To the Graduate Council:

I am submitting herewith a thesis written by Cynthia Greenlee Hart entitled "Adoption of No-Tillage Agriculture by Farmers Attending West Tennessee Field Days in 1982." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

Frank Leuthold

Frank Leuthold, Major Professor

We have read this thesis
and recommend its acceptance:

Charles L. Oldland

Robert Keller

Accepted for the Council:

Lew Minkel

The Graduate School

ADOPTION OF NO-TILLAGE AGRICULTURE BY FARMERS ATTENDING WEST TENNESSEE FIELD DAYS IN 1982

A Thesis

Presented for the

Master of Science

Degree

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Cynthia Greenlee Hart

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To:

My husband Willie for his encouragement throughout my graduate program.

My grandmother Mrs. Rosalee Greenlee for her support and faith in me.

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ABSTRACT

A study was conducted to examine the relationship between use of no-till planting and farmers' perception of advantages and disadvantages associated with no-tillage agriculture. Analysis was based on data collected from farmers who attended one of the three West Tennessee Agricultural field days held in 1982. A total of 509 farmers (primary occupation) participated in the survey. One hundred and fifty-six of the farmers had never used no-till, fifty-four farmers had discontinued no-till use, seventy-six farmers were using no-till for the first time in 1982, and two hundred and twenty-three farmers had used no-till for two or more years and were termed continued users.

Analysis indicated that for the farmers surveyed there was a relationship between their perceptions of the attributes of no-tillage agriculture and their no-till use. Most farmers, regardless of no-till use, appeared to believe that major conservation benefits result with no-till use. Reduced soil erosion and conservation of future soil productivity were the items most frequently rated as major no-till advantages. However, other advantages and disadvantages appeared to have more potential to influence use of no-till practices. Weed and grass control problems appeared to be the most serious disadvantage associated with no-till use.

Personal experience with no-till use appeared to have the most influence on how farmers perceive the attributes of no-tillage agriculture. Continued users of no-till gave the highest ratings to

advantages and the lowest ratings to no-till disadvantages, while discontinued users gave the highest ratings to disadvantages and lowest ratings to advantages. Ratings given by first-year users and never users were very similar with never users rating the advantages only slightly lower in importance than first-year users.

Although no-till agriculture has traditionally been promoted as a means of controlling soil erosion, this study indicates that educational programs seeking to increase no-till use should direct their primary efforts at assisting farmers to minimize the difficulties associated with no-till use.

Preventive types of innovations have traditionally experienced a slow rate of adoption. Analysis of data confirmed this for the farmers surveyed. Also, no-till use was in the decision and implementation states of adoption rather than in the confirmation stage. Only 19 of 223 farmers surveyed who had continued use reported planting all their suitable acreage using no-till in 1982. Analysis also indicated that the number of farmers using no-till and the acres planted in first use has increased over time. Further, a small but statistically significant relationship occurred between size of farm operation and no-till use. Double-crop soybeans and wheat appeared to be where the greatest acceptance has occurred.

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CHAPTER I

INTRODUCTION

Background and Problem Situation

Historically, farmers have strived to increase their wealth through increased crop production. The responsibility for current high crop production can be attributed to the development and adoption of new technology. Much of the technical development has concerned tillage of the soil. For centuries, man tilled the soil by hand with a wooden plow. The cast iron plow was then replaced by the steel plow in the 1840's. Since that time a vast amount of new tillage machinery has been introduced to the farmer. The result of the new technical developments was greater production and an idea that it was necessary to have extensive tillage of the soil to prepare the soil for planting and to control weeds. The tremendous growth in the world population along with accelerated industrialization created an increasing demand for agricultural products. Industrialization reduced the labor available for farm production. The result of these factors was that agriculture became mechanized and capital intensive.

The substitution of tillage machinery for human and animal labor created a problem--accelerating soil erosion. Years of plowing, pulverizing, smoothing, and leveling of the soil left the soil susceptible to wind and water erosion. Conventional methods of cultivation are especially harmful to sloping crop land with a thin layer of fertile

topsoil covering infertile subsoil. Over the years, the productivity of the soil gradually decreases causing reduced crop yields, higher production costs, and ultimately lower land values (Shelton, et al., 1983). Evidence of erosion includes soil crusting, gullies, decreased water retention, and poorer crop yields.

It took the devastating dust bowls and floods of the 1920's and 1930's for soil conservation to become a major public concern. The formation of the Soil Conservation Service in the United States in 1935 was the first significant national government action to deal with soil erosion. Not all soil erosion is so apparent as during "dust bowls" and floods. In 1977, after 40 years of policy for controlling soil erosion, an estimated 23.5 percent of the 413 million acres of cropland in the United States had erosion rates of 5 tons or more per acre per year (USDA, 1980). This same land accounted for 51 percent of all sheet and rill erosion.

Two major problems are linked to erosion and are associated with conventional tillage methods--environment hazards and high energy cost. Soil erosion not only decreases crop productivity, it is an environmental hazard. Water and soil sediment leaving cropland contributes a significant amount of chemicals, pesticides, heavy metals, and easily oxidizable organics into streams, lakes, and reservoirs (Bailey and Waddell, 1979). The high energy costs of operating tractors, tillage machinery, and fertilizer has made agriculture a very energy-dependent industry. It is estimated that the amount of energy expended on tillage in the United States each year is equivalent to

the energy required to build an interstate highway from New York to Los Angeles (Choi and Coughenour, 1979).

Due to the disadvantages associated with conventional tillage practices, no-tillage farming has received considerable attention since the 1950's. No-tillage is a system where crops are planted in an unplowed field by opening a narrow slot, trench, or band to a sufficient width and depth to obtain proper placement and coverage of the seeds for germination. Fertilizers and soil conditioners are applied directly to the soil surface. Pesticides and herbicides control unwanted insects and vegetation. The elimination of plowing and disking reduces energy inputs and soil erosion.

Government agencies have spent billions of dollars on the promotion, implementation, and maintenance of conservation practices through educational, technical, and cost-sharing programs. Despite expenditures of $311 million in 1981 there is little evidence that soil loss has been curtailed (McConnell, 1983). Approximately 23 percent of the United States cropland suffers from annual erosion rates in excess of five tons per acre (USDA, 1981).

A number of technologies have been promoted to curtail soil erosion. Contour tillage and terraces require cultivation across the slope of the land to reduce erosion. Erosion can be reduced by 50 percent or more depending on the slope of the land (Hunter, 1981; Behn, 1982). However, contouring and terraces generally increase fuel and labor requirements because of shorter rows which increase machinery turning time (Bradley, 1977; Behn, 1982; Shelton, et al., 1983).

Diversions, grassed waterways, and sediment basins which can be used in addition to contouring and terraces to reduce erosion may also increase fuel and labor requirements. Large machinery size also discourages the use of these conservation practices because long straight rows are more efficient (Shelton, et al., 1983).

While contour tillage and terraces can reduce erosion by 50 percent or more, studies have shown that no-tillage agriculture can reduce soil erosion to a much greater extent. McGregor, et al. (1975) found that on highly erodible soil in Mississippi erosion was reduced from 17.5 metric tons per hectare to approximately 1.8 tons per hectare. Langdale, et al. (1978) found that the use of no-till reduced soil losses from 40 tons per hectare to approximately 0.2 ton per hectare on Georgia soil with a 6 percent slope under simulated rainfall.

The advantages and disadvantages of no-tillage agriculture have been identified (Phillips, et al., 1980; Choi and Coughenour, 1979; Burns and Ashburn, 1979). The major advantages were identified as a) soil erosion caused by wind and water is reduced; b) the acreage of land that can be safely farmed for row crops can be increased by including sloping land that could not be conventionally tilled; c) energy requirements are reduced; d) time required for planting and harvesting is reduced; e) labor and capital cost are reduced; f) water infiltration is greater, and evaporation is reduced; and g) crop yields are apt to be greater during a dry growing season. The major disadvantages were identified as a) insect and disease damage may be increased because mulch and stubble provide a better habitat; b) greater management ability is required; c) mulching can cause lower soil

temperature causing a delay of spring planting; d) Johnson grass is more difficult to control; and e) crop yields may not be increased during a wet growing season. Yet despite government promotion and the ability of no-till to largely eliminate soil erosion, to reduce fuel consumption, and to reduce labor requirements, the adoption of no-till has been relatively slow, and soil erosion continues to be a major economic and social problem.

There are numerous explanations why farmers fail to adopt conservation methods, especially no-tillage agriculture. Possible variables include inadequate information, lack of incentives, and farmers' attitudes toward change and risk, etc. However, there is inadequate information on why farmers adopt or reject no-tillage agriculture. Knowledge gained from research in this area could be valuable in making future conservation policy. Greater knowledge of farmers' usage patterns, including non-use, discontinuance, and modified usage, and full use, along with the reasons and factors associated with these usage patterns should aid in efforts to increase utilization on no-tillage agriculture.

Objectives

In the summer of 1982, a survey was undertaken with farmers attending the three West Tennessee Agricultural Experiment Station Field Days held at Jackson, Milan, and Ames Plantation. The primary objectives of this research are as follows:

1. To establish a range of no-till usage patterns in West Tennessee.

2. To make an assessment of past and present use of no-tillage agriculture.
3. To assess the use of no-tillage agriculture based on farmers' attitudes about the advantages and disadvantages of no-tillage agriculture.
4. To assess which advantages and which disadvantages have the greatest impact on the usage of no-till.

CHAPTER II

REVIEW OF SELECTED LITERATURE

The roots of adoption/diffusion research can be traced to work done by anthropologists in the early twentieth century (Katz, et al., 1963; Rogers, 1983). In the 1920's and 1930's sociologists also developed an interest in diffusion research. J. C. van Es (1983) attributes the diffusion research tradition to theoreticians like Ogburn (1922) with methodological contributions from Chapin (1928), Likert (1932), and Guttman (1944). Rogers (1983) traced the intellectual roots to work by a French sociologist, Gabriel Tarde (1903), in the late 1920's through the early 1940's. Tarde was among the first to suggest that adoption of an innovation follows a normal, S-shaped distribution over time. Research in diffusion has also experienced contributions from education, communication, medical sociology, marketing, and other traditions (Rogers, 1983). The dominant research tradition however has been rural sociology (Rogers, 1983). Since the 1920's, the United States Department of Agriculture has conducted a series of studies by state extension services on adoption and diffusion of recommended agricultural practices (Rogers, 1983). The rural sociology research tradition viewed the farmer as an actor responding to stimuli concerning what was unquestionably viewed as improved agricultural technology (van Es, 1983).

Adoption and Diffusion in Agriculture

Diffusion of agricultural technology is of long-standing concern. The establishment of the Land-Grant Colleges and Universities in 1862, the Agriculture Experiment Stations in 1887, and the Agriculture Extension Service in 1914 were government efforts to educate and inform farmers about current agricultural problems and innovations. As development of new technology and communication of new ideas increased, concern arose over why a certain technology was adopted or rejected. There was also concern with what technique would be most effective in getting farmers to accept change and to adopt new ideas.

The earliest work on the adoption of agricultural innovations concentrated on communication channels which influenced the acceptance of hybrid seed corn (Ryan and Gross, 1943). Ryan and Gross distinguished between diffusion agents who were sources of information and those agents who were sources of influence in the adoption of the new corn. Mass media channels were the most important during the awareness stage of the diffusion process. Neighbors and farmers whose opinions were considered valuable were most important in the acceptance of a new idea.

In 1952, four major areas were identified for concentration of study by an Ad Hoc Subcommittee of the Rural Sociology Society. The areas included: 1) the differential acceptance of farm practices as a function of the social-cultural system; 2) the differential acceptance of farm practices as a function of status, role, and motivation;

3) diffusion as a study of cultural change; and 4) diffusion as a function of communication of information.

The committee also postulated five stages in the innovative decision making process. The stages were: 1) Awareness Stage, when the individual learns of the existence of the new idea, but lacks information; 2) Interest Stage, when the individual seeks information about the new idea; 3) Evaluation Stage, when the individual mentally applied the new idea to his present and anticipated future situation and decides whether or not to try the new idea; 4) Trial Stage, when the individual actually tries the new idea on a small scale to personally test it; and 5) Adoption Stage, when the individual uses the idea continuously on a full scale.

Conceptually, most researchers agree on these five stages as representative of the Innovation-Decision Making Process. However, the number of stages is open to debate. In 1943, Ryan and Gross developed a four-stage model. Wilkening (1956) used a three-stage model. Beal and Bohlen (1975) and Copp, et al. (1948) developed models with five stages.

The process of diffusion can be characterized as 1) acceptance, 2) over time, 3) of some specific item--an idea or practice, 4) by individuals, groups or other adopting units, linked a) to specific channels of communication, b) to a social structure, and c) to a given system of values, or culture (Katz, et al., 1963).

Rogers (1983) has modified the stages of the Innovation-Decision Making Process. The Rogers Model is summarized as follows:

1) Knowledge, the individual has exposure to and understanding of the innovation or new technical development; 2) Persuasion, the individual forms a favorable or unfavorable attitude toward the innovation; 3) Decision, the individual makes a choice to adopt or to fail to adopt the innovation; 4) Implementation, the individual puts the innovation into practice; and 5) Confirmation, the individual's experience with the new innovation or technology causes a reinforcement or a reversal of the decision to adopt or the failure to adopt.

Rogers (1983) also recognized that innovations have different characteristics that affect rate of adoption. He classified these attributes of innovations as follows: 1) Relative advantage, or the degree to which an innovation is perceived as being better than the idea it supersedes; 2) Compatibility, or the degree to which an innovation is perceived as consistent with existing values, past experiences, and needs of the receivers; 3) Complexity, or the degree to which an innovation is perceived as relatively difficult to understand and to use; 4) Trialability, or the degree to which an innovation may be experimented with on a limited basis; and 5) Observability, or the degree to which the results of an innovation are visible.

The rate at which adoption takes place is another area of concern. Most researchers agree that the rates at which farmers adopt new technology approximates a normal distribution curve (Roger, 1958; Wilkening, 1953). Lionberger (1960) characterized adoption rates as a curve with initially low rates that increases at an increasing rate

over time until it reaches a point of diminishing acceptance at a later date.

The existence of a normal distribution adoption curve allows researchers to use parametric statistics to analyze and categorize farmers according to their rate of adoption. The categories are identified by Rogers (1983) as follows:

1. The Innovators are the first to adopt a new practice, are usually financially well-off, operate larger farms, and have more working capital. Innovators usually have relatively high status in the farm community and a wide range of contacts outside the community with extension specialists, and other technical agents. Innovators use technical publications and specialized mass media as sources of information. Other farmers use innovators as sources of information.
2. Early Adoptors are the second group to adopt a new technology. Early adoptors are usually younger than the average farmer, have a higher level of education and social status, and more exposure to mass media. Early adoptors are "opinion leaders" and other farmers seek their advice about the new technology.
3. Early Majority is the next group to adopt new ideas. Farmers in this group tend to be slightly above average in age, education, social status, income, and exposure to government bulletins and extension service assistance.

4. Late Majority is the last major group to adopt a new technology. They tend to be less educated, older, have less capital and income, and less exposure to educational and informational channels than the early majority.
5. The Laggards are the very last to adopt. Laggards tend to be older, have less education, and less income. They have less contact with the extension service and participate very little in community activities. Laggards depend on their neighbors for information about new ideas.

By classifying farmers into adoptor categories, researchers have been able to correlate economic and social variables with adoption rates. By using socio-economic variables, the researcher is able to make generalizations about the characteristics of each adoptor category's population. The socio-economic variables have also been used to explain the variances in adoption rates.

One of the most significant factors which influences adoption rates is communication. Individuals in different adoptor categories tend to use different sources of information at various stages of the adoption process. Leuthold and Kennedy (1976) examined the sources of information used by Tennessee beekeepers in various stages of adoption. At the Knowledge Stage, mass media sources, such as beekeeping journals, books, catalogues, and other farm publications, were the most significant. Personal communication sources, such as beekeeper organizational meetings, extension agents, opinion leaders, and personal experiences were of greater importance during later stages

of the adoption process. Other studies support Leuthold and Kennedy's findings that one-way communication is most influential at the awareness stage, while two-way communication is more important in the persuasion and adoption stages (Copp, et al., 1958; Beal and Roger, 1960; Bohlen, 1964; and Lionberger, 1975).

The importance of two-way personal communication at the latter stages of the adoption process reinforces the significance of the "opinion leader." Rogers (1983) defines opinion leadership as the degree to which an individual is able to informally influence other individual's attitudes or behavior in a desired way with relative frequency. Leuthold and McManus (1977) in a study of Tennessee opinion leaders found that certain farmers are the primary sources of advice about agricultural technology. The farmers whose advice was sought were termed "opinion leaders." Opinion leaders were characterized as having a high gross income, operating relatively large farms, and having spouses with greater than average income; however, the opinion leaders had only slightly higher education levels and are slightly younger than other farmers. Rogers (1983) added several other inherent traits to Leuthold and McManus's findings. These traits include: a greater exposure to mass media, more cosmopolitan, greater change agent contact, more innovative, higher social status, and greater social contact.

Adoption and Diffusion in Resource Conservation

There are numerous explanations of why farmers fail to adopt conservation measures, why farmers tolerate soil erosion, and why

farmers are slow in their acceptance of no-till. Research has shown that farmers may misinterpret and underestimate the extent of their erosion problems. Nowak (1983a) reported that Iowa farmers recognized only dramatic instances of soil erosion, such as gullies and washings, and failed to recognize more subtle and prevalent forms of erosion such as water pollution, productivity damages, and increased fertilizer needs. While farmers may readily recognize erosion as a serious problem on a national or state level, they were less likely to perceive erosion as a serious problem in their community or on their own farm (Nowak, 1983a). Further it is unclear whether the conservation tillage practices that are being adopted are on the land that is in the most need of protection against erosion. Maureen K. Hinkle (1983:205) reported that according to the 1977 National Resource Inventory that:

> three fourths of the 26.7 million acres of cropland on which 'minimum till' and 'crop residue' practices were used in combination would have, at worst, eroded at less than 5 tons per acre in absence of these practices.

One of the factors affecting the control of soil erosion and acceptance of new technology is much research indicates that farmers are interested in short-term economic gain even at the expense of long-range gains (Kraft, 1978; Pimentel, et al., 1976). Individual farmers have no control over market forces and lack the ability to pass on additional costs to the product purchaser (van Es, 1983; McConnell, 1983). Additional costs are either absorbed by the farmer financially or in terms of inconvenience (van Es, 1983). Agricultural practices which provide highly profitable short-term returns are

frequently not compatible with erosion control practices (Pamel and van Es, 1977). Conventional tillage is the most effective technique for growing soybeans and corn, but is often harmful to the soil if used year after year without the use of erosion control practices (Berg and Carter, 1980). A 1982 study by Roneer Hi-Bred International Inc. (Agrichemical Age, 1983:30) that involved a series of group-attitude surveys and a quantitative analysis involving one thousand personal interviews with farmers concluded that:

> Farmers are economically motivated decision makers; they adopt soil conservation practices when they are convinced these measures serve their economic interest. Therefore, an appeal to conserve soil on any other basis--such as moral stewardship--is likely to be futile.

The continued use of conventional tillage practices and unacceptable rates of soil erosion are evidence that farmers do not believe conservation tillage practices are economically rewarding. In fact, farmers may believe that conservation practices may lower their net income. Napier and Foster (1981) cited previous work which showed Missouri farmers believe no-tillage would product lower levels of production than conventional tillage. Bultena and Hoiberg (1983) concluded that it was understandable that farmers were unwilling to discard use of moldboard plowing because soil inversion is a time-tested means of controlling many crop production problems, including distribution of fertilizer and pest control.

Other research suggests that economics may not be the only factor which affects the adoption of soil conservation practices. Education appears to be a key factor associated with the adoption of soil

conservation practices by Indiana farmers (Taylor and Miller, 1978). However, it should be noted that economic incentives were also included in the program. Other research indicates that education programs alone will not induce the adoption of soil conservation technology unless farmers have the economic means to use the information (Pampel and van Es, 1977; Lovejoy and Parent, 1981). Aesthetics may also contribute to the slow adoption of no-till because farmers take pride in cleanly tilled fields (Christensen and Magleby, 1983).

The traditional model of diffusion research has been criticized as being irrelevant in determining farmers' conservation behavior (van Es, 1983; Nowak, 1983b; Mason and Halter, 1980). J. C. van Es (1983) criticized the traditional diffusion model as being irrelevant because of changes in the structure of the United States agriculture. Agriculture has been so intertwined with industrial society that it is inseparable from it. Rates of diffusion are currently determined by economic and structural factors over which the farmer has limited control (van Es, 1983). Traditional diffusion models have been characterized as profit-oriented and voluntaristic (van Es, 1983). Current agriculture conservation technologies are public benefits rather than farm economic benefits (van Es, 1983).

Nowak (1983b) modified the traditional diffusion model in an attempt to explain the adoption and diffusion of conservation technology. A diagram of the Nowak Conservation Diffusion is presented in Figure 1. In the Nowak Diffusion Model there are three stages:

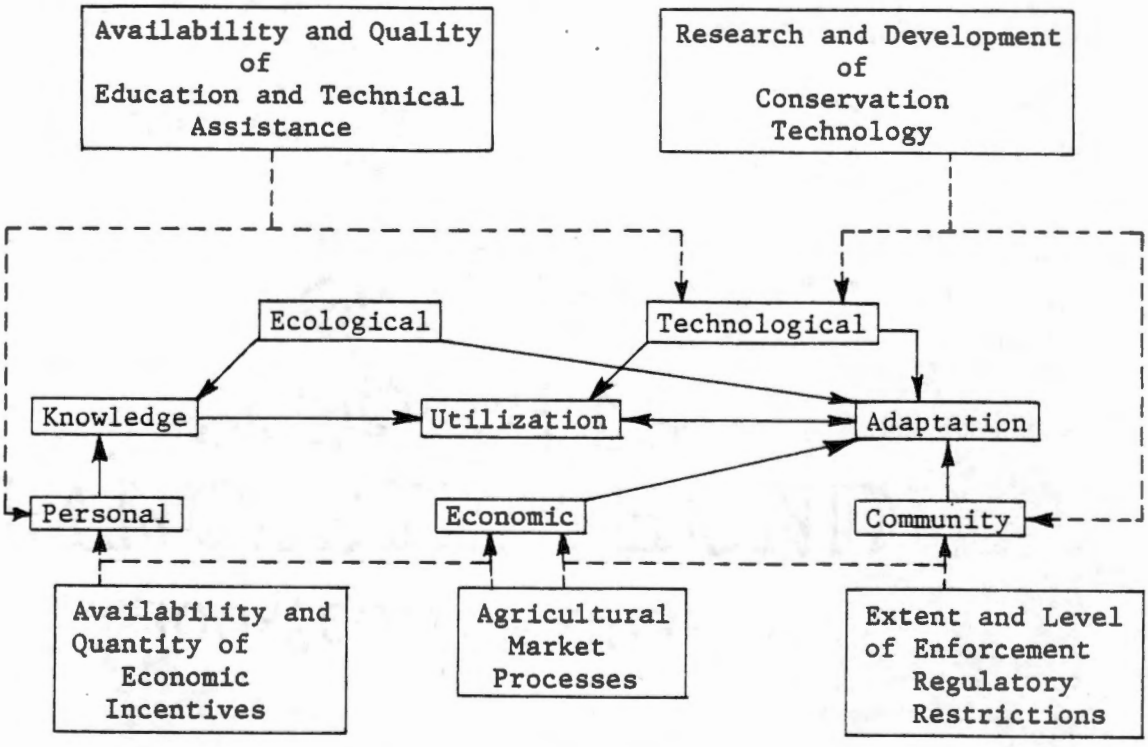


Figure 1. Micro/Macro influences on the use of conservation practices.

1) gaining knowledge; 2) acting on this knowledge; and 3) adopting the technology to increase overall utility. The process is influenced by a number of ecological, technological, personal, and community factors. These factors are influenced by the existence and level of enforcement of regulatory restrictions, the availability and quantity of economic incentives, the availability and quality of education, the market process, and the extent of research and development of conservation technologies.

Unlike the classical adoption model, the Nowak model contains little emphasis on the land user's social-psychological characteristics. The focus is on the individual decision making process, but the model recognizes that the land user has little control over the market process. The second assumption of the Nowak model is that adoption or rejection of conservation technology is not a dichotomous decision because there are no quick technological "fixes" (Nowak, 1983b). This is especially true of no-tillage use. Shelton, et al. (1983) recommends a program of rotating a no-tillage system with conventional systems for weed control.

There are many variables that can affect farmers' attitudes toward adoption of soil conservation practices. Rogers (1983) identifies two levels of attitudes. One is a specific attitude toward a new technology, and the other is a general attitude toward change. The farmer's level of aspiration, willingness to take risks, concern over the environment, and conservative or liberal orientation will affect his adoption of new ideas. The review of literature suggests that a

farmer's willingness to accept conservation tillage practices is the result of social, psychological, and economic variables. Economics and education together have a greater impact on a farmer's willingness to accept a new technology than either would alone.

Nowak (1983a) identified four strategies for increasing the adoption of conservation technologies. The strategies are identified as follows:

1. Conservation Education - which includes assisting land users in recognizing instances of erosion, in recognizing the causes of erosion through presentations and promotion of appropriate conservation technologies, and in assisting program managers and urban audiences in understanding land-users' agricultural decisions so they will be supportive of conservation costs.
2. Increasing the Social Utility of Conservation - which includes building the prestige associated with being a farmer who uses conservation practices.
3. Assisting in Conservation Investments - which includes targeting economic assistance at farmers with the greatest erosion problems rather than farmers with most community standing.
4. Promoting Local Adoption of Conservation Technologies - which includes organizing informal social networks for promoting adoption of conservation practices, organizing conservation clubs, and organizing demonstrations of the recommended technology.

CHAPTER III

METHODOLOGY

Area of Study

Soil erosion is Tennessee's most serious conservation problem. Erosion removes nutrients, organic matter, and microorganisms from the soil, while decreasing the soil's moisture-holding capacity. Loss of soil will eventually cause reduced crop yields, higher production costs, and lower land values. Water carrying soil sediment from the crop land are polluting the state's water resources. Recent studies by Soil Conservation Service show that Tennessee is leading the nation in average per acre soil losses to sheet and rill erosion from farmland. Statewide soil losses average about 14 tons per acre per year (Bice, 1980).

In West Tennessee, the problem is even more serious with average soil losses of almost 40 tons per acre per year (Bice, 1980). At this rate one inch of soil is lost every four years (Operation SOS, 1979). This soil loss is primarily the result of land use and tillage practices used in the production of soybeans on highly erosive loess and coastal plains soils (Shelton, et al., 1983). Soil erosion rates range from less than two tons to more than 200 tons per acre annually on cropland in West Tennessee (Operation SOS, 1979). Soils in West Tennessee have the consistency of granulated sugar and are highly erodable when exposed to wind and rain. Average soil losses in West

Tennessee are about five times the national average and about eight times the rate at which soil can be formed (Bice, 1980).

Soil losses in West Tennessee are especially important because of the area's fertility. For detailed information on basic land and resource data on West Tennessee see Appendix A. The twenty-one county area between the Tennessee and Mississippi Rivers produces more than half of the state's corn, soybeans, and cotton (Bice, 1980). Figure 2 contains a map showing the three major geographical regions of Tennessee. There are 6.8 million acres in West Tennessee of which 3.5 million acres are planted in conventional tilled crops. About 3.2 million acres of the crops are grown on sloping cropland where most of the erosion occurs (Bice, 1980). Rill and sheet erosion are the most serious and the most common forms of erosion (Operation SOS, 1979).

West Tennessee has experienced erosion problems for many years. In the 1960's the need for feed grain crops and higher profits greatly expanded production especially of row crops. Land that had been taken out of production in conservation programs was reclaimed for row cropping.

Other factors contributed to the problem. High land prices press farmers into producing crops with higher yields and greater profitability. Large scale farm machinery encourages farmers to enlarge and level fields often destroying fence rows and old terrace systems. In the 1950's, the average farmer had a total investment of less than $50,000 including land, buildings, livestock, machinery,

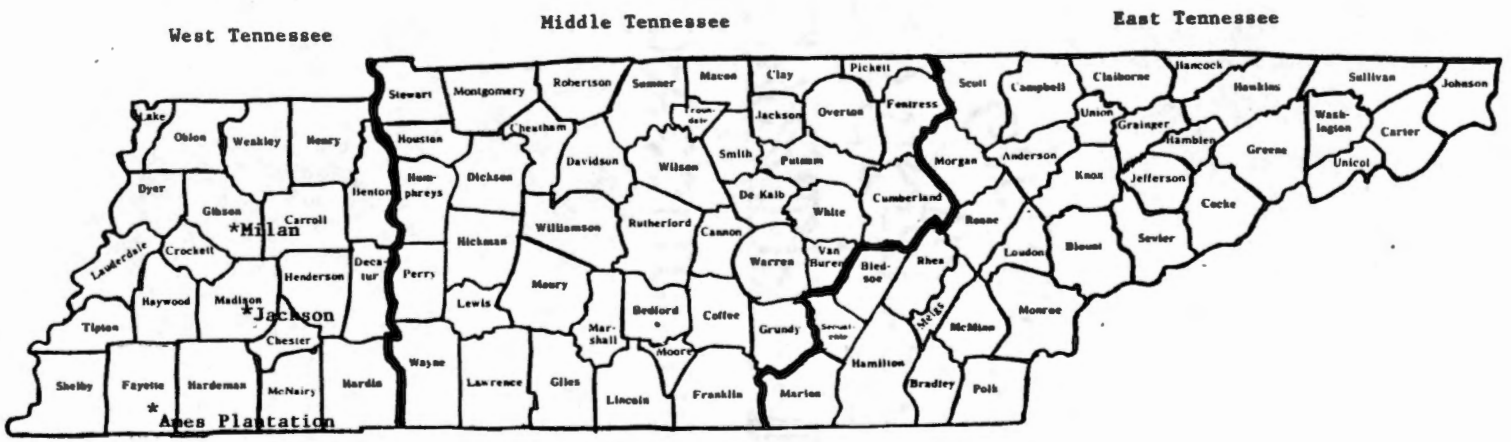


Figure 2. Map of the three major geographical regions of Tennessee showing the location of Milan, Jackson, and Ames Plantation Agricultural Experiment Stations.

etc. (Operation SOS, 1979). In the 1980's many farmers in West Tennessee have over $50,000 in a single piece of equipment, and more than a million dollars in total investment in their farm operation (Operation SOS, 1979).

An intensive conservation program, Save Our Soil (SOS), was formulated and implemented by local, state, federal agencies and organizations, and local landowners in 1977 (Bice, 1980). The program was designed to reduce soil erosion, improve water quality, and maintain or improve profit for farmers. The SOS and other programs use a combination of educational and cost-sharing incentives to promote the best management practices available. No-tillage agriculture was strongly encouraged under these programs. While adoption of no-till has increased, many farmers remain skeptical.

Survey Population

A primary goal of the study was to gather data on the usage of no-tillage agriculture in Tennessee as quickly and inexpensively as possible. The decision was made to survey where a large number of farmers would be present at agricultural field days. Agricultural field days provide a means for agricultural researchers to demonstrate new technologies and to transmit useful information to farmers. Farmers are able to see test plots and exchange information with other farmers. The field days at Jackson, Milan, and Ames Plantation were chosen because of the importance of row crops and the extent of erosion in West Tennessee. Soybeans are the leading cash crop grown in West Tennessee (Shelton, et al., 1983).

The survey was limited to farmers whose primary occupation was farming. The survey was not limited to West Tennessee farmers and the results of this non-random survey were not meant to be generalized to all West Tennessee farmers. The 513 completed questionnaires collected at the three field days composed the original data set. Appendix B contains data analysis for the individual field days based on attendance patterns. Most of the questionnaires, 78.0%, were collected at the Milan Field Day, while 12.7% of the questionnaires were collected at the Jackson Field Day and 9.4% at the Ames Plantation Field Day. Of the 513, only four questionnaires were identifiable as duplicate farm operations gathered at two of the field days. Therefore, there was little justification for the concern that the same farmers would be present at each field day. Table 1 contains a summary of the number of questionnaires completed and of the acreage controlled by farmers completing the questionnaires at each field day.

Questionnaire Construction

The questionnaire was printed so that farmers could complete the two-sided form with or without the use of a table. Care was taken in the design of the questionnaire so that the form would be concise and easy to understand and complete. The questionnaires were essentially self-administered and conducted under field conditions. The construction of the questionnaire was broken down into sections. Appendix C contains a copy of the form used in data collection.

Table 1. Summary of Questionnaires Completed by Farmers at Three Agricultural Field Days

Field Day	Number of Farm Operations Surveyed	Percent	Total Acres Operated
*Jackson Agricultural Experiment Station	65	12.7	47,108
*Milan Agricultural Experiment Station	400	78.0	357,012
Ames Plantation Agricultural Experiment Station	48	9.4	41,801
Totals	513	100.1	445,921

*Four questionnaires from the Milan Field Day were determined to be duplicates of four farm operations obtained from the Jackson Field Day.

Introductory heading. A short introductory heading was used to increase the reliability of the survey by linking the survey to the Agricultural Experiment Station. Farmers were asked to give their opinions on the advantages and disadvantages of no-tillage agriculture. The heading was also used to assure farmers that the information they provided on the questionnaire was confidential and their participation in the survey was voluntary.

Survey body. The body of the questionnaire contained five sections. The first and the second sections contained Likert-type scales

where farmers were asked to give their opinions on a list of advantages and disadvantages of no-tillage agricultural practices.

The list was composed of eight advantages and eight disadvantages of no-tillage.[1] The lists were taken from previous research on no-tillage agriculture. The no-tillage opinion questions were purposely placed first on the questionnaire in the expectation that farmers would be interested in expressing their opinions and that they would not find the questions threatening or difficult to answer.

Section three of the questionnaire contained questions on farmer present and past use of no-till planting. These questions were used to identify no-till users, non-users, discontinued users, and new users.

Section four of the questionnaire contained questions on the farm operation including type and acreage of crops and the acreage of each crop planted by no-till agriculture. Section five contained four background information questions.[2]

Data Collection

The Jackson Field Day was held on July 15, 1982, at the Jackson Experiment Station in Madison County. The theme for the field day was "Row Crop Production" and while information on no-tillage was provided on the field tours, the primary focus of the field day was on increasing

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[1] In the Jackson Survey, which was used in part as a questionnaire pretest, nine disadvantages were given. The no-tillage disadvantage of "more difficulty to use in wet year" was dropped in the other surveys.

[2] The fourth question on primary occupation was added after the Jackson pretest when it became apparent that non-farmers were also completing the survey form.

and improving row crop production. The Jackson Field Day served as a test for the questionnaire. Two changes were made on the questionnaire after preliminary analysis of the Jackson data. The no-till disadvantage of "difficulty to use in wet years" was dropped when farmers failed to identify it as a disadvantage. A background information question on primary occupation was added when data analysis showed that persons whose primary occupation was not farming also completed the survey form. Sixty-seven usable questionnaires were collected at the Jackson Field Day.

The Milan Field Day was held on July 29, 1982, at the Milan Experiment Station in Gibson County. The theme of the field day was "No-Tillage Agriculture." The event was sponsored by the University of Tennessee Agricultural Experiment Station and Agricultural Extension Service, the USDA Soil Conservation Service, the Tennessee Valley Authority, the Tennessee Department of Agriculture, and other cooperating agencies. The field day included four separate tours with 18 discussions of no-till equipment and planting was also held. Twenty no-till planters demonstrated planting soybeans in wheat-stubble. Exhibition tents featured 84 commercial and 24 educational displays related to no-till production.

Data collection at the Milan Field Day was complicated by the size of the field day and the lack of a central registration location. Approximately 2,600 people were registered by the experiment station staff. Previous research on attendance at Tennessee Agricultural Field Days suggest that only 40% of those in attendance were farmers (Leuthold,

1980). Public and private agricultural personnel, students, Agri-businessmen, etc., composed the remainder.

Data were collected from farmers while they waited on tour wagons for the next tour. Farmers were given the survey form, and most farmers were able to complete the form during the fifteen minute intervals while tour wagons were loaded. The forms were collected before the start of the tour or when farmers returned from the hour-long tour. Farmers were very cooperative in filling out the survey form. Less than 2 percent of the farmers approached refused to fill out the form.

Slightly under 500 survey forms were collected at the Milan Field Day. Of these, 400 questionnaires were usable. The remainder were eliminated for several reasons such as the participants identified their primary occupation as other than farming, they were identified as duplicates of the same farm operations, or the information provided was incomplete.

The Ames Plantation Field Day was held on August 12, 1982. The theme of the field day was "Cotton Production." Although the Tennessee Agricultural Extension Service was not recommending no-till for cotton production in 1982, the Ames Plantation Field Day was included in the study because of its West Tennessee location. Forty-eight usable questionnaires were completed at the Ames Plantation Field Day.

Data were collected at Jackson and Ames Plantation Field Days during registration by the Agriculture Experiment Station. Farmers were asked to complete the survey form after they had completed the registration form.

Data Characteristics

The survey was limited to farmers who attended a field day in West Tennessee who were actively engaged in farming as their principle occupation. The final data sets were limited to one observation or survey per farm operation. Previous research on field day attendance indicated that a wide cross-section of farming operations were represented (Leuthold, 1980). Farmers who attend field days and demonstration farms generally have larger farm operations, higher education, higher income, and are more favorable to change than the general population (Rogers, 1983). The respondents average farm size was greater and level of education was higher than for commercial farmers in West Tennessee generally. Survey participants undoubtedly held more favorable views toward no-till and had higher usage of no-till than a fully representative sample of West Tennessee farmers would have contained. The difference between those farmers surveyed and a fully representative sample of farmers is unknown and constitute the major bias of the study.

Because data were collected by use of a self-administered questionnaire, it was necessary to carefully inspect each form for complete or incomprehensible data, and for duplicate surveys of the same farm operation. Survey forms were inspected after each field day. A common error was that some farmers failed to realize that there were two sides to the questionnaire and only completed one side. Because farmers completed the questionnaire with little supervision it was difficult to monitor their completion of the form. Questionnaires with

incomplete data were dropped from the survey.[3] Duplicate forms of the same farm operation were also dropped, as were questionnaires completed by part-time farmers or farmers no longer active in farming were dropped.

The justification for excluding part-time and non-active farmers was that previous research indicates that approximately 40% of those attending days are public and private change agents (Leuthold, 1980). Many of the agricultural businessmen and government employees are encouraged to identify themselves as "farmers" to increase their influence among the farm community (Rogers, 1983). Including these paid change agents in the survey would make farmers attending field days appear to be more highly educated and more innovative than they actually were. A decision was also made to exclude from analysis any respondent at the Jackson Agricultural Field Day operating less than 100 acres of crops who had a college education since the question on primary occupation was not on the survey form. It was felt that these respondents were probably receiving primary income from an occupation other than farming.

Data Analysis

After being inspected for errors, the questionnaires were grouped according to field day and to no-till use. The groups were then ranked according to farm size. The data were then transferred to coding sheets based on numerical codes representing the variables contained on the survey form. This was then transferred to IBM cards and to a

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[3]Survey forms with missing data were used if the data could be ascertained from another question or if the item did not affect data analysis. Otherwise they were dropped from the survey.

DEC-10 file. A printout of the data was compared to the original survey forms to check for coding and keypunching errors.

Data were analyzed for each individual field day using a group of computer programs known as Statistical Analysis System (SAS). Data sets from Jackson and Ames Plantation were small in relationship to the Milan data set, and analysis showed that they followed similar patterns found in the Milan data set. Therefore, it was decided to collapse the three data sets into a single data set of 509 observations for descriptive and statistical analysis.

Data from the survey forms were converted into numerical codes representing variables for analysis. These codes were designed to maintain the maximum amount of detail permitting greater flexibility in analysis if needed. Table 2 contains a list and description of variables used in the analysis.

Farmers were categorized according to their reported no-till use. Those with no previous on-farm experience with no-till planting were classified as never users. Discontinued users had used no-till in the past, but were not using the technology in 1982. No measurement was taken to determine if the discontinuance was temporary or permanent. Farmers using no-till for the first time in 1982 were classified as first-year users. Those farmers classified as continued users had used no-till in the past and were using no-till in 1982. No measurement was taken to determine if continued users had used no-till intermittently or continuously. Also no data were obtained on plans for future no-till use.

Table 2. Description of Variables Used in Analysis

Type	Description
Farm Operation	Field Day - Milan, Jackson, Ames
	Use of no-tillage
	Year of first use of no-till
	Acres of soybeans and wheat planted all methods
	Acres of soybeans and wheat planted no-till
	Acres of soybeans planted all methods
	Acres of soybeans planted no-till
	Acres of wheat planted all methods
	Acres of wheat planted no-till
	Acres of corn planted all methods
	Acres of corn planted no-till
	Acres of grain sorghum planted all methods
	Acres of grain sorghum planted no-till
	Acres of cotton planted
	Acres of hay and pasture
	Total number of acres operated
Background	County of residence
	State of residence
	Years of education
	Type of tenure
	Primary occupation
Advantages	Reduced labor requirements
	Reduced fuel costs
	More intensive use of land
	Improved timeliness in planting and harvesting
	Increased yields
	Increased moisture retention
	Reduce soil erosion
	Conserve future soil productivity
Disadvantages	Weed and grass control problems
	More precision in planting needed
	Yield variability
	Increased chemical costs
	More difficult to manage
	Spray residues
	Necessity of keeping conventional planting equipment
	Cost of no-tillage equipment

A number of variables were modified to be more appropriate for analysis. Farmers were asked to rank the advantages and disadvantages of no-till on a Likert-type scale with values of 0 = not true or incorrect, 1 = little or no advantage or disadvantage, 2 = some advantage or disadvantage, and 3 = major advantage or disadvantage. Analysis showed that the majority of farmers tended to rank items as major advantage or major disadvantage. The scale was collapsed so that an item was ranked either as a major advantage or disadvantage or not. Both the original and modified scales were used in analysis.

Year of first use of no-tillage was used to create time intervals of 1960-1969, 1970-1974, 1975-1979, 1980-1981, and 1982. Modified total acreage was created based on crop acreages reported by the individual farmers. The new variable was used for statistical analysis because of discrepancies between total acreage operated reported as a single figure and the sum of crop acreages reported. Farm operati were also classified as large, medium, or small based on modified total acreage. Suitable no-till acres (SNTAC) was developed based on the acreage reported for soybeans and wheat, soybeans, wheat, corn and grain sorghum. Appendix D contains a list of variables created or modified based on the original data.

Statistical Procedures

Descriptive inferential statistics were used in data analysis in spite of the non-random character of the sample. For the purposes of this study, the number of respondents was sufficiently large and the number of users of no-till practices was also large enough to justify

the use of such statistics to describe and analyze the relationships found. Frequency distributions and cross tabulations were used to summarize values for the variables found in the data set. Descriptive procedures, including the mean, standard deviation, range, and sum were used to summarize information on participation in agricultural field days, on no-till use, and on farm operation characteristics. Descriptive procedures were also used to identify farm operation characteristics and attitude toward the attributes of no-till based on use category.

Inferential statistics were used to examine the relationships between variables and no-till use. The null hypothesis that no relationship exists between no-till use and attitude toward the advantages and disadvantages of no-tillage, size of farm operations, type and acres of crop planted, education, and land ownership was made.

CHAPTER IV

RESULTS AND DECISION

Farmer Attitudes and Use of No-Tillage Agriculture

Data were analyzed on how farmers' experience with no-till affected their perceptions of the advantages and disadvantages of no-till use. Farmers attending three agricultural field days in West Tennessee in 1982 were asked to rate the importance of eight advantages and eight disadvantages on a Likert-type scale. The information collected was analyzed to determine if variations existed between ratings given by farmers in different user categories. As indicated in the methodology chapter, analysis was based primarily on whether or not an advantage or disadvantage was rated as being of major importance. Knowledge of how farmers perceive the advantages and disadvantages based on their experience with no-till methods could hopefully provide insight into how "change agents" could influence no-till adoption rates.

Advantages. The characteristics listed most frequently as a major advantage of no-till was reduced soil erosion. Some 84.7% of the 509 farmers surveyed felt that reduced soil erosion was a major advantage (see Table 3). However, there was little difference in rating by user category. For example, reduced soil erosion was rated as a major advantage by 75.9% of discontinued users compared to 83.3% of never users, 84.2% of first year users, and 87.9% of continual users. The difference was not statistically significant at the .05

Table 3. Number and Percentage of Farmers Attending a West Tennessee Field Day in 1982 Who Listed Eight Attributes as Being a Major Advantage of No-Till Planting

	USER CATEGORY										
	Discontinued Users (n=54)		Never Users (n=156)		First Year Users (n=76)		Continued Users (n=223)		All Users (n=509)		
Advantages	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Chi Square Values of Difference
Increased yields	6	11.1	19	12.2	8	10.5	32	14.4	65	12.8	.9
More intensive use of land	18	33.3	54	34.6	28	36.8	101	45.3	201	39.5	5.6
Improved timeliness in planting and harvesting	23	42.6	62	39.7	42	54.1	121	54.3	248	48.7	9.9[1]
Increased moisture retention	20	37.0	76	48.7	36	47.4	145	65.0	277	54.4	20.2[1]
Reduce labor requirement	22	40.7	88	56.4	41	54.0	151	67.7	302	59.3	15.6[1]
Reduce fuel cost	24	44.4	105	67.3	49	64.5	161	72.2	339	66.6	15.2[1]
Conserve future soil productivity	38	70.4	102	65.4	53	69.7	166	74.4	359	70.5	3.7
Reduce soil erosion	41	75.9	130	83.3	64	84.2	196	87.9	431	84.7	5.2
Average	-	44.4	-	51.0	-	52.8	-	60.2	-	54.6	-

[1]The Chi Square Value was statistically significant at the .05 level of probability with 3 d.f.

level of probability. The results demonstrated that many farmers surveyed believed that no-till planting would reduce erosion regarding their use of no-till. In fact, none of the farmers surveyed rated reduced soil erosion as "not true or incorrect" and only 2 percent rated it as "little or no advantage."

Conservation of future soil productivity was the second most frequently rated characteristic as a major advantage. Some 70.5% of the farmers surveyed rated it as a major advantage. Again little difference existed between the ratings given by farmers in different user categories, and the difference was not statistically significant. Thus, the ratings given to both reduced soil erosion and conservation of future soil productivity both failed to distinguish farmers in different user categories. Although the majority of farmers surveyed agreed that these items were major advantages, it was not clear that increased soil conservation benefits alone influenced many farmers to use or to continue no-till use. Therefore, programs stressing the importance of no-tillage agriculture as a means of reducing soil erosion and conserving soil productivity may have limited use in promoting the adoption of no-till. Nowak (1983:165) in his study of why farmers use or do not use conservation tillage practices also indicated this when he stated that:

> We can begin by acknowledging that conservation tillage is a complex system. It takes a better farmer to use this system in an economically viable manner than does conventional tillage. It also takes a more dedicated and knowledgeable conservationist to promote the system. Farmers do not need more sermons on moral stewardship. They need timely, accurate answers to tough questions.

Two other no-till advantages that failed to distinguish farmers by user categories at statistically significant levels were 1) more intensive use of land and 2) increased yields. Some 39.5% of the farmers surveyed rated more intensive use of land as being a major advantage. Only 12.8% of the 509 farmers surveyed rated increased yields as a major advantage. Increased yield was rated "not true or incorrect" by 9 percent of the farmers surveyed and 50 percent rated it as of "little or no advantage." Thus few farmers believed that no-till planting would increase yields regardless of their usage of no-till.

Differences by user category were statistically significant at the .05 level of probability for 1) improved timeliness in planting and harvesting, 2) increased moisture retention, 3) reduced labor requirements, and 4) reduced fuel costs.

Improved timeliness in planting and harvesting was rated as a major advantage by 48.7% of all farmers surveyed, and continued users and first year users rated it more frequently than never users and discontinued users. Some 65.0% of continued users rated the increased moisture retention as of major importance compared to only 37.0% of discontinued users. Never users and first year users were very similar on the frequency this item was rated as a major advantage. Reduced labor requirement was rated as a major advantage by 59.3% of the farmers surveyed, but 67.7% of continued users rated the item as of major importance compared to only 40.7% of discounted users. Never users and first year users rated this item at nearly the same frequency. Reduced

fuel requirement was rated as a major advantage by 66.6% of the farmers surveyed. Some 72.2% of continued users rated the item as a major advantage compared to 44.4% of discontinued users. Again, fuel requirement was rated as a major advantage by a similar proportion of never users and first year users.

The average ratings of importance given to the eight advantages varied according to user category. The highest ratings were given by continued users at 60.2%, and the lowest ratings were given by discontinued users at 44.4%. The average ratings given were 51.0% for never users and 52.8% for the first year users. Thus, differences seem to be related to whether or not the farmer had personal experience or "trial use" of no-till. Only small differences in ratings occurred between never users and first year users with exception that farmers using no-till for the first time rated improved timeliness in planting and harvesting somewhat more frequently than farmers who had never used no-till. The differences on the other seven advantages were very slight.

Clearly the greatest rating difference occurred between farmers who continued use and those who discontinued use. Differences were larger for the advantages of increased moisture retention, reduced labor requirements, and reduced fuel costs. Lower ratings apparently reflect a negative attitude toward no-till by farmers who discontinued use while higher ratings reflect a positive attitude by farmers who continued use.

Disadvantages. The disadvantage most frequently rated as a major disadvantage by the farmers surveyed was increased chemical cost, 60.5% (Table 4). However, the difference in ratings given by farmers in the four user categories was not statistically significant at the .05 level of probability. Increased chemical cost was rated as a major disadvantage by 57.9% of continued users, 57.1% of never users, and 64.8% of discontinued users. Somewhat surprising was the fact farmers using no-till for the first time gave the highest rating, this high rating was apparently the result of first year users being unaccustomed to the chemical costs associated with no-till. In 1982, the chemical cost for no-tilled soybeans was an estimated $31.82 per acre compared to $23.49 per acre for conventionally tilled soybeans and for no-tilled corn it was an estimated $27.99 per acre compared to $19.14 per acre for conventionally tilled corn (Hudson, 1981).

The disadvantage of more precision in planting needed also failed to distinguish farmers by user category at a statistically significant level. Only 19.3% of the farmers surveyed rated the item as a major disadvantage.

Ratings given to six of eight disadvantages by users category were statistically significant at the .05 level of probability. These items were 1) yield variability, 2) spray residues, 3) necessity of keeping conventional planting equipment, 4) more difficult to manage, 5) cost of no-till equipment, and 6) weed and grass control problems.

Yield variability was the item least frequently rated as a major disadvantage, 13.0%. Only 6.7% of continued users rated the

Table 4. Number and Percentage of Farmers Attending a West Tennessee Field Day in 1982 Who Listed Eight Attributes as Being a Major Disadvantage of No-Till Planting

	USER CATEGORY										
	Discontinued Users (n=54)		Never Users (n=156)		First Year Users (n=76)		Continued Users (n=223)		All Users (n=509)		
Disadvantages Given	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Chi Square Values of Difference
Yield variability	12	22.2	28	18.0	11	14.5	15	6.7	66	13.0	15.3[1]
Spray residues	13	24.1	32	20.5	7	9.2	17	7.6	69	13.6	19.6[1]
Necessity of also keeping conventional planting equipment	15	27.8	43	27.6	10	13.2	30	13.5	98	19.3	16.0[1]
More precision in planting needed	15	27.8	29	18.6	16	21.1	38	17.0	98	19.3	3.3
More difficult to manage	19	35.2	58	37.2	19	25.0	56	25.1	152	29.9	8.0[1]
Cost of no-till equipment	23	42.6	76	48.7	31	40.8	61	27.4	191	37.5	19.0[1]
Weed and grass control problems	32	59.3	94	60.3	36	47.4	90	40.4	252	49.5	16.9[1]
Increased chemical cost	35	64.8	89	57.1	55	72.4	129	57.9	308	60.5	6.5
Average	-	38.0	-	36.0	-	30.3	-	24.5	-	30.3	-

[1]The Chi Square Value was statistically significant at the .05 level of probability with 3 d.f.

item as a major disadvantage while 22.2% of discontinued users rated yield variability as a major disadvantage. Spray residue was rated as a major disadvantage by 13.6% of the farmers surveyed. Only 7.6% of continued users and 9.2% of first year users rated the item as a major disadvantage, compared to 20.5% of never users and 24.1% of the discontinued users. While the vast majority of farmers did not rate spray residues as being a major problem, spray residues may be the most serious environmental hazard associated with no-till use. The complete metabolic degradation is known for only three or four of the 150 chemicals used as herbicides (Hinkle, 1983). The effect of herbicide use on human and animal health, on the soil, and on the total environment has not been adequately studied, and herbicide use has been linked to cancer and birth defects (Hinkle, 1983).

The necessity of keeping conventional planting equipment was rated as a major disadvantage by 19.3% of the farmers surveyed. The item was rated as a major disadvantage by 13.5% of continued users and 13.2% of the first year users. On the other hand, it was rated as a major disadvantage by 27.6% of never users and 27.8% of discontinued users. The disadvantage more difficult to manage was rated as a major disadvantage by 29.9% of farmers surveyed. Ratings given by farmers in different user categories followed a similar pattern as those given necessity of keeping conventional planting equipment. Some 25.1% of continued users and 25.0% of first year users rated more difficult to manage as a major disadvantage of no-till planting while

37.2% of never users and 35.2% of discontinued users rated the item as a major disadvantage.

Cost of no-till equipment was rated as a major disadvantage by 37.5% of the farmers surveyed. The item was rated as a major disadvantage by 48.7% of never users and only 27.4% of continued users. High cost of no-till equipment has been suggested as a reason for farmers' failure to try no-till. Price of no-till planters range from $1,200 to $2,000 or more per row (Stubblecropper, 1983). A farmer could therefore invest from $5,000 to $7,000 in a four-row planter. High cost has traditionally discouraged "trial use" of a new technology (Rogers, 1983). Some 42.6% of discontinued users and 40.8% of first year users rated cost of no-till equipment as a major disadvantage.

The disadvantage, weed and grass control problems, was rated as a major disadvantage by 49.5% of the farmers surveyed. While 40.4% of continued users rated the item as a major disadvantage, weed and grass control problems were rated as a major disadvantage by 60.3% of never users and 59.3% of discontinued users. The item was rated as a major disadvantage by 47.4% of first year users. The high ratings for this disadvantage were not without support from previous research. Previous research has documented increased resistance to herbicides by a number of weed species, and there is concern that resistance may be developing in more species (Hinkle, 1983). Heavy use of herbicides is required to successfully use no-tillage, and use of herbicides also requires more management ability by a farmer. Irregularity in herbicide application or adverse weather conditions can cause week control

measures to fail, causing decreased crop yields or possible crop fail ure (Hinkle, 1983).

Continued users and first year users, with the exception of the rating given by first year users to increased chemical costs, consistently rated the disadvantages as of lower importance than never users and discontinued users. Rating differences given by farmers in different user categories were not large although six of eight disadvantages were statistically significant at the .05 level of probability.

While increased chemical costs was the only disadvantage rated as a major disadvantage by the highest proportion of the farmers surveyed, weed and grass control problems which was rated as a major disadvantage by one half of the farmers surveyed appeared to have a much more critical effect on no-till use. Increased chemical costs and weed and grass control problems were the only items rated as major disadvantages by over 50 percent of never users and discontinued users.

The average ratings given to the eight disadvantages varied with user category. The average ratings were lowest for continued users 24.5% and first year users, 30.3%, of the four user categories. The ratings were highest for discontinued users, 38.0% and never users, 36.0%. While only very slight differences occurred between never users and first year users for the advantages, some differences occurred for the disadvantages. This was especially true for the disadvantages of spray residues, necessity of also keeping conventional planting equipment, more difficult to manage, and week and grass control problems.

Comparison of mean scores given to total advantages and to total disadvantages. Attitudinal data were also analyzed based on the total scores given by farmers in different user categories to the eight advantages and eight disadvantages. The scores were based on a Likert-type scale. The score given by an individual farmer could range from 0- if all advantages or disadvantages were rated as "not true or incorrect," to 24- if all advantages or disadvantages were rated as "major advantage or major disadvantage." Mean scores for total advantages given by farmers in different user categories were compared to the mean score given to total disadvantages (Table 5). Scoring differences were analyzed to determine if farmers rated the advantages and disadvantages differently based on their use of no-till.

Mean scores given for the total of eight advantages were greater than the mean scores given for total of the eight disadvantages regardless of the farmer's experience with no-till. For instance, farmers who discontinued use gave the lowest mean score for total advantages still rated these slightly higher than the disadvantages. Discontinued users' mean score total advantages was 17.6 compared to 17.0 for total disadvantages for a difference of 0.6.

Never users rated total advantages somewhat higher than discontinued users, but they also rated total disadvantages slightly higher than discontinued users. Mean scores given by never users to total advantage were 18.5 and 17.2 for total disadvantages or a difference of 1.3. Farmers using no-till for the first time in 1982 rated total advantage slightly higher and disadvantages somewhat lower than

Table 5. Comparison of the Mean Scores for Total Advantages and Total Disadvantages Given by 509 Farmers in Different User Categories of No-Till

User Category	Mean Score
Discontinued Users (n=54)	
Total Advantages	17.6
Total Disadvantages	17.0
Difference	0.6
Never Users (n=156)	
Total Advantages	18.5
Total Disadvantages	17.2
Difference	1.3
First Year Users (n=76)	
Total Advantages	18.9
Total Disadvantages	15.7
Difference	3.2
Continued Users (n=223)	
Total Advantages	19.8
Total Disadvantages	14.5
Difference	5.3
All Categories (n=509)	
Total Advantages	19.0
Total Disadvantages	15.7
Difference	3.3

never users. The mean score for total advantage was 18.9 and 15.7 for total disadvantage or a difference of 3.2.

Continued users gave the highest rating, 19.8, to total advantages and the lowest, 14.5, to total disadvantages of the four user categories. Personal experience with no-till appeared to have effected the ratings given. Farmers with previous no-till use appeared to be influenced by whether their experience with no-till was positive or negative. Farmers who continue use become more favorable toward the technology. Ratings given by never users appeared to be greatly influenced by the farmer's concern about the extent disadvantages associated with no-till would influence crop production.

A pattern could be observed based on average scores given by farmers in different user categories and use of no-till. Discontinued users rated total advantages and total disadvantages as approximately equal. Apparently, they felt that the benefits of no-till use were equal to the costs associated with the disadvantages. Never users rated advantages slightly higher than the disadvantages, and this could be an indication of future use since ratings given to total advantages were similar for never users and first year users. However, first year users rated the disadvantages somewhat lower than never users.

Use of no-till appeared to occur when farmers felt the advantages outweighed the disadvantages enough to warrant on-the-farm trial use. Trial use was a function of a farmer's ability and willingness to accept risks.

Summary of farmer attitudes towards advantages and disadvantages of no-till. Of the total of sixteen advantages and disadvantages evaluated by farmers surveyed at field days in West Tennessee in 1982, four advantages and six disadvantages produced differences by user category which were statistically significant at the .05 level of probability. The advantages that appeared to have the most influence on a farmer's decision to use no-till were 1) improved timeliness in planting and harvesting, 2) increased moisture retention, 3) reduced labor requirements, and 4) reduced fuel costs. The disadvantages that appeared to have the most influence were 1) yield variability, 2) spray residues, 3) necessity of keeping conventional planting equipment, 4) more difficult to manage, 5) cost of no-till equipment, and 6) weed and grass control problems.

Reduced soil erosion was the item most frequently rated as a major advantage while conservation of future soil productivity received the second highest rating. This was true for all four user categories and rating differences given by farmers in different user categories were not statistically significant. Farmers, regardless of their no-till use, apparently recognized the conservation benefits associated with no-tillage agriculture. However, the importance of conservation in influencing farmers to use no-till remained unclear and it probably represents a necessary, but not sufficient condition for farmers to try or continue use of no-till.

Although advantages received higher ratings, disadvantages associated with no-till use appeared to have the most influence on

establishing trial use. Increased chemical cost was the item most frequently rated as a major disadvantage; however, ratings given by farmers in different user categories were not statistically significant. Weed and grass control problems which was also a highly rated disadvantage appeared to have influence on farmer's decision to use and continue no-till. Other disadvantages that apparently influence no-till use were cost of no-till equipment and the view that no-till is more difficult to manage than conventional tillage. Continued use occurred when farmers apparently felt that the disadvantages associated with no-till use were less than previously expected although few continued users planted all their row crop acreage by no-till. Ratings for total advantages were similar for never users and first year users. Ratings for total disadvantages were similar for discontinued users and never users.

The data implied that continued users appeared to become slightly more favorable toward the advantages with use, but that the greatest change occurred in the decreasing importance given to the disadvantages by continued users. Possible explanations are that with on-the-farm experience no-till farmers were able to minimize some of the problems associated with no-till use. Also as they become more familiar with the technology they may have been more able to evaluate advantages and disadvantages realistically.

No-Till Use Patterns

Information on no-till use was obtained from 509 farmers showed that 69.4% had used no-till on their farm operation at one time although

some of the farmers reporting previous no-till use had discontinued use and some were using no-till for the first time in 1982.

Year of first no-till use. The earliest no-till use reported by the farmers surveyed was four acres planted in 1960 by one of the farmers. Figure 3 contains a bar graph showing the pattern of first year no-till use reported for the 353 farmers who had tried no-till. Research has generally shown that the adoption process follows a normal, bell-shaped curve when frequency of use is plotted over time (Rogers, 1983). Figure 4 contains a graph showing the bell-shaped curve and the S-shaped cumulative frequency curve that are associated with a normal rate of adoption over time. The bell-shaped curve shows adoption in terms of the number of individuals adopting a technology each year, and the S-shaped curve shows the number of individuals adopting on a cumulative basis (Rogers, 1983). Plotting a true adopter distribution was not possible based on the available data. Total acceptance of no-till has not occurred for either the population surveyed or for most the continued users. Only 8.5% of continued users reported planting their total suitable acreage by no-tillage in 1982. The distribution curve formed by plotting year of first no-till use did show a pattern. However, the distribution appeared to be leptokurtic because a large amount of first year no-till use occurred near what would be the center of the distribution. The pattern showed that the number of farmers using no-till for the first time in the 1960's was small. The rate of use increased slowly through the 1970's and accelerated greatly in the early 1980's.

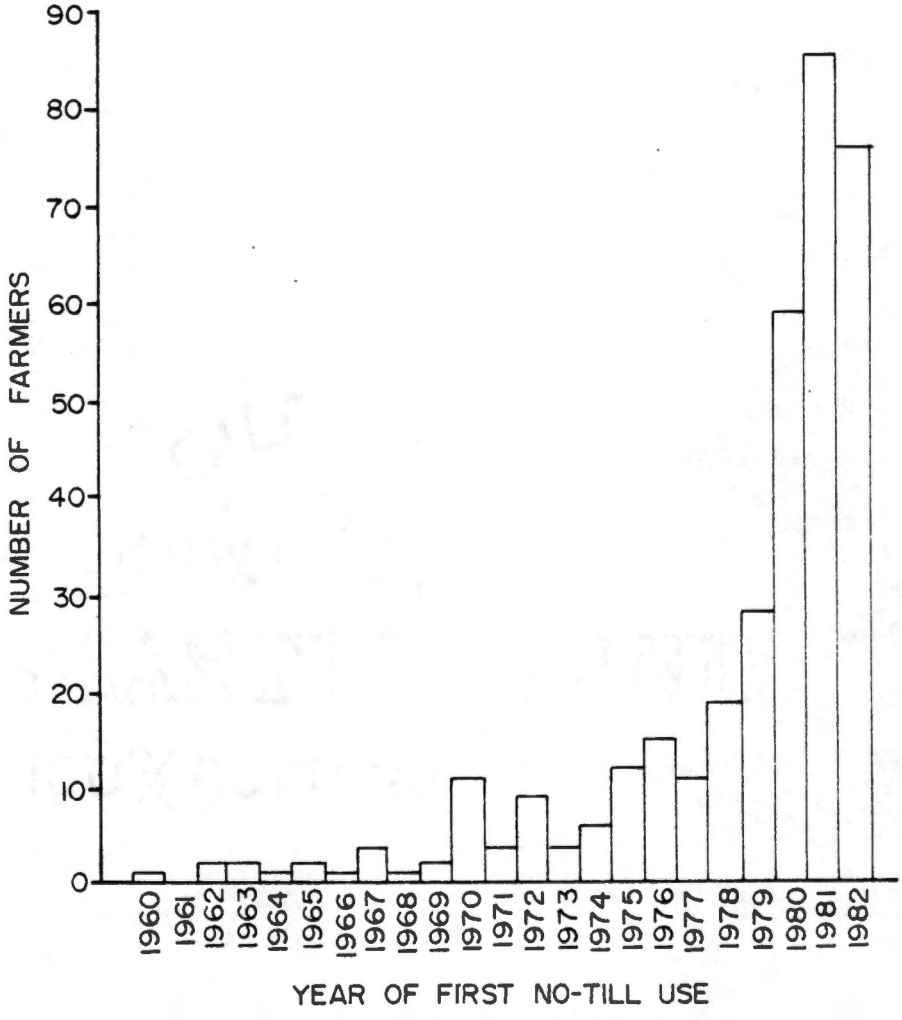


Figure 3. Bar graph showing the pattern of first no-till use by farmers attending West Tennessee Field Days in 1982.

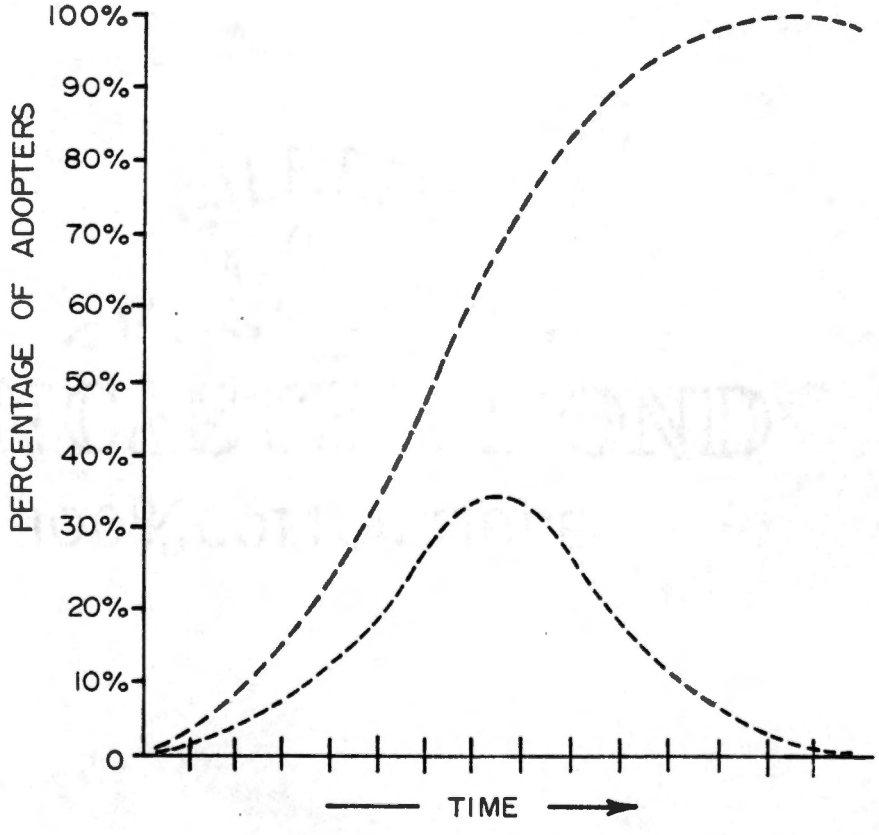


Figure 4. Graph showing the bell-shaped frequency curve and the S-shaped cumulative frequency curve based on a normal rate of adoption over time.

Rogers (1983) has identified five adopter categories based on the amount of innovativeness a farmer displays and on the existence of a normal distribution curve. These ideal types are 1) innovators, 2) early adopters, 3) early majority, 4) late majority, and 5) laggards. Figure 5 graphically represents the relationship between adopter categories and time of adoption based on the existence of a normal distribution (Rogers, 1983).

If the farmers surveyed at West Tennessee Field Days constituted a population, farmers who first used no-till in the 1960's could be classified as innovators. Those farmers whose first no-till use occurred in the early and mid 1970's could be classified as early adopters. Those farmers who first used no-tillage in the late 1970's and early 1980's could be classified as the early majority. Farmers who first used no-till in 1982 could be classified as the late majority and the farmers who never used no-till as laggards. Since those surveyed were undoubtedly more innovative than a fully representative sample these designations are not fully appropriate.

Acres planted in first year use. No-till acreage planted in the first or initial year use by the farmers generally increased over time. Acres planted ranged from 1 to 1,000 acres, but fifty percent of the farmers surveyed planted less than 65 acres in the first year of no-till use, while only 3 percent of the farmers planted 500 or more acres in their first use. Table 6 contains a summary of the average acreage planted in the first year use reported by the farmers surveyed.

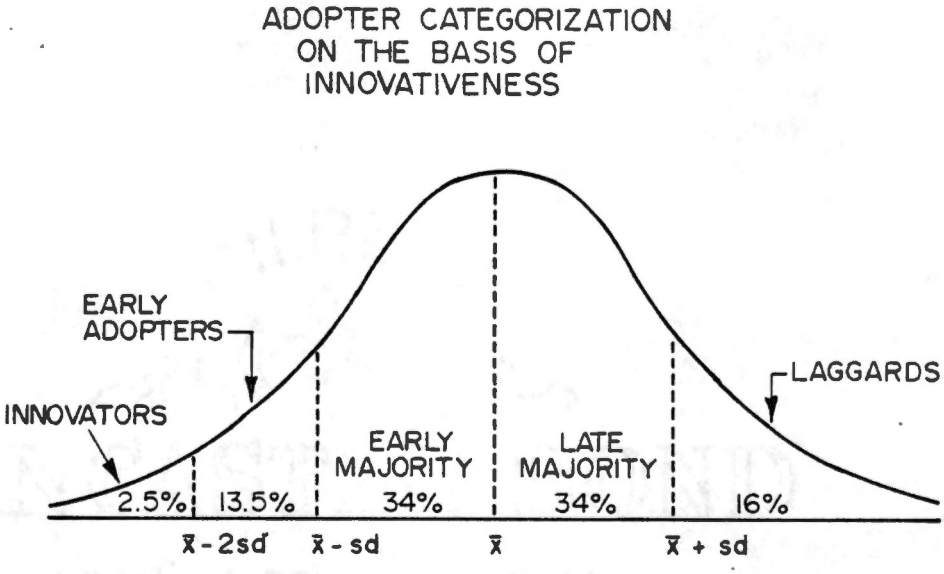


Figure 5. Graph showing the relationship between adopter categories and time of adoption based on the existence of a normal distribution.

Table 6. Average Acreage No-Till Planted in First Year Use by Farmers Attending Field Days in 1982

			No-till Acreage Planted in Year of First Use			
			Acreage			
	Number	Percent	Mean	Minimum	Maximum	Total Acreage
1960-1969[1]	15	4.2	84.1	1	600	1,262
1970-1974	32	9.1	72.2	2	300	2,310
1975-1979	85	24.1	87.0	5	800	7,396
1980-1981	145	41.1	133.7	6	1,000	19,392
1982	76	21.5	134.7	10	800	10,239
All users	353	100.0	115.0	1	1,000	40,599

[1]In 1969 one farm operator reported 600 acres of no-till crops planted in first year use. If this acreage was not included the mean acres planted by farmers using no-till for the first time in 1960-1969 would be 47.3 acres.

Only 4.2% of farmers reported that their first no-till use occurred in the 1960's, and the average acreage planted in first year use was 84 acres. However, one farmer reported planting 600 acres by no-till in 1967 which substantially raised the average. If this acreage was not included the average acreage planted would be only 47 acres. Nine percent of the farmers surveyed reported their first no-till use occurred in the early 1970's, and the average acreage was

72 acres for those first planting from 1970-74. Twenty-four percent of farmers reported that their first no-till use occurred in the 1975-79 period, and the average first year acreage was 87 acres. Forty-one percent of farmers surveyed reportedly used no-till for the first time in 1980 or 1981, and the average planted was 134 acres or substantially greater than in earlier periods. Approximately 22 percent of the farmers reported their first no-till use occurred in 1982, and average acreage was 135 acres.

Comparison of average ratings given to total advantages and total disadvantages based on first year no-till use. Analysis of data comparing the mean scores given to total advantages and disadvantages by farmers based on first year no-till use showed that disadvantage ratings declined from the more recent users to earlier users in each of the first time periods (Table 7). Farmers using no-till for the first time in the 1960's gave the lowest average rating to the disadvantages, 13.0. However, they also gave the lowest average rating to the advantages, 18.5. Farmers, using no-till for the first time during the 1970's, gave the second lowest rating to the disadvantages, and the highest rating to the advantages. Farmers using no-till for the first time in 1982 gave the highest rating to total disadvantages, 15.7. The ratings of the advantage did not show a consistent pattern because the two lowest scores were for users in the 1960's and 1982 users. There was a systematic pattern of the difference in the scores with the least difference, 3.2, for the farmers first using no-till in

Table 7. Comparison of the Mean Scores for Total Advantages and Total Disadvantages Given by Farmers Based on the No-Till Use

Year of First No-till Use		Mean Score
1960-1969 (N=15)	Total advantages	18.5
	Total disadvantages	13.0
	Difference	5.5
1970-1974 (N=32)	Total advantages	19.8
	Total disadvantages	14.3
	Difference	5.5
1975-1979 (N=85)	Total advantages	19.7
	Total disadvantages	14.5
	Difference	5.2
1980-1981 (N=145)	Total advantages	19.0
	Total disadvantages	15.5
	Difference	4.5
1982 (N=76)	Total advantages	18.9
	Total disadvantages	15.7
	Difference	3.2
Never Users (N=156)	Total advantages	18.5
	Total disadvantages	17.2
	Difference	1.3

1982 and the most difference 5.5, for those using no-till initially in the 1960's and 1970-74 periods.

Crops and Use of No-Tillage Agriculture

Farmers were asked to provide information on their farm operation including type and acreage of crops grown and the percentage, if any, that were planted by no-tillage. Table 8 contains a summary of the information provided.

Total acreage reported by the 509 farmers surveyed was 444,673 acres and acreage ranged from 28 to 7,450 acres. Average farm size was 873.6 acres. A total of 360,396 acres was suitable for no-till use and 73,154 acres were reportedly planted by no-tillage. This was 20.3% of the suitable acres.

Eighty-one percent of the farmers surveyed reported planting a total of 149,505 acres of double crop soybeans and wheat. The average acreage planted was 294 acres. Sixty-five percent of these farmers reported that they planted a portion of their double crop by no-till. Average no-till acres planted was 115. Double-cropped soybeans and wheat appeared to be the area where the major no-till acceptance has occurred. Thirty-nine percent of the total double-cropped soybeans and wheat was planted using no-till by the farmers surveyed. This compares to only 4 percent of 130,506 acres of single crop soybeans which was no-till planted. Farmers growing single crop soybeans and single crop wheat appeared to be slow in their no-till use.

A total of 44,320 acres of corn was reported and average acreage planted was 87 acres. Only 15.5% of the corn was planted by no-till.

Table 8. Summary of Crops Grown by Farmers Attending Field Days in 1982

Crops	Farmers with enterprise (N=509)		Farmer that used no-till (N=509)		Acres Operated in 1982		No-Till Acres in 1982	
	Number	Percent	Number	Percent	Total	Mean	Total	Mean
Double crop								
Soybeans and Wheat	414	81.3	269	65.0	149,505	293.7	58,485	114.9
Single crop								
Soybean	365	71.7	38	10.4	130,506	265.3	5,316	10.4
Wheat	138	27.1	7	5.1	21,606	42.4	800	1.6
Corn	282	55.4	68	24.1	44,320	87.1	6,882	15.5
Sorghum	101	19.8	15	14.9	14,459	28.4	1,671	3.3
Cotton	134	26.3	-	-	35,469	69.7	-	-
Hay & Pasture	231	45.4	-	-	48,808	95.9	-	-
Total Acres	509	100.0	299	58.7	444,673	873.6	73,154	143.7
Acres Suitable for No-Till Use	509	100.0	299	58.7	360,396	708.0	73,154	143.7

Use of no-tillage for planting corn appeared to be increasing. Grain sorghum was grown on 20 percent of the farm operations. Approximately 12 percent of the grain sorghum acreage was no-till planted.

Size of Farm Operation and Use of No-Tillage Agriculture

Research has linked use of conservation tillage to size of farm operation (Bulkna and Hoiberg, 1983). Large farm operators reportedly used and adopted new technology earlier (Rogers, 1983). Analysis based on no-till use and number of acres operated showed this relationship existed for the farmers surveyed. Continued users operated the largest farms, and average size was 997 acres. This compares to an average of 734 acres operated by never users and 756 acres by discontinued users. The average acreage for first year users was 883 acres. Table 9 contains a comparison of acreage operated and no-till use.

Comparison of average farm size and no-till use. Analysis was also conducted on categorized data based on average farm size. Thirty-five percent of the farmers surveyed reportedly operated farms with less than 500 acres. Farm size reported by 32 percent of the farmers surveyed was between 500 acres and 1,000 acres. Thirty-three percent of farmers surveyed had farm operations containing 1,000 acres or more.

Approximately 60 percent of small farm operators reported no-till use (see Table 10). The average number of acres planted in the initial year was 72 acres. In 1982 small farm operators planted a

Table 9. Comparison of No-Till Use Based on an Acreage Operated by Farmers in Different No-Till User Categories

User Categories	Mean	Total	Mean	Total	Percent of Suitable Acreage
Discontinued Users (n=54)	756.3	40,838	--	--	--
Never Users (n=156)	734.1	114,525	--	--	--
First Year Users (n=76)	882.6	67,079	138.7	10,539	20.6
Continued Users (n=223)	996.6	222,231	280.8	62,615	32.8
Total	873.6	444,673	143.7	73,154	20.3

[1]A total of 360,396 acres of the total acreage reported by farmers attending field days in 1982 was suitable for no-till planting.

Table 10. Comparison of No-Till Use and Farm Size Reported by Farmers Attending Field Days in 1982

Total Farm Size[1]	No-Till Users[2]		Mean No-Till Acres Planted[3]	1982 No-Till Acreage		Percent of Suitable Acreage[3]
	Total	Percent	First Use	Mean	Total	
Small Farm Operation (n=177) 1-499 acres	106	59.9	71.6	48.4	8,559	22.1
Medium Sized Farm (n=164) Operation 500-999 acres	117	71.3	101.0	138.2	22,669	23.3
Large Farm Operation (n=168) 1,000 or more acres	130	77.4	163.0	249.6	41,926	18.7
Total (n=509)	353	69.4	115.0	143.7	73,154	20.3

[1]Total farm size included all acreage operated by the farm operators.

[2]Includes all farmers with previous no-till use including discontinued users.

[3]A total of 360,396 acres of the total acreage was suitable for no-till planting.

[4]Average farm size reported in the 1982 Census of Agriculture for counties in West Tennessee was 225 acres.

total of 8,559 no-till acres. This was 22.1% of the total acreage suitable for no-till use and average no-till acres planted was 48.4 acres for all farmers in the small farm category.

Seventy-one percent of the medium sized farm operations had previously used no-till. The average acreage planted in the initial year of use was 101 acres. In 1982 a total of 22,669 acres was no-till planted by medium sized farm operators which was 23.3% of the total acreage suitable for no-till use for all medium sized farm operators. Average no-till acreage was 138 acres for these operators.

Approximately 77 percent of large farm operators had used no-till, and they planted an average 162 acres by no-till in their first year of use. This was the largest acreage planted in first use. Large farm operation planted a total 41,926 no-till acres in 1982. This was only 18.7% of the acreage suitable for no-till use for all large sized farm operations. While the highest percentage of no-till users were located in the large farm operators category, the large farm operators had the lowest percentage of their total acreage suitable for no-till use planted by no-tillage in 1982.

Comparisons of average ratings given to total advantages and total disadvantages based on farm size. A comparison of the ratings given for total advantages and disadvantages based on size of farm operation is shown in Table 11. Average ratings given to total advantages and total disadvantages by small farm operators and large farm operators were almost identical. On the other hand, medium sized farm

Table 11. Comparison of the Mean Scores for Total Advantages and Total Disadvantages by Farmers Based on Their Reported Farm Size

Farm Size	Mean Score	
Small Farm Operators (n=177) 1-499 acres	Total Advantages	18.9
	Total Disadvantages	15.8
	Difference	3.1
Medium Sized Farm Operators (n=164) 500-999 acres	Total Advantages	19.2
	Total Disadvantages	15.5
	Difference	3.7
Large Farm Operators (n=168) 1,000 Or more acres	Total Advantages	18.9
	Total Disadvantages	15.9
	Difference	3.0
All Categories (n=509)	Total advantages	19.0
	Total Disadvantages	15.7
	Difference	3.3

operators gave slightly higher ratings to total advantages and slightly lower ratings to total disadvantages than farmers in other two categories although difference was not meaningful. Average size of farm operation was not systematically associated with farmers ratings on advantages or disadvantages.

Land Tenure and Use of No-Tillage Agriculture

Data on land tenure practices were collected and analyzed. Seventy-five percent of the 509 farmers surveyed owned and leased their farm operation. Approximately 18 percent of farm operations were fully owned while less than 8 percent of farmers leased their entire farm operation. Table 12 contains a comparison no-till use with type of land tenure.

A total of 56,817 acres was farmed by full owners and average operation size was 618 acres which was the lowest of all three tenure categories. Seventy-six percent of the full owners had previous no-till use which was the highest of any tenure category. The average acreage planted in first year use was 92 acres. Thirty percent of their total suitable acreage was no-till planted in 1982 which was the highest of the three tenure categories.

Sixty-nine percent of farmers who owned and leased acreage had used no-till. The average acres planted in first year use was 121 acres. Average operation size by owners with leased acreage was 940 acres which was the highest of the three tenure categories. However, less than 20 percent of the total suitable acreage was no-till planted by the farmers who owned and leased land.

Table 12. Comparison of No-Till Use and Type of Land Tenure Reported by Farmers Surveyed at Field Days in 1982

Type of Tenure	1982 Total Acres		Previous No-Till Users[1]			1982 No-Till Acres		
	Mean	Total	Number	Percent	Acres Planted First Year Use	Mean	Total	Percent of Suitable Acres
Full owners (n=92)	617.6	56,817	70	76.1	91.6	137.3	12,626	30.0
Owners with leased acreage (n=379)	940.3	356,389	262	69.1	121.0	151.5	57,406	19.6
Full renters (n=38)	828.1	31,467	21	55.3	122.8	82.2	3,122	12.3
Total (n=509)	873.6	444,673	353	69.4	115.0	143.7	73,154	20.3

[1]Computed on all farmers with previous no-till use including discontinued use.

Approximately 55 percent of the renters had used no-till. Average acreage planted was 123 acres during the initial year of use. A total of 31,467 acres was operated by farmers who fully leased or rented their operation, and average size of operation was 828 acres. A total of 3,122 acres, or 12.3% of the suitable acreage, was no-till planted by full renters, which was the lowest of the three tenure categories.

Comparison of ratings given for total advantages and disadvantages based on type of tenure is shown in Table 13. Only slight differences occurred with full owners having the greater difference in ratings and full renters the smallest. This pattern was consistent with level of use of no-till by tenure classification.

Education and Use of No-Tillage Agriculture

Data on education reported by farmers surveyed at West Tennessee Field Days were analyzed. Years of education ranged from 2 to 18 years. The average educational attainment was 13.2 years. Approximately 57 percent of the farmers surveyed reported 12 years of education or less. Thirty-eight percent of farmers reported some college education. Eighteen years of education was reported by 2 percent of the farmers surveyed.

Higher education has been linked to greater change agent contact, innovativeness, and earlier adoption (Rogers, 1983). Table 14 contains a comparison based on education reported and no-till use. Average educational attainment was similar for discontinued users, never users, and continued users. Years of education reported by

Table 13. Comparison of the Mean Scores for Total Advantages and Total Disadvantages by Farmers Based on Type of Land Tenure

Type of Tenure	Mean Score	
Full owners (n=92)	Total Advantage	19.2
	Total Disadvantage	15.1
	Difference	4.1
Owners with lease (n=379)	Total Advantage	18.9
	Total Disadvantage	19.2
	Difference	3.1
Full renters (n=38)	Total Advantage	19.2
	Total Disadvantage	16.4
	Difference	2.8
All categories (n=509)	Total Advantage	19.0
	Total Disadvantage	15.7
	Difference	3.3

Table 14. Comparisons of No-Till Use and Years of Education Reported by Farmers Attending Field Days in West Tennessee in 1982

User Categories	Mean Year of Education	Years of Education	
		Minimum	Maximum
Discontinued User (n = 54)	13.4	10	18
Never User (n = 156)	13.2	2	18
First Year User (n = 76)	12.6	4	18
Continued User (n = 223)	13.2	6	18
Total (n = 509)	13.2	2	18

first year users were slightly lower than years of education reported by farmers in the other user categories and discontinued had the highest mean year of education although all differences were slight showing no real relationship.

Information on year of first no-till use and education was also compared (Table 15). Farmers reporting first no-till use in the 1960's reported the highest average years of education, 14.0. The lowest average education attainment was reported by first year users, 12.6. However, no statistically significant relationship existed between educational attainment and years of no-till use.

Table 15. Comparisons of Year of First No-Till Use and Years of Education Reported by Farmers Attending Field Days in West Tennessee in 1982

First year no-till use	Education Years	Range	
		Minimum	Maximum
1960 - 1969 use (n = 15)	14.0	10	18
1970 - 1974 use (n = 32)	13.0	9	17
1975 - 1979 use (n = 85)	13.5	6	17
1980 - 1981 use (n = 145)	13.3	8	18
1982 use (n = 76)	12.6	4	18
Never used (n = 156)	13.2	2	18
Total (n = 509)	13.2	2	18

CHAPTER V

CONCLUSION AND IMPLICATIONS

Diffusion researchers have traditionally regarded all innovations as equivalent units from the viewpoint of study and analysis (Rogers, 1983). Research has been centered on determining the characteristics of different adopter categories rather than how properties of an innovation affect its rate of adoption (Rogers, 1983). However, all innovations are not equivalent units and the way that farmers perceive the attributes of the innovation will affect its rate of adoption. Adoption of no-till agriculture has been affected by farmers' perceptions of the advantages and disadvantages associated with no-till use. No-till agriculture can largely eliminate soil erosion and reduce labor and energy requirements for crop production. However, no-till use requires more management ability, higher chemical costs, and more intensive chemical use.

The relative advantage, compatibility, complexity, trial ability, and observability are characteristics used by farmers to evaluate a new technology. Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes (Rogers, 1983). The relative advantage of no-till use versus conventional tillage use appears to be a function of 1) the importance placed on soil conservation by the farmers and 2) whether or not the farmer believes that benefits of no-till use outweigh the costs. Compatibility is the

degree to which an innovation is perceived as consistent with existing values, past experience, and needs of the receivers (Rogers, 1983). Use of cleanly tilled fields is a time-tested means of controlling many problems associated with crop production, including fertilizer distribution, pest control, and weed control problems. Therefore, no-till use is perceived as risky while conventional tillage has been proven a successful means of row crop production. Complexity is the degree to which an innovation is perceived as relatively difficult to understand and use (Rogers, 1983). No-till is a complex technology that must be constantly adapted to the changing environment. Trialability is the degree to which an innovation may be experimented with on a limited basis (Rogers, 1983). Trial use of no-till can either be expensive--if the farmer buys the equipment--or inconvenient--if the farmer borrows or rents the equipment. Observability is the degree to which the results of an innovation are visible to others (Rogers, 1983). Reduced erosion is not easily observable because a farmer cannot look at a field and measure inches of topsoil lost or retained which is a major difficulty.

Analysis of data obtained at three West Tennessee field days in 1982 indicated that for the farmers surveyed there was a relationship between their perceptions of advantages and disadvantages and no-till use. Ratings given to a list of sixteen advantages and disadvantages associated with no-till use reflected the attitudinal differences found between farmers in different user categories. Most farmers, regardless of no-till use, appeared to believe in the conservation

benefits associated with no-till use. Reduction of soil erosion and conservation of future soil productivity were the items most frequently rated as major no-till advantages. However, farmers' perceptions of other advantages appeared to have more potential to influence continued no-till use. These items were 1) improved timeliness in planting and harvesting, 2) increased moisture retention, 3) reduced labor requirements, and 4) reduced fuel costs. Farmers did not believe that no-till would increase yields.

Although farmers gave no-till advantages somewhat higher ratings of importance, the associated disadvantages appeared to have more influence on farmers' use, non-use or continued use of no-till. Weed and grass control problems appeared to have the most potential to affect no-till use. Other items that influenced no-till use were 1) yield variability, 2) spray residues, 3) necessity of keeping conventional planting equipment, 4) more difficult to manage, and 5) cost of no-till equipment. Increased chemical cost was the most frequently rated disadvantage of no-till use, but it did not appear to influence farmers' no-till use, non-use, or continued use.

Personal experience with no-till appeared to have the most influence on how farmers perceived attributes of no-till agriculture. Trial use appeared to occur when a farmer perceived the advantages associated with no-till use as greater than the risks associated with the disadvantages. Discontinuance seemingly occurred when the farmer believed that the benefits and the costs of no-till use were no better

than equal. Continued no-till use occurred if the farmer perceived the benefits as greater than the costs.

Not only did rating differences occur for individual characteristics of no-till, but the scores given to total advantages and disadvantages reflected differences based on no-till use. The farmers who discontinued no-till use had the lowest rating of total advantages and the highest rating of total disadvantages. Ratings given to the disadvantages were similar for farmers who had never used no-till and farmers who discontinued use. Somewhat surprising, the ratings given no-till advantages were similar for non-users and first year users. This indicates possible future use by non-users. Continued users gave the highest rating to total advantages and the lowest rating to total disadvantages of the four user categories studies.

Ratings given to the importance of the advantages increased with use, while the importance given to the disadvantage decreased. Farmers using no-till for the first time in the 1960's and 1970's gave the most favorable ratings and had the highest percentage of available acreage planted using no-tillage. Experience apparently enabled farmers to minimize the problems associated with no-till use.

The relationship for ratings and higher no-till use were shown to exist for size of farm operation and type of land tenure. Small farm operators and large farm operators gave similar ratings to total advantages and disadvantages. Medium-size farm operators gave a slightly more favorable rating and had higher no-till use. Ratings given by full owners were more favorable than owners with leased acreage

or full renters. Full owners also had the highest percentage of available acreage planted by no-till.

No-till agriculture is primarily a preventive innovation and has been promoted as a means of controlling erosion since the 1950's. However, analysis of farmer use and their perceptions of the advantages and disadvantages associated with no-till, indicates that programs seeking to increase use of no-till agriculture should direct their efforts at providing farmers with information that would enable them to minimize the difficulties associated with no-till use rather than at promotion of improved conservation. This has been suggested by other researchers including Nowak (1983) in his study of why farmers use or do not use conservation tillage practices.

Preventive innovations have traditionally shown a slow rate of adoption (Rogers, 1983). Analysis of data taken at field days in West Tennessee in 1982 confirmed this slow rate of no-till adoption. The earliest no-till use reported was four acres planted in 1960; however, 69 percent of no-till use reported occurred during the 1980-82 period. Further, no-till use was clearly in the decision and implementation stages rather than in the confirmation stage for the majority of the farmers surveyed. Only 19 of 223 continued users reported planting all of the suitable acreage by no-tillage in 1982.

Seventy-six farmers were using no-till for the first time and fifty-four farmers had discontinued use. However, no data was taken to determine if the discontinuance was temporary or permanent. A total of 156 farmers had never used no-tillage. No direct measurement

was taken to determine if farmers planned to use or increase use of no-till in the future. Analysis based on the information given by the farmers surveyed indicated that the number of farmers using no-till had increased dramatically in the 1980's. Less than 3 percent of the farmers surveyed reported no-till use in the 1960's. While 15 percent reported using no-till for the first time in 1982. Data also confirmed that the number of acres planted in the first year use increased over time for most continued users. Further, farmers using no-till in the 1960's planted an average of 84 no-till acres compared to 135 no-till planted by 1982 users. A total of 73,134 acres was no-till planted in 1982 by the farmers surveyed which was 20.3% of the land suitable for no-till use for all the farmers surveyed.

Farmers attending West Tennessee field days in 1982 reported an average educational attainment of 13.2 years. Thirty-eight percent of the farmers surveyed reported some college training. No statistically significant relationship existed between educational attainment and no-till use for the farmers surveyed.

Relationship between size of farm operation and no-till use was statistically significant. Continued users had farm operations that averaged 997 acres. This compared to average farm size of 734 acres for non-users.

The area where no-till use appears to have greatest acceptance is double-crop soybeans and wheat. The potential to increase productivity through double-cropping was cited as a no-till advantage by Phillips, et al. (1980). Thirty-nine percent of all double-crop

soybeans and wheat was no-till planted. This compares to only four percent of the single crop soybeans and single crop wheat acreage. Use of no-till planting for corn appears to be gaining acceptance among the farmers surveyed.

The survey participants undoubtedly held more favorable views toward no-till agriculture and greater use than a fully representative sample of West Tennessee farmers. Further research is needed to determine if similar no-till use patterns exist in a representative sample. Also, more in-depth study is needed to test the relationship between farmers' perceptions of attributes of no-till agriculture and their no-till use.

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APPENDIXES

APPENDIX A

Appendix A contains a description of basic land and resource data for West Tennessee

Basic Land Resource Data

West Tennessee contains 6.8 million acres of total land area (Operation SOS, 1980). Of this, in 1974 approximately 4.5 million acres was in farmland. By 1980 the amount of farmland had been reduced to 4.3 million acres.

West Tennessee contains approximately 3.5 million acres of cropland used primarily to grow soybeans, wheat, corn and cotton. Soybeans are Tennessee's leading cash crop. Tennessee soybean production in 1982 was 63,450,000 bushels from 2.35 million acres with a value of almost $349 million (Tennessee State Rural Development Committee, 1983). Of this, $279 million were grown in West Tennessee.

Erosion exceeded 15 tons per acre per year on over 1.4 million acres of West Tennessee cropland. It is estimated that soil loss from all land in Tennessee is about 116.2 millions tons annually, of which approximately 58 percent occurs in West Tennessee (Tennessee State Rural Development Committee, 1983).

Figure 6 contains a bar graph comparing the importance of West Tennessee acreage to the state as a whole. In 1980, 77% of the soybeans acres were located in West Tennessee. In 1981 this had increased to 78% of the soybean acres. West Tennessee had 63% of the wheat acreage in 1980 and 68% of the wheat acreage in 1981. West Tennessee also contained 47% of the corn acreage and 97% of the cotton acreage (Tennessee State Rural Development Committee, 1983).

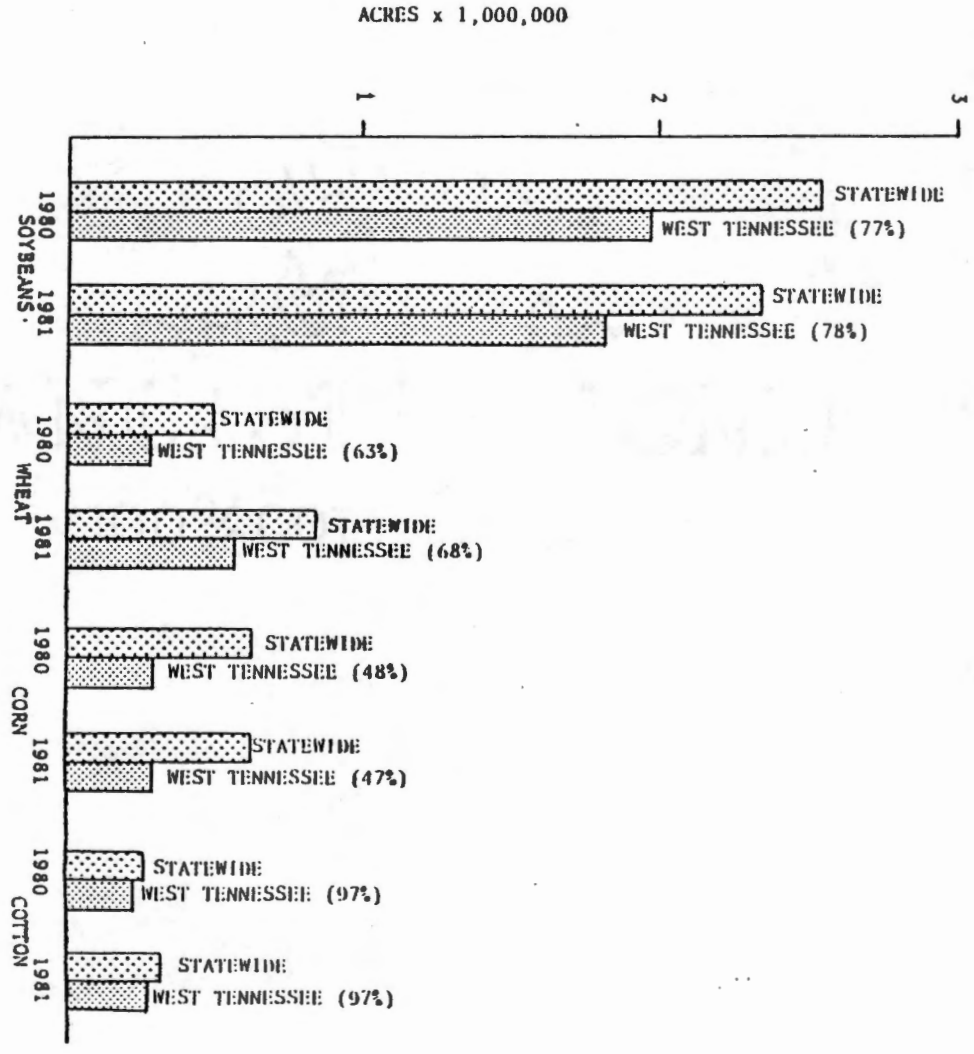


Figure 6. West Tennessee importance to Tennessee agriculture.

APPENDIX B

Appendix B contains data analysis of attendance at Jackson, Milan, and Ames Plantation field days based on counties.

Data Analysis Based on County Data

A total of 513 usable observations made up a data set composed of information collected at the Jackson, Milan, and Ames Plantation field days. Of this, a total of 64 farm operations from 20 counties was represented at the Jackson Agricultural Field Day. Figure 7 contains a map showing the number of farm operations by county and the number of those operations with previous no-tillage use. Eleven of the 64 farm operations were in Madison County, the location of the experiment station. Fayette and Henderson Counties had the next highest attendance with 7 farm operations each. In 9 out of the 20 counties, all of the farms represented had utilized no-tillage practices.

Of the 64 farm operations present at Jackson, 41 (64.0%) had used no-till in the past (Table 16). The total Tennessee acreage operated by farmers interviewed at the Jackson Field Day was 46,823 acres.* The average farm size was 732 acres. The number of acres operated ranged from 60 acres to 2,995 acres. A total of 38,024 acres was suitable for no-tillage use and 5,172 acres (13.6%) was planted by no-till methods. Seven of the counties had no acreage planted by no-till methods.

A total of 302 farm operators from 51 Tennessee counties were interviewed at the Milan Agricultural Field Day. Figure 8 contains a

*One farm operator from Mississippi completed the survey form at the Jackson Agricultural Field Day.

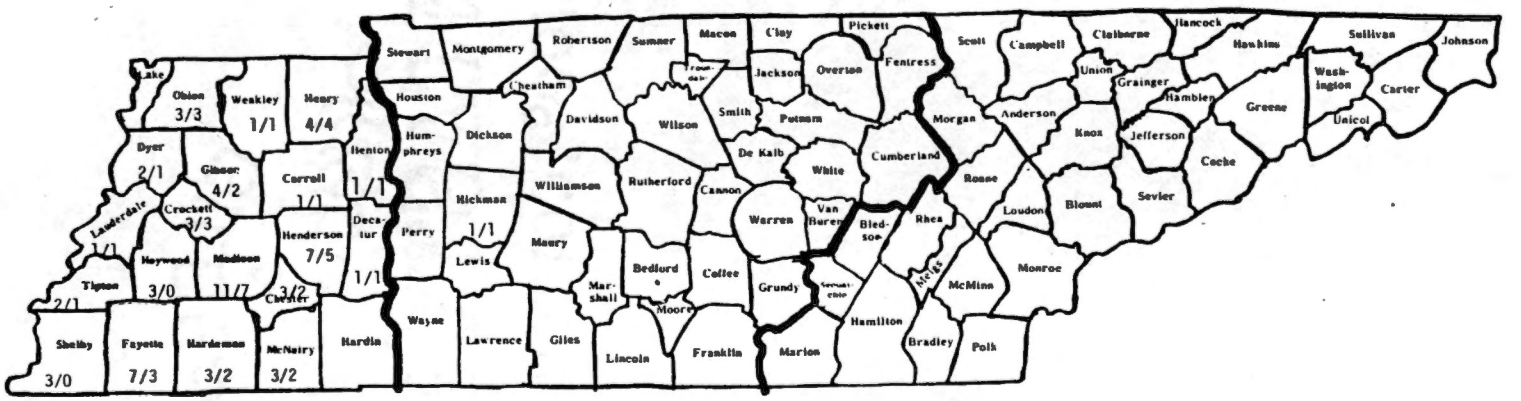


Figure 7. Summary of attendance at the Jackson Agricultural Field Day showing the number of farm operations per county and the number of farms with previous no-tillage use.*

*a/b where a = number of farm operations per county
b = number of farm operations with no-till use per county.

Table 16. Summary of Attendance by County at Jackson Field Day in 1982

County Name	Number of farm operations represented	Total acreage per county	Mean farm size (acres)	Acreage Range		Number of farm operations with previous No-tillage use	Acres suitable for No-tillage use	Total acres planted by No-tillage	Percent of suitable acres planted by No-tillage
				Minimum	Maximum				
Carroll	1	570	570	-	-	1	500	50	10.0
Chester	3	1,538	513	125	1,163	2	1,538	0	0
Crockett	3	1,855	618	480	750	3	1,365	220	16.1
Decatur	1	115	115	-	-	1	85	0	0
Dyer	2	1,830	915	480	1,350	1	1,770	0	0
Fayette	7	6,440	920	60	3,100	3	4,585	655	14.3
Gibson	4	2,454	613	274	1,175	2	1,709	275	16.1
Hardeman	3	2,243	748	493	1,250	2	1,235	650	52.6
Haywood	3	5,810	1,937	115	2,995	0	5,185	0	0
Henderson	7	4,499	643	212	1,470	5	3,597	217	6.0
Henry	4	3,160	790	70	1,600	4	2,760	880	31.9
Hickman	1	330	330	-	-	1	330	180	54.5
Humphreys	1	420	420	-	-	1	400	200	50.0
Lauderdale	1	518	518	-	-	1	468	0	0
Madison	11	4,781	435	28	1,250	7	3,882	185	4.8
McNairy	3	1,607	536	190	1,167	2	1,567	800	51.0
Obion	3	1,698	566	150	1,275	3	1,548	765	49.4
Shelby	3	2,530	843	630	1,100	0	2,000	0	0
Tipton	2	4,180	2,090	1,430	2,750	1	3,405	0	0
Weakley	1	245	245	-	-	1	95	95	100.0
Totals	64	46,823	X_T = 731.6			41	38,024	5,172	13.6

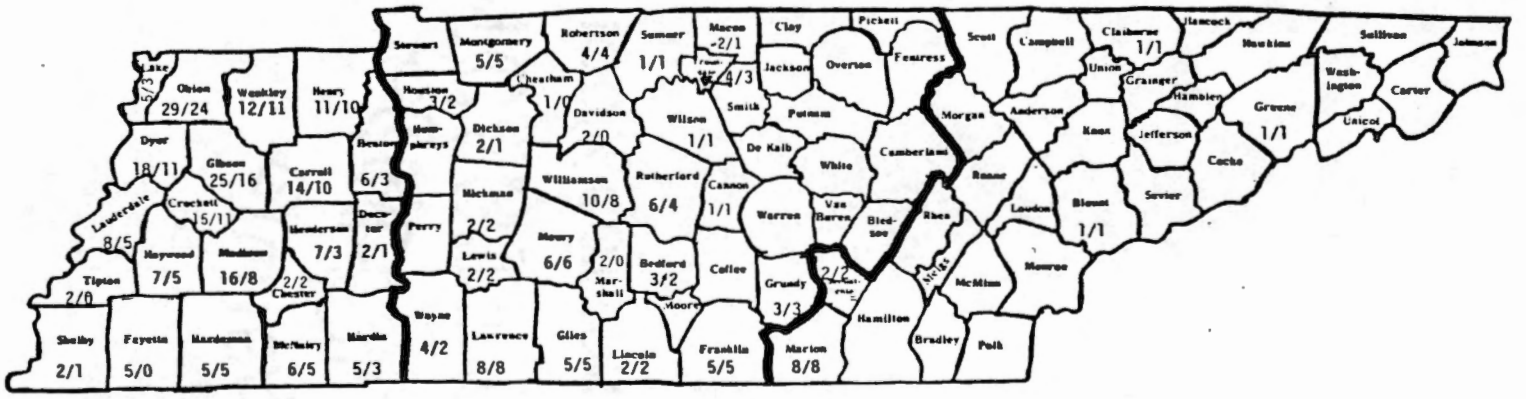


Figure 8. Summary of attendance at the Milan Agricultural Field Day showing the number of farm operations per county and the number of farms with previous no-tillage use.*

*a/b where a = number of farm operations per county
b = number of farm operations with no-till use per county.

map showing the number of farm operations per county and the number of those operations with previous no-tillage use. Sixteen farm operators interviewed were from six East Tennessee counties. All 16 farm operators had previously used no-tillage agriculture. Eighty-four (27.8%) of the 302 farm operations represented were located in 24 Middle Tennessee counties. In 12 of these Middle Tennessee counties all the farm operators had previously used no-till. The remaining 202 farm operations were in 21 West Tennessee counties. In two of these West Tennessee counties all the farm operators reported using no-till.

A pattern was formed by farmers attending the field days. The greater the distance traveled to attend the field day the more likely the farm operator was to have previously used no-till planting on their farm operation. This pattern was also found at the Jackson and Ames Plantation Field Days.

Operators of the 302 farm operations interviewed at the Milan Field Day, 227 (75.2%) had previously used no-tillage agriculture (Table 17). A total of 251,500 acres was operated by Tennessee farmers interviewed at the Milan Field Day*. The average farm size was 833 acres. The size of farm operations ranged from 40 acres to 7,450 acres. A total of 207,377 acres was suitable for no-till use. Of this, 45,510 acres (21.9%) were planted by no-till methods.

Nineteen farm operators interviewed at the Milan Agricultural Field Day gave no county of residence. Total acreage operated by those

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*Seventy-nine out of state farm operators completed survey forms at the Milan Field Day.

Table 17. Summary of Attendance by County at Milan Field Day in 1982

County name	Number of farm operations represented	Total acreage per county	Mean farm size (acres)	Acreage Range		Number of farm operations with previous No-tillage use	Acres suitable for No-tillage use	Total acres planted by No-tillage	Percent of suitable acres planted by No-tillage
				Minimum	Maximum				
Bedford	3	2,265	755	150	1,195	2	2,215	650	29.3
Benton	6	5,548	925	550	2,145	3	3,348	420	12.2
Blount	2	1,090	545	425	665	2	915	435	47.5
Cannon	1	130	130	-	-	1	70	70	100.0
Carroll	14	13,219	944	58	3,000	10	11,208	1,523	13.6
Cheatham	1	450	450	-	-	0	450	0	0.0
Chester	2	1,493	747	615	878	2	1,203	221	18.4
Claiborne	1	2,970	2,970	-	-	1	2,570	50	2.0
Crockett	15	11,894	793	40	2,200	11	6,469	1,796	27.8
Davidson	2	988	494	318	670	0	538	0	0.0
Decatur	2	415	208	175	240	1	235	0	0.0
Dickson	2	560	280	230	330	1	410	135	32.9
Dyer	18	14,365	798	150	2,110	11	13,075	1,788	13.7
Fayette	5	2,942	588	57	1,145	0	1,597	0	0.0
Franklin	5	2,280	456	145	1,225	5	1,970	487	24.7
Gibson	25	20,151	806	190	2,100	16	17,126	3,293	19.2
Giles	5	5,265	1,053	650	1,450	5	4,965	1,205	24.3
Greene	1	247	247	-	-	1	247	60	24.3
Grundy	3	1,800	600	175	1,000	3	1,450	900	62.0
Hardeman	5	4,332w	886	240	2,065	5	3,290	600	18.2
Hardin	5	4,994	999	192	3,400	3	4,284	552	12.8
Haywood	7	8,265	1,181	250	2,090	5	5,205	820	15.8
Henderson	7	3,121	446	295	670	3	2,351	201	8.6
Henry	11	7,777	707	70	2,550	10	7,677	3,472	45.2
Hickman	2	1,170	585	570	600	2	1,020	380	37.3
Houston	3	2,040	680	220	1,470	2	1,240	85	6.9
Lake	5	8,296	1,659	750	2,346	3	8,280	1,150	13.9
Lauderdale	8	6.098	762	200	1,250	5	5,728	1,530	26.7
Lawrence	8	7,675	959	180	1,850	8	7,667	1,675	21.8
Lewis	2	780	390	200	580	2	780	215	27.9

Table 17. (Continued)

County name	Number of farm operations represented	Total acreage per county	Mean farm size (acres)	Acreage Range		Number of farm operations with previous No-tillage use	Acres suitable for No-tillage use	Total acres planted by No-tillage	Percent of suitable acres planted by No-tillage
				Minimum	Maximum				
Lincoln	2	2,270	1,135	850	1,420	2	2,000	625	31.3
Macon	2	870	435	380	490	1	470	70	14.9
Madison	16	13,360	835	183	2,250	14	11,425	2,023	17.7
Marion	8	4,729	591	80	1,200	8	4,084	628	15.4
Marshall	2	4,640	2,320	2,000	2,650	0	4,000	0	0.0
Maury	6	4,501	750	535	1,210	6	3,701	1,475	39.9
McNairy	6	5,837	973	120	2,300	5	5,137	1,568	30.5
Monroe	2	1,745	873	445	1,300	2	1,335	515	38.6
Montgomery	5	5,107	1,021	666	1,430	5	4,007	1,301	32.5
Obion	29	23,286	803	72	1,800	24	20,055	6,672	33.3
Robertson	4	2,555	639	590	750	4	2,380	950	40.0
Rutherford	6	2,980	497	280	800	4	2,470	766	31.0
Sequatchie	2	1,270	635	370	900	2	1,070	450	42.0
Shelby	2	2,133	1,067	483	1,650	1	1,258	0	0.0
Sumner	1	65	65	-	-	1	65	16	24.6
Tipton	2	1,747	874	247	1,500	0	1,512	0	0.0
Trousdale	4	4,120	1,030	480	1,700	3	1,720	305	17.7
Wayne	4	3,520	880	260	1,700	2	2,220	380	17.1
Weakley	12	10,980	915	200	1,925	11	10,475	1,920	18.3
Williamson	10	12,400	1,240	105	7,450	8	9,945	2,083	20.9
Wilson	1	765	765	-	-	1	365	50	13.7
County Missing	19	12,184	614	100	2,150	18	9,824	3,647	37.1
Total	321	263,684	$\bar{X}_T$ = 821.5			245	217,201	49,157	22.6

farmers was 12,184 acres. The mean farm size was 614 acres. The size of farm operations ranged from 100 acres to 2,150 acres. Eighteen (94.7%) of the farm operators represented had previously used no-tillage. A total of 3,647 acres (37.1% of the suitable acres) was planted by no-till.

Representatives of 47 farm operations from 10 counties were interviewed at the Ames Plantation Field Day. Figure 9 contains a map showing the number of farm operations from each county and the number of these operations with previous no-tillage use. There were 21 farm operations from Fayette County and 7 farm operations from Hardeman County. The Ames Plantation Agricultural Experiment Station is located in these counties. Seven out of the 10 counties had farm operators with pervious no-till experience.

Of the 47, eighteen farm operators (38.2%) had previously used no-till (Table 18). Total Tennessee acreage operated by farmers interviewed at the Ames Plantation Field Day was 40,701 acres, and the mean farm size was 866 acres.* The number of acres operated ranged from 68 acres to 4,455 acres. A total of 27,368 acres was suitable for no-till planting. Of this, 1,943 acres (7.1%) was planted by no-till methods.

Eighty-one farmers from six states other than Tennessee were interviewed at West Tennessee field days. Figure 10 contains a map showing the number of farm operations per state and the percentage of

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*One farm operator from Mississippi completed the survey form at the Ames Plantation Field Day.

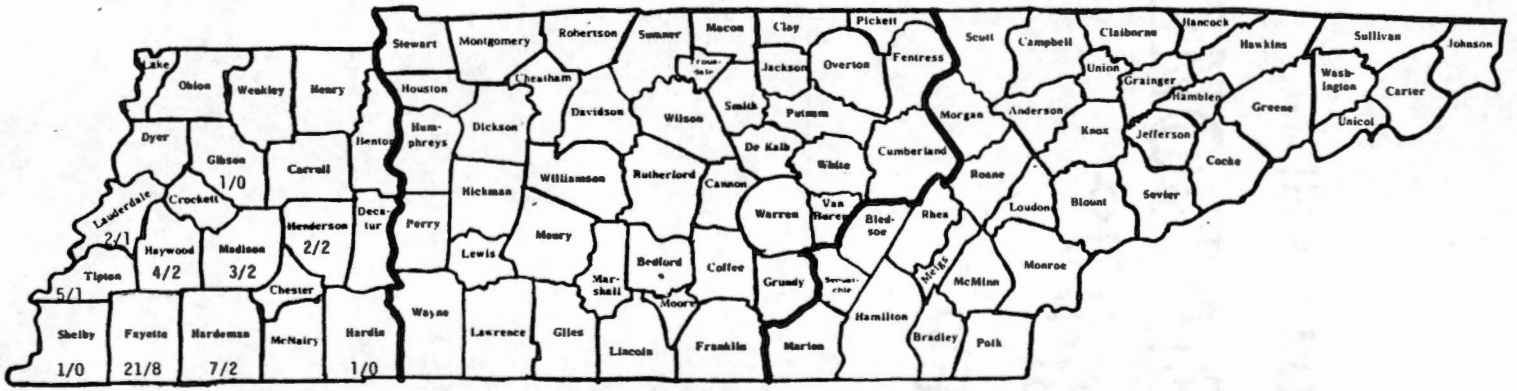


Figure 9. Summary of attendance at the Ames Plantation Agricultural Field Day showing the number of farm operations per county and the number of farms with previous no-tillage use.*

*a/b where a = number of farm operations per county
b = number of farm operations with no-till use per county.

Table 18. Summary of Attendance by County at Ames Plantation Field Day in 1982

County name	Number of farm operations represented	Total acreage per county	Mean farm size (acres)	Acreage Range		Number of farm operations with previous No-tillage use	Acres suitable for No-tillage use	Total acres planted by No-tillage	Percent of suitable acres planted by No-tillage
				Minimum	Maximum				
Fayette	21	16,688	795	68	4,455	8	11,835	628	5.3
Gibson	1	205	205	-	-	0	95	0	0.0
Hardeman	7	6,803	971	300	2,260	2	4,403	250	5.6
Hardin	1	1,500	1,500	-	-	0	1,500	0	0.0
Haywood	4	3,200	800	440	1,325	2	1,820	300	16.5
Henderson	2	2,055	1,028	1,025	1,030	2	325	0	0.0
Lauderdale	2	2,830	1,415	1,170	1,660	1	2,400	700	29.2
Madison	3	3,000	1,000	750	1,450	2	2,050	50	2.4
Shelby	1	920	920	-	-	0	740	0	0.0
Tipton	5	3,500	700	200	1,135	1	2,200	15	0.7
Total	47	40,701	$\bar{X}_T$ = 866	---	---	18	27,368	1,943	7.1

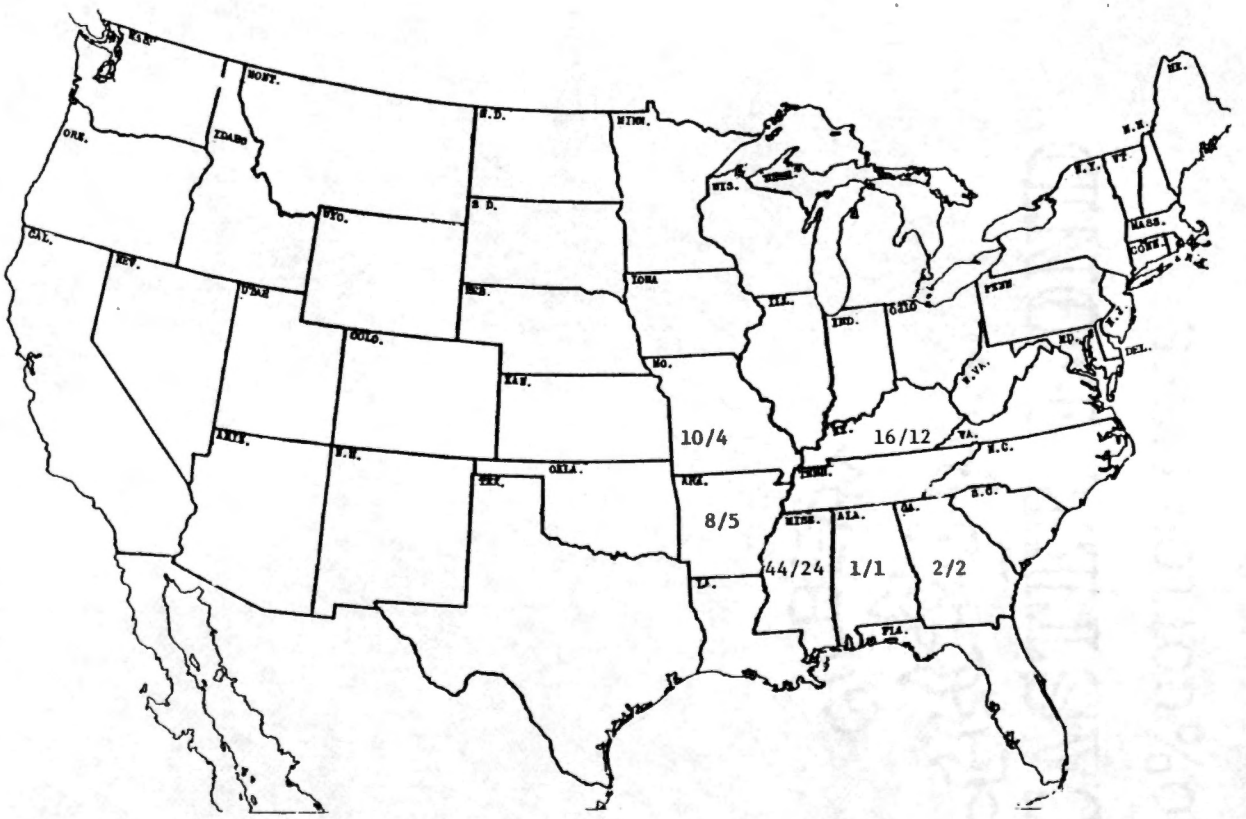


Figure 10. States that were represented by farmers at agricultural field days in West Tennessee showing number of farm operations and the number of farms with previous no-tillage use.*

*a/b where a = number of farm operations per county
b = number of farm operations with no-till use per county.

those farm operations with previous no-till use. Of the 81 farm operations, 44 were in Mississippi, 16 were in Kentucky, 10 were in Missouri, 8 were in Arkansas, 2 were in Georgia, and 1 was in Alabama. Total acreage operated by these farmers was 97,138 acres (Table 19). The average farm size was 1,199 acres. The number of acres operated ranged from 160 acres to 4,750 acres.

Of the 81 farmer operators, 48 (59.2%) had previous experience with no-tillage. A total of 78,225 acres were suitable for no-till use, and 17,137 acres (21.9% of the land suitable) was planted by no-tillage agriculture.

Table 19. Summary of Out of State Attendance at West Tennessee Field Days in 1982

County name	Number of farm operations represented	Total acreage per county	Mean farm size (Acres)	Acreage Range		Number of farm operations with previous No-tillate use	Acres Suitable for No-tillage use	Total acres planted by No-tillage	Percent of suitable acres planted by No-tillage
				Minimum	Maximum				
Alabama	1	2,450	2,450	-	-	1	2,000	500	25.0
Arkansas	8	9,102	1,138	160	2,300	5	6,762	2,640	39.0
Georgia	2	5,765	2,883	2,070	3,695	2	5,765	2,660	46.1
Kentucky	16	15,037	940	190	1,900	12	14,152	3,562	25.2
Missouri	10	10,540	1,054	200	3,000	4	9,260	2,020	21.8
Mississippi	44	54,244	1,233	113	4,750	24	40,286	5,755	14.3
Total	81	97,138	1,199	-	-	48	78,225	17,137	21.9

APPENDIX C

Appendix C contains an example survey form used in data collection.

SURVEY OF FARMERS ATTENDING THE AMES PLANTATION FIELD DAY
GRAND JUNCTION, TENNESSEE, AUGUST 12, 1982

The survey is conducted by the Tennessee Agricultural Experiment Station in order to learn about farmers' opinions on the use of no-tillage agriculture. Participation in the survey is voluntary. All information is confidential and only a summary of all farmers' answers will be made.

1. In your opinion how important are the following advantages of no-tillage planting compared to conventional tillage?

ADVANTAGES	CHECK ONE FOR EACH ITEM: Major adv.	Some adv.	Little or no adv.	Not true or correct
a. Reduced labor requirements	☐	☐	☐	☐
b. Reduced fuel costs	☐	☐	☐	☐
c. More intensive use of land	☐	☐	☐	☐
d. Improved timeliness of planting and harvesting	☐	☐	☐	☐
e. Increased yields	☐	☐	☐	☐
f. Increased moisture retention	☐	☐	☐	☐
g. Reduced soil erosion	☐	☐	☐	☐
h. Conserve future soil productivity	☐	☐	☐	☐

2. In your opinion how important are the following disadvantages of no-tillage planting compared to conventional tillage?

DISADVANTAGES	CHECK ONE FOR EACH ITEM: Major disadv.	Some disadv.	Little or no disadv.	Not true or correct
a. Weed and grass control problems	☐	☐	☐	☐
b. More precision in planting needed	☐	☐	☐	☐
c. Yield variability	☐	☐	☐	☐
d. Increased chemical costs	☐	☐	☐	☐
e. More difficult to manage	☐	☐	☐	☐
f. Spray residues	☐	☐	☐	☐
g. Necessity of keeping conventional planting equipment as well	☐	☐	☐	☐
h. Cost of no-till equipment	☐	☐	☐	☐

(OVER)

3. Indicate the usage pattern of no-tillage planting on your farm operation.

(CHECK ONE)

- ☐ - never used no-tillage planting
- ☐ - used no-tillage planting for first time in 1982
- ☐ - used no-tillage in past and continued its use in 1982
- ☐ - used no-tillage in past, but not in 1982

a. What year did you first use no-tillage planting? _____

b. How many acres did you plant by no-tillage the first year? _____

4. First, indicate the number of acres that you operate (owned and/or leased) in various crops in 1982. Second, indicate how many of these were planted by no-tillage method.

CROPS	1982 ACREAGE Planted by all methods	1982 ACREAGE Planted by no-tillage
a. Soybeans and wheat (double-crop)	_____	_____
b. Soybeans (single-crop only)	_____	_____
c. Wheat (single-crop only)	_____	_____
d. Corn	_____	_____
e. Grain sorghum	_____	_____
f. Cotton	_____	xxxx
g. Pasture and hay	_____	xxxx
TOTAL ACRES OPERATED	_____	xxxx

5. Background information

a. County of residence _____

b. Years of education _____

c. Land tenure category
- ☐ - own all land operated
- ☐ - own and lease land operated
- ☐ - lease all land operated

d. Primary occupation
- ☐ - farming
- ☐ - other

THANK YOU FOR YOUR COOPERATION

APPENDIX D

Appendix D contains a list and description of modified variables used in analysis.

List and Description of Modified Variables

Variable Name	Description
TADV	Sum of the scored values for the advantage of no-tillage
TDISADV	Sum of the scored values for the disadvantages of no-tillage
DADVDIS	Equals the difference between TADV and TDISADV
MODTACRE	Modified total acreage (to sum of acreage of crops planted)
SNTAC	Suitable acreage available for no-tillage (sum of soybean and wheat, soybeans, wheat, corn, and grain sorghum planted)
NTACRE	No-tillage acreage (to sum of number of no-tillage crops planted)
USE	Use of no-tillage (when farmers who discontinued use equals 0, never used equals 1, first used in 1982 equals 2, and use for 2 or more years equals 3)
USER	Use of no-tillage (when farmers who discontinued use and never used equals 0, and 1982 use and continual use equals 1)
FSIZE	Farm size (when 499 acres or less equals 0, 500-999 equals 1, and 1,000 acres or more equals 2)
YEAR	Year of first use of no-tillage (when 1960-1969 equals 0, 1970-1974 equals 1, 1975-1979 equals 2, 1980-1981 equals 3, and 1982 equals 4)

VITA

Cynthia Greenlee Hart was born in Knoxville, Tennessee, on February 9, 1958. She attended elementary school in Rutledge, Tennessee, and was graduated from Rutledge High School and entered The University of Tennessee, Knoxville, in June 1977.

She received a Bachelor of Science in Home Economics with a major in Child and Family Studies in June 1981. She was awarded membership in Omicron Nu and Gamma Beta Phi.

In the fall of 1981, she entered the Graduate School of The University of Tennessee, Knoxville, and accepted a research assistantship from the Department of Agricultural Economics and Rural Sociology. She was awarded membership in Gamma Sigma Delta. She completed the requirements for a Master of Science degree in June 1984.

She is married to William E. Hart III of Jonesboro, Tennessee.