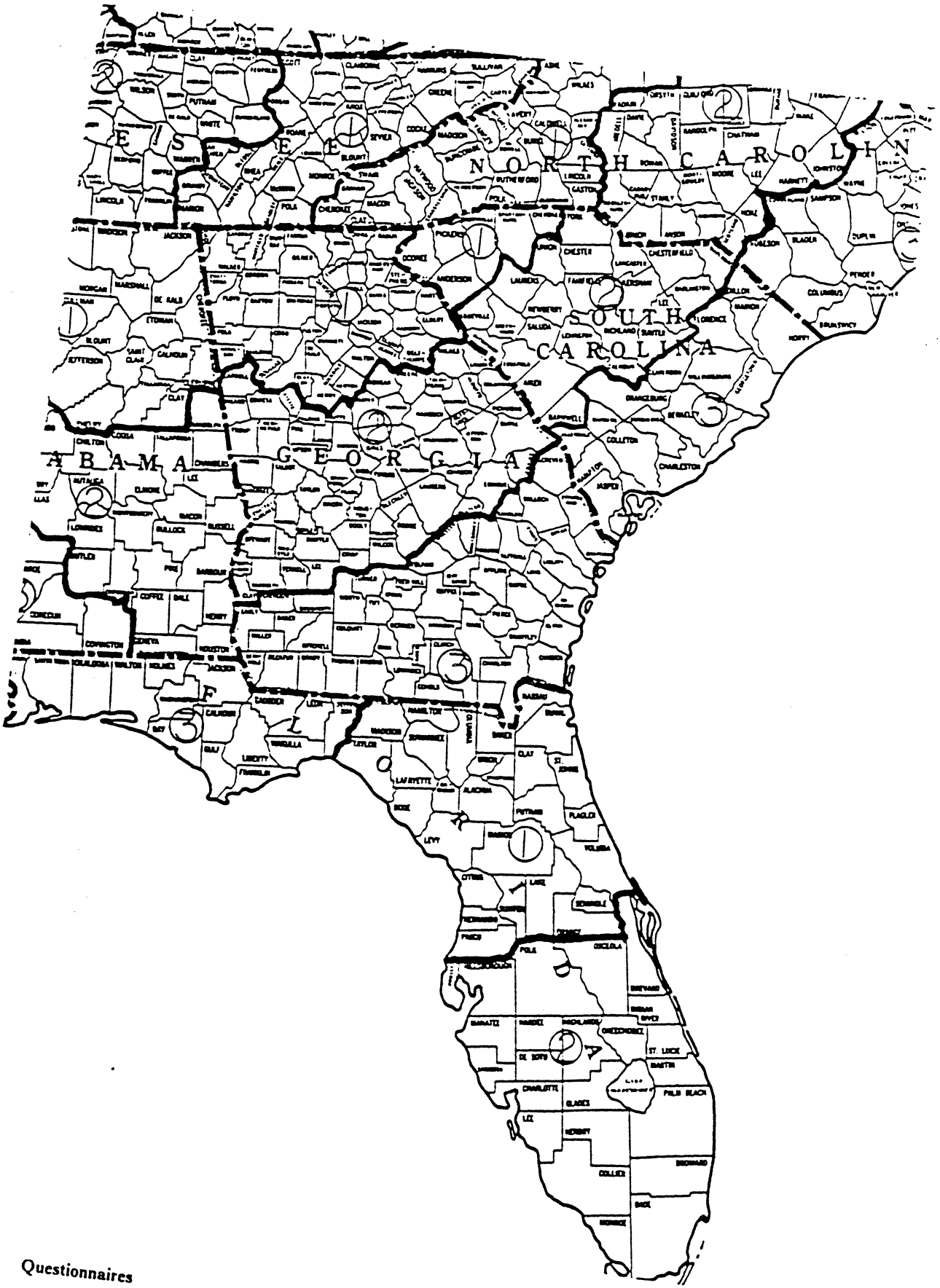
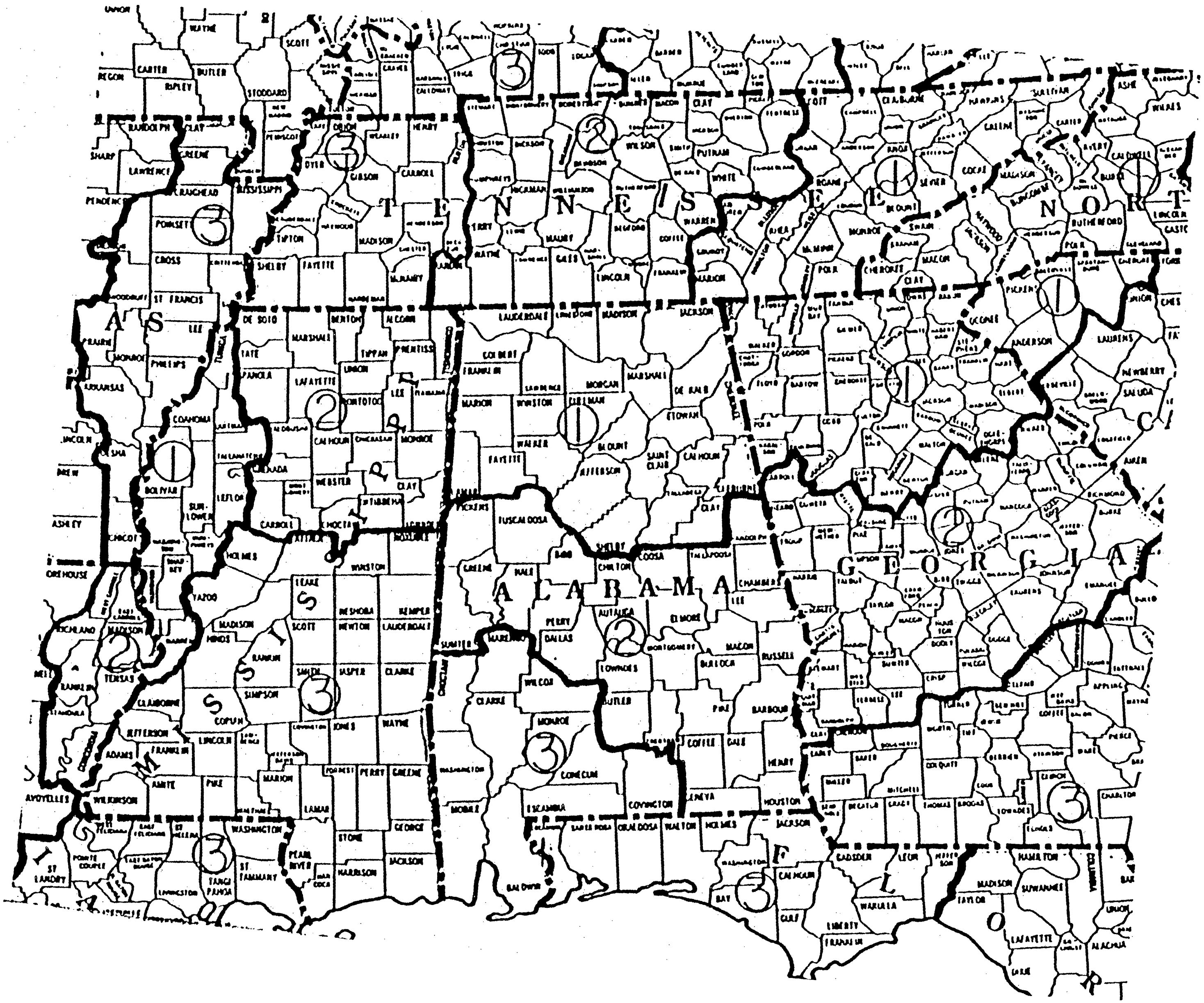
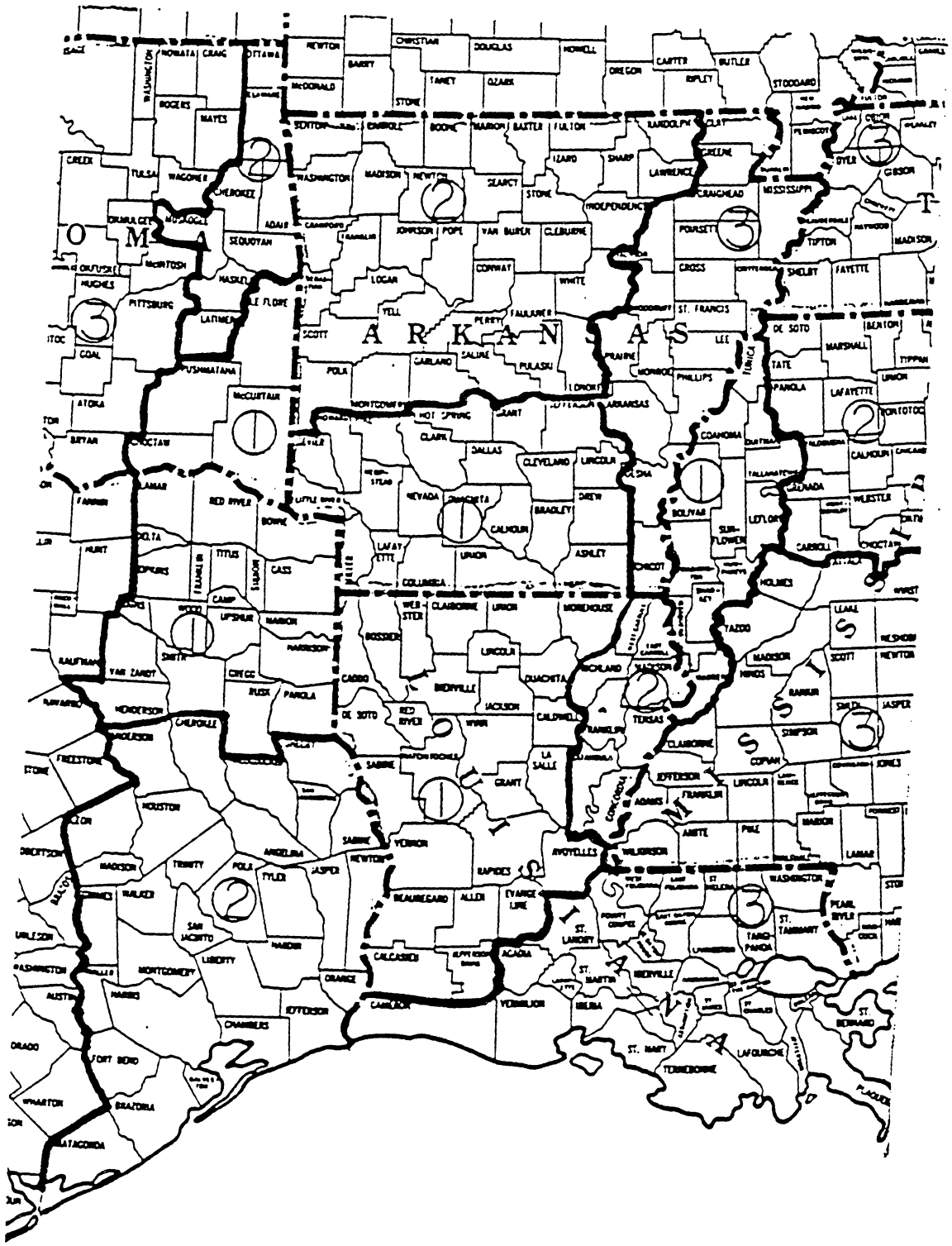
DELAWARE
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA



Questionnaires

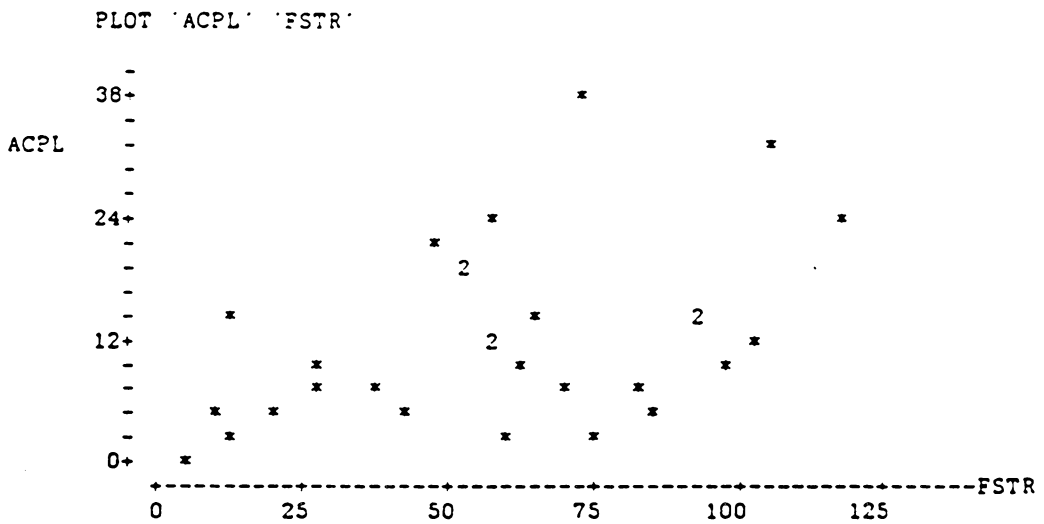

T E N N E S S E E
NORT
A S
ALABAMA
GEORGIA
F L O R
MISSISSIPPI
TUSCALOOSA
JEFFERSON
MONROE
CONECUH
ESCAMBIA
COVINGTON
BALDWIN
MOBILE
WASHINGTON
CLARKE
LOWNDES
DALLAS
AUTAUGA
ELMORE
CHILTON
SHELBY
MARENGO
WILCOX
BUTLER
PIKE
COFFEE
DALE
HENRY
HOUSTON
GENEVA
BARBOUR
BULLOCK
MACON
RUSSELL
LEE
CHAMBERS
TALLAPOOSA
COOSA
CLAY
CALHOUN
ETOWAH
BLOUNT
CULLMAN
WINSTON
MARION
WALKER
FAYETTE
PICKENS
GREENE
SUMTER
MORGAN
MARSHALL
DE KALB
JACKSON
MADISON
LAUDERDALE
COLBERT
LEAKE
NESHOBA
KEMPER
SCOTT
NEWTON
LAUDERDALE
SMITH
JASPER
CLARKE
SIMPSON
COPIAH
JONES
WAYNE
LINCOLN
FRANKLIN
ADAMS
AMITE
PIKE
MARION
LAMAR
FORREST
PERRY
GREENE
STONE
GEORGE
HARRISON
JACKSON
PEARL RIVER
HINDS
YAZOO
HOLMES
CARROLL
ATTALA
WINSTON
CHOCTAW
WEBSTER
CLAY
CALHOUN
MONROE
LAFAYETTE
PANOLA
TATE
DE SOTO
MARSHALL
BENTON
TIPPAH
UNION
PONTOTOC
LEE
PRENTISS
ALCORN
BOLIVAR
COAHOMA
SUNFLOWER
LEFLORE
TUNICA
SHELBY
FAYETTE
TIPTON
HARDEMAN
MADISON
GIBSON
CARROLL
HENRY
OBION
DYER
CROSS
POINSETT
ST FRANCIS
LEE
PHILLIPS
ARKANSAS
CRAIGHEAD
GREENE
LAWRENCE
RANDOLPH
CLAY
SHARP
CARTER
BUTLER
RIPLEY
STODDARD
WAYNE
SCOTT
CHICOT
ASHLEY
MONROE
WILSON
PUTNAM
WHITE
WARREN
COFFEE
LINCOLN
MAURY
GILES
PERRY
WAYNE
HICKMAN
CLAY
CLAIBORNE
SULLIVAN
BLOUNT
MONROE
POLK
MEIGS
RHEA
COCKE
SEVIER
CHEROKEE
MACON
CLAY
PICKENS
OCONEE
ANDERSON
LAURENS
NEWBERRY
SALUDA
UNION
AIKEN
RUTHERFORD
POLK
BUNCOMBE
HAYWOOD
MADISON
YANCEY
AVERY
CALDWELL
BURKE
LINCOLN
GASTON
WILKES
ASHE
FLOYD
GORDON
BARTOW
COBB
POLK
HARALSON
CARROLL
TROUP
MERIWETHER
UPSON
TALBOT
SUMTER
DOOLY
CRISP
TURNER
TIFT
WORTH
DOUGHERTY
MITCHELL
COLQUITT
DECATUR
GRADY
THOMAS
BROOKS
LOWNDES
ECHOLS
CLINCH
CHARLTON
WARE
APPLING
TATTNALL
EMANUEL
LAURENS
JOHNSON
PIERCE
GADSDEN
LEON
JEFFERSON
MADISON
HAMILTON
COLUMBIA
SUWANNEE
TAYLOR
LAFAYETTE
ALACHUA
UNION
WAKULLA
LIBERTY
FRANKLIN
GULF
BAY
CALHOUN
WASHINGTON
JACKSON
HOLMES
WALTON
OKALOOSA
SANTA ROSA
ESCAMBIA
ST TAMMANY
TANGIPAHOA
WASHINGTON
LIVINGSTON
ST HELENA
WILKINSON
AVOYELLES
ST LANDRY
POINTE COUPEE
TENSAS
MADISON
RICHLAND
FRANKLIN
CONCORDIA
CATAHOULA
OUACHITA
MOREHOUSE
ASHLEY
DREW
LINCOLN
DESHA
PRAIRIE
WOODRUFF
INDEPENDENCE
1
2
3



Questionnaires

Appendix B

Two-variable Scatter Plots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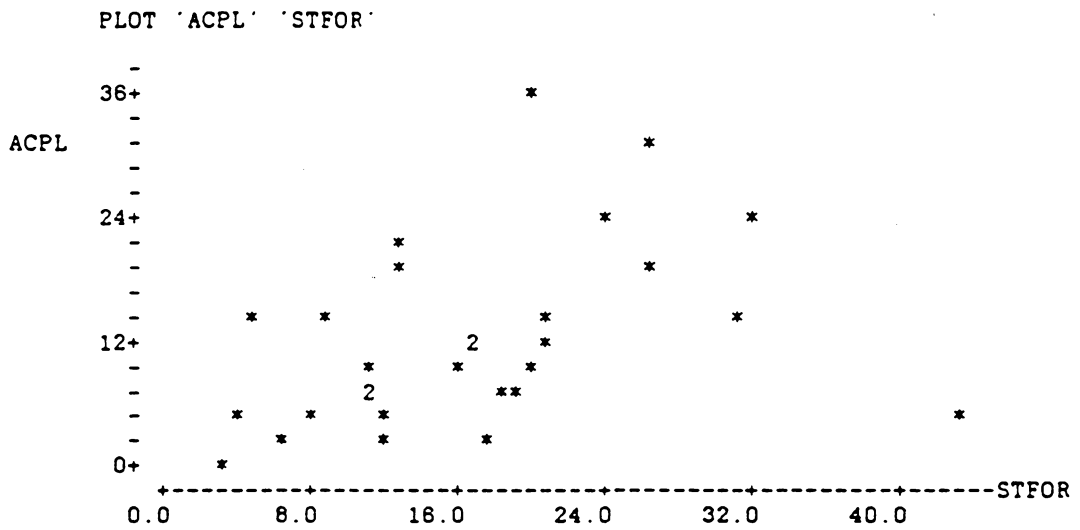
38+
24+
12+
0+
2
2
2
+----------+----------+----------+----------+----------+----------FSTR
0
25
50
75
100
125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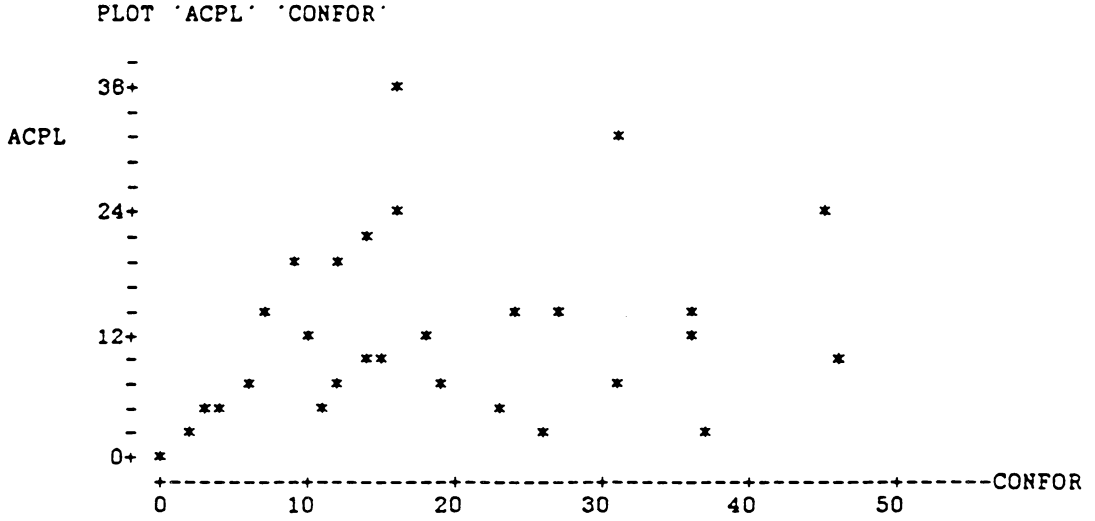
8.0
16.0
24.0
32.0
40.0
STFOR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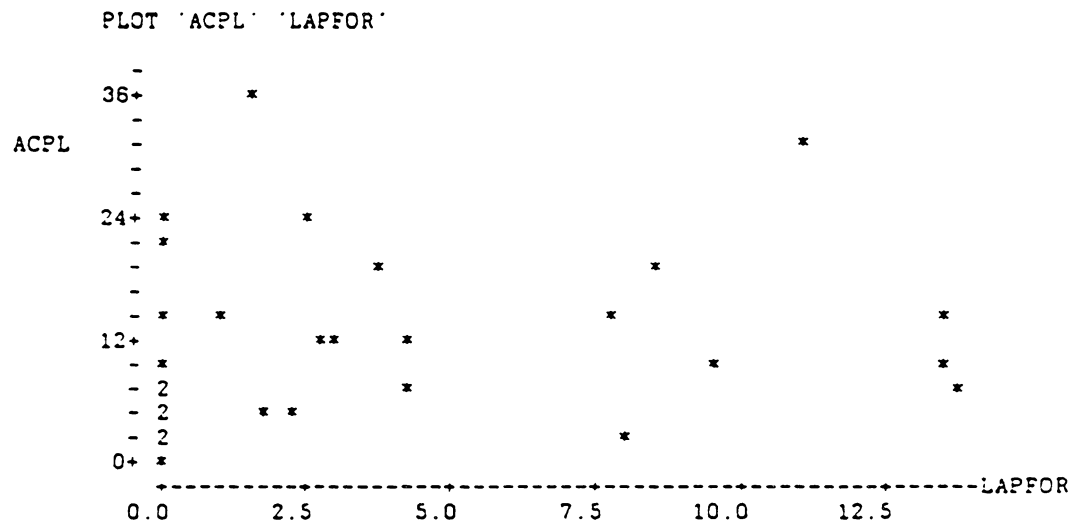
12+
0+
0
10
20
30
40
50
CONFOR


PLOT 'ACPL' 'LAPFOR'
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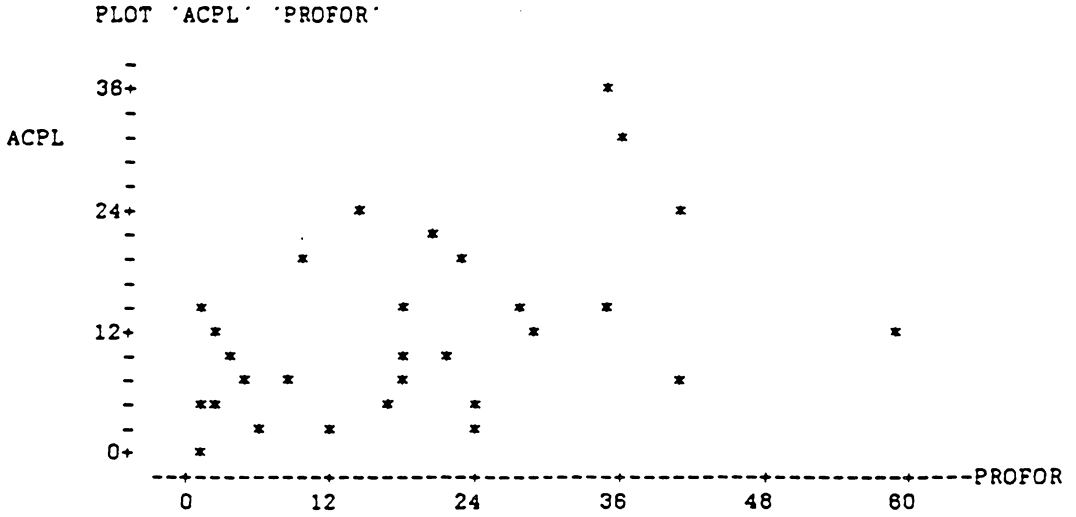
24+
12+
0+
0.0
2.5
5.0
7.5
10.0
12.5
LAPFOR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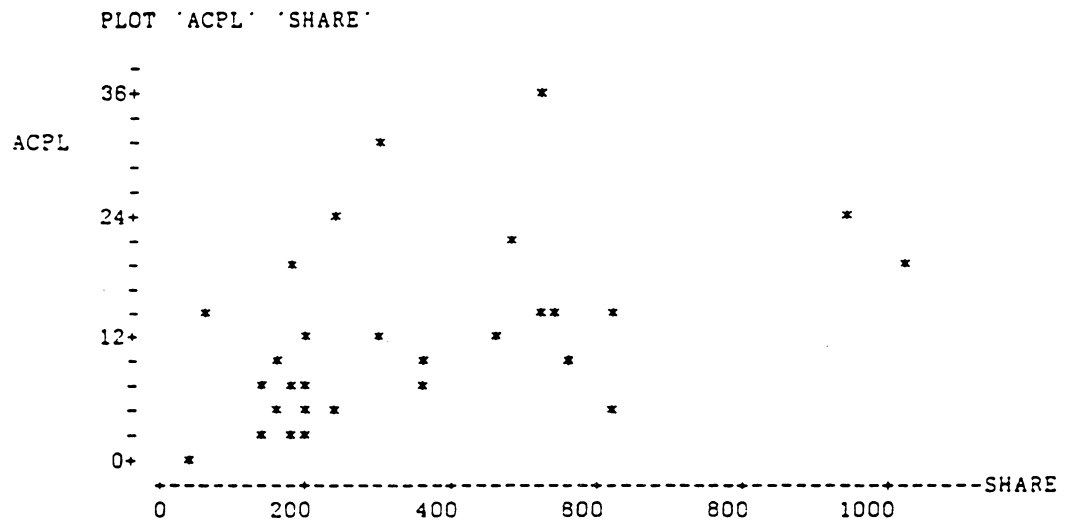
24+
12+
0+
0
12
24
36
48
60
PROFOR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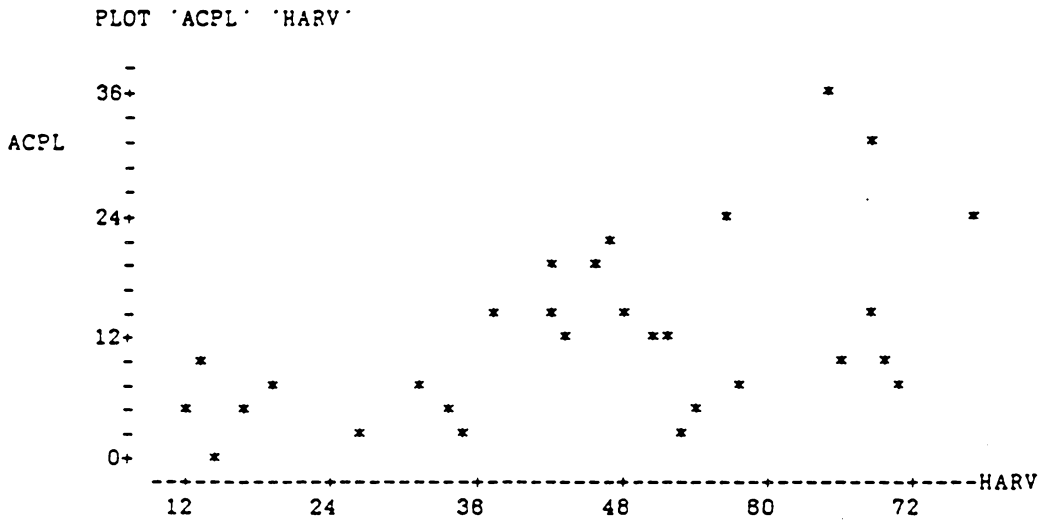
24+
12+
0+
0
200
400
600
800
1000
SHARE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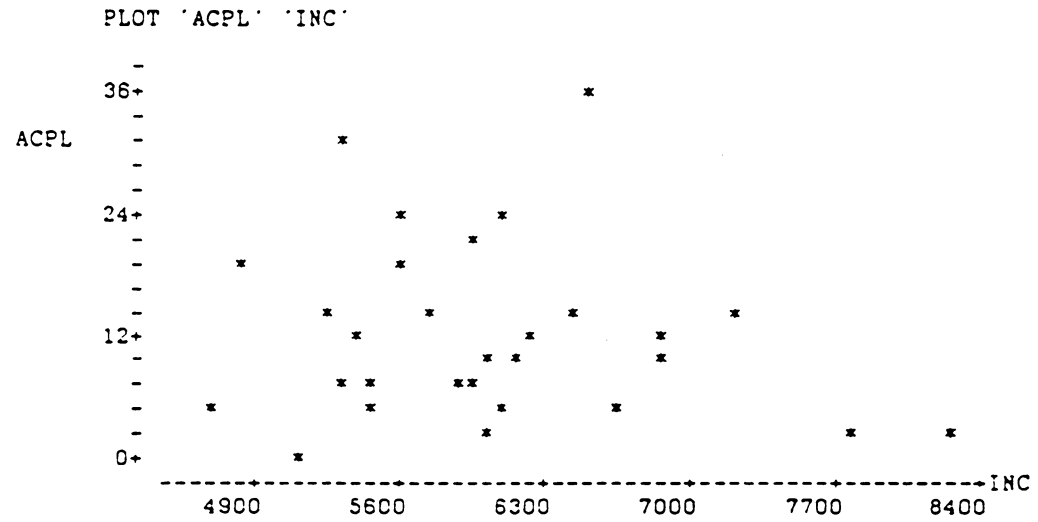
24+
12+
0+
12
24
36
48
60
72
HARV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12+
0+
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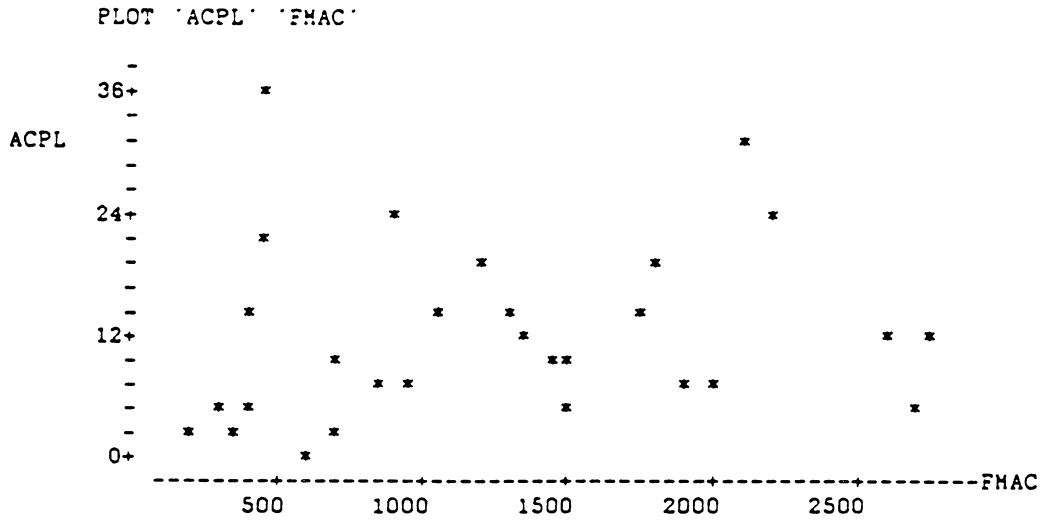
5600
6300
7000
7700
8400
INC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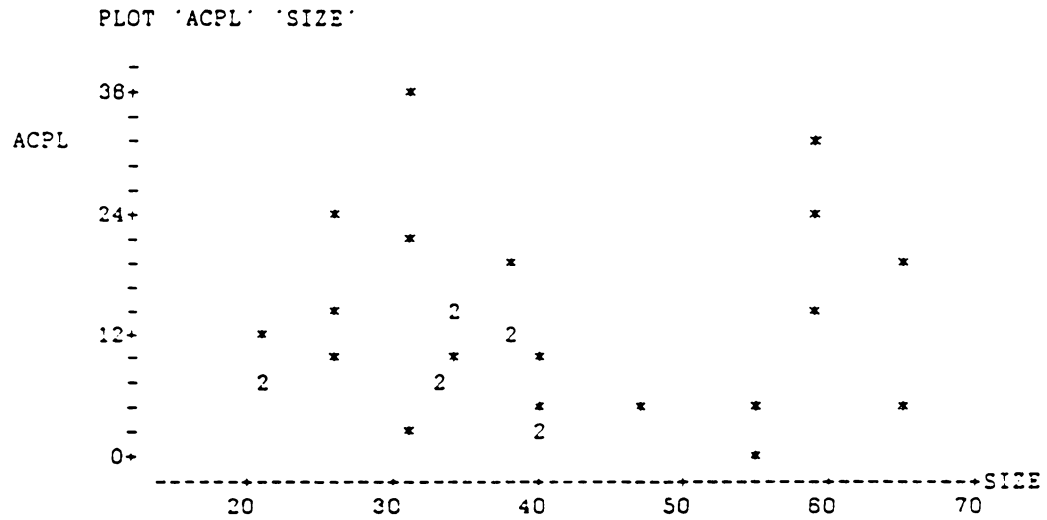
24+
12+
0+
500
1000
1500
2000
2500
FMAC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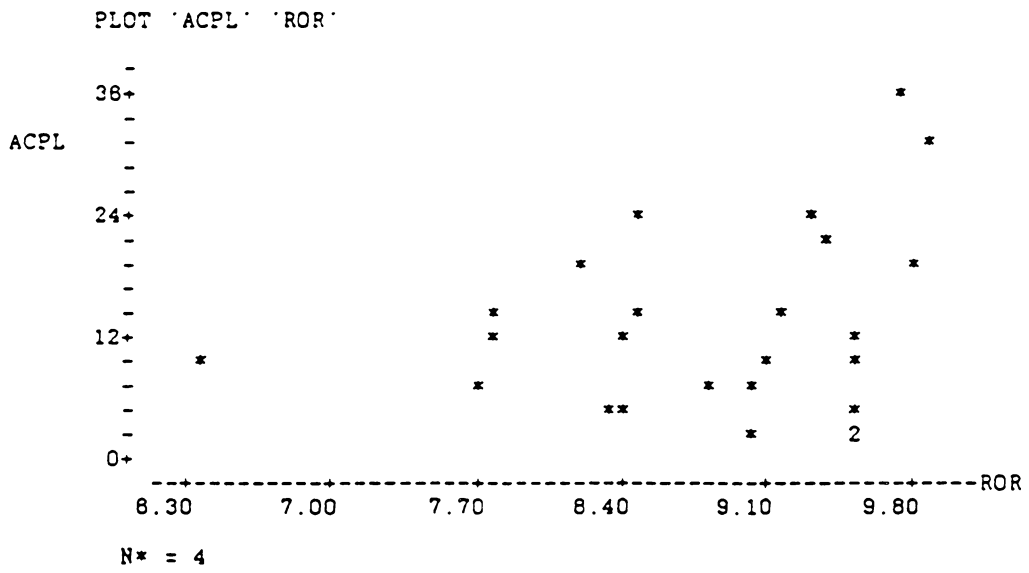
0+
20
30
40
50
60
70
SIZE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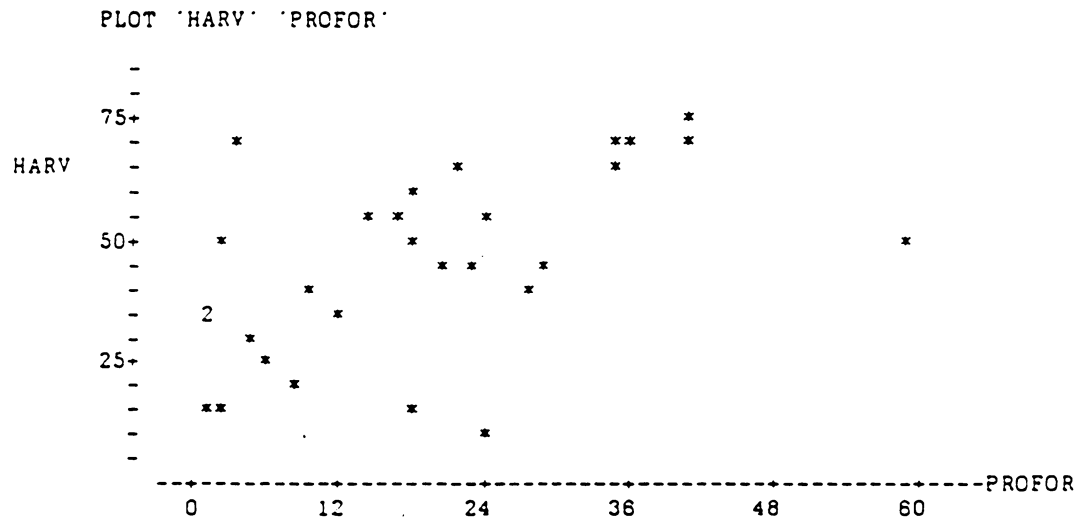
24+
12+
0+
6.30
7.00
7.70
8.40
9.10
9.80
ROR
N* = 4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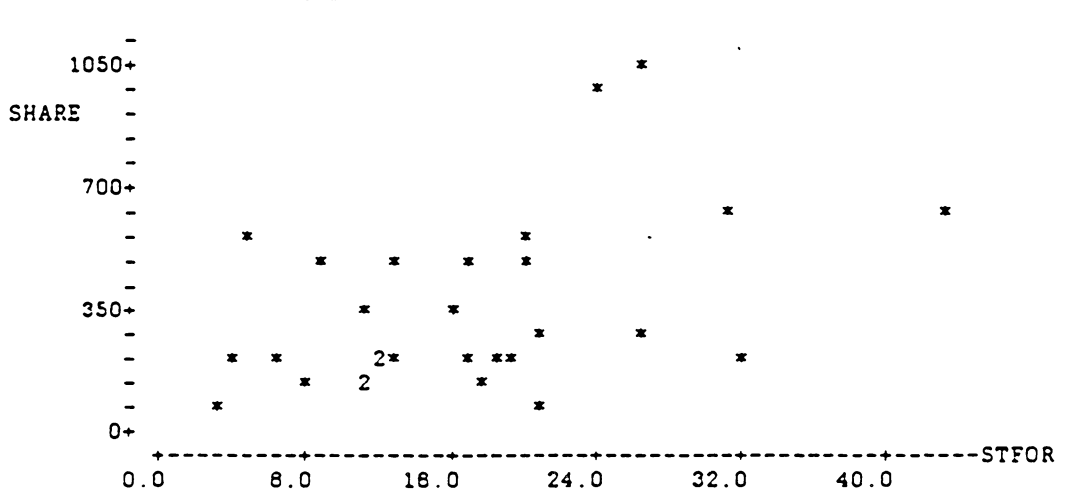
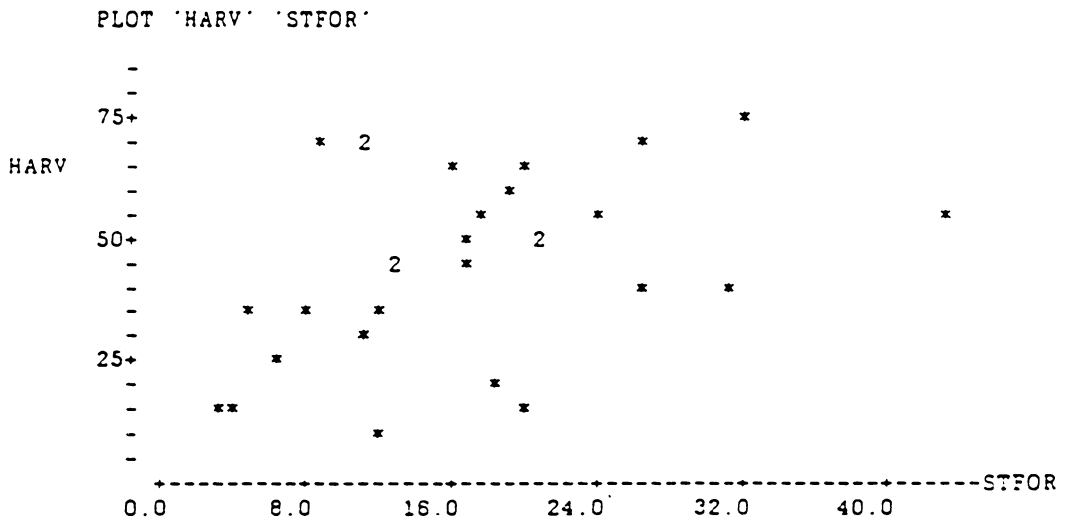
HARV
75+
50+
25+
2
0
12
24
36
48
60
PROFOR


PLOT 'SHARE' 'STFOR'
SHARE
1050+
700+
350+
0+
2
0.0
8.0
16.0
24.0
32.0
40.0
STFOR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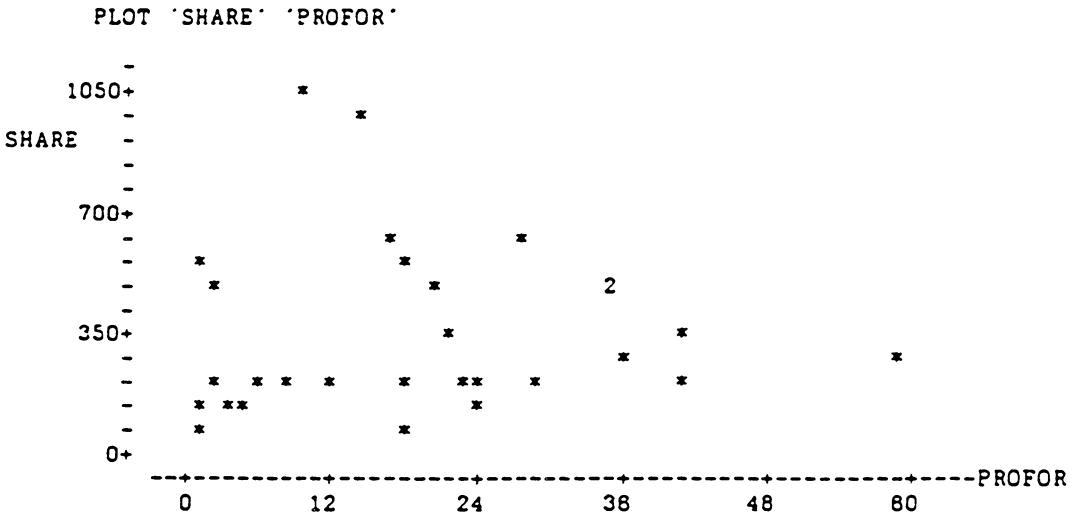
STFOR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12
24
36
48
60
PROFOR

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