TILLAGE 2000 AND ITS EFFECT ON AWARENESS OF CONSERVATION TILLAGE

by

Kathleen Zimmerman
In Collaboration With
Dr. D.J. Blackburn, Dr. J.C.M. Shute, and Dr. R.G. Kachanoski

Department of Rural Extension Studies
Ontario Agricultural College
University of Guelph

March, 1988

Prepared For

Soil And Water Environmental Enhancement Program

ACKNOWLEDGEMENTS

All of the contributions of the many people involved in this study are gratefully acknowledged. Appreciation is extended to the Ontario Ministry of Agriculture Soil and Water Conservation Advisors, the randomly selected respondents, and the Tillage 2000 cooperators in southwestern Ontario for their cooperation.

This report draws heavily upon the M.Sc. thesis prepared by the principal author. She would like to acknowledge the help and guidance of Dr. Don Blackburn, Dr. Jim Shute, and Dr. Gary Kachanoski. The help of Jim Angel for the statistical analysis, and Alec Drysdale for word processing is also acknowledged. She, however, accepts full responsibility for the data and their interpretation. Any errors or omissions are the complete responsibility of the principal author.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

TILLAGE 2000 AND ITS EFFECT ON AWARENESS OF CONSERVATION TILLAGE

INTRODUCTION

The major purpose of this study was to examine the factors that motivate farmers in southwestern Ontario to adopt conservation tillage practices. Specifically, this research focussed on the adoption of conservation tillage practices in conjunction with Tillage 2000, an on-farm conservation tillage demonstration and research program.

Through analysis of the study results, it was hoped that knowledge of farmers' existing attitudes and perceptions could be used to develop more effective educational programs and incentives for higher levels of adoption.

Background and Statement of the Problem

The soil erosion problem in Ontario is of particular concern for a number of reasons. Almost one-half of Canada's class one agricultural land (land which has few or no limitations for crop production) is located in southwestern Ontario. Unfortunately, much of the province's urban and industrial development has already occurred on this valuable farmland (Ketcheson,1977).

Recent empirical research has highlighted the seriousness of the problem. Wall and Driver (1982) estimated total erosion costs attributable to yield, nutrient, and pesticide losses to be approximately $68 million per annum in Ontario. More than 80 per cent of these erosion costs occurred in the southern and western regions of the province.

Equally serious are the off-farm costs of soil erosion. Wall and Dickinson (1978) estimated that Canadian agricultural land contributes 3,000 tonnes of phosphorus and over one million tonnes of sediment to streams in the Great Lakes basin annually. Seventy to 90 percent of this load was the result of agricultural activity. This impact, in turn, resulted in such off-farm costs as $7.7 million for dredging sediment from Lake Erie harbours, $23.6 million for sediment removal from drains and highway ditches, and $8.1 million for water treatment. These costs have undoubtedly increased since 1978 (Fairbairn, 1984).

According to Wall, Vaughan, and Driver (1985), farmers in southwestern Ontario are generally aware of soil degradation problems on their land, and erosion is perceived as a significant problem. Despite this awareness, soil conservation practices have not been widely implemented. Of the farmers studied in 1984 (Wall, Vaughan, and Driver, 1985), 44 per cent wanted to adopt new conservation practices. Of this group, the largest proportion wanted to adopt better tillage techniques, including conservation tillage. Further evidence of the growing interest in conservation tillage was the equipment loan program operated by the Thames River Implementation Committee. Over a period of two years, 112 farmers in the area applied for the use of a mulch tiller, but due to time constraints, only 75 were actually able to use it (Bos and Sadler Richards, 1983).

Consequently farmers appear to be aware of the soil erosion problem, and aware of conservation tillage as a possible solution. However, there appears to be a gap between their awareness and remedial action taken.

In the past, conservation problems have frequently been approached from the perspective that creating an appropriate technology or technique will eliminate the identified problem. Recently, researchers have begun to realize that conservation is also a social problem. The effects of soil conservation policies, the manner in which programs are implemented, and human behaviour are often as important as technology (Lovejoy and Napier, 1986).

There has been increasing awareness on the part of researchers and farmers of the environmental consequences of soil erosion, and the role conventional tillage has played in contributing to this erosion. The research problem addressed in this study was how conservation tillage techniques can be promoted among the farm population in order to reduce soil degradation. Are there subgroups within the farm population that are more prone to adopt conservation tillage? Are certain types of extension techniques more effective in promoting adoption of conservation practices?

Objectives

The purpose of this study was to examine the factors that motivate farmers in southwestern Ontario to adopt conservation tillage. Additionally, the study focussed on the adoption of conservation tillage practices in conjunction with Tillage 2000, a conservation tillage program. The study had six objectives:

1) To list and rate the factors that motivated the demonstration farmers to participate in the Tillage 2000 program.

2) To identify the differences in levels of awareness of soil erosion among the Tillage 2000 and randomly selected farmers.

3) To identify the differences in knowledge, perceptions, and use of conservation tillage practices among the Tillage 2000 and randomly selected farmers.

4) To determine the immediate impact that the Tillage 2000 program has had on awareness, knowledge, and practices of conservation tillage in southwestern Ontario.

5) To develop a profile of the personal and economic characteristics of the Tillage 2000 and randomly selected farmers.

6) To determine preliminary levels of awareness and use of conservation tillage practices. These baseline data can then be compared to levels of awareness at the end of the Tillage 2000 program to facilitate summative evaluation.

Significance of the Study

The results of the study will provide information on the factors that influence farmers' attitudes toward and perceptions of conservation tillage, one of the proposed solutions to soil erosion and enhancement of water quality. These factors are especially important when voluntary participation in critical soil erosion areas, like

southwestern Ontario, is sought. Knowledge of existing attitudes and perceptions can be used to develop more effective educational programs and incentives for higher levels of participation. The study should also aid in assessing the effectiveness of demonstration farms as extension techniques in promoting adoption of conservation tillage practices.

This type of research should ultimately enhance the effectiveness of the linkages among researchers, extension staff, and farmers. With the use of demonstration farms as both extension and research tools, the evaluation, trial, and adoption stages are closely linked with ongoing research and development. The close coordination of users and researchers may improve technology transfer, reduce the cost of development, and increase adoption (Blackburn, 1987).

This study will also act as a type of formative evaluation to provide feedback to the Tillage 2000 staff. This information should serve a real need, as the program has no explicit evaluation component. The data should help the program staff to determine the effectiveness of Tillage 2000's extension efforts.

Research Design

The Study Area

The study area approximated that of the Soil and Water Environmental Enhancement Program (SWEEP) survey conducted in the fall of 1986 (Coleman and Roberts, 1987). Exceptions were that the counties of Dufferin and

Hamilton-Wentworth were not included, due to the difficulty of randomly selecting names from specific townships within the two counties (as was done in the 1986 survey). Consequently, the study area included the counties of Essex, Kent, Lambton, Huron, Middlesex, Elgin, Oxford, Brant, Wellington, and the Regional Municipalities of Waterloo and Haldimand-Norfolk in southwestern Ontario. The area sampled is shown in Figure One. The number of farmers selected per county was based on the number of farmers in each county, as a percentage of the farmers in the total study area.

The names of potential respondents were randomly selected from the list of respondents for the Wall, Vaughan, and Driver (1985) study. Of the 1026 farmers who were interviewed for the 1984 study, 137 names were randomly selected. Each selected respondent with a complete mailing address was sent a covering letter. The Conservation Advisors in the study area were also sent letters asking them to contact the Tillage 2000 farmers in their districts about participating in this study. An example of the respondents' covering letter can be found in Appendix I.

The list of Tillage 2000 demonstration farmers included those in the study area who had been participating in the program for at least one year. Sixteen of the 17 farmers who met these qualifications were interviewed. One farmer was missed due to a sampling error.

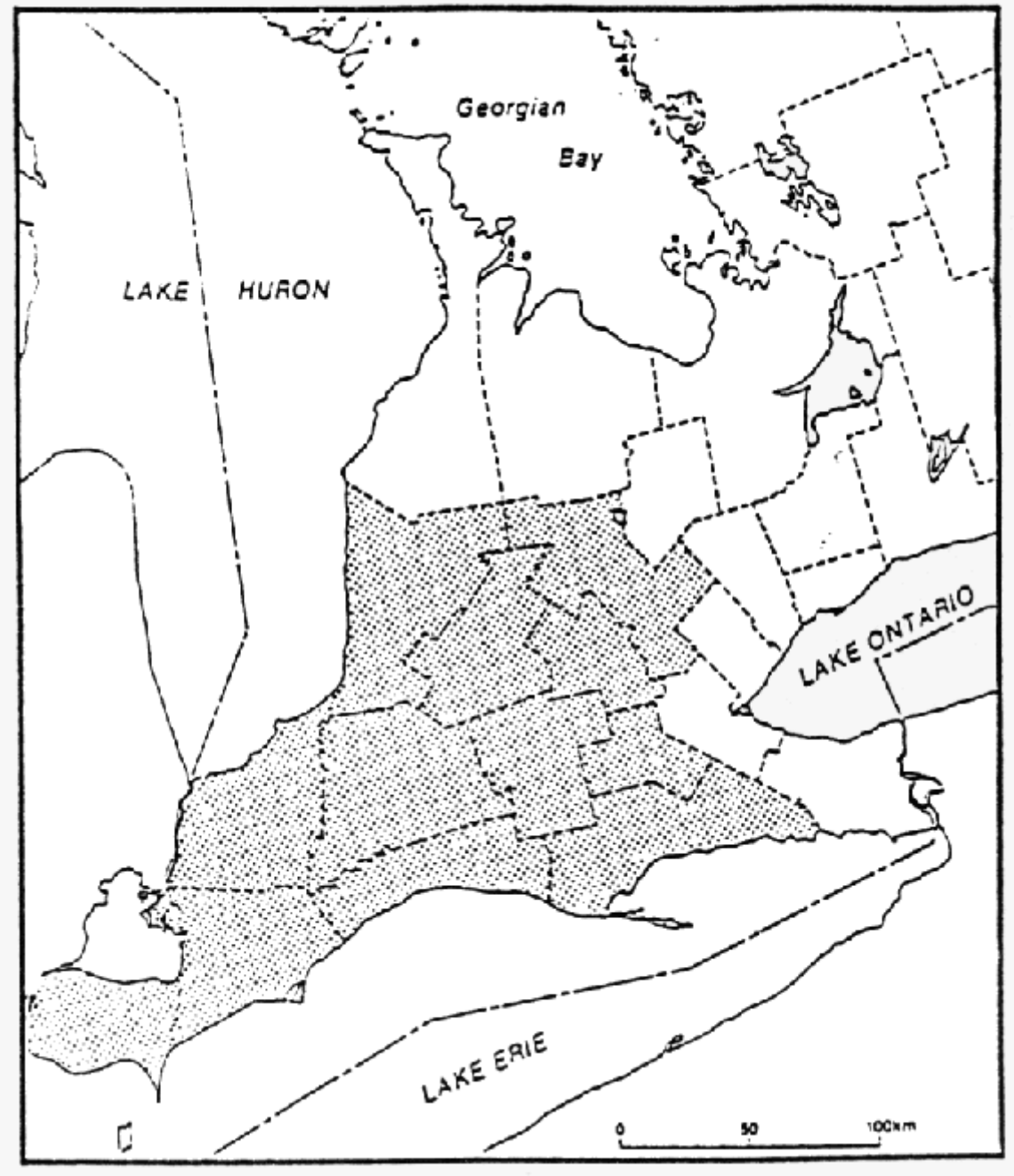

Figure1: The Study Area

Sampling and Data Collection

Of the 148 randomly selected farmers, five had their covering letters returned (they were no longer at the 1984 address), and 11 had incomplete addresses, making it impossible to locate them within the time restrictions of the study. Of the 132 who had current and complete addresses, 12 could not be contacted by phone (after a minimum of five attempts), and 13 refused to be interviewed. Consequently, 107 randomly selected farmers and 16 Tillage 2000 farmers were interviewed, for a total of 123 completed interviews. This constituted a response rate of 81 per cent for the randomly selected farmers and a 94 percent response rate for the Tillage 2000 farmers. The major part of the interviewing occurred over the period of six weeks, from July 13 to August 25. Another three days were required in October to complete the Wellington County interviews.

Instrumentation

A cross-sectional study of Tillage 2000 farmers and randomly selected farmers was employed to assess differences in predetermined variables of interest. A personal interview questionnaire was developed to meet the study's objectives.

An attempt to listen actively to all that the farmers had to say, not just to fill in the required spaces on the questionnaire. This was a matter of courtesy, but also of practicality. A large number of respondents mentioned that they had been inundated with requests for interviews by various companies, government organizations and

educational institutions. They were fed up with taking the time to answer questions, particularly when they received no feedback as to the results of the studies. This may account for the fact that Wellington County farmers, with their proximity to the University of Guelph, had the highest refusal rate. In order to maintain this group's cooperation for future research, it is important that researchers respect the farmers' opinions and beliefs, and acknowledge the time they have donated to answering questions.

The questionnaire was pre-tested with five farmers and questions with unclear wording were modified accordingly. One important modification was the inclusion of the farmers' definition of conservation tillage. It was discovered during the pre-test, and confirmed during the interviews, that relatively few farmers defined conservation tillage in terms of residue cover. It was often defined as fewer passes over the field, or including a legume plow-down to improve the soil's organic matter content. A copy of the questionnaire is located in Appendix II.

The quantitative analysis was conducted using the Statistical Package for Social Sciences (SPSSx). The statistical methods used included frequency tables, cross-tabs, and the t-test. Data were analyzed using the computer facilities at the University of Guelph.

Limitations

The major limitations of this study were the time constraints of both the researcher and the respondents. The interviews covered ten counties and two regional municipalities, and were completed in just under seven weeks. The researcher was the sole interviewer, and the majority of the interviews were conducted in July and August during the farmers' busy summer season.

The sample size of 123 respondents is fairly minimal to establish representativeness for the area. However, the variability of the characteristics measured was deemed more important than the sampling fraction.

Definition of Terms

Conservation Tillage

Conservation tillage is defined as "any tillage system that reduces loss of soil or water relative to conventional tillage; often a form of non-inversion tillage that retains protective amounts of residue mulch on the surface" (Soil Conservation Society of America, 1982, 33). Generally a 30 percent residue cover is considered necessary for effective erosion control (Magleby et al.,1985).

Conservation tillage is a system. The type of equipment selected must take into account soil and climatological conditions. Its adoption affects not only

tillage practices but fertilizer application, weed and pest control, and the crop varieties chosen (Mannering and Fenster, 1983).

Tillage 2000

Tillage 2000 is a five year program that began in 1986. It is sponsored by the Ontario Ministry of Agriculture and Food, the University of Guelph, and the Ontario Soil and Crop Improvement Association. The goal of the Tillage 2000 program is to determine the best conservation tillage systems for specific soil types, climatic zones, and farming operations, in order to maximize productivity and minimize soil degradation.

The program is comparing conventional tillage systems with conservation tillage systems on selected demonstration farms throughout Ontario. The demonstration farmers were selected on the basis of field site suitability (soil type, topography, location, and access), and their interest and capabilities (Lang, Aspinall, and Kachanoski, 1987).

In order to make the public aware of its findings, annual reports will be published. A final report will be produced at the end of the program. During the five years, program staff will attempt to increase awareness of conservation tillage and its benefits through tours of the demonstration farms. These tours are offered to farmers, industry representatives, politicians, and university faculty, staff, and students.

This type of extension technique -- the use of decentralized demonstration farms -- is not a new one. However, Tillage 2000 is unique to soil conservation efforts in Ontario. The program has both a research and an on-farm demonstration component. The process is both investigative and developmental. Less successful conservation tillage systems will be modified in the following year, and suggestions for improvement from the cooperator and successful components from other locations will be incorporated (Aspinall et al.,1987).

SUMMARY OF RELEVANT STUDIES

Introduction

Most of the research on the adoption of conservation practices has been conducted in different areas of the United States, and each study has found that different independent variables were significant in explaining adoption. Consequently, this research will use caution in attempting to apply the results of previous studies to southwestern Ontario. Ontario information will be used wherever possible, and the American studies will serve as a guide to the type of variables that have been found to be relevant in past research.

Awareness of the Erosion Problem

The adoption of soil conservation practices process begins with the recognition of the erosion problem. Farmers who do not believe they have a problem will not act to alleviate it. Their awareness depends on a number of factors, including information sources and personal factors such as age and education.

A number of surveys conducted in Ontario have shown that farmers both underestimate the erosion on their own land, as well as the off-farm impacts of erosion. Bangay (1979) found that 80 percent of farmers across Ontario felt that farming activities contributed in only a minor extent or not at all to water pollution.

Ninety-four percent believed that their present farm management practices were adequate for controlling water pollution.

A 1987 study of farmers in the Avon River watershed (near Stratford, Ontario) compared farmers' perceptions of soil erosion on their fields to soil loss measurements in studies conducted by the Upper Thames River Conservation Authority and the Ontario Ministry of Agriculture and Food. The researcher found that all respondents with farms classified as having a severe rate of soil erosion underestimated their erosion problems. A small percentage (7.5 percent) believed that erosion on their farms was nonexistent. Almost one-half of the farmers who had farms rated as having a serious erosion problem thought that erosion in their township was a greater problem than erosion on their farm (Marshall, 1987).

That farmers are not always aware that erosion is <u>their</u> problem is not just a Canadian phenomenon. Studies done in the United States have parallel findings (see for example, Bultena and Hoiberg (1986), Esseks and Kraft (1986), and Christensen and Norris (1983)). However it is important to realize that this misperception does not mean that farmers are irrational or unintelligent. Part of the problem is that educational and extension programs have focussed on dramatic portrayals of excessive erosion, such as gullies large enough to swallow tractors or equipment, and ditches filled with sediment. These types of dramatic circumstances do not occur very often. Sheet erosion (a small layer of soil is removed over an entire field) or rill erosion (water concentrates in small rivulets in the fields) tend to be much more insidious, and tend

to be largely invisible (Nowak, 1983). Other possible explanations are the farmers' desire to reduce the cognitive dissonance associated with the recognition of a problem that is going unmet, or the feeling that they are already effectively dealing with erosion (Bultena and Hoiberg, 1983).

Soil conservation experts have been trained to understand the concepts of the Universal Soil-Loss Equation [1]/ and the T-value [2]/ could have different perceptions from farmers of what "severe," "moderate," and "low" erosion means. For example, a farmer with land classified as having a "severe" erosion problem may accurately perceive the amount of erosion occurring, but may not perceive this amount as being severe (Marshall, 1987).

> The basic principles of soil (science) clearly indicate that excessive erosion will have negative implications for plant growth. Yet knowing that excessive erosion has these consequences is not the same as knowing when it will occur within a specific soil profile, how it will manifest itself, and how these consequences might be offset through additional technological inputs. Simply stated, if our agricultural experts have

---

[1]/ USLE - an equation that combines metric measures of land factors, climatic factors and management factors to calculate annual tonnes of soil lost per hectare.

[2]/ Soil loss tolerance value - found when the rate of soil loss is not greater than the rate of soil formation, so that soil use can be sustained indefinitely (Hudson, 1981).

> difficulty in specifying the interactive effects between erosion, productivity, and technology, can we really expect the farmer to understand this process (Nowak, 1983, 88)?

Awareness of Conservation Tillage

While farmers' awareness of the off-farm impacts of soil erosion appears to be increasing, so does their awareness of conservation tillage as a possible means of controlling erosion (Wall, Vaughan, and Driver, 1985). Conservation tillage has come to the forefront in the last ten years, but an Ontario study discovered that many farmers were not even certain what the term conservation tillage meant. If the farmers in the Thames River watershed identified at all with conservation tillage, it was only in reference to specific implements.

> (D)iscussions on the merits of chisel plowing produced more response than did the general topic of conservation tillage...even though choice of primary tillage equipment is just one component of conservation tillage systems (Sadler Richards, 1983, 256).

A further problem is farmers' perception of what constitutes conservation tillage. The amount of crop residue left on a field surface is one indication of having adopted the managerial techniques that are part of a conservation tillage system. In an Iowa study, only 19 percent of the respondents, based on the researchers' calculations of the crop residue left on their fields, were actually practicing conservation tillage. Yet 78 per cent claimed to be using such a system. Obviously there was a significant

difference between the perceived and actual use of conservation tillage(Nowak and Korsching, 1985).

Wells, Borich, and Frus (1983) suggest two reasons for this discrepancy. The first is that the researchers must state clearly what they mean by conservation tillage in their studies, as farmers may have different understandings of the term. The second possible reason might be the social pressure that farmers feel to practice conservation. It maybe easier for them to respond "properly" to a direct (yes-no) question than to a question requiring specifics about their tillage practices.

Again, the reason for including this point is not to imply that there is something "wrong" with farmers. Conservation tillage is a relatively new and complex technology (White, 1985), and various perceptions of it are bound to occur. It is important for extension agents and researchers to realize what these various perceptions are in order to avoid communication problems.

Physical Factors

Control of soil erosion is related to land characteristics. Soil is not homogeneous, and differences in topography, soil, and climatic conditions may result infailure or inappropriate use of conservation tillage. Dusault (1985) found that counties in southwestern Ontario where clay soils are extensive, like Essex, Kent and Haldimand, had a higher number of respondents who indicated "not appropriate for local soil or ground conditions" as a concern when considering the adoption of a chisel plow.

Experimental trials in Ontario confirm the validity of these concerns (Sadler Richards, 1983).

Economic Factors

Economic factors that have been hypothesized to influence adoption of soil conservation measures include farm size, income, type of enterprise, and type of tenure.

Large-scale farmers are thought to be able to adopt new machinery and capital intensive technologies more easily than small-scale farmers. In addition, large-scale farmers tend to farm land that has a lower soil erosion potential, while small-scale farmers usually farm less desirable land, often located on steeper slopes (Heffernan and Green, *1986).*

This hypothesis has been confirmed by studies in Iowa ((Korsching et al., *1983)* and (Rahm and Huffman, *1984)).* Epplin and Tice (1986) point out that these differences are not due to differences in stewardship between the two groups, but rather to differences in economies of scale.

Level of farm income appears to be correlated with the adoption of soil conservation practices. Carlson and Dillman (1986) found that no-till users had significantly higher incomes than non-users in Washington and Idaho. In Iowa, Korsching et al. (1983) found that adopters of minimum tillage had significantly greater gross farm incomes than nonadopters.

Soil conservation measures which can be easily integrated into existing farm enterprises are more likely to be adopted than measures which require significant changes. Magleby et al. (1985) found that conservation tillage is used primarily to grow corn, soybeans, and grain. Conversely, Napier et al. (1984) discovered that highly capitalized grain farmers found it more difficult to integrate conservation tillage into their farming operations.

The farmers' tenure may also affect the adoption of erosion control measures. In a United States-wide survey, most of the farmers using conservation tillage were part or full owners of the cropland they worked (Magleby et al., 1985). In contrast, Lee (1983) found that full-owner operators had lower minimum tillage adoption rates than did part-owners and landlords (after accounting for farm size, land quality, and regional location).

Personal Factors

A number of personal factors, drawn from the diffusion-adoption model, as well as its criticisms, have been hypothesized to affect the adoption of conservation practices. These include age, education, years farming, peer influence, information sources, management skills, and group participation.

In Iowa, both Bultena and Hoiberg (1983) and Korsching et al. (1983) found that adopters of conservation tillage were younger than nonadopters. In Iowa (Nowak and

Korsching, 1985) and Washington and Oregon (Carlson and Dillman, 1986) users of no-till and conservation tillage (respectively) had more years of formal education.

Pampel and van Es (1977) found that number of years farming was a good predictor of the adoption of environmental innovations in Illinois. However Napier, Camboni, and Thraen (1986) concluded that the number of years farming was not statistically significant in helping to explain how environmental concern related to the adoption of farm technologies (in Ohio).

Farmers often use their neighbours' experiences and attitudes to pass judgment on a new idea. If their neighbours are enthusiastic about a new practice and have adopted it, study respondents' motivation to adopt should increase. Bultena and Hoiberg (1983) found that adoption was more prevalent among those who perceived that half or more of their neighbours used conservation tillage.

Carlson and Dillman (1986) found that early users of no-till in Washington and Oregon were more likely to have obtained information about no-till from sources outside of their immediate area -- either by travelling to see a demonstration or by making long-distance telephone calls. Nonusers were influenced most by other farmers. Napier, Camboni, and Thraen (1986) concluded that farmers who used more numerous institutional sources of information tended to be more concerned about environmental issues in the decision-making process. Institutional sources of information were defined as experimental stations, local farmer organizations, county extension agents, and agricultural universities.

None of the studies encountered have operationalized management skills as a variable in adoption of conservation practices. Nowak and Korsching *(1985)* assumed that formal education was an indicator of managerial ability. Bultena and Hoiberg (1983) theorized that operators of larger farms would most likely have the managerial skills needed to implement a complex farming practice like conservation tillage, but did not attempt to measure management skills.

Innovators are hypothesized to be more cosmopolite than the other adopter groups. A part of this attribute is membership and participation in organizations, with the degree of innovativeness related directly to participation. Napier et al. *(1984)* found that the number of organizations in which family members participated was not a significant factor in the adoption of conservation tillage. Conversely, Korsching et al. (1983) concluded that there was a significant difference in organizational involvement between adopters and nonadopters of minimum tillage in Iowa.

FINDINGS AND ANALYSIS

Motivating Factors for Involvement In Tillage 2000

The cooperators' reasons for becoming involved with Tillage 2000 are outlined in Table 1. The largest proportion wanted to experiment with and/or learn as much as possible about conservation tillage, and ranked this reason as "very important" (44 percent) or "moderately important" (19 percent). Four respondents knew there was someone needed as a cooperator in their area and felt that it was important to participate in the program. Three respondents were made aware of the opportunity to become a cooperator through their local Soil and Crop Improvement Association. Three others were approached by Tillage 2000 staff, while one heard of the program through a relative who worked for aconservation authority. Three had been previously experimenting with conservation tillage and wanted the opportunity to continue their experiments in a more rigorous and intensive way.

MISSING PAGE

TABLE 1

COOPERATORS' REASONS FOR JOINING THE TILLAGE 2000 PROGRAM

	DEGREE OF IMPORTANCE					
	LOW		MODERATE		HIGH	
Reason[a]	Number	Percent	Number	Percent	Number	Percent
Experiment/ Learn As Much As Possible	0	0%	3	19%	7	44%
Someone Needed For Area	1	6%	1	6%	2	13%
Connections With Other Organizations	0	0%	1	6%	2	13%
Personal Contacts	0	0%	3	19%	1	6%
Previously Trying Some Conservation Tillage	1	6%	1	6%	1	6%
Conservation Ethic	0	0%	1	6%	1	6%
Adverse Effects of Conventional Tillage	0	0%	0	0%	1	6%

[a] Respondents could give multiple responses. (N=16)

Overall, the cooperators exhibited the expected characteristics of innovators. This was displayed through: their desire to experiment and gain new knowledge; their sense of responsibility about participating in the program; their connections with other organizations; and the fact that they were well known enough in their communities to be personally contacted by Tillage 2000 staff.

Tillage 2000 and Randomly Selected Respondents':

Awareness and Perceptions of Soil Erosion

Table 2 outlines the respondents' perceptions of the type and severity of erosion on their farms. A larger percentage of the Tillage 2000 cooperators had observed both wind and water erosion on their farms. Only two of the randomly selected respondents perceived the wind erosion on their farms as severe. Sixty-nine percent of the Tillage 2000 cooperators felt that the wind erosion on their farms was slight to moderate, compared to only 37 percent of the randomly selected farmers. Eighty-two percent of the Tillage 2000 farmers perceived the water erosion on their farms as slight to moderate, as compared to 62 percent of the randomly selected farmers.

TABLE 2

RESPONDENTS' AWARENESS OF EROSION ON OWN FARM

Wind Erosion Observed		TILLAGE 2000		RANDOM	
		Number	Percent	Number	Percent
Yes		11	69%	51	48%
No		5	31	56	52
	Total	16	100%	107	100%
Severity of Wind Erosion					
Not At All		5	31%	66	62%
Slight		7	44	33	31
Moderate		4	25	6	6
Severe		0	0	2	2
	Total	16	100%	107	100%
Water Erosion Observed					
Yes		14	88%	83	78%
No		2	13	24	22
	Total	16	100%	107	100%
Severity of Water Erosion					
Not At All		3	19%	37	35%
Slight		6	38	48	45
Moderate		7	44	18	17
Severe		0	0	4	4
	Total	16	100%	107	100%

These results can be compared to Table 3 which outlines the potential annual soil loss for the respondents' farms. Fifty percent of the Tillage 2000 cooperators had farms that were ranked as having medium potential soil loss, while none had farms in the high potential soil loss category. Among the randomly selected farmers, 65 percent

had farms with medium potential soil loss, and 11 percent had farms with high potential soil loss. Interestingly, the Tillage 2000 farmers reported higher observation rates for both wind and water erosion, and perceived higher degrees of severity for both types of erosion, yet were located on the less erosion-prone land. This could be because, as innovators, they were more sensitive to the issue of soil erosion.

TABLE 3

POTENTIAL ANNUAL SOIL LOSS FOR RESPONDENTS' FARMS[a]

Soil Loss Categories[b]	TILLAGE 2000		RANDOM	
	Number	Percent	Number	Percent
High	0	0%	7	11%
Medium	5	50	41	65
Low	5	50	15	24
Total[c]	10	100%	63	100%

[a] Source: Environment Canada, Lands Directorate, Ontario Region, and the Grand River Conservation Authority.
Potential Annual Soil Loss From Rural Areas (Maps),1933.

[b] High soil loss was defined as > 11 tonnes/ha/yr (>5 tons/ac/yr).
Medium soil loss was defined as 2-11 tonnes/ha/yr (1-5 tons/ac/yr).
Low soil loss was defined as <2 tonnes/ha/yr (<1 ton/ac/yr).

[c] Six Tillage 2000 and 44 randomly selected respondents had missing values because potential soil loss information was not available.

Farmers' perceptions (or misperceptions) of erosion on their farms were determined by examining the percentage of those who underestimated or overestimated the erosion on their farms (Table 4). The categories were created by cross tabulating the farms' potential soil loss with the respondents' perceptions of the water erosion on

their farms. Forty percent of the Tillage 2000 respondents underestimated the soil loss maps' predicted erosion problem on their farms, compared to 60 percent of the randomly selected respondents. Approximately equal percentages of the two groups seemed to accurately perceive the erosion problem on their farms. Only 20 percent of the Tillage 2000 respondents and three percent of the randomly selected respondents overestimated the predicted erosion on their farms. The results implied that a higher percentage of the randomly selected respondents tended to underestimate the erosion on their farms, while a higher percentage of Tillage 2000 respondents tended to overestimate the erosion on their farms.

These results must be interpreted with caution. There were a number of limitations to the potential soil loss maps' accuracy. Huron County, the Regional Municipality of Haldimand-Norfolk, and various parts of other counties have not been mapped, which led to a large number of missing values. The soil loss map units are based on the Universal Soil Loss Equation (USLE). The C factor (crop management factor)in the calculations was based on pre-1983 information. Although the C values reflected the rotational average rather than the crops in any one year, it is quite probable that the crop management has changed since that time.

Tillage 2000 respondents appeared to be more aware of the soil erosion on their farms. Both groups tended not to accurately perceive their erosion problems, but the Tillage 2000 respondents tended to err on the side of overestimating their erosion

problems. This almost extreme level of awareness might have influenced their higher adoption rates of conservation tillage (as will be outlined in the next section).

TABLE 4

RESPONDENTS' PERCEPTIONS OF THE WATER EROSION ON THEIR FARMS

	TILLAGE 2000		RANDOM	
	Number	Percent	Number	Percent
Underestimated Erosion By 2 Categories	0	0%	5	8%
Underestimated Erosion By 1 Category	4	40	33	52
Accurately Perceived Erosion	4	40	23	37
Overestimated Erosion By 1 Category	2	20	2	3
Total[a]	10	100%	63	100%

[a] Six Tillage 2000 respondents and 44 randomly selected respondents had missing values because potential soil loss information was not available.

Perceptions, Knowledge, and Use of Conservation Tillage

The respondents' definitions of conservation tillage were grouped and listed in Table 5. Three of the randomly selected farmers were not familiar with the term "conservation tillage".

Tillage 2000 cooperators more frequently defined conservation tillage in terms of residue cover (the definition generally accepted by specialists) than did the randomly selected respondents. The randomly selected farmers had a higher percentage rate for defining conservation tillage in terms of "crop rotations." The latter is, strictly speaking, a conservation practice and not necessarily a part of conservation tillage. The Tillage 2000 respondents seemed to have slightly more accurate definitions of conservation tillage.

TABLE 5

CONSERVATION TILLAGE DEFINITIONS AS REPORTED BY RESPONDENTS

	TILLAGE 2000		RANDOM	
	N=16		N=107	
Definitions	Number [a]	Percent	Number [ab]	Percent
Saving Time/Fuel	3	19%	7	7%
Conserving Soil	6	38%	54	51%
Minimum Number of Passes	8	50%	22	21%
Residue Cover	5	31%	18	17%
Crop Rotations	1	6%	17	16%
Modern Equipment	0	0%	13	12%
Spring Plowing	1	6%	6	6%
Cross-slope/ Contour Plowing	0	0%	6	6%

[a] Respondents could give multiple responses.

[b] Five respondents did not define conservation tillage.

In rank order, the three most frequently cited definitions among the Tillage 2000 cooperators were "minimum number of passes," "conserving soil," and "residue cover."

These three definitions were also the most frequently cited by the randomly selected farmers, although in a different order. These results suggested that both groups had a common general understanding of the definition of conservation tillage.

Ninety-four percent of the Tillage 2000 cooperators and 69 percent of the randomly selected respondents felt they were using conservation tillage on their farms, when using their own definition of conservation tillage (Table 6). When given the definition relating to residue cover, the same number of Tillage 2000 respondents were still classified as adopters, but the number of adopters among the randomly selected group decreased to 50 percent (Table 7). This finding indicates that not only did the Tillage 2000 farmers have a significantly high rate of adoption, but they also had a more accurate perception of what conservation tillage was. This finding also highlights the need for extension agents and researchers to clearly define what they mean by the term conservation tillage when dealing with farmers.

TABLE 6

CONSERVATION TILLAGE USE AS DEFINED BY RESPONDENTS

Use of Conservation Tillage	TILLAGE 2000		RANDOM	
	Number	Percent	Number	Percent
Adopter	15	94%	74	69%
Nonadopter	1	6	31	29
Don't Know	0	0	2	2
Total	16	100%	107	100%

TABLE 7

CONSERVATION TILLAGE USE BY PERCEIVED PERCENT RESIDUE LEVELS

Use of Conservation Tillage	TILLAGE 2000		RANDOM	
	Number	Percent	Number	Percent
Adopter	15	94%	53	50%
Future Adopter	1	6	4	4
Nonadopter	0	0	40	37
"Questionable" Adopter	0	0	10	9
Total	16	100%	107	100%

In recognition of the fact that adoption of an innovation usually occurs over time, respondents were also asked if they intended to adopt conservation tillage in the next year or two. Only one Tillage 2000 cooperator (the rest of the Tillage 2000 respondents had already adopted conservation tillage) and four randomly selected respondents were future adopters. The low rate of future adoption among

randomly selected respondents may have been related to their tendency to underestimate the erosion on their farms.

An attempt was made to achieve a balance between representing the respondents' views and perceptions, and maintaining objectivity. Consequently the responses of ten of the randomly selected farmers were classified as "questionable" adopters (Table 7). They felt they were using conservation tillage as it was defined in the study, but from what they stated later in response to survey questions and in casual conversation, it seemed impossible that they were actually leaving a 30 percent residue cover. Possibly their responses were due to the social pressure of responding "properly" to a direct (yes-no) question.

The names of ten conservation tillage implements, listed on a card, were shown to respondents and they indicated those with which they were familiar with (Table 8). Seventy-five percent or more of the Tillage 2000 respondents indicated a knowledge of each of the implements listed, while only one-half of the randomly selected respondents indicated this level of knowledge.

TABLE 8
RESPONDENTS' KNOWLEDGE OF CONSERVATION TILLAGE IMPLEMENTS

Implements	TILLAGE 2000 N = 16		RANDOM N = 107	
	Number[a]	Percent	Number[a]	Percent
Soil Saver	16	100%	83	78%
Chisel Plow	16	100%	103	96%
Modified Moldboard	15	94%	68	64%
Disc	16	100%	105	98%
Ridge Planter	15	94%	64	60%
No-till Corn Planter	16	100%	91	85%
No-till Seed Drill	16	100%	82	77%
Roto-strip Tiller	12	75%	30	28%
Paraplow	14	88%	33	31%
Stubble-mulch Tiller	12	75%	44	41%

[a] Respondents could give multiple responses

The finding that the Tillage 2000 respondents expressed more knowledge about conservation tillage implements was further reinforced by the data in Table 9. Thirty-seven percent of the Tillage 2000 respondents were able to identify one or two conservation implements (other than the ten listed for them), while only 22 percent of the randomly selected farmers could do so. These other implements and practices included a cultivator, "Forest City Dual,-" strip-cropping, airplane seeding, V-plow, subsoiler, vibrashank, Johnson power bedder, Fiskar's plow, and a prongpoint plow.

TABLE 9
TOTAL KNOWLEDGE OF CONSERVATION TILLAGE IMPLEMENTS

Number of Other Implements Known	TILLAGE 2000		RANDOM	
	Number	Percent	Number	Percent
0	10	63%	83	78%
1	5	31	24	22
2	1	6	0	0
Total	16	100%	107	100%
Total Number of Implements Known				
< 5	0	0%	33	31%
6	1	6	16	15
7	0	0	15	14
8	0	0	16	15
9	5	31	11	10
10	5	31	13	12
11	5	31	3	3
Total	16	100%	107	100%

T-value = -5.09 p = < 0.001

The Tillage 2000 respondents reported knowledge of an average of ten implements, while the randomly selected farmers reported knowledge of an average of seven implements. "Other" implements used were a cultivator, airplane seeding, vibrashank, springtooth harrow, and power bedder. Using the t-test, it was determined that there were statistically significant differences between the two groups' knowledge of conservation tillage implements (Table 9).The Tillage 2000 respondents had a significantly higher knowledge of conservation tillage implements.

Data in Table 10 indicate the extent of respondents' use of the ten listed conservation tillage implements. The Tillage 2000 respondents reported a higher rate of usage for all implements except the roto-strip tiller and the modified moldboard. These percentages may be slightly inflated as they included the implements used on the Tillage 2000 demonstration plots.

TABLE 10
RESPONDENTS' USE *OF* CONSERVATION TILLAGE IMPLEMENTS

Implements[a]	TILLAGE 2000 N=16		RANDOM N = 63[b]	
	Number	Percent	Number	Percent
Soil Saver	9	56%	16	25%
Chisel Plow	10	63%	28	44%
Modified Moldboard	3	19%	13	21%
Disc	14	88%	51	81%
Ridge Planter	1	6%	0	0%
No-till Corn Planter	12	75%	4	6%
No-till Seed Drill	11	69%	2	3%
Roto-strip Tiller	0	0%	1	2%
Paraplow	7	44%	2	3%
Stubble-mulch Tiller	1	6%	3	5%

[a] Respondents could give multiple responses.

[b] This question was not applicable to the 40 nonadopters and four future adopters.

In comparing the two groups' total use of conservation tillage implements as shown in Table 11, there were again obvious differences. The Tillage 2000 respondents had a greater range of total implements used (two to ten, compared to zero to five for the

randomly selected respondents), and an average of four implements used, as compared to two implements for the randomly selected respondents. Using the t-test it was determined that there were statistically significant differences between the two groups' use of conservation tillage implements.

TABLE 11
TOTAL USE OF CONSERVATION TILLAGE IMPLEMENTS

Number of Other Implements Used		TILLAGE2000		RANDOM	
		Number	Percent	Number	Percent
0		14	88%	91	85%
1		2	13	16	15
	Total	16	100%	107	100%
Total Number of Implements Used					
0		0	0%	41	38%
1		0	0	20	19
2		3	19	27	25
3		3	19	15	14
4		4	25	3	3
5		3	19	1	1
6 or more		3	19	0	0
	Total	16	100%	107	100%

T-value = -8.26 p = <0.001

When respondents volunteered the names of implements (other than the ten listed on the sheet they were given), it became apparent that there were a few misperceptions of what constituted a conservation tillage implement. The Tillage 2000 respondents expressed no misperceptions, while four of the randomly selected respondents cited implements or practices that a conservation tillage expert at the

University of Guelph deemed were misperceptions. This included a "Rotaro", a saber plow, and stripcropping (cited by two respondents).Stripcropping is however a conservation practice.

Table 12 indicates which conservation tillage implements respondents felt they might be trying in the next year or two (other than those which they had already tried). The Tillage 2000 respondents indicated that they might use three other implements in the future, while the randomly selected respondents listed seven of the implements. Perhaps the Tillage 2000 respondents listed fewer implements because, as innovators, they have already tried a greater variety of implements.

TABLE 12
CONSERVATION TILLAGE IMPLEMENTS TO BE USED IN THE FUTURE

	TILLAGE 2000		RANDOM	
	N=16		N=67[b]	
Implements	Number[a]	Percent	Number[a]	Percent
Soil Saver	0	0%	4	6%
Chisel Plow	0	0%	1	1%
Modified Moldboard	1	6%	5	7%
No-till Corn Planter	2	13%	3	4%
No-till Seed Drill	1	6%	2	3%
Paraplow	0	0%	2	3%
Stubble-mulch Tiller	0	0%	2	3%

[a] Respondents could give multiple responses.

[b] This question was not applicable to the 40 respondents who were nonadopters.

Overall, the Tillage 2000 respondents had a significantly higher usage rate of conservation tillage implements. This finding was in keeping with their more accurate perception and higher adoption rate of conservation tillage.

The respondents' reasons for adopting conservation tillage are listed in Table 13. The Tillage 2000 cooperators had a higher percentage response rate for each reason. Their higher response rate for some of the reasons were particularly noteworthy. Their 50 percent response rate to the reason "to increase residue levels" indicated a slightly greater perception of the importance of residue levels in a conservation tillage system. Their 75 percent response rate for "to experiment with an interesting new farming technique" displayed one of the classic characteristics of innovators.

"Other" reasons given by the Tillage 2000 respondents for adopting conservation tillage were: to control the runoff of phosphate; the presence of less compaction and crusting; to control soil moisture loss; and ability to use less skilled labour to operate the machinery. "Other" reasons mentioned by the randomly selected respondents included: to cut residue more for better incorporation; to cultivate shallowly for fewer weeds; to conserve soil moisture; to avoid soil compaction; and the use of less skilled labour.

TABLE 13
RESPONDENTS' REASONS FOR ADOPTING CONSERVATION TILLAGE

Reasons[a]	TILLAGE 2000 N = 16		RANDOM N = 67[b]	
	Number	Percent	Number	Percent
To Increase Residue Levels	8	50%	29	43%
To Control Erosion	14	88%	48	72%
To Reduce Production Costs	14	88%	38	57%
To Build Soil Structure	11	69%	48	72%
To Increase Yields	5	31%	32	48%
Changed Crops/Equipment	4	25%	6	9%
Problems With Stoniness	4	25%	7	10%
To Increase Income	9	56%	34	51%
To Experiment With A New Technique	12	75%	22	33%
To Reduce Time Spent in the Fields	10	63%	36	54%
Other	6	38%	11	16%

[a] Respondents could give multiple responses.

[b] This question was not applicable to the 40 respondents who were nonadopters.

Table 14 indicates the randomly selected respondents' reasons for not adopting conservation tillage. In rank order, the top four reasons were "no need and/or not appropriate for farm," "using other conservation practices,""not appropriate for soils," and "the cost of equipment." The most frequently cited reason ("no need and/or not appropriate for farm") reinforces the randomly selected respondents' low perception of the erosion on their farms.

Interestingly, the financial reason cited was not the most popular, despite agriculture's current economic situation.

TABLE 14
RESPONDENTS' REASONS FOR NOT ADOPTING CONSERVATION TILLAGE

Reasons[a]	RANDOM N=40	
	Number [b]	Percent
Decline in Yields	6	15%
Not Appropriate for Soils	12	30%
Cost of Equipment	11	28%
Poor Results By Others	9	23%
Weed/Disease Problems	7	18%
No Need/Not Appropriate For Farm	17	43%
Using Other Conservation Practices	17	43%
Satisfied With Conventional Tillage	8	20%
Poorer Seedbed/Aeration	6	15%

[a] Respondents could give multiple responses.

[b] This question was not applicable for the 53 respondents who were adopters, the 4 future adopters, and the 10 "questionable" adopters.

The agronomic reasons of "decline in yields," "not appropriate for soils," "weed and/or disease problems," and "poorer seedbed"are all recognized limitations of conservation tillage. This would seem to indicate that these respondents were behaving rationally by using this reason for not adopting conservation tillage. The reasons given are also indicative of later adopters who wait until the technical problems are solved before adopting an innovation.

Table 15 shows the percent of respondents' cultivated acreage conservation tillage was used on. Tillage 2000 respondents had an average of 57 percent of their cultivated acreage that was conservation tilled. Randomly selected respondents had an average of 39 percent of their cultivated acreage that was conservation tilled.

TABLE 15
PERCENT OF CULTIVATED ACREAGE CONSERVATION TILLAGE WAS USED ON RESPONDENTS' FARMS

Percent of Cultivated Acreage	TILLAGE 2000		RANDOM	
	Number	Percent	Number	percent
0 - 20	2	13%	49a	46%
21 - 40	4	25	11	10
41 - 60	2	13	15	14
61 - 80	5	31	10	9
81 - 100	3	19	22	21
Total	16	100%	107	100%

[a] Includes 40 respondents who were nonadopters.

This result seems to indicate that the Tillage 2000 respondents are willing to take more risks by putting more of their land under conservation tillage. They have probably spent more time working out the problems associated with conservation tillage, and may feel more confident about conservation tilling a larger percentage of their acreage.

Economic Characteristics

The economic characteristics examined in this study were major farm enterprise, gross farm income, farm size, and farm tenure.

In rank order the top three farm enterprises for the Tillage 2000 respondents were grain corn, grain, and oilseeds (Table 16). The Tillage 2000 respondents reported having greater percentages of these three major cash crops, while the randomly selected respondents had tended to report having greater percentages of livestock enterprises

"Other" farm enterprises included clover seed, kidney beans, custom work, maple syrup, ginseng, popcorn, white beans, buckwheat, oil radish, geese, and lupin beans. The two groups appear to differ in their general farm enterprises.

Table 17 summarizes the respondents' principal farm enterprises. Fifty percent of the Tillage 2000 respondents reported cash crops were their principal farm enterprise, compared to 44 percent of the randomly selected respondents. The "other" principal farm enterprises listed were white beans. These results suggest that adoption of conservation tillage is associated with particular farm enterprises, specifically cash crop enterprises.

TABLE 16

RESPONDENTS' FARM ENTERPRISES

Multiple Response By Enterprise	TILLAGE 2000		RANDOM	
	N=16		N=107	
	Number	Percent	Number	Percent
Grain Corn	14	88%	82	77%
Fodder Corn	3	19%	33	31%
Tobacco	0	0%	7	7%
Fruit	0	0%	1	1%
Beef Cows	2	13%	12	11%
Feedlot Cattle	2	13%	29	27%
Dairy Cattle	2	13%	25	23%
Swine	3	19%	35	33%
Sheep	0	0%	4	4%
Turkeys	0	0%	3	3%
Laying Hens	1	6%	7	7%
Broilers	1	6%	2	2%
Vegetables [a]	1	6%	6	6%
Grain	13	81%	84	79%
Oilseeds	11	69%	55	51%
Hay/Pasture	8	50%	64	60%
Other	7	44%	20	19%

[a] Includes potatoes.

TABLE 17
RESPONDENTS' PRINCIPAL FARM ENTERPRISES

	TILLAGE 2000		RANDOM	
Enterprise	Number	Percent	Number	Percent
Grain Corn	4	25%	14	13%
Fodder Corn	0	0	0	0
Tobacco	0	0	5	5
Fruit	0	0	0	0
Beef Cows	0	0	4	4
Feedlot Cattle	1	6	7	7
Dairy Cattle	2	13	20	19
Swine	0	0	12	11
Sheep	0	0	0	0
Turkeys	0	0	1	1
Laying Hens	1	6	3	3
Broilers	0	0	0	0
Vegetables [a]	0	0	4	4
Grain	0	0	1	1
Oilseeds	3	19	17	16
Hay/Pasture	0	0	3	3
Other	1	6	2	2
Mixed	4	25	14	13
Total	16	100%	107	100%

[a] Includes potatoes.

The respondents' annual gross farm income is summarized in Table 18. The average gross farm income category for the Tillage 2000 respondents was $100,001 to $150,000, while the average gross farm income category for the randomly selected respondents was $50,001 to $100,000. However, using the T-test, the results were not statistically significant. Thus, these results do not follow the diffusion of innovations theory. The respondents' net income might have been a more accurate measurement of their financial well-being, but it was felt that it was too sensitive a question to ask.

TABLE 18
RESPONDENTS' ANNUAL GROSS FARM INCOME

Percent	TILLAGE 2000		RANDOM	
	Number	Percent	Number	Percent
< $12,000	0	0%	3	3%
$12,000 - $25,000	1	6	8	8
$25,001 - $50,000	1	6	11	10
$50,001 - $100,000	0	0	22	21
$100,001 - $150,000	7	44	26	24
> $150,000	7	44	37	35
Total	16	100%	107	100%

T-value = -1.44 p = 0.152

Table 19 shows the respondents' cultivated acreage. The average size of cultivated acreage for the Tillage 2000 respondents was 440 acres, compared to 176 acres for the randomly selected respondents. Using the t-test, it was determined that these differences were statistically significant. These results were in keeping with the Tillage 2000 respondents' tendency of operating cash crop enterprises.

Table 20 outlines the respondents' percent of cultivated acreage owned. The Tillage 2000 respondents owned an average of 72 percent of their cultivated acreage, while the randomly selected farmers owned an average of 81 percent. Using the t-test, these results were not statistically significant. This data suggest that tenure is not a significant variable in the adoption of conservation tillage.

TABLE 19

RESPONDENTS' SIZE OF CULTIVATED ACREAGE

Acres[a]	TILLAGE 2000		RANDOM	
	Number	Percent	Number	Percent
10 - 69	1	6%	3	3%
70 - 129	0	0	23	22
130 - 179	1	6	19	18
180 - 239	2	13	22	21
240 - 399	4	25	23	22
400 - 559	4	25	7	7
≥ 560	4	25	10	9
Total	16	100%	107	100%

T-value = -3.02 p = 0.003

[a] Metric equivalents are 4-28 ha, 29-52 ha, 53-72 ha, 73-97 ha, 98-162 ha, 163-226 ha, and > 227 ha.

TABLE 20

PERCENT OF CULTIVATED ACREAGE OWNED BY RESPONDENTS

Percent	TILLAGE 2000		RANDOM	
	Number	Percent	Number	Percent
≤20	0	0%	6	6%
21 - 40	3	19	6	6
41 - 60	3	19	11	10
61 - 80	3	19	13	12
81 - 100	7	44	71	66
Total	16	100%	107	100%

T-value = 1.20 p = 0.232

Personal Characteristics

The personal characteristics examined in this survey were age, education, years

operating a farm, peer influence, information sources, farm management skills, and group participation.

The average age of the Tillage 2000 respondents was 37.3 years, while the average age of the randomly selected respondents was 41.5 years. These results were not statistically significant, so it was concluded that age was not a significant variable in the adoption of conservation tillage.

The respondents' level of formal education is summarized in Table 21. The largest concentration of Tillage 2000 respondents was in the "college and/or some university category", while the highest concentration of randomly selected respondents was in the "some high school" category. Thus the Tillage 2000 respondents were younger and had a higher level of formal education, as the diffusion of innovation theory suggests.

TABLE 21

RESPONDENTS' FORMAL EDUCATION LEVEL

	TILLAGE 2000		RANDOM	
Levels	Number	Percent	Number	Percent
Some Elementary	0	0%	2	2%
Completed Elementary	1	6	25	23
Some High School	1	6	38	36
Completed High School	1	6	19	18
College/Some University	9	56	19	18
University	4	25	4	4
Total	16	100%	107	100%

There were no differences between the two groups as far as years operating a farm. The mean and the modal category for both the Tillage 2000 and randomly selected respondents was 11 to 20 years. It could be concluded that years operating a farm was not a significant variable in the adoption of conservation tillage.

The respondents' perceived percent of neighbours using conservation tillage is depicted in Table 22. The Tillage 2000 respondents perceived lower percentages of their neighbours were using conservation tillage, and the differences between the two groups were statistically significant. Thus it might be concluded that the influence of their neighbours was not a significant factor in their decision to adopt conservation tillage.

The Tillage 2000 respondents' perceptions of conservation tillage use also more closely reflected the results of two previous studies on tillage practices in southwestern Ontario. Wall, Vaughan, and Driver (1985) concluded that 35 percent of their respondents used conservation tillage, while Coleman and Roberts (1987) found that 26 percent of their respondents used conservation tillage. This finding would seem to indicate that the Tillage 2000 respondents had a clearer perception of the amount of conservation tillage adoption in their areas.

TABLE 22

PERCEIVED PER CENT OF NEIGHBOURS USING CONSERVATION TILLAGE

Percentage of Peers		TILLAGE 2000		RANDOM	
		Number	Percent	Number	Percent
0 - 20		13	81%	50	47%
21 - 40		3	19	20	19
41 - 60		0	0	22	21
61 - 80		0	0	6	6
81 - 100		0	0	9	8
	Total	16	100%	107	100%

T-value = 3.27 p = 0.001

Tables 23 and 24 depict the respondents' first information source and important follow-up information sources for conservation tillage. In rank order, the top four initial information sources for the Tillage 2000 respondents were farm media, University of Guelph and/or agricultural colleges and/or experimental farms, farm organizations, and company representatives. The top four sources for the randomly selected respondents were farm media, neighbours and/or family, University of Guelph and/or agricultural colleges and/or experimental farms, and "other." "Other" initial information sources included farm shows, plowing matches, and conservation authorities.

The Tillage 2000 respondents had markedly higher response rates for two of the three institutional sources of information (educational institutions and farm organizations). Given the Tillage 2000 cooperators higher level of education, it was not

surprising that the University of Guelph and/or agricultural colleges were one of the top ranked categories of initial information sources.

TABLE 23

RESPONDENTS' FIRST INFORMATION SOURCE FOR CONSERVATION TILLAGE

Information Source	TILLAGE2000		RANDOM	
	Number	Percent	Number	Percent
Personal Experience/ Common Knowledge	0	0%	5	7%
Farm Media	4	25	20	30
Demonstrations	0	0	0	0
OMAF	0	0	4	6
Neighbours/Family	0	0	13	19
Universities/Colleges/ Experimental Farms	4	25	9	13
Company Representatives	3	19	3	4
Farm Organizations	3	19	6	9
Other	2	13	7 [a]	10
Total[a]	16	100%	67	100%

[a] This question was not applicable to the 40 respondents who were nonadopters.

The top three ranked follow-up information sources for the Tillage 2000 respondents were "other," farm media, and OMAF. The top three ranked follow-up information sources for the randomly selected respondents were neighbours and/or family, farm media, and OMAF. "Other" follow-up information sources included plowing matches, consulting firms, trips to the United States, farm shows, a conservation authority, and a film. Once again, the Tillage 2000 respondents had a higher response

rate for institutional sources of information. They also did not rank neighbours or family as an important source of information.

TABLE 24

RESPONDENTS' IMPORTANT FOLLOW-UP INFORMATION SOURCES

Information Source[a]	TILLAGE 2000 N=16 Number	Percent	RANDOM N=67 Number[b]	Percent
Personal Experience/ Common Knowledge	1	6%	1	1%
Farm Media	4	25%	22	33%
Demonstrations	0	0%	2	3%
OMAF	4	25%	11	16%
Neighbours/Family	3	19%	25	37%
Universities/Colleges/ Experimental Farms	3	19%	5	7%
Company Representatives	0	0%	5	7%
Farm Organizations	3	19%	4	6%
Other	7	44%	9	13%

[a] Respondents could give multiple responses.

[b] Includes the 40 respondents who were nonadopters.

Demonstrations were not mentioned as an initial information source, and only two respondents included them as a follow-up information source. Either demonstrations are not significant information sources, or perhaps they were incorporated into some of the other responses given, such as OMAF.

The farm management score was calculated according to the respondents' use of fertilizer, herbicides, breeding practices, and method used for record-keeping (Appendix III). Table 25 shows the distribution of respondents by their management

scores. The Tillage 2000 respondents' scores ranged from 7.1 to ten, with a mean score of 9.5. The randomly selected respondents' scores ranged from 3.9 to ten, with a mean score of 8.0. Using the t-test it was determined that there were statistically significant differences between the two groups' scores. The Tillage 2000 cooperators' higher management scores were characteristic of innovators, and were needed for the successful implementation of conservation tillage in a farming enterprise.

TABLE 25

RESPONDENTS' FARM MANAGEMENT SCORE

Score	TILLAGE2000		RANDOM	
	Number	Percent	Number	Percent
≤ 6.0	0	0%	6	6%
6.1 - 7.0	0	0	13	12
7.1 - 8.0	3	19	36	34
8.1 - 9.0	0	0	31	29
9.1 - 10.0	13	81	21	20
Total	16	100%	107	100%

T-value = -4.62 p = <0.001

The frequency distribution of total organizational participation scores is presented in Table 26. Respondents were questioned as to the type of organizations they belonged to, their membership positions, and their attendance. The total participation score was calculated by giving one point for each group membership, one point for currently holding an executive position, and one point for holding an executive position in the past. Attendance was scored by assigning no points for attending less than one-third

of a group's meetings, one point for attending one-third to two-thirds of the meetings, and two points for attending more than two-thirds of the meetings. Consequently, respondents with high scores were the most involved in organizations, while those with low scores were less involved.

Tillage 2000 respondents had a mean score of 18 which indicated significantly higher organizational participation than the randomly selected respondents, with a mean score of seven. The finding that adopters of conservation tillage have a higher degree of organizational involvement paralleled that of Korsching et al. (1983).

TABLE 26

RESPONDENTS' ORGANIZATIONAL PARTICIPATION SCORE

	TILLAGE 2000		RANDOM	
Score	Number	Percent	Number	Percent
0 - 5	2	13%	56	52%
6 - 10	2	13	22	21
11 - 15	4	25	20	19
16 - 20	2	13	7	7
21 - 25	1	6	2	2
≥ 26	5	31	0	0
Total	16	100%	107	100%

T-value = -6.53 p = <0.001

Tillage 2000

Of the randomly selected respondents, 25 percent were aware of the Tillage 2000 program (Table 27). Of the 25 percent, only five (five percent) had visited a Tillage 2000 demonstration farm. An even smaller percentage, 17 percent, recognized the Tillage 2000 logo (Table 28). The researcher concluded that the Tillage 2000 staff should expand their extension efforts.

TABLE 27

RANDOM SAMPLE RESPONDENTS' AWARENESS OF THE TILLAGE 2000 PROGRAM

Response	Number	Percent
Aware of Program	27	25%
Not Aware of the Program	69	65
Don't Know	11	10
Total	107	100%

TABLE 28

RANDOM SAMPLE RESPONDENTS' RECOGNITION OF THE TILLAGE 2000 LOGO

Response	Number	Percent
Recognized the Logo	18	17%
Did Not Recognize the Logo	77	72
Don't Know	12	11
Total	107	100%

Paralleling the low rate of awareness of the program was the degree of influence Tillage 2000 has had on the respondents' tillage practices (Table 29). Only 25 percent of the Tillage 2000 respondents and two percent of the randomly selected respondents felt the program had had a "moderate" or "great deal" of influence on their tillage practices.

TABLE 29

DEGREE OF INFLUENCE TILLAGE 2000 HAS HAD ON RESPONDENTS' TILLAGE PRACTICES

Degree of Influence	TILLAGE 2000		RANDOM	
	Number	Percent	Number	Percent
Not At All	5	31%	105	98%
Slight	7	44	0	0
Moderate	1	6	2	2
A Great Deal	3	19	0	0
Total	16	100%	107	100%

However, the 12 Tillage 2000 respondents who answered "slightly" or "not at all" gave further reasons for their responses. Five of the 12 said the reason for the program's low rate of influence was the short amount of time they had been involved with it. Six of the 12 respondents cited their previous involvement or experimentation with conservation tillage as the reason for the program's low degree of influence.

In an attempt to determine if location or distance played a role in awareness of Tillage 2000, the respondents were asked the distance to the nearest demonstration farm and how often they drove past it in the summer (Tables 30 and 31). The majority of respondents (71 percent) lived within 20 miles (32 km) of a demonstration farm, while at the same time 70 percent never drove past the nearest demonstration farm. This would seem to indicate that while the demonstration farms are well distributed throughout the study area, they are not on well-frequented routes.

TABLE 30

DISTANCE TO NEAREST TILLAGE 2000 DEMONSTRATION FARM FROM RANDOM SAMPLE RESPONDENTS' FARMS

Distance (Miles)[a]	Number	Percent
0 - 10	22	21%
11 - 20	53	50
21 - 30	23	22
31 - 40	8	8
41 - 50	1	1
Total	107	100%

[a] Metric equivalents are 0-16 km, 17-32 km, 33-43 km, 49-64 km, and 65-30 km.

TABLE 31

TIMES PER MONTH IN THE SUMMER THAT NEAREST TILLAGE 2000 FARM IS DRIVEN PAST BY RANDOM SAMPLE RESPONDENTS

Number of Times Per Month		Number	Percent
0		75	70%
1		12	11
2		12	11
3		3	3
4		2	2
≥ 5		3	3
	Total	107	100%

Perhaps a clue to awareness of Tillage 2000 lies in the responses of the two randomly selected farmers who said their tillage practices had been influenced by the program. One was going to be a Tillage 2000 cooperator but had had too many other time commitments. The other worked full-time off the farm and had heard of the program through farm newspapers. This would seem to indicate that personal contact and the farm media have been the best sources of publicity for the program thus far.

SUMMARY OF PRINCIPAL FINDINGS AND RECOMMENDATIONS

Motivating Factors for Involvement in Tillage 2000

The factors that motivated the demonstration farmers to participate in the Tillage 2000 program were varied. The majority wanted to experiment with and/or learn as much as possible about conservation tillage, and ranked this reason as "very important" (44 percent) or "moderately important" (19 percent). One-quarter of the demonstration farmers mentioned that they knew that someone was needed as a cooperator in their area, and felt they had a responsibility to participate. Another one-quarter were personally contacted, either by Tillage 2000 staff or conservation authority staff, and asked if they would participate in the program. In rank order, the remaining reasons given were: connections with the Soil and Crop Improvement Association (three respondents); previously practiced some conservation tillage (three respondents);concerned about preserving agricultural land for the future (two respondents); and the adverse effects of conventional tillage (one respondent).

Overall, the cooperators exhibited the conventional characteristics of innovators. This was displayed through their desire to experiment and gain new knowledge; their sense of responsibility about participating in the program; their connections with other organizations; and the fact that they were well known enough in their communities to be personally contacted by Tillage 2000 staff.

Awareness and Perceptions of Soil Erosion

A larger percentage of the Tillage 2000 demonstration farmers, compared to the random sample, reported observing both wind and water erosion on their farms. Ninety-three percent of the randomly selected farmers felt that wind erosion on their farms was either nonexistent or slight, compared to 75 percent of the Tillage 2000 farmers who felt this way. Eighty percent of the randomly selected farmers felt that water erosion on their farms was either nonexistent or slight, compared to 57 percent of the Tillage 2000 farmers. The randomly selected respondents had a lower observation rate of wind and water erosion, and tended to perceive both types of erosion on their farms as being less severe. From this it could be concluded that the Tillage 2000 respondents were more aware of the erosion on their farms, and that this may have influenced their higher adoption rates of conservation tillage.

These results were compared to potential annual soil loss rankings derived from Environment Canada maps for each respondent's farm. None of the Tillage 2000 respondents was located in high potential soil loss areas, compared to 11 percent of the randomly selected respondents. Fifty percent of the Tillage 2000 cooperators had farms that were ranked as having medium potential soil loss, and 50 percent were ranked as having low potential soil loss This proportion corresponds to 65 percent of the randomly selected respondents who were located in medium potential soil loss

areas, and 24 percent who were located in low potential soil loss areas. It can be concluded that Tillage 2000 farmers were more aware of both types of erosion, and perceived higher degrees of severity of erosion on their farms, yet on average were located on less erosion-prone land. This could be because, as innovators, they were more sensitive to the issue of soil erosion.

A measure of the accuracy of the respondents' perceptions of erosion on their farms was provided by cross tabulating the farms' potential soil loss with the respondents' perceptions of the water erosion on their farms. By this measure, a smaller percentage of the Tillage 2000 respondents underestimated the erosion problem on their farms, while a larger percentage fo them overestimated the erosion on their farms. Approximately equal percentages of the two groups accurately perceived the erosion problem on their farms.

Overall, it can be concluded that the Tillage 2000 respondents had a more accurate perception of the erosion on their farms, and in some cases, even tended to exaggerate their erosion problems. This almost extreme level of awareness may have influenced their higher adoption rates of conservation tillage.

Perceptions, Knowledge, and Use of Conservation Tillage

When asked to define conservation tillage, three of the randomly selected respondents were not familiar with the term. The same three definitions "minimum number of passes," "conserving soil," and "residue cover" -- were the most frequently cited by both groups of respondents, although in a different rank order. These results suggested that both groups had a common general understanding of the definition of conservation tillage.

The Tillage 2000 respondents more frequently defined conservation in terms of residue cover (the definition used by specialists). The randomly selected respondents more frequently defined conservation tillage in terms of "crop rotations." This term is, more correctly, a conservation practice and not necessarily a part of conservation tillage.

When using their own definition of conservation tillage, 94 percent of the Tillage 2000 respondents and 69 percent of the respondents felt that they had adopted conservation tillage. When given the study definition (the definition used by specialists), the proportion of adopters among the randomly selected group decreased to 50 percent, while the proportion of adopters among the Tillage 2000 respondents remained unchanged.

From their 94 percent adoption rate, it could be concluded that the Tillage 2000 respondents had a significantly higher rate of adoption of conservation tillage, and a more accurate perception of what conservation tillage was.

Another interesting result of the study was the rather high (50 percent) rate of adoption of conservation tillage among the randomly selected respondents. Two previous studies in the same study area concluded that 35 percent (Wall, Vaughan, and Driver, 1985) and 26 percent (Coleman and Roberts, 1987) of their respondents had adopted conservation tillage, respectively.

Part of the reason for the differences may be accounted for in the way that conservation tillage use was defined. In the two previous studies, respondents were asked which primary tillage implements they used. If the respondents gave the name of a conservation tillage implement, they were considered to be using conservation tillage. In this study, respondents were asked if they felt their tillage practices -- regardless of the type of implements used -- were leaving a 30 percent residue level. This was because, theoretically, one can leave a 30 percent residue level with a properly adjusted moldboard plow (G. Driver, *personal communication).* At the same time, as one respondent mentioned, the first time his father tried their new chiselplow, he came back to the house complaining that it had taken him five passes across the field before all the residue was buried!

As was mentioned in the literature review, farmers tend to overestimate the amount of crop residue left on their fields (Nowak and Korsching, 1985). Admittedly, defining conservation tillage adoption in terms of implements used circumvents this problem. However, at the same time, researchers studying adoption rates may be blinded to farmers' perceptions of the situation. If farmers feel they have adopted conservation tillage, regardless of the type of tillage implements used or the amount of residue actually left in their fields, they may feel that further extension and research activities are no longer applicable to them.

There were statistically significant differences between the two groups with respect to knowledge and use of conservation tillage. The Tillage 2000 respondents on average were able to identify a greater number of implements, and had a higher usage rate for conservation tillage implements. This finding is in keeping with their more accurate perception and higher adoption rate of conservation tillage.

A higher proportion of Tillage 2000 respondents also indicated that each of the reasons listed on a card for them had been relevant in their decision to adopt conservation tillage. From this finding it could be concluded that they were more aware of the potential benefits of adoption. They recognized the importance of increasing crop residue levels, and were more willing to experiment with a potentially effective new farming technique.

In rank order, the top four reasons given for not adopting conservation tillage by the randomly selected respondents were "no need and/or not appropriate for farm," "using other conservation practices," "not appropriate for soils," and "the cost of equipment." The financial reason cited was not the most frequently cited despite the current farm financial situation. The most frequently cited reason ("no need and/or not appropriate for soils") reinforces the randomly selected respondents' low perception of the erosion on their farms. The agronomic reasons given were all recognized limitations of conservation tillage. The reasons given were indicative of later adopters who wait until the technical problems are solved before adopting an innovation.

Profile of the Tillage 2000 and Randomly Selected Respondents

The Tillage 2000 and randomly selected respondents were compared on the basis of economic and personal characteristics.

The economic characteristics examined were gross farm income, cultivated acreage, and percent of cultivated acreage owned. The average gross farm income for the Tillage 200 respondents was in the range of $100,001 to $150,000, compared to $50,001 to $100,000 for the randomly selected respondents, although the differences were not statistically significant. Perhaps the respondents' net farm income

might have been a more accurate measure of their financial well-being, but net farm income was felt to be too sensitive a question to ask.

The Tillage 2000 respondents had an average cultivated acreage of 440 acres, while the randomly selected respondents had an average cultivated acreage of 176 acres. At the same time the Tillage 2000 respondents owned an average of 72 percent of their cultivated acreage, while the randomly selected respondents owned an average of 81 percent.

The Tillage 2000 respondents' larger cultivated acreage was in keeping with their status as innovators, and with their tendency to operate cash crop enterprises. The Tillage 2000 respondents may have owned a smaller percentage of their cultivated acreage because of their higher farm management skills. One cooperator had sold some of his land when commodity prices started to fall, was currently renting any extra land he needed, and planned to repurchase more land when he felt commodity prices were on the upswing.

The personal characteristics examined were age, formal education, years operating a farm, peer influence, information sources, farm management skills, and group participation.

The Tillage 2000 respondents were younger on average (although not significantly younger), and had a significantly higher level of formal education. There was no

difference between the two groups with respect to number of years they had been operating a farm. It was concluded that formal education level was a significant factor in the adoption of conservation tillage, and that age was not.

The Tillage 2000 respondents reported lower percentages of their neighbours were using conservation tillage, compared to the randomly selected respondents. Their perceptions of their neighbours' use of conservation tillage more closely reflected the results of previous studies done in southwestern Ontario. It seemed that the influence of neighbours was not a significant factor in the Tillage 2000 respondents' decision to adopt conservation tillage, and that they had a more accurate perception of the degree of conservation tillage use in their area.

Proportionately more Tillage 2000 respondents reported using institutional sources of conservation tillage information (OMAF, University of Guelph, and farm organizations). This was not surprising, given their higher level of formal education, and innovators' tendency to consult institutional sources.

The Tillage 2000 respondents had higher scores for both the farm management skills index as well as the organizational participation index.

Tillage 2000's Immediate Impact

Of the 107 randomly selected respondents, 25 percent 27 respondents) were aware of the Tillage 2000 program. Seventeen percent of the randomly selected respondents recognized the program's logo, and five percent had visited a demonstration farm. Only two percent of the randomly selected respondents had changed their tillage practices as a result of the Tillage 2000 program. Neither location of or distance from the demonstration farms appeared to play a role in awareness of the program.

The program has not, so far, had a great amount of impact on tillage practices in southwestern Ontario. However, the program was only in its second summer and had just published the results of its first year when the research for this study was conducted. The low rate of influence recorded was possibly due to the short time the program has been in existence.

Recommendations

In response to the findings and conclusions, several recommendations can be made:

1. It is recommended that research and extension agencies clarify what they mean by the term conservation tillage to avoid perpetuating the various perceptions and misperceptions among the farm population.

2. It is recommended that sources who supply information on conservation tillage emphasize that conservation tillage is a system. To obtain optimal results, conservation tillage, as a system, must be experimented with over time.
3. It is recommended that the effect of Tillage 2000 on awareness of conservation tillage be re-evaluated at the program's end, and the results compared to those of this study to facilitate a more holistic evaluation of the program's effectiveness.
4. It is recommended that Tillage 2000 staff increase their extension efforts to make farmers in Ontario more aware of pertinent local research.

On the basis of the researcher's overall impressions after finishing the research and analysis, one further recommendation can be made:

5. It is recommended that public and private extension agencies attempt to increase awareness of the availability of existing custom conservation tillage and/or conservation tillage equipment loan or rental, and recognize that innovators who have been practicing conservation tillage for several years are a valuable information source. This measure might aid in increasing adoption through limited trial, rather than simply providing information on the benefits of conservation tillage.

One example of this is the Huron Soil and Water Conservation District. This grassroots organization has had a 78 percent adoption rate among its members. The primary objective of the group is to help its members gain practical experience with

conservation tillage. They focus on projects rather than demonstrations because they feel that demonstrations suggest a level of competence which is not yet established, and can lead to disillusionment.

BIBLIOGRAPHY

Aspinall, J.D.; Lang, H.C.; Kachanoski, R.G.;Arnold, J.B.;Fisher, A.G.; and Rudy, H.B. Tillage 2000: 1985-86 Progress Report. University of Guelph: Department of Land Resource Science, 1987.

Bangay, Garth E. Agriculture and Water Pollution - An Assessment of the Practices and Attitudes of Ontario Farmers. Toronto: Environmental Control Branch, Environment Canada, 1979.

Blackburn, Donald J. "Technology Transfer." *In* In Search of Soil Conservation Strategies in Canada, pp.107-123. Edited by Darwin W. Anderson. Ottawa: Agricultural Institute of Canada, 1987.

Bos, A.W., and Sadler Richards, Jane. Conservation Tillage Assessments. Upper Thames River Conservation Authority, Stratford-Avon River Environmental Management Program, Report R-12, 1983.

Bultena, Gordon, and Hoiberg, Eric O. "Factors Affecting Farmers' Adoption of Conservation Tillage." Journal of Soil and Water Conservation 38 (May-June 1983): 281-284.

Carlson, John E., and Dillman, Don A. "Early Adopters and Nonusers of No-till in the Pacific Northwest: A Comparison."In Conserving Soil: Insights from Socio-economic Research, pp.83-92. Edited by Stephen B. Lovejoy and Ted L. Napier. Ankeny: Soil Conservation Society of America, 1986.

Christensen, Lee A., and Norris, Patricia E. "Soil Conservation and Water Quality Improvement: What Farmers Think." Journal of Soil and Water Conservation 38 (January-February 1983): 15-20.

Coleman, Dell, and Roberts, Peter. Cropping, Tillage and Land Management Practices in Southwestern Ontario-1986. Guelph Agriculture Centre, 1987.

Dusault , Allen J. "Assessment of Soil Degradation on Row Cropped Land in Southwestern Ontario Using Perception Based Measures." M.Sc. Thesis, University of Guelph, 1984.

Epplin, Francis M., and Tice, Thomas F. "Influence of Crop and Farm Size on Adoption of Conservation Tillage." Journal of Soil and Water Conservation 41 (November-December 1986): 424-427.

Esseks, Dixon J. and Kraft, Steven E. "Landowner Views of Obstacles to Wider Participation in the Conservation Reserve Program." Journal of Soil and Water Conservation 41 (November-December 1986): 410-414.

Fairbairn, Garry Lawrence. Will the Bounty End? The Uncertain Future of Canada's Food Supply. Saskatoon: Western Producer Prairie Books, 1984.

Heffernan, William D. and Green, Gary P. "Farm Size and Soil Loss: Prospects for Sustainable Agriculture." Rural Sociology 51 (Spring 1986): **31-42.**

Hudson, Norman. Soil Conservation. 2nd ed. Ithaca: CornellUniversity Press, 1981.

Ketcheson, John. "Conservation Tillage in Eastern Canada." Journal of Soil and Water Conservation 32 (January-February 1977): 57-60.

Korsching, Peter F.; Stofferahn, Curtis W.; Nowak, Peter J.; and Wagener, Donald J. "Adopter Characteristics and Adoption Patterns of Minimum Tillage: Implications for Soil Conservation Programs." Journal of Soil and Water Conservation 38 (September-October 1983): 428-431.

Lang, Howard; Aspinall, J.D.; and Kachanoski, R.G. "Tillage 2000- An On Farm Conservation Demonstration and Research Project." Presented at the Agricultural Institute of Canada Conference, London, Ontario, 1987.

Lee, Linda K. "Land Tenure and Adoption of Conservation Tillage." Journal of Soil and Water Conservation 38 (May-June 1983): 166-168.

Lovejoy, Stephen B. and Napier, Ted L. "Conserving Soil: Sociological Insights." Journal of Soil and Water Conservation 41 (September-October 1986): 304-308.

Magleby, Richard; Gadsby, Dwight; Colacicco, Daniel; and Thigpen, Jack. "Trends in Conservation Tillage." Journal of Soil and Water Conservation 40 (May-June 1985):274-276.

Mannering, Jerry V., and Fenster,Charles R. "What is Conservation Tillage?" Journal of Soil and Water Conservation 38 (May-June 1983): 141-143.

Marshall, Heather. "Farmers' Perceptions of Soil Erosion and Attitudes Towards Soil Erosion Control." Senior Honours Thesis, University of Waterloo, 1987.

Napier, Ted L.; Camboni, Silvana M.; and Thraen, Cameron S. "Environmental Concern and the Adoption of Farm Technologies." Journal of Soil and Water Conservation 41 (March-April 1986):109-113.

Napier, Ted L.; Thraen, Cameron S.; Gore, Akia; and Gore, W. Richard. "Factors Affecting Adoption of Conventional and Conservation Tillage Practices in Ohio." Journal of Soil and Water Conservation 39 (May-June 1984) : 205-209.

Nowak, Peter J. "Adoption and Diffusion of Soil and Water Conservation Practices." The Rural Sociologist 3 (Number 2 1983a): 83-91.

Nowak, Peter J. "Obstacles to Adoption of Conservation Tillage." Journal of Soil and Water Conservation 38 (May-June 1983b):162-165.

Nowak, Peter J., and Korsching, Peter F. "Conservation Tillage: Revolution or Evolution?" Journal of Soil and Water Conservation 40 (March-April 1985): 199-201.

Pampel, Fred Jr., and van Es, J.C. "Environmental Quality and Issues of Adoption Research." Rural Sociology 42 (Spring 1977): 57-71.

Rahm, Michael R. *and* Huffman, Wallace E. "The Adoption of Reduced Tillage: The Role of Human Capital and Other Variables." American Journal of Agricultural Economics 66 (November 1984): 405-413.

Sadler Richards, Jane. *"Changing* Farmer Attitudes: An Ontario Experience." Journal of Soil and Water Conservation 38 (May-June 1983): 255-257.

Soil Conservation Society of America. Resource Conservation Glossary. 3rd ed. Ankeny, Iowa, 1982.

Wall, G.J. and Dickinson, W.T. "Economic Impact of Erosion," Notes on Agriculture 14 (December 1978): 11-12.

Wall, G.J. and Driver, G. Cropland Soil Erosion: Estimated Cost to Agriculture in Ontario. Guelph: Ontario Institute of Pedology, 1982.

Wall, Gregory J.; Vaughan, Elizabeth E.; and Driver, Galen. Cropping, Tillage, and Land Management Practices in Southwestern Ontario - 1984. Guelph: Ontario Instituteof Pedology, 1985.

Wells, Betty L.; Borich, Timothy O.; and Frus,Jack D. "Conservation Tillage in an Iowa County." Journal of Soil and Water Conservation 38 (May-June 1983): 284-286.

White, James. A Framework for Understanding Technology Transfer Within the Agri-Food System. Ottawa:Agriculture Canada, 1985.

APPENDIX I

COVERING LETTER

UNIVERSITY OF GUELPH
ONTARIO AGRICULTURAL COLLEGE
Department: of Rural Extension Studies

GUELPH, ONTARIO, CANADA N1G 2W1
Telephone (519) 8244120

June 26, 1987

Dear Sir or Madam:

Your name has been randomly selected from a list of farmers who were interviewed in 1994 for a cropping, tillage, and land management practices study in southwestern Ontario. We would appreciate your assistance in a follow-up survey.

This second survey is part of our ongoing research and is co-funded by both the Ontario Ministry of Agriculture and Food and Agriculture Canada. The interviewing will be conducted by Ms. Kathleen Zimmerman, who is a graduate student in our Department. The goal cf this follow-up survey is to determine what tillage practices farmers are using, and some related facers. The survey results should help in the design cf better educational and assistance programs.

Within a few weeks you will receive a phone call from Kathleen Zimmerman to arrange an interview date convenient for you. The interview will take about 45 minutes, and I think you might find it interesting. All the information will be treated by us as strictly confidential. Only grouped data will appear in cur reports.

We would very much appreciate your assistance in this study as a cross-section of farmers is needed to obtain accurate results. Thank you!

Yours sincerely,

Donald J. Blackburn, P.Ag. Professor

APPENDIX II

SAMPLE QUESTIONNAIRE AND INTERVIEW CARDS

Office Number

INTERVIEW QUESTIONNAIRE

OPENING REMARKS

In this survey we are interested in some of your opinions and feelings about soil erosion, conservation tillage, farming, and about some of the activities in whichyou might be involved. Please remember that there are no right or wrong answers for most of these questions. What we want to know is how you personally feel about these things. All of your answers will be confidential.
I'd like to start by asking you some questions about your farm.

1) What is the total number of cultivated acres you are farming? Please include rented land, if any.

_____ Acres

2) What percentage of the cultivated acreage you are farming is owned by you?

_____ %

3) (Show card number 1.) Just tell me the number on the card beside each enterprise which you happen to have. (If more than one, ask which is the major farm enterprise, and circle.)

____ 1.Grain Corn
____ 2. Fodder Corn
____ 3. Tobacco
____ 4. Fruit
____ 5. Beef cows
____ 6. Feedlot cattle
____ 7. Dairy cattle
____ 8. Swine
____ 9. Sheep
____ 10. Turkeys
____ 11. Laying hens
____ 12. Broilers
____ 13. Vegetables
____ 14. Grain
____ 15. Oilseeds
____ 16. Hay and/or Pasture
____ 17. Other (specify)

4) Have you happened to observe any wind erosion on your property during the past few years?

____ 1. Yes
____ 2. No
____ 7. Don't Know

If "YES":

4a) How serious a problem is this wind erosion on your farm? Would you say:

____ 3. Extremely serious
____ 2. Moderately
____ 1. Slightly
____ 0. Not at all

5) Have you happened to observe any water erosion on your property during the past few years?

____ 1. Yes
____ 2. No
____ 7. Don't Know

If "YES":

5a) How serious a problem is this water erosion on your farm? Would you say:

____ 3. Extremely serious
____ 2. Moderately
____ 1. Slightly
____ 0. Not at all

Now I would like to ask you some questions specificallyabout conservation tillage.

6) What does the term "conservation tillage" mean to you?

_____
_____
_____
_____

6a) By your own definition, are you using conservation tillage practices on your farm?

____ 1. Yes
____ 2. No
____ 3. Don't Know

In this study we are defining conservation tillage as any tillage practice that leaves a minimum of 30 percent residue after planting. To help give you a better idea of what a 30 percent residue level looks like, I have a photograph here of various residue levels. (Explain photo.)

7) Using this study's definition of conservation tillage, have you incorporated any conservation tillage practices into your farming operation within the last five years?

____ 1 . Yes
____ 2. No (If "No" skip to Question 12.)

8) (Show card number 2.) Please look at this card and tell me which if any of the conservation tillage practices,that are listed, you are familiar with.

____ 1. Soil saver
____ 2. Chisel plow
____ 3. Modified moldboard
____ 4. Disc
____ 5. Ridge planter
____ 6. No-till corn planter
____ 7. No-till seed drill
____ 8. Roto-strip tiller
____ 9. Paraplow
____ 10. Stubble-mulch tiller

8) These are some, there may be others. Are there any other conservation tillage practices, not listed on this card, that you are familiar with?

_____
_____
_____

9) Of the types of conservationtillage that you are familiar with, what type(s) have you used within the last five years, if any?

____ 1. Soil saver
____ 2. Chisel plow
____ 3. Modified moldboard
____ 4. Disc
____ 5. Ridge planter
____ 6. No-till corn planter
____ 7. No-till seed drill
____ 8. Roto-strip tiller
____ 9. Paraplow
____ 10. Stubble-mulch tiller

9a) Are there any other types of conservation tillage that you have used that are not listed on this card? (Please specify.)

_____
_____
_____

10) Are there any other types of conservation tillage practices that you are planning to use in the next year or two?

_____
_____
_____

11) On approximately what percentage of your cultivated acreage is conservation tillage used?

_____ Percent (Skip to Question 16.)

12) Are you planning to incorporate any conservation tillage practices into your farming operation in the next year or two?

____ 1. Yes
____ 2. No
____ 7. Don't know (If "No"or "Don't know" to both
Question 7 and 12, skip to Question 21.)

13) (Show card number 2.) Please look at this card and tell me which if any of the conservation tillage practices, that are listed, you are familiar with.

____1. Soil saver
____2. Chisel plow
____3. Modified moldboard
____4. Disc
____5. Ridge planter
____6. No-till corn planter
____7. No-till seed drill
____8. Roto-strip tiller
____9. Paraplow
____10. Stubble-mulch tiller

13a) These are some, there may be others. Are there any other conservation tillage practices, not listed on this card, that you are familiar with?

_____
_____
_____

14) Of the types of conservation tillage that you are familiar with, what type(s) will you be using within the next year or two?

____ 1. Soil saver
____ 2. Chiselplow
____ 3. Modified moldboard
____ 4. Disc
____ 5. Ridge planter
____ 6. No-till corn planter
____ 7. No-till seed drill
____ 8. Roto-strip tiller
____ 9. Paraplow
____ 10. Stubble-mulch tiller

14a) Are there any other types of conservation tillage that you will be using that are not listed on this card? (Please specify.)

_____
_____
_____
_____

15) On about or approximately what percentage of your cultivated acreage will conservation tillage be used?

_____ Percent

16) About what percentage of the farmers in your area do you think are practicing some form of conservation tillage?

_____ Percent

17) (Showcard number 3.) Which of the following reasons, listed on this card, influenced your decision to adopt conservation tillage?

____ 1. To increase residue levels
____ 2. To control erosion
____ 3. To reduce production costs
____ 4. To maintain or build soil structure
____ 5. To improve yields
____ 6. Changed crops/equipment
____ 7. 7.Problems with stoniness
____ 8. To increase farm income
____ 9. To experiment with an interesting new farming technique
____ 10. To reduce time spent in the fields
____ 11. Other(specify) _____

18) Who or what was your first information source, regarding conservation tillage, that you can remember?

_____
_____
_____
_____

19) Who or what were the most important follow-up information sources regarding conservation tillage, that you can remember?

_____
_____
_____
_____

20) How satisfied are you with your decision to adopt conservation tillage? Would you say:

____ 3. Extremely satisfied
____ 2. Moderately satisfied
____ 1. Slightly satisfied
____ 0. Not at all

20a) Why are you (choice from 20)?

_____
_____
_____
_____

(Skip to Question 24 for randomly selected farmers, Question 28 for Tillage 2000 farmers.)

21) (Show card number 2.) Please look at this card and tell me which if any of the conservation tillage practices,that are listed, you are familiar with (from seeing them being used by a neighbour, in a demonstration, or having read about them).

____ 1. Soilsaver
____ 2. Chisel plow
____ 3. Modified moldboard
____ 4. Disc
____ 5. Ridge planter
____ 6. No-till corn planter
____ 7. No-till seed drill
____ 8. Roto-strip tiller
____ 9. Paraplow
____ 10. Stubble-mulch tiller

21a) These are some, there may be others. Are there any other conservation tillage practices, not listed on this card, that you are familiar with?

_____
_____
_____
_____

22) What influenced your decision <u>not</u> to adopt conservationtillage (as it is defined in this study)?

_____
_____
_____
_____

23) About what percentage of the farmers in your area do you think are practicing some form of conservation tillage?

_____ Percent

FOR RANDOMLY SELECTED FARMERS:

24) Have you happened to have heard of the Tillage 2000 program, or not?

____ 1. Yes
____ 2. No
____ 7. Don't Know

24a) (Show card number 4.) Have you happened to have seen this sign before?

____ 1. Yes
____ 2. No
____ 7. Don't Know

(If "No" or "Don't Know" to both 24 and 24a, skip to Question 27.)

25) Have you happened to have visited any of the Tillage 2000 demonstration farms?

____ 1. Yes
____ 2. No
____ 7. Don't Know

26) To what extent has Tillage 2000 influenced your tillage practices, if at all? Would you say:

____ 3. A great deal
____ 2. A moderate amount
____ 1. Slightly
____ 0. Not at all

27) (Show location of the nearest Tillage 2000 demonstration farm on map.) What is the approximate distance in miles (by road) to this location from your farm?

_____ Miles

27a) How many times per month, if ever, in the summer do you take a route past this farm?

_____Times per month

FOR RANDOMLY SELECTED FARMERS, SKIP TO QUESTION NUMBER 30.

FOR DEMONSTRATION FARMERS:

28) What first influenced you to become involved with Tillage 2000?

28) Reason:	28a) Rating:
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

28a) Please rate each influencing factor as very important, moderately important, slightly important, or not at all important (mark in the question above).

29) To what extent has Tillage 2000 influenced your tillage practices, if at all? Would you say:

____ 3. A great deal
____ 2. A moderate amount
____ 1. Slightly
____ 0. Not at all

Now I'd like to ask you some general questions about yourself.

30) (Show card number 5.) Which clubs and organizations, like those on this next card, do you belong to, if any? (See next two pages.)

30. Which clubs and organizations like those on this next card do you belong to?

REPEAT IF MEMBER	FOR EACH SEPARATE GROUP CHECKED	30 a. What is name of this group?
_____	A. Civic or business groups	_____
_____	B. Political groups	_____
_____	C. Fraternal groups	_____
_____	D. Professional groups	_____
_____	E. Nationality or patriotic groups	_____
_____	F. Labor unions	_____
_____	G. Farm organizations	_____
_____	H. Recreational, sport, hobby groups	_____
_____	I. Church-connected groups	_____
_____	J. Parent-teacher groups	_____
_____	K. Community & neighborhood improvement groups	_____
_____	L. Homemakers clubs	_____
_____	M. Study clubs	_____
_____	N. Charitable and welfare groups	_____
_____	O. Governmental groups	_____
_____	P. Other groups than above	_____

RECORD ANSWERS FOR EACH GROUP R IS IN,
THEN GO ON TO NEXT PAGE

	30b. Are you now serving as an officer or on any committees of this group?	30c. Did you formerly serve as an office: or on any committees of this group?	30d. How often has this group met over the last 12 months? (GET SPECIFIC NUMBER)	30e. And how any of these meetings did you attend? (GET SPECIFIC NUMBER
A.	_____	_____	_____	_____
B.	_____	_____	_____	_____
C.	_____	_____	_____	_____
D.	_____	_____	_____	_____
E.	_____	_____	_____	_____
F.	_____	_____	_____	_____.
G.	_____	_____	_____	_____
H.	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____
I.	_____	_____	_____	_____
J.	_____	_____	_____	_____
K.	_____	_____	_____	_____
L.	_____	_____	_____	_____
N.	_____	_____	_____	_____
O.	_____	_____	_____	_____
P.	_____	_____	_____	_____
	_____	_____	_____	_____

31) Now I'd like to have you do something that we hope will tell us a little bit about some of the things you think are most important in life. What we have here is a group of paired statements which I will read to you. You can follow along on this sheet to help you remember both sentences. I would like you to tell me which sentence, the first or the second, most closely represents your own personal feelings or beliefs. Remember there are no right or wrong answers. (Give interviewee card number 6.)

a.___ It is better to specialize in order to get a higher income even if it is more risky.
OR
___ A farmer should diversify his farming operation to hedge against the greater risks in specialization.

b. ___ I most admire the farmer who has the best cattle and the most modern tools and equipment.
OR
___ I most admire the farmer who is friendly, kind and gets along well with others.

c. ___ It is better to make a smaller profit each year than to attempt something where there is a chance of losing.
OR
___ I would rather take a chance on making a big profit than to be content with a smaller but more sure profit.

d. ___ Probably the greatest satisfaction in farming is making it pay.
OR
___ Having a lot of friends is a more important goal in life than being a success financially.

e. ___ The (young) farmers who are going broke these days are the ones who are scared to take a few chances.
OR
___ Young people today are too willing to take chances because they don't know how tough times can be.

f. ___ Farming is first of all a business in which the major goal is profit.
OR
___ There are so many desirable things about farming that aperson can afford to get along on a lower income to maintain these advantages.

g. ___ The major goal of young farm families should be to stay out of debt, (as far as possible).
OR
___ It is best to borrow as much as you need to get your farm to a size that really pays.

h. __ Farming is a good occupation because it provides the farmer with a chance to make a capital gain, it is a challenge and is a chance to achieve.
OR
___ Farming is a good occupation because it provides the farmer with independence, a healthy way of life, and agood place to raise a family.

I. ___ In order to provide my family with a sense of security I would likely avoid makingmajor changes in my operation.
OR
___ If a major chan$_g$e in my farm operation had the possibility of bringing in substantially more income Iwould consider that change even if it meant risking some of my family's financial security.

j. ___ I most admire farmers who are good business men and have developed profitable farms.
OR
___ I most admire farmers who are the first to contribute help or money if a community need arises.

Now I'd like to ask you some more specific questions about your farm.

32) How did you decide how much fertilizer to apply to your major crop last year?

_____
_____
_____
_____

33) Have you had any of your fields soil tested in the last five years?

____ 1.Yes
____ 0. No

34) Have you used herbicides or some alternative weed control method on your crops in the last five years?

____ 1.Yes
____ 0. No (If "NO", skip to question 36)

35) How did you decide what method or type to use, and how to use it or how much to use?

_____
_____
_____
_____

36) Have you used insecticides or some alternative pest control method on your crops during the last five years?

____ 1.Yes
____ 0. No (If "NO", skip to question 38)

37) How did you decide what method or type to use, and how to use it or how much to use?

_____
_____
_____
_____

38) What breed improvement methods do you use on your livestock?

_____
_____
_____
_____

39) Which type of financial record system do you happen to keep?

____ 0. No system
____ 1. Bills/receipts in file folders or box
____ 2. Record book, ledgers, or CANFARM
____ 3. Other system (explain)

40) What do you use your financial records for?

_____
_____
_____

41) Do you keep written production records (for livestock and/or crops)?

____ 1. Yes
____ 0. No (If "NO", skip to question 43)

42) What do you use these records for?

_____
_____
_____

43) How many years,since you grew up, have you been operating a farm?

Number of years _____

44) (Show card number 7.) Looking at this card, could you tell me which category comes closest to your total or gross farm sales for last year? Just tell me the number beside the category.

___ 1. Less than $12,000
___ 2. between $12,000 and $25,000
___ 3. between $25,000 and $50,000
___ 4. between $50,000 and $100,000
___ 5. between $100,000 and $150,000
___ 6. over $150,000
___ 7. N.A.

45) In what year were you born?

Year _____

46) What was the highest level of schooling you reached?

_____ some elementary school
_____ completed elementary school
_____ some high school
_____ completed high school
_____ technical training beyond high school
_____ college or some university
_____ graduated from university
_____ other (specify)

CONCLUDING REMARKS

Well, that's all the questions I have for you! Do you have any questions you would like to ask me?

_____
_____
_____
_____

If you are interested, I will take your name and address and send you a summary report when this study is completed, as well as the addresses of places to get more information on Tillage 2000 and conservation tillage.

Name _____

Address _____

Thank you for your help. I certainly appreciate your taking the time to answer these questions.

CARD NUMBER ONE

FARM ENTERPRISES

1. Grain Corn
2. Fodder Corn
3. Tobacco
4. Fruit
5. Beef cows
6. Feedlot cattle
7. Dairy cattle
8. Swine
9. Sheep
10. Turkeys
11. Laying hens
12. Broilers
13. Vegetables
14. Grain
15. 0ilseeds
16. Hay and/or Pasture
17. 0ther (specify)

CARD NUMBER TWO

CONSERVATION TILLAGE PRACTICES

1. Soil saver
2. Chisel plow
3. Modified moldboard
4. Disc
5. Ridge planter
6. No-till corn planter
7. No-till seed drill
8. Roto-strip tiller
9. Paraplow
10 .Stubble-mulch tiller

CARD NUMBER THREE

REASONS FOR USING CONSERVATION TILLAGE

1. To increase residue levels
2. To control erosion
3. To reduce production costs
4. To maintain or build soil structure
5. To improve yields
6. Changed crops/equipment
7. Problems with stoniness
8. To increase farm income
9. To experiment with an interesting new farming technique
10. To reduce time spent in the fields
11. 0ther (specify)

CARD NUMBER FOUR

SOIL

CONSERVATION

CARD NUMBER FIVE

CLUBS AND ORGANIZATIONS

A. CIVIC OR BUSINESS GROUPS
B. POLITICAL GROUPS
C. FRATERNAL GROUPS
D. PROFESSIONAL GROUPS
E. NATIONALITY OR PATRIOTIC GROUPS
F. LABOUR UNIONS
G. FARM ORGANIZATIONS
H. RECREATIONAL, SPORT, HOBBY GROUPS
I. CHURCH - CONNECTED GROUPS
J. PARENT - TEACHER GROUPS
K. COMMUNITY AND NEIGHBOURHOOD IMPROVEMENT GROUPS
L. HOMEMAKERS CLUB
M. STUDY CLUBS
N. CHARITABLE AND WELFARE GROUPS
O. GOVERNMENTAL GROUPS
P. OTHER GROUPS THAN THE ABOVE

CARD NUMBER SIX

PAIRED STATEMENTS

a. ___ It is better to specialize in order to get a higher income even if it is more risky.
OR
___ A farmer should diversify his farming operation to hedge against the greater risks in specialization.

b. ___ I most admire the farmer who has the best cattle and the most modern tools and equipment.
OR
___ I most admire the farmer who is friendly, kind and gets along well with others.

c. ___ It is better to make a smaller profit each year than to attempt something where there is a chance of losing.
OR
___ I would rather take a chance on making a big profit than to be content with a smaller but moresure profit.

d. ___ Probably the greatest satisfaction in farming is making it pay.
OR
___ Having a lot of friends is a more important goal in life than being a success financially.

e. ___ The (young) farmers who are going broke these days are the ones who are scared to take a few chances.
OR
___ Young people today are too willing to take chances because they don't know how tough times can be.

f. ___ Farming is first of all a business in which the major goal is profit.
OR
___ There are so many desirable things about farming that a person can afford to get along on a lower income to maintain these advantages.

g. ___ The major goal of young farm families should be tostay out of debt, (as far as possible).
OR
___ It is best to borrow as much as you need to get your farm to a size that really pays.

h. ___ Farming is a good occupation because it provides the farmer with a chance to make a capital gain, it is a challenge and is a chance to achieve.

OR

___ Farming is a good occupation because it provides the farmer with independence, a healthy way of life, and a good place to raise a family.

I. ___ In order to provide my family with a sense of security I would likely avoid making major changes in my operation.

OR

___ If a major change in my farm operation had the possibility of bringing in substantially more income I would consider that change even if it meant risking some of my family's financial security.

j. ___ I most admire farmers who are good business men and have developed profitable farms.

OR

___ I most admire farmers who are the first to contribute help or money if a community need arises.

CARD NUMBER SEVEN

GROSS FARM INCOME

___ 1. Less than $12,000
___ 2. between $12,000 and $25,000
___ 3. between $25,000 and $50,000
___ 4. between $50,000 and $100,000
___ 5. between $100,000 and $150,000
___ 6. over $150,000

APPENDIX III

FARM MANAGEMENT SCORE

Calculation of Farm Management Score

Formal Education

0 Not completed elementary school

1 Elementary school completed and/or some or all of Secondary School

2 Post Secondary Education

Crop Practices - Fertilization

0 Used what landlord sent; not codable, ambiguous

1 Don't know; always used same amount or same as last year; used what he/she had on hand

2 On the basis of general knowledge or experience; followed the recommendations or practices of family, relatives, or other farmers; from the recommendations of commercial interests, e.g. salesperson; according to information gained through the mass media

3 According to soil test; followed the general recommendations of government authorities and/or professionals; according to careful observation in trial-and-error-like procedures of a fairly scientific nature; critical observation, recording of data, etc.

Crop Practices - Herbicide/Insecticide Use

0 Used what landlord sent; not codable, ambiguous

1 Don't know; always used same amount or same as last year; used what he/she had on hand

2 On the basis of general knowledge or experience; followed the recommendations or practices of family, relatives, or other farmers; from the recommendations of commercial interests, e.g. salesperson; according to information gained through the mass media

3 Followed the general recommendations of government authorities and/or professionals; according to careful observation in trial-and-error-like procedures of a fairly scientific nature; critical observation, recording of data, etc.

Livestock Practices - Stock Selection

0 Don't know; don't bother to select; just let them breed; no effort made to be selective

1 Try to breed the best stock on hand without having to resort to buying a special stud animal

2 Select according to some general knowledge or experience such as the practice of always buying a pure bred animal because it will always produce better stock

3 Select according to careful observation in trial-anderror-like procedures of a fairly scientific nature, but with no written production records

4 Select according to careful observation in trial-anderror-like procedures of a fairly scientific nature but with particular attention paid to production records

Financial Records - Type

0 None kept

1 Bills/receipts in box or folders

2 Record book or ledgers

Financial Records - Use

0 Not used at all

1 Used to determine income tax; payment to Canada Pension Plan

2 Used to estimate farm profit or loss; aid in improving farm practices; to analyze specific segments of the farm operation (e.g. profit from a major enterprise)

Written Production Records - Use

0 None kept

1 Records kept on some aspects of the enterprise but not used, or seldom used, in aiding evaluation of farm or particular enterprise production

2 Records kept on some aspects of the enterprise, and used in aiding evaluation of farm or particular enterprise performance

MANAGEMENT SCORING METHOD

Component	Minimum	Maximum
Formal Education	0	**2**
Fertilizer Use	0	**3**
Herbicide/Insecticide Use	0	**3**
Stock Selection	0	4
Type of Financial Records	0	**2**
Use of Financial Records	0	**2**
Use of Production Records	0	2
Total	0	18